Independent Schools Victoria

2018 Cognizance Project Research Report

Learning how to Learn

The Independent Schools Victoria Vision:

'A strong Independent education sector demonstrating best practice, providing excellent outcomes for students and choice for families'.

To realise this, we:

- advocate for excellence in education
- champion Member Schools
- support quality education
- protect the right of parents to choose where and how their children are educated.

Independent Schools Victoria will assist our 218 diverse Member Schools to continue providing the best possible education outcomes for the citizens of tomorrow.

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Research that's Worth Sharing

Independent Schools Victoria (ISV) supports its Member Schools in every area of their complex operations, including finance, funding, administration, staff management and government compliance.

But this wide ranging assistance does not obscure our prime focus: students and their teachers. That's why we support schools and teachers in curriculum development, school improvement, professional learning and student welfare.

This important report highlights one aspect of the pioneering work ISV has done focusing on the science of how students learn.

This work draws on scientific discoveries made possible by new technology and brain imaging processes that have provided scientists with new ways of studying the brain.

These discoveries have revealed that the brain is not a fixed entity, but that it can be transformed throughout our lives.

Based on what science tells us, ISV is engaged in two programs focused on how students think and learn – their metacognition.

We conduct the internationally respected Feuerstein program, focusing on enhancing students' cognitive functions to improve their decision making, planning and flexible thinking.

And since 2014, we have conducted the Cognizance program, which is the focus of this report, based on a project undertaken at six Member Schools last year.

It shows how students are capable of taking responsibility for their own learning once they are more informed about their brain, how it works and how they think.

The results are encouraging, with strong evidence that the students and teachers involved in the project have emerged with confidence in their understanding of the principles of metacognition and their willingness to apply this in their teaching and study.

Importantly, the report provides evidence that students involved in the project have improved not only their academic performance, but they have gained a better understanding of themselves.

Encouraged by this project, we have continued this work in 2019. We believe what we've found is worth sharing with a wide audience, so that others can benefit from the Cognizance program.

Michelle Green is Chief Executive of Independent Schools Victoria

Michelle Green
Chief Executive

The Skill that Never Falls Out of Fashion

Nearly every aspect of the modern world is marked by constant change and rapid evolution. Technology, medicine, art, pop culture, design and engineering: nothing is stagnant, everything is moving.

To address this, it's important our children learn how to change, evolve and move as well. But what exactly is required to ensure this occurs?

The number of answers put forward to address this question is matched only by the number of critics to each answer. Whereas some argue the next generation requires creative skills to thrive, others point out that creativity isn't the same across each field, thereby making it a meaningless pursuit. Whereas some argue the next generation requires digital skills to thrive, others point out that digital tools may be the very things to hinder and stall the next generation.

Through all this debate, there has been only one constant; only one skill everyone agrees will never fall out of fashion; only one skill that will forever drive people to change, evolution and movement. That skill is **learning**.

Those people who know how to learn quickly and effectively will always be the people at the forefront of every major change – be it in business, industry, society, technology, whatever. Those people who know how to take in, embody and apply emerging concepts will always be the people driving innovation and creation.

Learning is the only truly future-proof skill, and this is the skill that Cognizance hopes to impart to students. Through four engaging lessons, students learn how their mind works, how their brain works, how their memory works, and how to apply these principles in order to assume agency over their own learning process.

As we enter the fifth year of this project, we are helping more students than ever before to recognise and take control over their own thinking processes. To date, the data has demonstrated increased understanding, confidence and self-mastery amongst participating students.

This year, however, we hope to push further. Beyond helping more students understand their own learning, we hope to maintain contact with past students to ensure these benefits are sustained and become habits.

As parents, teachers and leaders, one of our biggest (and hardest) jobs is to ensure that we prepare the next generation to flourish in a world that we cannot predict. Metacognition, learning-how-to-learn, and the Cognizance program are great ways to ensure we are meaningfully addressing this responsibility and best preparing our children and students for whatever may come.

Jared Cooney Horvath (PhD, MEd) is an expert in the field of educational neuroscience, with a focus on enhancing teaching and learning practices. Jared has conducted research and lectured at Harvard University, Harvard Medical School, the University of Melbourne, and over 40 schools around Australia. Jared is currently a research fellow at the Melbourne Graduate School of Education and he serves as Director of the Science of Learning Group, a team dedicated to bringing the latest in brain and behavioural research to teachers, students, and parents alike.

Dr Jared Cooney Horvath

Learning how to Learn

ISV has run the Cognizance project since 2014, to help students and teachers understand and apply the science of learning, known as metacognition.

Metacognition encourages students to think about their own thinking, to know their strengths and weaknesses, and to work out how to expand their knowledge and abilities.

It builds on neuroscience's discovery that the brain is not 'fixed' – it is malleable and can be changed throughout our lives.

In 2018, ISV conducted a Cognizance research project involving 383 Year 9 students and 22 teachers from six Member Schools.

The project, run in collaboration with educational neuroscientist Dr Jared Cooney Horvath, aimed to teach students the fundamentals of metacognition and neuroscience and provide them with the tools to take charge of their own learning.

Students participated in lessons that focused on understanding the importance of stories, the basics of neuroplasticity, how the brain deals with errors, the role of memory, and how they can incorporate these lessons to control aspects of their learning.

The study revealed that the explicit teaching of metacognition and neuroplasticity has a major impact on students.

It resulted in:

Significant shift	in students' perceptions of their cognitive abilities and their understanding of neuroscience and metacognition
Change	in student mindsets – they thought deeper about their studies and life in general
Positive changes	to students' learning practices, with some revealing improved test scores as a result
Strong growth	in teachers' confidence and ability to create and implement interventions in students' cognition

Building on this experience, ISV has extended the project to 10 schools in 2019. This will see us working with approximately 926 Year 9 students and 48 Year 9 teachers.

The 2019 project will extend its reach by working with Year 10 students at several schools to capture insights on how they have applied this new knowledge. It will also involve educating Year 9 parents about neuroscience, specifically the workings of the teenage brain.

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1. Executive Summary

ISV developed the Cognizance Project in 2014 with the main aim of understanding the science of learning. Since its inception, the project has been reiterated to continually improve the process of providing students with skills to understand their brain and improve their learning. The aim of the 2018 Cognizance project was two-fold:

1. to increase students' understanding of metacognition and explore their process of thinking and learning
2. to improve teachers' ability to coach students on metacognition.

While the Cognizance Project has been evaluated since its inception, the main aim of the 2018 research evaluation was to guage the impact of the explicit teaching of metacognition on students and teachers. A mixed-method approach involving quantitative and qualitative data collection was used.

Six schools and a total of 383 students and 22 teachers were involved. Four, 90-minute metacognition lessons with students facilitated by an expert in educational neuroscience were conducted in each school between 23 May and 6 September 2018. Two prescribed micro-projects were provided to teachers to apply their learning on metacognition to the classroom.

The evaluation uncovered key findings that attest to the success of the project, with students and teachers identifying substantial benefits. The key findings are summarised below:

- Evidence of a clear increase in students' understanding that skills/intelligence are not pre-determined and fixed. Pre and post-surveys indicated a significant shift in students' perceptions of their cognitive abilities. The biggest positive shift was students' ability to change their mind at any time and exploit their memory.
- There was strong evidence of positive changes to students' learning practices. Some revealed improved test scores as a result.
- Qualitative insights revealed increased curiosity among students as they reported thinking deeper about their studies and life in general. Qualitative analysis showed that students were able to use the concepts they learned throughout the project to reflect and explain their thinking.
- There was clear growth in students' understanding and interest in neuroscience and metacognition. There was a 63 per cent increase in students understanding of the four pillars of metacognition – aspire, analyse, assess and adapt – between the pre and post-surveys, and a 64 per cent increase relating to students' ability to deeply consider concepts around neuroplasticity and learning.
- Qualitative analysis demonstrated that students clearly grasped the metacognitive techniques presented to them and were able to implement these concepts in their own study.
- In general, teachers and students were highly satisfied with the project. The mean satisfaction scores for both cohorts are strong, with a rating of 8.0 out of 10 for students' and 8.4 out of 10 for teachers.
- Satisfaction was a strong contributing factor to the perceived changes in learning processes among students and teaching practice among teachers. Driving this satisfaction was sound project structure and management, and delivery of a unique practical learning experience to Year 9 students. Correlation analysis showed that satisfaction was more pronounced among those who attended more lessons.
- The key drivers of satisfaction were statements around metacognitive acquisitions and development, such as 'I am in charge of my brain', and 'it is important for me to assess my own performance'. When coupled with the qualitative findings, it is clear that once students grasp the understanding that they are in charge of their own learning and performance, they are more likely to adopt the metacognitive strategies to regulate their cognition and orchestrate their learning journey.

- There was a strong growth in teachers' confidence and ability to create and implement interventions around students' cognition. Teachers were more likely to agree with all of the statements in the post-survey than they did in the pre-survey, where the largest positive difference was in relation to teachers' knowledge of the pillars of metacognition (a 2.40-point average increase), followed by their confidence in teaching students about neuroscience and cognition (a 2.15-point average increase).
- The micro-projects provided teachers the opportunity to reflect on their own teaching practice and put in place the metacognitive techniques they learned with students. While the micro-project process needs some refinement, the project produced highly successful examples of how teachers were able to apply the project learnings in the classroom.
- Qualitative findings revealed that the explicit teaching of metacognition resonated strongly with teachers as they saw a strong alignment with the course content and the school's curriculum, and real positive shifts in their students as a result of this project.

In conclusion, there was evidence of substantial benefits flowing into the wider school that can be attributed to the project and a strong appetite to establish a metacognitive culture school-wide. The study showed the potential for the Cognizance project to bring a distinctively different approach in incorporating metacognition in schools to enrich the learning opportunities for students, teachers and schools.

The evaluation uncovered potential areas for refinement, mostly relating to the teacher strand. This includes more support for teachers, further reading on metacognition, concrete examples of classroom activities based on metacognition, and continued professional learning in relation to metacognition and neuroscience.

The evaluation and research outcomes support the continuation and expansion of the Cognizance project to cultivate a metacognitive culture in Victorian Independent schools.

2. Research Context

2.1 Project background

The Cognizance project was developed in 2014 with the main aim of understanding the science of learning. Since then, the project has been reiterated to continually improve the process of providing students with skills to understand their brain and improve their learning.

In 2017, as part of the Cognizance project, Dr Jared Cooney Horvath, an expert in the field of educational neuroscience, supported teachers to further harness neuroscience information and develop micro-projects. While the project has made inroads into supporting Member Schools to develop knowledge and capability in metacognition, the fundamental problem of how to explicitly teach metacognition in the classroom remains. Teaching the science of learning needs to be explicit to enable effective learning.

On the basis of what had been learned in 2017 and earlier, the 2018 interation of the project aimed to link the educator and student streams in metacognition and the science of learning. The integration of the two streams was conducted by explicitly teaching metacognition in the classroom and providing teachers with strategies to address issues of student cognition.

2.1.1 2018 Cognizance project structure

The aim of the 2018 Cognizance project was two-fold: to increase students' understanding of metacognition and explore their process of thinking and learning; and to improve teachers' ability to coach students on metacognition. The table below lists the schools and the number of teachers and students involved.

School	Students	Teachers
Bayview College	34	3
Oakleigh Grammar	54	2
Plenty Valley Christian College	40	5
Ruyton Girls' School	91	3
St Michael's Grammar School	72	5
Strathcona Baptist Girls Grammar School	92	4
Net	**383**	**22**

The project began with all teachers attending a professional learning session facilitated by Dr Cooney Horvath on 8 May. The session covered topics on metacognition, plans for student metacognition lessons, and development of micro-projects and execution with students.

Four, 90-minute metacognition lessons facilitated by Dr Cooney Horvath were conducted between 23 May and 6 September 2018. The lessons were taught to Year 9 students in five schools, and Year 8 students in one school. The metacognition lessons were 'Get your mind right' (stories and errors), 'Master the hardware' (plasticity), 'Gaming the system' (memory) and 'Owning your learning' (metacognition). All students and teachers were also given a 'brain book' to reflect on and monitor their own thinking and write what they have learned after each lesson.

All teachers were given two prescribed micro-projects to explain and document inventions, changes, and ideas. The micro-projects were prescribed to guide teachers in applying the metacognitive strategies in the classroom. Dr Cooney Horvath guided teachers in developing, executing and measuring the outcomes from the micro-projects. The following were the micro-projects:

- micro-project 1: Embrace error to boost learning
- micro-project 2: Metacognition for study routine.

The 2018 Cognizance ISV project team members were Michael Noonan (Head of Research), Lili-Ann Kriegler (Manager, Mind, Brain Learning Projects) and Winnie Wong (Research and Evaluation Advisor).

2.2 Research and evaluation objectives

Evaluation of the project was needed to ensure that ISV's services remain competitive, relevant and beneficial to Member Schools. An evidence-based project was needed to further refine the project and ensure it reflects the needs of students.

The following were the key research questions:

1. To what extent does explicit teaching of metacognition and neuroscience increase students' perceptions of their cognitive abilities?
2. To what extent were students satisfied with the project?
3. Can explicit professional learning in metacognition lead to changes in teaching practice?

2.3 Research design and methodology

Quantitative and qualitative research approaches were used for this study. The qualitative component was conducted after the project to investigate and supplement the quantitative findings.

2.3.1 Quantitative component

The quantitative component consisted of the ISV survey for students and teachers. A questionnaire averaging 10 minutes was designed for both cohorts to measure and establish the project's impact. The surveys were administered prior to the project commencing (pre-survey conducted no more than two weeks before the first lesson), and after the end of the project (post-survey conducted no more than two weeks after the last lesson). Apart from the ISV survey, teachers and students also completed the CLARA (Crick Learning for Resilient Agency) survey.

Both the ISV and CLARA surveys were administered at the same time.

The sample framework includes students and teachers who participated in this project.

2.3.1.1 Student cohort

Two hundred and seventy-one students completed both ISV pre and post-surveys. This resulted in a response rate of 71 per cent, with a 3.2 per cent margin of error.

Number of students who completed the ISV surveys from participating schools:

School	%	n
Bayview College	10%	26
Oakleigh Grammar	18%	48
Plenty Valley Christian College	11%	31
Ruyton Girls' School	23%	61
St Michael's Grammar School	19%	51
Strathcona Baptist Girls Grammar School	20%	54
Net	**100%**	**271**

Metacognition lesson attended and total number of lessons attended:

		%	n
Metacognition lesson attended	Lesson 1: Stories and Errors	92	248
	Lesson 2: Neuroplasticity	89	241
	Lesson 3: Memory	86	234
	Lesson 4: Metacognition	93	253
	Did not attend any lesson	1	4
Total number of lessons attended	None	1	4
	One	3	8
	Two	4	11
	Three	17	46
	Four	75	202
	Net	**100**	**271**

2.3.1.2 Teacher cohort

The following table shows the number of teachers who completed one or both or the pre survey and post-surveys. Only 13 teachers completed both pre and post-surveys, which results to a response rate of 59 per cent.

	n
Completed pre-survey	20
Completed post-survey	20
Completed both pre and post-surveys	13

Metacognition lessons and total number of lessons attended (among those who completed the post-survey):

		%	n
Metacognition lesson attended	Lesson 1: Stories and Errors	100	20
	Lesson 2: Neuroplasticity	90	18
	Lesson 3: Memory	95	19
	Lessons 4: Metacognition	95	19
Total number of lessons attended	Three	20	4
	Four	80	16
	Net	**100**	**20**

2.3.2 Qualitative component

Fieldwork for the qualitative component was conducted at each school after the project from 22 October to 9 November 2018.

Two focus groups were conducted in all participating schools, one with teachers and another with six to eight randomly selected students. Thirty to forty-minute discussions were conducted for both focus groups.

A de-brief session was also conducted at ISV where teachers were invited to share their experience of the project. In particular, teachers shared their experience with the micro-projects, lesson structure, lesson content, challenges and impact of the project. Dr Cooney Horvath and the ISV project team facilitated the session aimed to develop a shared learning experience.

2.3.3 Reading this report

All survey questions in this report are reported in an overall level.

Note that the qualitative and quantitative findings are presented together. This report will mainly discuss the findings from the ISV student and teacher surveys and the qualitative interviews with teachers, school leaders and students.

3. To what extent does explicit teaching of metacognition and neuroscience increase students' perceptions of their cognitive abilities?

This section explores the shift in students' perception of their cognitive abilities and understanding of metacognition, using quantitative and qualitative findings.

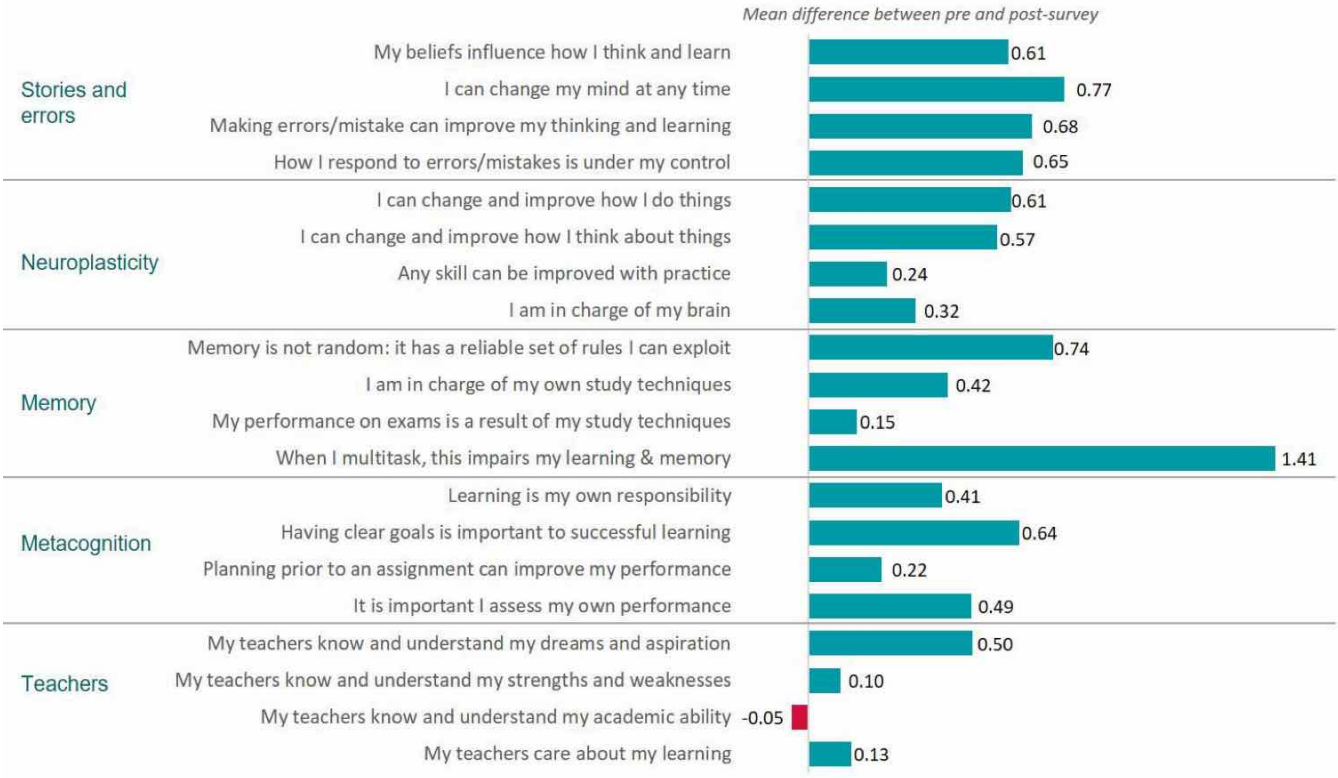
3.1 To what extent did the project change students' perception of their metacognitive abilities?

Students were asked to rate their likelihood of agreeing with the statements below in the pre and post-surveys. The statements reflect and measure the four metacognition topics students attended, which include stories and errors, neuroplasticity, memory and metacognition. The last four questions reflect students' perception of their teachers. Figure 1 shows the mean difference between the pre and post-surveys for each statement. The mean score for both the pre and post-survey can be found in the Appendix.

Students were more likely to agree with the majority of the statements in the post-survey following their involvement in the metacognition lessons. Pre and post-test paired analysis showed that the mean differences between the pre and post-surveys were statistically significant for 14 out of 20 statements above. This shows that there was a real shift in students' perception of all four metacognitive topics.

While a general positive difference was observed, no significant difference was found for 'my performance on exams is a result of my study techniques', 'planning prior to an assignment can improve my performance', and statements on students' perception of their teachers.

Figure 1: Shift in students' mindset and perception of their abilities



Data Source:
Total Sample: Unweighted base; n=271 (Among those who completed both ISV pre and post-surveys)
Q5. Thinking about yourself in general, please rate how likely you are to agree or disagree with the following statements on a scale from 0 to 10. A rating of 0 means 'Strongly Disagree' and a rating of 10 means 'Strongly Agree'

The biggest positive difference post-project was students' understanding that multitasking impairs learning and memory, where there was approximately one-and-a-half-point mean increase on a 10-point agreement scale. Similar with the quantitative findings, nearly all students in the focus groups indicated that they had changed their study habits and learning approach, especially on multitasking.

A quote from a Strathcona Baptist Girls Grammar School student illustrates changes in students' approach to learning and multitasking:

'I now use the techniques I've learnt, to help me use my time appropriately, like we can't multitask if it's something new to us.'

Students' perceptions of their ability to change their mind at any time and exploit their memory also improved significantly (a mean difference of .77 and .74 respectively). The qualitative interviews provided consistent examples of students thinking deeper about issues and showing a tendency to reject the status quo. Teachers observed this shift in curiosity among their students. As one teacher put it: 'It's my favourite moment when they [the students] are now thinking and are not scared to be wrong and ask questions'. A student at St Michael's Grammar School elaborated on this shift in mindset:

> *I think now I will start to question the things around me and the processes of my brain more after learning all the things it can do and all of the misconceptions about how much power it has.*

Some students indicated that they now understand what it means to have a growth mindset, an educational concept they are often aware of, yet may not comprehend and lack the skills to implement:

> *I always knew that we should have a growth mindset but didn't know what it meant. But now I've changed my mind.*
>
> – Strathcona Baptist Girls Grammar School

Qualitative interviews at all six schools uncovered a profound change in students' confidence, their ability to learn and in a willingness to own their learning, as encapsulated in the comment of a student from Plenty Valley Christian College:

'I have begun thinking positively and changed my mindset towards things that I think negatively towards'.

The evidence demonstrates that the metacognition lessons have helped students to challenge and change their perceptions on metacognition. While the impact of this will take some time to materialise, there are many potential benefits of the increased comprehension of their own thinking and learning processes.

3.2 To what extent did the project increase students' understanding of metacognition?

Students completed four open-ended questions and four multiple-choice questions as part of the surveys, which aimed to determine the extent to which they understood and engaged with the lessons on metacognition. The same questions were asked in the pre and post-surveys.

The open-ended questions were assessed using the rubric consisting of two parts: the use of content knowledge; and deep consideration of relevant issues. The following are the indicators used in scoring students' responses:

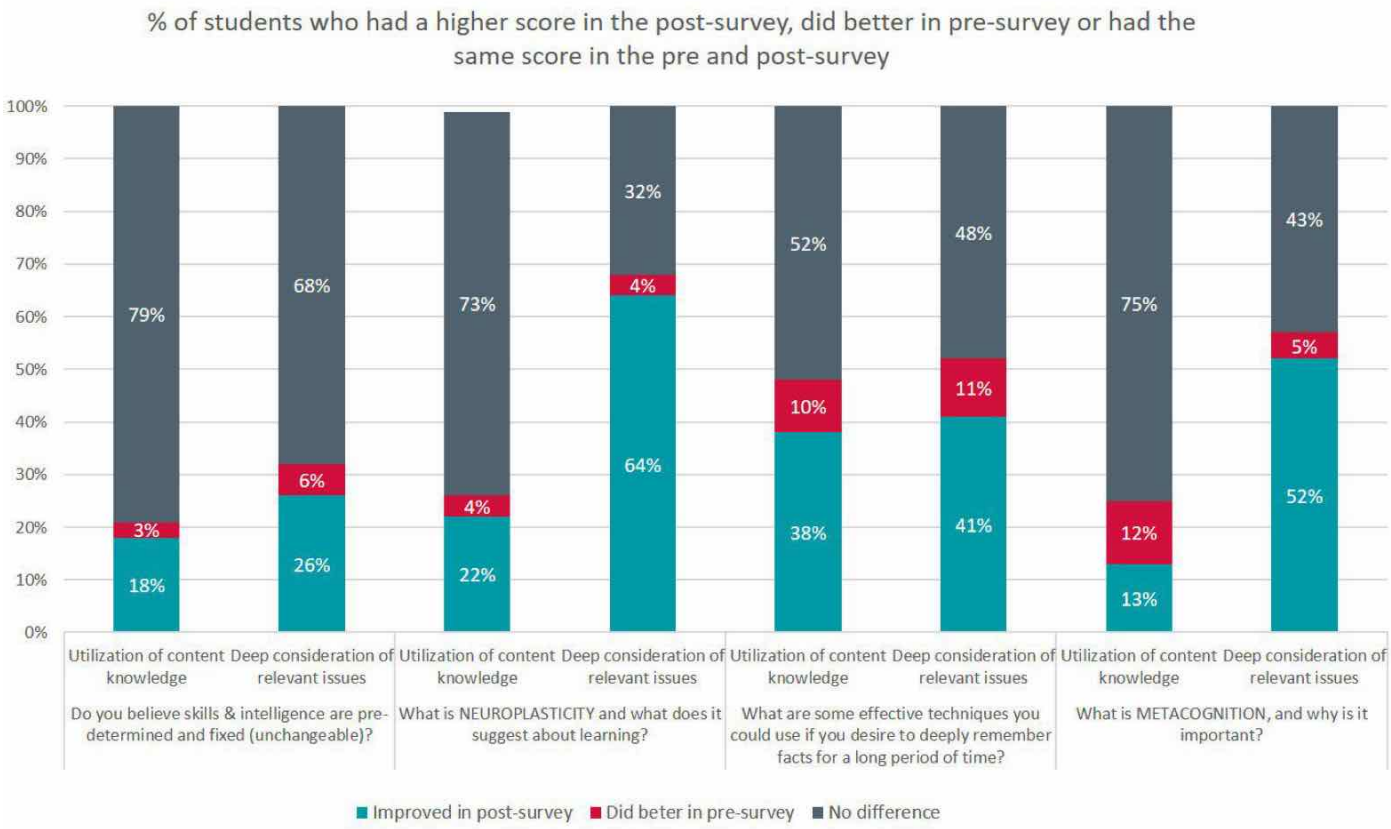
- use of content knowledge: number of relevant vocabulary words / key concepts mentioned within the response
- deep consideration: conceptualisation and support for argument.

The rubric used to score each open-ended and multiple-choice response, including the list of relevant vocabulary words, is included in the Appendix.

Figure 2 below shows changes in students' scores in the pre and post-surveys for each open-ended question. The following legend is used to depict the shifts in percentage scores between surveys:

- Teal: Percentage of students who scored higher in the post-survey than they did in the pre-survey (improved).
- Gray: Percentage of students who had no difference in the pre and post-surveys (no difference).
- Red: Percentage of students who scored lower in the post-survey than they did in the pre-survey (did worse).

Figure 2: Changes in students' score in the pre and post-surveys for all open-ended course questions



Data Source:
Total Sample: Unweighted base; n=271 (Among those who completed both ISV pre and post-surveys)
Pre and post-course open-ended questions

In general, the majority of students scored the same in the pre and post-surveys for most of the questions. However, there was a positive change across all questions ranging from an increase of 18 to 64 per cent. The most significant improvement related to students' ability to deeply consider concepts around neuroplasticity and learning (64 per cent improved in the post-survey).

We explored this change during the qualitative fieldwork and found that all students interviewed indicated a better understanding of their brain and neuroplasticity as a result of the project. They had a better understanding of the physical brain, and that the brain is passive and malleable. As one student put it:

'Well now I believe that we can actually change our brain and adapt in situation; before this course I didn't think I was very good at English but now I realise that I have just told myself that and I can actually try harder to understand it.'
– Ruyton Girls' School

To further illustrate this point, a comment from a student at St Michael's Grammar School highlights not only the immediate impact of a greater understanding of neuroplasticity, but also the potential impact of this knowledge into adult life:

> *I understand a lot more about my brain and the way it works now, which I think will help me to succeed in life, knowing the best ways to help my learning.*

The second biggest improvement related to the students' ability to conceptualise metacognition and its importance (52 per cent improved in the post-survey). A comment from a student at Oakleigh Grammar indicates the depth of understanding many students gained from the project:

'It [metacognition] is our own awareness of our own thinking. When we fully understand and analyse our thought process and being able to process our thoughts. It's important to be able to track and fully understand our thinking because it helps us better with thinking and gives us the opportunity to analyse what we are thinking'.

In relation to understanding the role of memory in the learning process, around two in five students (41 per cent) improved in their consideration of effective techniques to use to remember facts. This improvement was also apparent in students' use of content knowledge, where 38 per cent employed more specific vocabulary when responding to this question. For example:

'Revise over a period of time and avoid cramming too much information. Getting sufficient amounts of sleep regularly allows you to reflect on memories in dreams. Studying in similar environments to which you will have to use these memories.'
– St Michael's Grammar School

The qualitative insights provided many examples of how students were taking this new found knowledge of metacognition and applying it. Changes in study techniques attributed to their involvement in the project had positively influenced some students' test results:

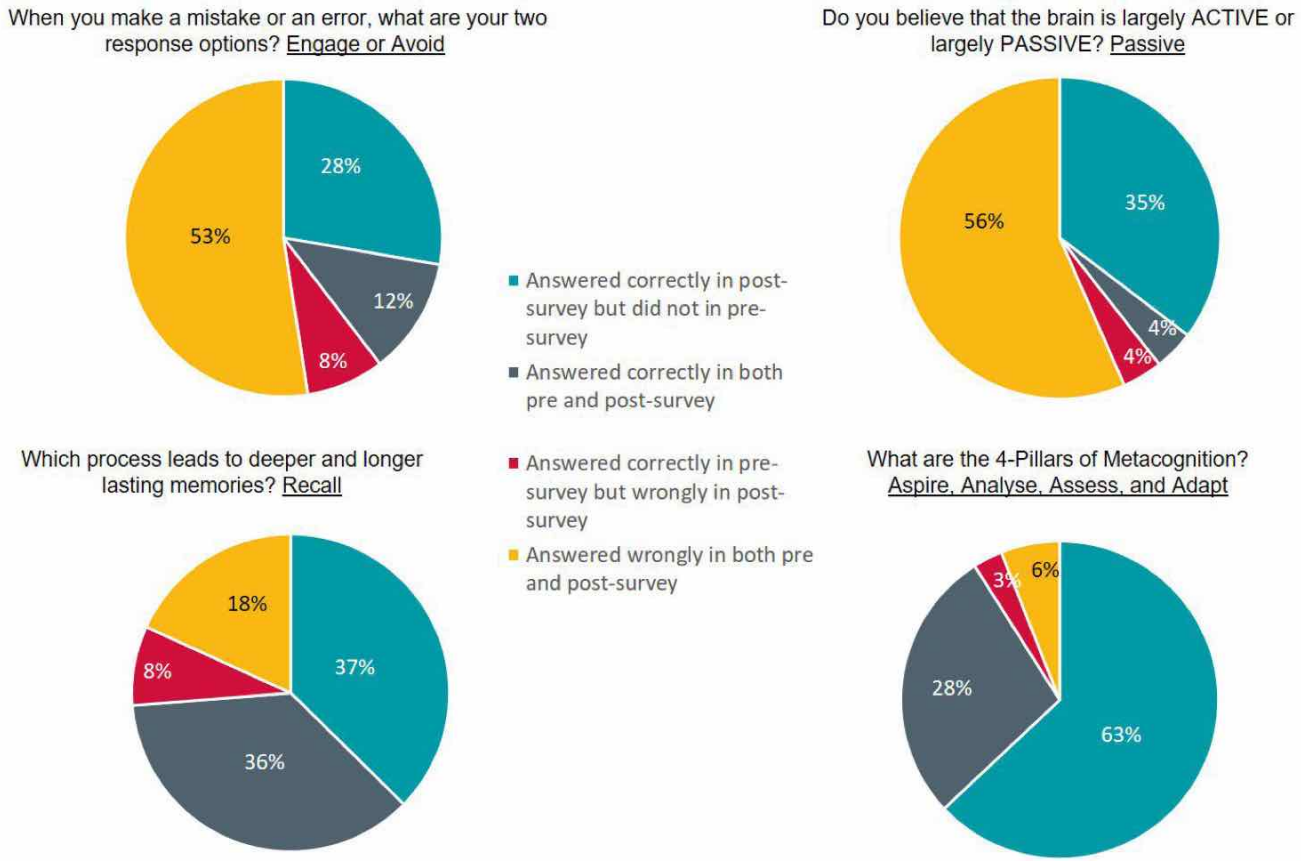
'I have taken into practice some of the things we learnt and it has helped improve my test results'.
– Plenty Valley Christian College

The evidence points to a distinct improvement in students' ability to understand and comprehend metacognition. This has the potential to impact on students in a variety of positive ways, inside and outside the classroom.

Figure 3 below shows changes in students' scores in the pre and post-surveys for each multiple-choice question. The following legend is used to depict the shifts in percentage scores between surveys.

- Teal: Percentage of students who answered the question correctly in the post-survey but wrongly in the pre-survey (improved).
- Dark grey: Percentage of students who answered the question correctly in both pre and post-surveys (no difference but correct). Change to corporate grey
- Yellow: Percentage of students who answered the question wrongly in both pre and post-surveys (no difference but wrong).
- Red: Percentage of students who answered the question correctly in the pre-survey but did not in the post-survey (did worse).

Figure 3: Changes in students' score in the pre and post-surveys for all multiple-choice questions. The correct answer to the questions are underlined below.



Data Source:
Total Sample: Unweighted base; n=271 (Among those who completed both ISV pre and post-surveys)
Pre and post-course open-ended questions

The most significant improvement relates to students' knowledge of the four pillars of metacognition, where the majority who failed to answer this question correctly in the pre-survey provided a correct answer in the post-survey (63 per cent). This supports other quantitative findings and, as demonstrated in the following quote, provides a platform for students to take ownership of their own learning pathway:

> *I now know that I can in fact change my brain in order for it to adapt and aid my learning rather than it becoming an obstacle. I can use the four rules or key points of metacognition to continue practicing how to effectively use my brain.*
>
> – Strathcona Baptist Girls Grammar School

While the majority of students answered correctly when asked 'what are the four pillars of metacognition', and 'which processes lead to deeper and longer lasting memories' (bottom two pie charts in Figure 3), more than half still did not provide a correct answer post-project when asked whether the brain is passive or active and if they should engage or avoid when facing a mistake or an error (top two pie charts in Figure 3). This shows that more emphasis of these concepts and real examples could be provided to students to help them understand better.

In conclusion, it is evident that the project was successful in delivering its aim of increasing students' perceptions of their cognitive abilities. The shift in students' confidence, mindset, study habits and understanding of metacognition facilitated their ability to design interventions to change their own behaviour. As students learn to use the right metacognitive techniques to regulate their thinking and decision making process, they will become the architect of their own experience and story as they have more control over how they think. This is likely to accrue benefits throughout their their life-long learning journey.

4. To what extent were students satisfied with the project?

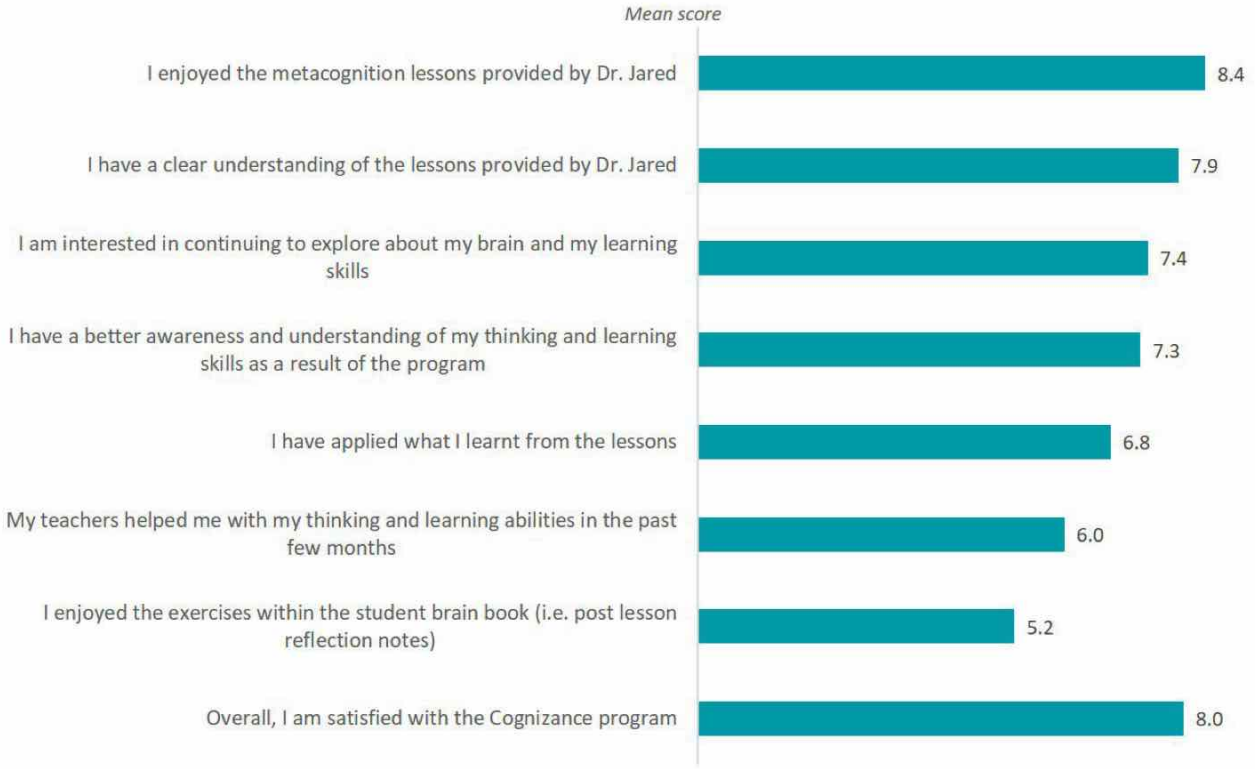
This section explores students' level of satisfaction and experience with the project.

4.1 What is the overall satisfaction and experience of the project?

In general, students portrayed strong satisfaction with the project (an average mean score of 8 out of 10). Similarly, nearly all students reiterated this in the focus groups. Students who were satisfied were also more likely to be advocates of this project (all students who provided a satisfaction score of 9 or 10 out of a 10-point scale rated the same when asked their likelihood to recommend the project).

Figure 4 below shows students' likelihood to agree with statements in relation to their overall experience and satisfaction of the project.

Figure 4: Mean score for statements in the post-survey



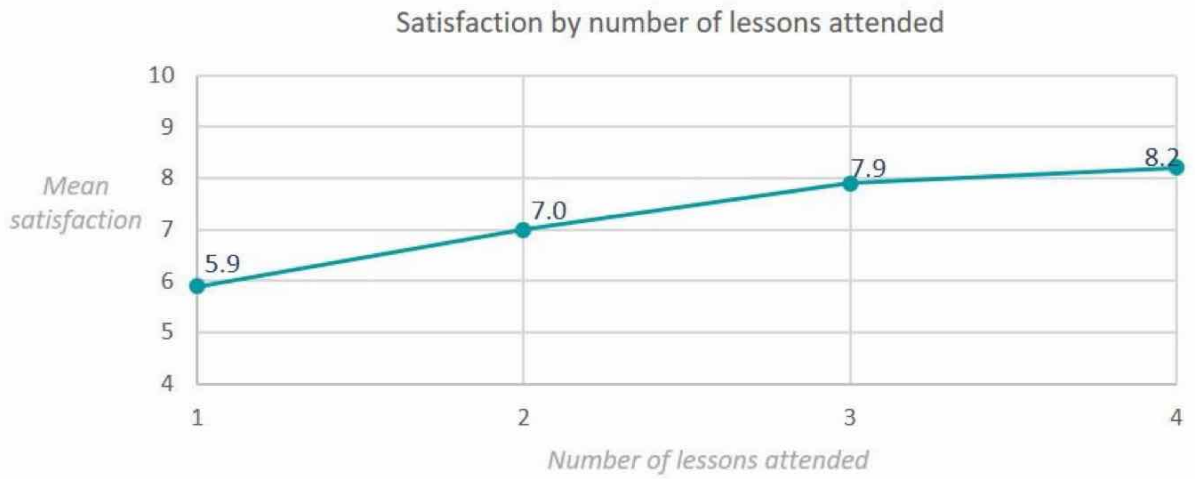
Data Source:
Total Sample: Unweighted base; n=271 (Among those who completed both ISV pre and post-surveys)
Q6. Please rate how likely you are to agree or disagree with the following statements on a scale from 0 to 10. A rating of 0 means 'Strongly Disagree' and a rating of 10 means 'Strongly Agree'

Students showed strong enjoyment and understanding of the metacognition lessons (8.4 and 7.9 respectively). The lessons resonated well with students as nearly all reiterated the lessons without prompting during the qualitative sessions. They enjoyed the lecture/university style presentation and felt they were treated as adults during the course. They found the novelty refreshing in learning, as a student from St Michael's Grammar School commented:

> *I am way more open in learning in this environment compared to the classroom. I saw a big shift in [students] engagement and what they wanted to do.*

Indeed, it was evident that the more lessons students attended, the higher their level of satisfaction. There was a moderate positive correlation between the total number of lessons attended and students' level of satisfaction (r=0.17, p=0.012). Following are the mean satisfaction scores by the total number of lessons attended, which are also illustrated in Figure 5 below.

Figure 5: Level of satisfaction by number of lessons attended



Data Source:
Total Sample: Unweighted base; n=271 (Among those who completed both ISV pre and post-surveys)
Note: small sample size for those who did not attend any lessons therefore not reported in the chart above
Q6. Please rate how likely you are to agree or disagree with the following statement (Overall, I am satisfied with the Cognizance project) on a scale from 0 to 10. A rating of 0 means 'Strongly Disagree' and a rating of 10 means 'Strongly Agree'

Further analysis by total number of lessons attended also showed that students who only attended one lesson were significantly less likely to agree that they have a better awareness and understanding of their thinking and learning skills as a result of the project.

There was also considerably strong interest to continue learning about the brain and learning skills (7.4) and understanding of thinking and learning skills as a result of the project (7.3).

4.1.1 What are the key drivers of satisfaction?

Key driver analysis for satisfaction was conducted using relative importance analysis, with satisfaction as dependent variable and course agreement statements as independent variables. The driver (importance) analysis test computes an estimate of the importance of various independent variables in predicting a dependent variable.

As discussed above and illustrated in Figure 1, the top three positive mean differences between the pre and post-surveys were shifts in the following statements:

- 'When I multitask, this impairs my learning' (Memory)
- 'I can change my mind at any time' (Stories and Errors)
- 'Memory is not random; it has reliable set of rules I can exploit' (Memory).

Driver analysis using the mean difference between the pre and post-surveys for each statement as independent variables and level of satisfaction as dependent variable revealed the following as top statements that drive satisfaction:

- 'I am in charge of my brain' (Neuroplasticity)
- 'It is important I assess my own performance' (Metacognition)
- 'My beliefs influence how I think and learn' (Stories and Errors).

The biggest shift post project related to 'Stories and Errors' and Memory'. It is clear that most students were able to understand the role of stories and exploit their memory as a result of the project. However, further analysis revealed that those who were strongly satisfied with the project were those who had a shift in their understanding that they are 'in charge of their brain', and understanding of 'the importance of accessing their own performance'.

Driver analysis of satisfaction coupled with the qualitative findings revealed that there is a clear distinction among students who portrayed strong satisfaction with the project. These students do not only understand that stories are important in driving their reality and that they can exploit their memory (metacognitive knowledge), but they showed progress in their process of planning, monitoring and evaluating their approach in studies and in life (metacognitive regulation). Students' ability to reflect and assess their own performance and apply intentional learning is one of the primary objectives of the Cognizance project.

The ability to orchestrate one's own learning was evident in the qualitative sessions. A comment from a student at St Michael's Grammar School outlines the way in which many students, once they understood the importance of the stories we tell ourselves, began to look at their own learning pathways in a different light and take ownership and control of their own journey.

> *It has made me realise that we are all capable of being more than we are and through training our brain to follow certain habits we can gain skills and intelligence. Through being aware of myself, my brain and my learning, I have learnt that all the people I look up to are not born with any more skills than I have, but what makes them so great is their ability to work so hard and consistently aspire to analyse and bring their best outcome. We are all born with no pre-determined ideals or skills but we are born to aspire and from there on achieve.*

Similarly, when asked how the project has changed students' thinking about themselves, their brain, and learning, the most common theme revolved around students' motivation and determination to learn and excel in life. The following quotes illustrate the growth in aspirations for study and life some students attributed to the project:

- 'I have implemented some of the things I learned into my life and I am benefiting from actually setting goals.'
  – St Michael's Grammar School

- 'It has made me think about how I could tweak my brain and how I can change it to provide me with an advantage when it comes to studying, tests and life in general.'
  – Oakleigh Grammar

- 'It makes me think of the future of what I want to do.'
  – Plenty Valley Christian College

As alluded to above, satisfaction with the project was not only the result of observed positive changes in students' cognitive abilities, but also improvements in their emotional intelligence. Some students have used the metacognitive techniques to exert greater self-directed cognitive control over their behaviour and emotions.

> *I know that I have more control over my emotions and the way I learn. I should continue to strive to do my best and know that if I want to achieve something I can.*
>
> – Bayview College

In summary, the overall findings and conclusions of the student survey revealed a strong level of satisfaction with the project. The level of satisfaction intensifies as students attended more lessons, indicating that those who attended more lessons were able to use the metacognitive techniques they learned.

While significant shifts were observed in students' ability to understand and exploit their memory, the key driver of satisfaction lies within the shift in students' understanding that their stories influence their reality, and the changes they saw in themselves from assessing and applying what they learned. Students who have adopted the four pillars of metacognition (aspire, analyse, assess and adapt) in aspects of their lives found profound improvements in themselves through their own initiative and effort to change their own story and choose who they want to be in life.

5. Can explicit professional learning in metacognition lead to changes in teaching practice?

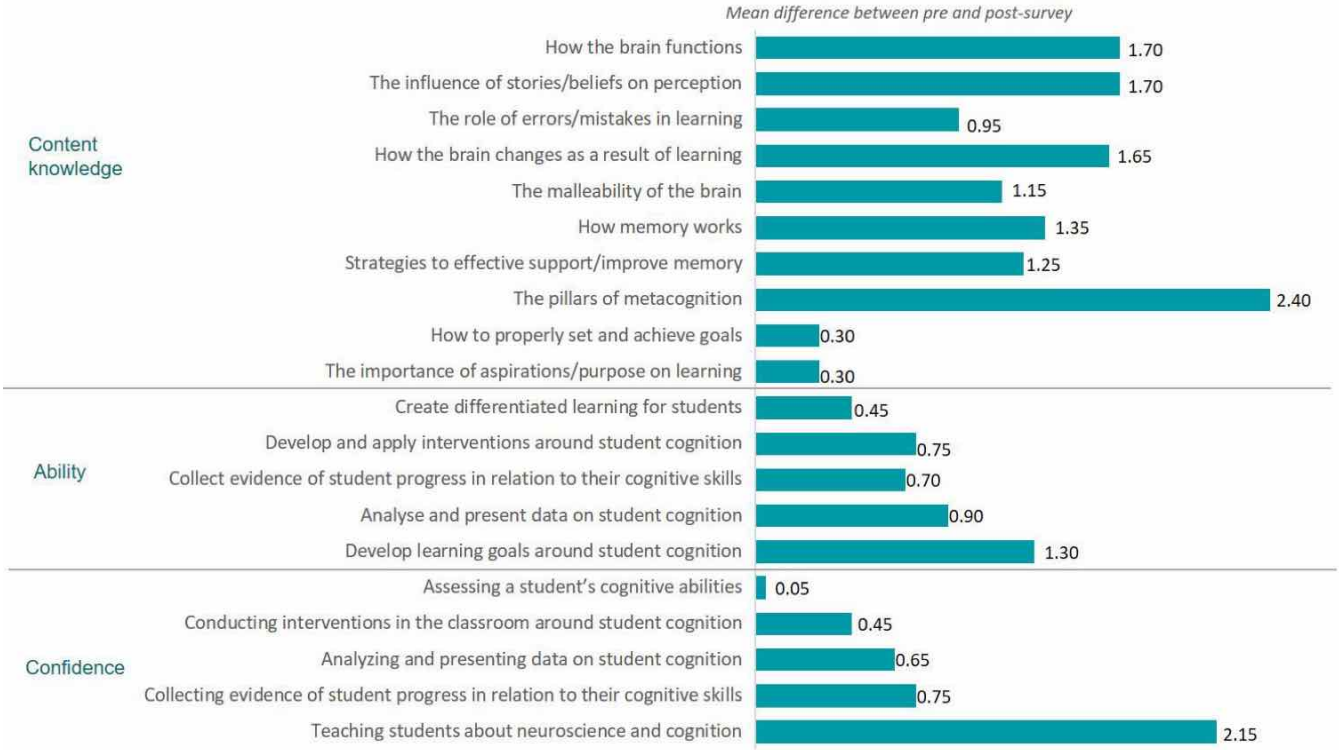
This section explores the shift in teachers' perceptions of their content knowledge, ability and confidence as a result of their participation in the project.

5.1 To what extent did the project change teachers' perception of their content knowledge, ability and confidence?

Teachers were asked to rate their likelihood to agree with the statements below in the pre and post-survey. The statements reflect and measure their knowledge of metacognition and learning (content knowledge), and ability and confidence to create and implement interventions around students' cognition.

Figure 6 shows the mean difference between the pre and post-survey for each statement. The mean score for both surveys can be found in the Appendix.

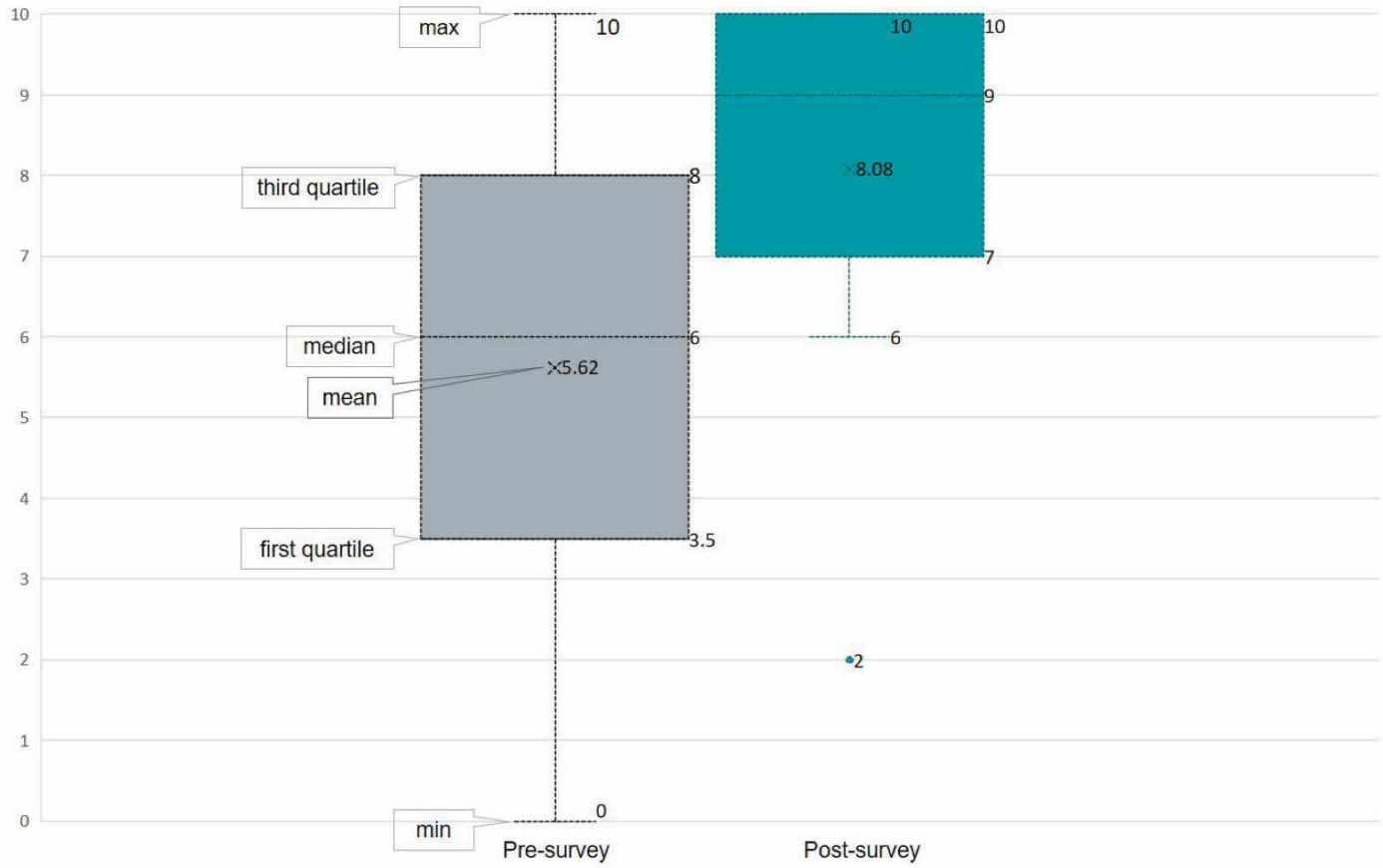
Figure 6: Mean difference for statements between pre and post-surveys (content knowledge, ability and confidence)



Data Source:
Total Sample: Unweighted base; n=20 for both pre and post-surveys
Q. Please rate how likely you are to agree or disagree with the following statements on a scale from 0 to 10. A rating of 0 means 'Strongly Disagree' and a rating of 10 means 'Strongly Agree'.

Teachers were more likely to agree with all of the statements above in the post-survey than they did in the pre-survey. The largest positive difference was in relation to teachers' knowledge of the pillars of metacognition, followed by their confidence in teaching students about neuroscience and cognition. Both statements saw an approximate two-point mean increase on a 10-point scale. This shift is further depicted in Figure 7 and Figure 8 below.

Figure 7: Boxplot for pre and post-survey data for level of knowledge of the four pillars of metacognition



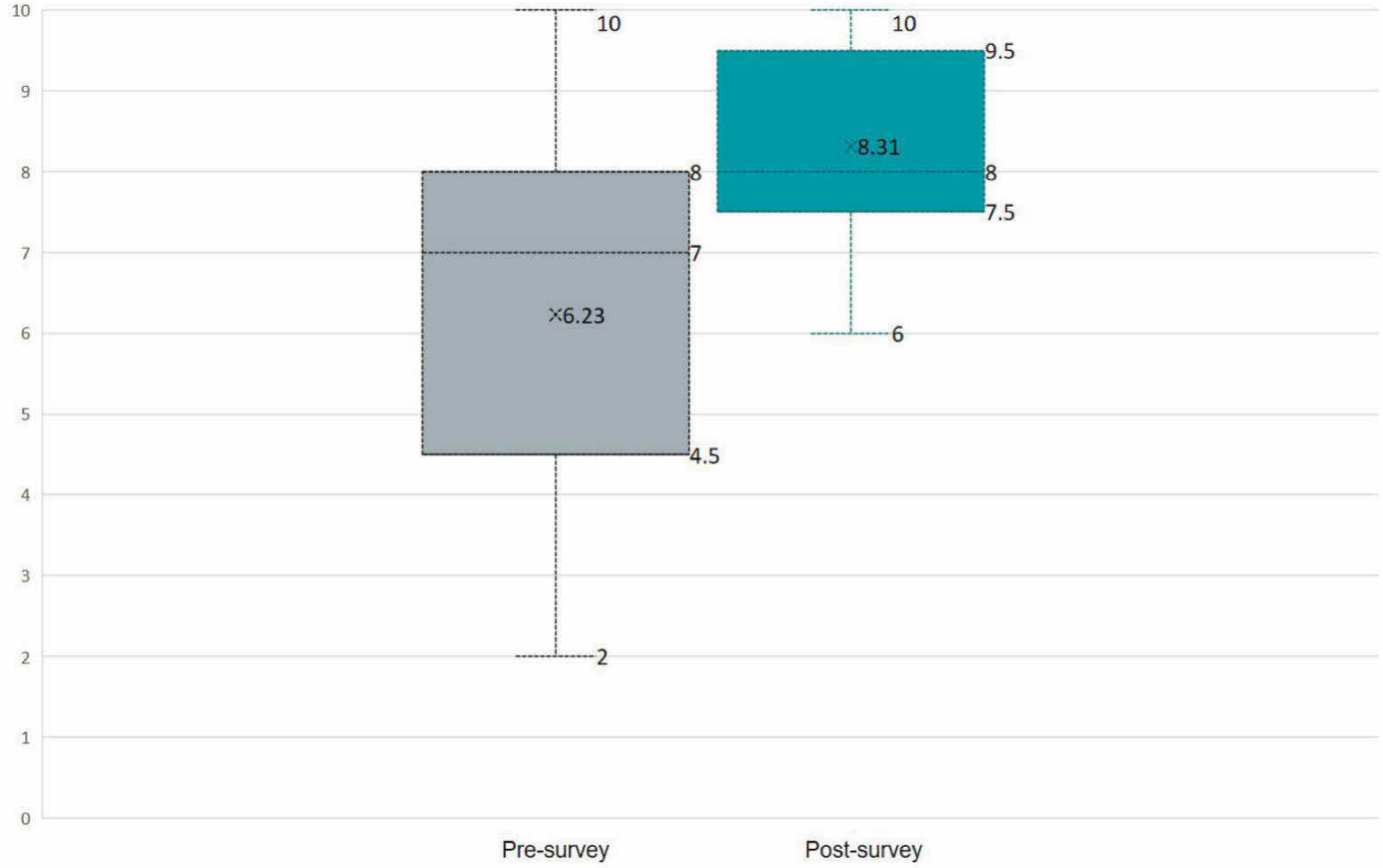
Data Source:
Total Sample: Unweighted base; n=13 (Among those who completed both ISV pre and post-surveys)
Q. Please rate how likely you are to agree or disagree with the following statements in relation to your knowledge of (the four pillars of metacognition) on a scale from 0 to 10. A rating of 0 means 'Strongly Disagree' and a rating of 10 means 'Strongly Agree'.

The boxplots above represent the shift between the pre and post-surveys. The chart represents the distribution of the data and includes the minimum, maximum and quartile range. The derived mean and median are also represented in the boxplot.

There was a clear positive shift post-project in teachers' scores in their perception of their knowledge of the pillars of metacognition. There was a smaller spread of distribution in the post-survey than in the pre-survey (range between the top and bottom of the box), showing that individual data scores were clustered at the top end of the scale, with the exception of an outlier (one teacher provided a score of two). While a two-point mean increase can be seen post-project, close to a three-point mean increase can be observed if the outlier is removed. Nevertheless, this shows a significant improvement in teachers' perception of their understanding of the pillars of metacognition.

Figure 8 depicts the shift in teachers' confidence in teaching students about neuroscience and cognition.

Figure 8: Boxplot for pre and post-survey data for level of confidence in (teaching students about neuroscience and cognition)



Data Source:
Total Sample: Unweighted base; n=13 (Among those who completed both ISV pre and post-surveys)
Q. Please rate how likely you are to agree or disagree with the following statements in relation to your confidence in (teaching students about neuroscience and cognition) on a scale from 0 to 10.

Again, the boost in teachers' confidence post-project in teaching students about neuroscience and cognition is evident in the chart above. Approximately two-point mean increase out of a ten-point agreement scale was observed post-project. The smaller spread of distribution in the post-survey shows that there was less variation in the data with scores clustered at the top end of the scale compared with the pre-survey.

Teachers' profound improvements in understanding metacognition, and confidence in teaching students about neuroscience and metacognition, were reiterated in the qualitative interviews as well. One teacher said:

> *When helping students develop study schedules I use metacognition principles to explain the 'why' behind the strategies. I also spend much more time at the beginning of classes having students recall knowledge from previous classes to ensure they are cementing that knowledge and not forgetting it.*
>
> – Plenty Valley Christian College

The qualitative insights further revealed teachers' confidence not only in teaching students, but in conversations with their colleagues as well, as a teacher from St Michael's Grammar School commented:

> *I am more confident in the conversations I have with staff and students and I'm using the techniques to enhance memory all the time. This is with myself, my peers and students.*

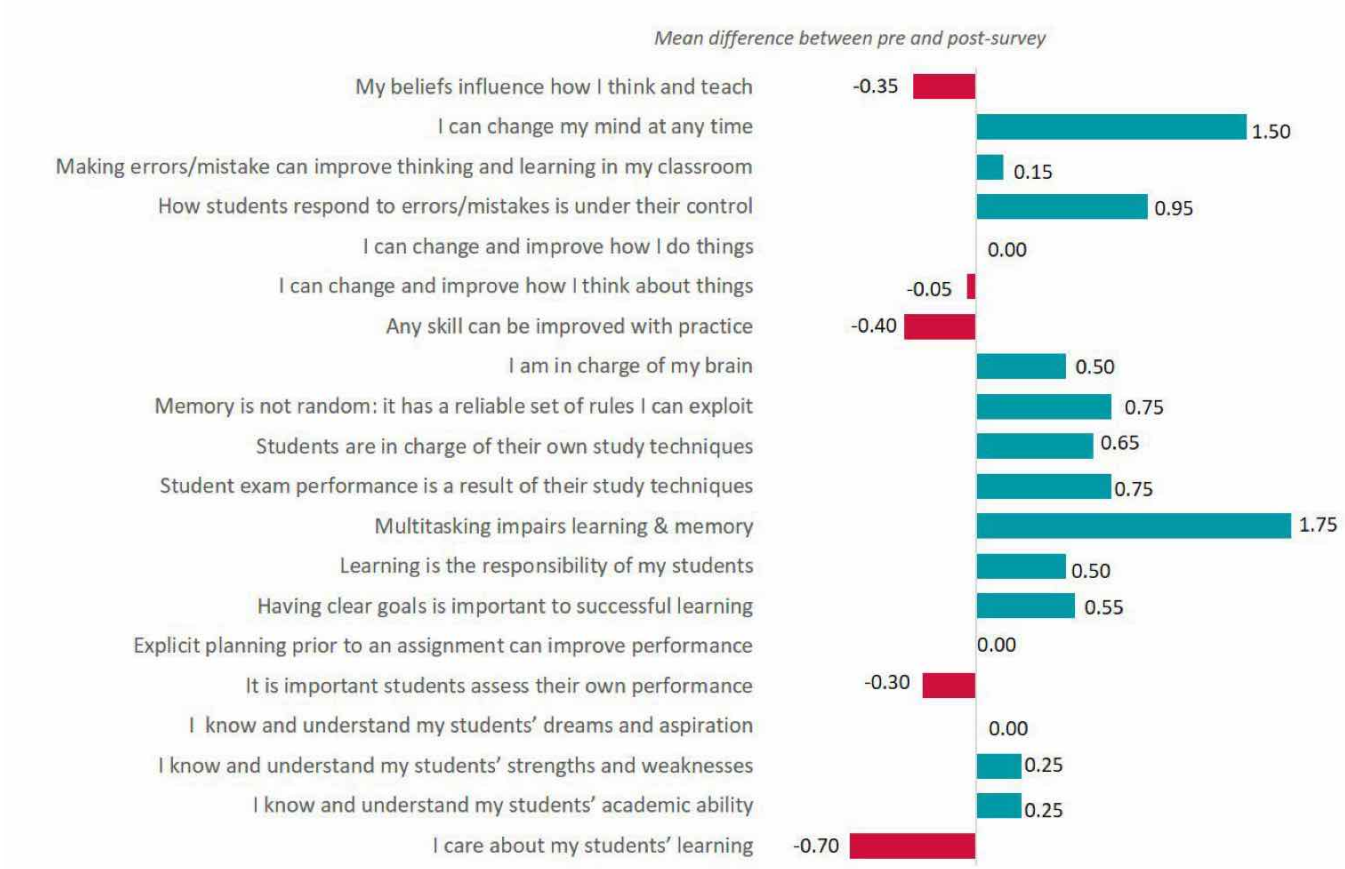
The evidence demonstrates that participation in the project has boosted teachers' confidence, knowledge of metacognition and learning, and ability to create and implement interventions around students' cognition.

5.2 To what extent did the project change teachers' perception of their attitude in teaching?

This section explores the shift in teachers' perception of their cognitive abilities and understanding of metacognitive principles in relation to teaching. Teachers were asked to rate their likelihood to agree with the statements below in the pre and post-survey. The statements reflect the four metacognition topics covered under the project. The last four questions reflect teachers' perception of their students. The mean score for both pre and post-surveys can be found in the Appendix.

Figure 9 shows the mean difference between pre and post-surveys for these statements.

Figure 9: Mean difference for statements between pre and post-surveys (attitude)



Data Source:
Total Sample: Unweighted base; n=20 for both pre and post-surveys
Q. Please rate how likely you are to agree or disagree with the following statements on a scale from 0 to 10. A rating of 0 means 'Strongly Disagree' and a rating of 10 means 'Strongly Agree'.

Teachers were more likely to agree with 12 of the 20 the statements in the post-survey than they did in the pre-survey. Similar with the student findings, the biggest positive difference post-project was teachers' understanding that multitasking impairs learning and memory where close to a two-point mean increase on a 10-point scale was observed. The second biggest shift was teachers' belief that they can change their mind at any time, where a mean increase of one-point-five-points post-project was observed.

We explored this change during the qualitative fieldwork and found that all teachers indicated a change in their mindset and attitudes towards teaching.

> *It [the project] has shifted my mindset even more to the belief that learning is a result of good practices and techniques. That the brain is more influenced by the conscious attitudes and decisions we make. This has profound implications on learning. It shifts the focus away from a perception that innate abilities limit the brain's ability to learn.*
>
> – Plenty Valley Christian College

Qualitative interviews also uncovered a profound change in teachers' teaching practice and their confidence in teaching. Most teachers found that their teaching practice has been invigorated as a result of the project, as illustrated in the following quote below:

'It [the project] made me reflect about my practices, but also about the things I believe I can and can't do. It reminded me of the importance oftaking risks and failing, in order to develop, progress and grow. It somewhat reminded me that my abilities are endless, if I decide to.'
– St Michael's Grammar School

In relation to explicitly teaching students metacognition, all teachers concurred that this is essential for students' learning development.

'The project did make me realise that we don't explicitly teach this stuff to our students. The only time a student would be made aware of these concepts is if they elect to take psychology at Year 12, which is such a shame. I think all Year 8 (or 9 or 10) students should have a compulsory unit of work on the brain, learning and memory and will be advocating for such a unit with our Head of Science.'
– Strathcona Baptist Girls Grammar School

Although the explicit teaching of metacognition was a relatively new concept in schools, it resonated with teachers as they believed that there was a strong alignment with course content and curriculum. When asked whether anything should be removed from the lessons, one teacher replied, 'Take nothing out'.

In addition, teachers considered the explicit teaching of metacognition important and necessary to enable a whole-school metacognitive culture.

'I am determined to ensure that our students have continued opportunities to learn about metacognition, to encourage them into taking charge of their own learning. We want to think about how we will continue with this knowledge and have it embedded into how we teach and have common language amongst staff and students.'
– Plenty Valley Christian College

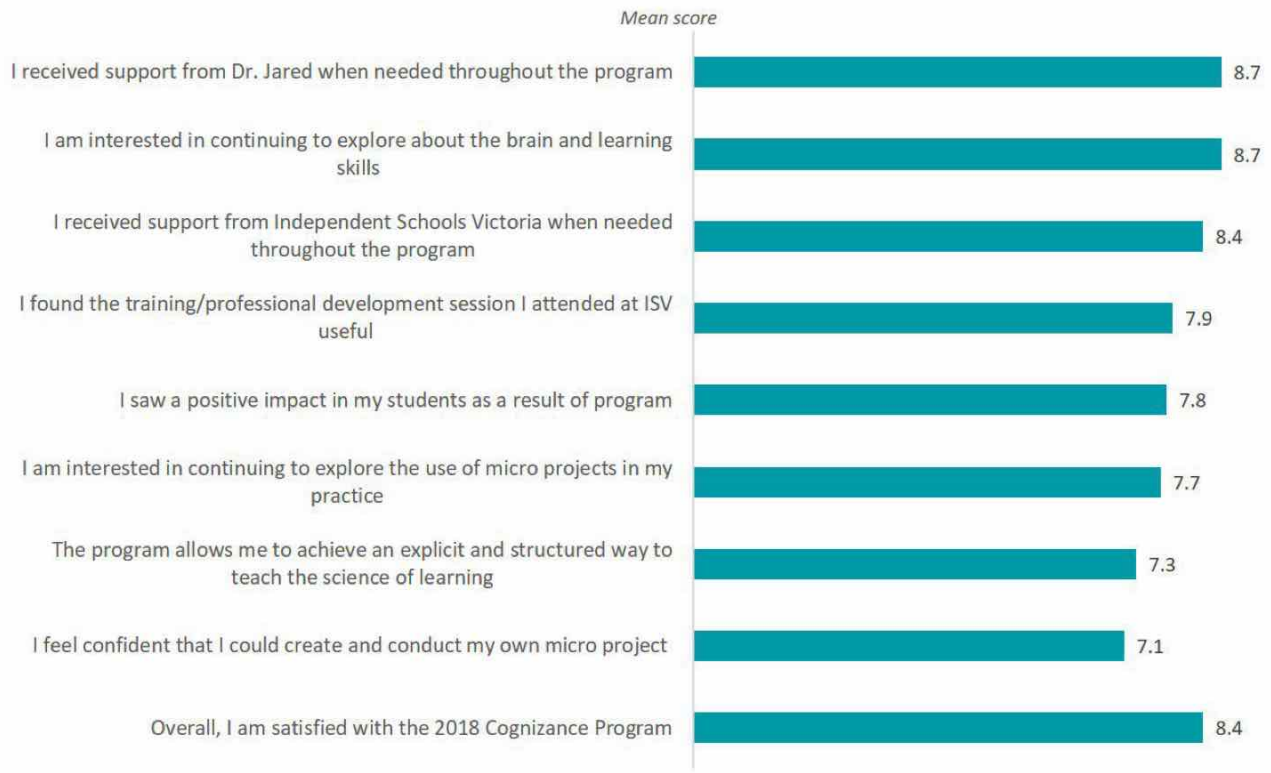
In conclusion, the project has assisted teachers to feel empowered to change their mindsets and improve their teaching practice. The explicit teaching of metacognition was strongly favoured among teachers as they came to see the importance of having a metacognitive stance in both educators and learners.

5.2.1 To what extent were teachers satisfied with the project?

In general, teachers expressed strong satisfaction with the project (an average mean score of 8.4 out of 10). Similarly, nearly all teachers expressed their strong appreciation and satisfaction in being part of this project during the qualitativeinterviews. The high level of satisfaction goes with strong advocacy, where 3 in 5 (60 per cent) of all teachers surveyed provided a score of 9 or 10 out of 10 when asked their likelihood to recommend the project.

Figure 10 shows teachers' likelihood to agree with statements in relation to their overall experience and satisfaction of the project.

Figure 10: Mean score for agreement questions asked in post-survey



Data Source:
Total Sample: Unweighted base; n=20 for both pre and post-surveys
Q. Please rate how likely you are to agree or disagree with the following statements on a scale from 0 to 10. A rating of 0 means 'Strongly Disagree' and a rating of 10 means 'Strongly Agree'.

Overall, the majority of teachers strongly agreed that they received the support they needed throughout the project (an average score of 8.5 for support from both Dr Cooney Horvath and ISV), and that they were interested in continuing to explore the brain and learning skills (mean score of 8.7). We explored this in the qualitative interviews and found that many teachers reiterated their interest in learning more about neuroscience and were keen to be part of this project again. One teacher from Plenty Valley Christian College commented:

'I am excited to learn more about the potential power of the brain to learn and adapt in an educational context. Thanks for the experience.'

The metacognition topics sparked interest not only among participating teachers and students but also the entire school. The qualitative interviewed revealed that nearly all students and teachers have shared the stories they learned with friends and family, which highlights their positive experience with the lessons. As one teacher from Plenty Valley Christian College commented:

'Our students have really enjoyed his classes but have also continued talking and thinking in other classes and I am told at home too.'

5.2.2 What was the impact of the micro-projects on teacher practice?

Although a considerably high score was observed among teachers in their confidence in creating and conducting micro-projects (mean score of 7.1), they were least likely to agree with this compared to the other statements presented in Figure 10. While the majority of teachers who completed the micro-projects were satisfied with their ability to incorporate the metacognitive topics in the classroom, and some teachers could point to how this process was changing their teaching practice, others felt that they needed more assistance and time to complete the micro-projects before they can become part of their teaching routine. This shows that more guidance and follow ups on micro-projects are needed in the next iteration of this project.

The overall findings and conclusions of the teacher survey demonstrate that the project was successful in delivering its aims to assist teachers in their understanding of metacognition, their confidence in teaching, and in changing their teaching practice. Alongside the high satisfaction of teachers with the project, the analysis of project level data revealed that most teachers saw improvements in their mindset and teaching practice following their involvement in the project. They were able to also observe positive shifts in their students first hand and were convinced that the explicit teaching of metacognition is important and necessary to create a holistic learning experience and a metacognitive culture in school.

6. Key findings and conclusions

This section draws out the key findings and conclusions from the research and evaluation.

6.1 Growth in students' perception on their congnitive abilities

The evidence collected throughout the research project shows a clear increase in students' understanding that skills/intelligence are not pre-determined and fixed. There was a clear shift in students' mindset as they began to live in their story and see the world not 'as it is' but 'as it should be'. Students were able to use the concepts that they learned to reflect and explain their thinking.

There was clear growth in students' understanding and interest in neuroscience and the brain. As students learned that the brain is malleable, they saw a profound shift in their ability to adapt to the volatility that they face in their studies and in life. Their ability to comprehend the metacognition topics was driven by the well-planned course outline, which included the provision of real stories/ testimonies and execution of successful team activities and practical games.

The project produced strong evidence of positive changes to students' learning practices. Students clearly grasped the techniques presented to them to enable deep and long-term memory, and they were able to implement them in their own study and learning practices. Students were able to use their learning practice to maximum efficacy and efficiency, and some revealed improved test scores as a result.

6.2 Changes in student perceptions of themselves and their learning journey

The greatest shift and impact of the project was in students' perceptions of their own learning journey. The metacognition lessons helped students to challenge and change their perceptions of metacognition and their learning. They realised that their stories shape their perceptions, that they are able to control and manage their own learning journey.

Students who were satisfied with the project were those who were able to delineate and draw upon the four pillars of metacognition (aspire, analyse, assess and adapt) in their lives. We uncovered examples of students saying that they have translated this positive change in perceptions to other areas of their lives, such as study, exams, sports, music and interactions with their peers. This is likely to accrue benefits throughout their lives.

6.3 High satisfaction and experience with the project

Satisfaction with the project was high. Satisfaction was a strong contributing factor to the perceived changes in learning processes among students and teaching practice among teachers. Driving this satisfaction was the sound project structure and management, and delivery of a unique practical learning experience to the students. The strong advocacy of the project and interest to continue learning about metacognition and participate in the next iteration of the project highlights a successful project.

6.4 Changes in teachers' knowledge, skills and confidence in relation to metacognition

Participation in the project has boosted teachers' knowledge of metacognition and shifted their mindset and attitudes towards teaching. Teachers reported greater confidence and ability to create and implement interventions around students' cognition, particularly using the metacognition principles they learned in their pedagogy.

Similar with the students' findings, the biggest impact of the project was on teachers' ability to draw upon the four pillars of metacognition in their teaching practice. The project provided teachers the opportunity to reflect on their teaching practice and put in place the metacognitive techniques they learned with students, such as actively encouraging students to embrace errors. Some teachers reported an increased confidence in conversations with colleagues and improvements in their professional learning as a result of the project.

The development and refinement of the micro-project process provides a platform for participating teachers to implement metacognitive techniques into their practice. While the micro-project process needs some refinement, the project produced highly successful examples of how teachers were able to apply project learnings in the classroom. Potential areas for refinement include more support for teachers, further reading on metacognition, concrete examples of classroom activities based on metacognition, and continued professional leanring in relation to metacognition and neuroscience.

The explicit teaching of metacognition resonated strongly with teachers as they saw a strong alignment with course content and the school's curriculum, and positive shifts in their students as a result. The success of the project has contributed to a strong appetite among teachers in all six schools to establish a metacognitive culture school-wide.

In conclusion, the 2018 Cognizance project was a highly successful program that met its chief aims of improving teachers' abilities to coach students on metacognition, and increasing students' understanding of metacognition and thinking and learning processes. The overarching concept of developing a lesson program to introduce key concepts of metacognition was proven to be beneficial, achievable and highly desirable. The high satisfaction among students and teachers demonstrates that the broad structure of the project was effective, and with some minor tweaks, has the potential to support more Year 9 students in Victorian Independent schools. The benefits accrued from this project have the potential to stay with participating students and teachers throughout their lives.

7. Appendix

7.1 Mean score for pre-survey and post-survey

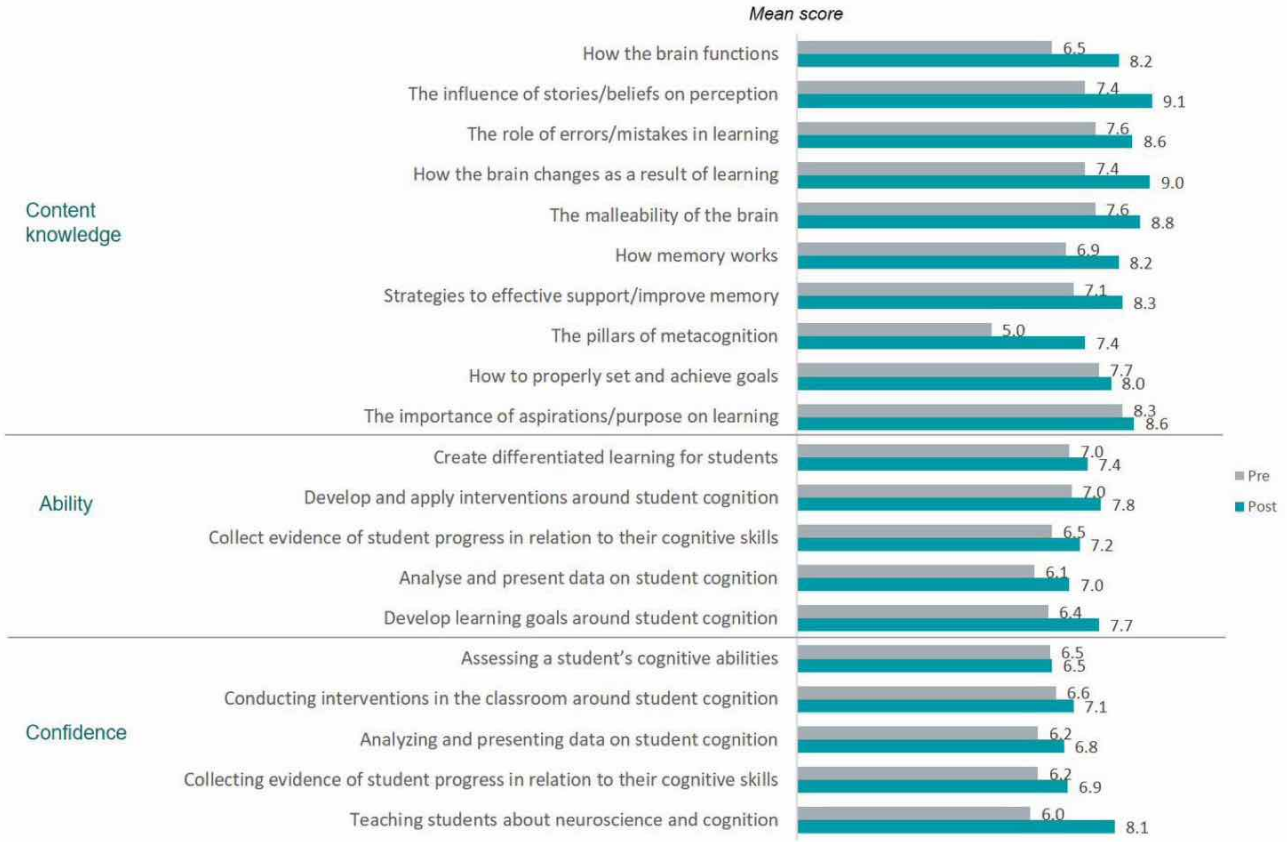
7.1.1 Students' mean score

Figure 11: Mean score for course agreement statements pre and post-survey

Data Source:
Total Sample: Unweighted base; n=271 (Among those who completed both ISV pre and post-survey)
Q5. Thinking about yourself in general, please rate how likely you are to agree or disagree with the following statements on a scale from 0 to 10. A rating of 0 means 'Strongly Disagree' and a rating of 10 means 'Strongly Agree'

7.1.2 Teachers' mean score (content knowledge, ability and confidence)

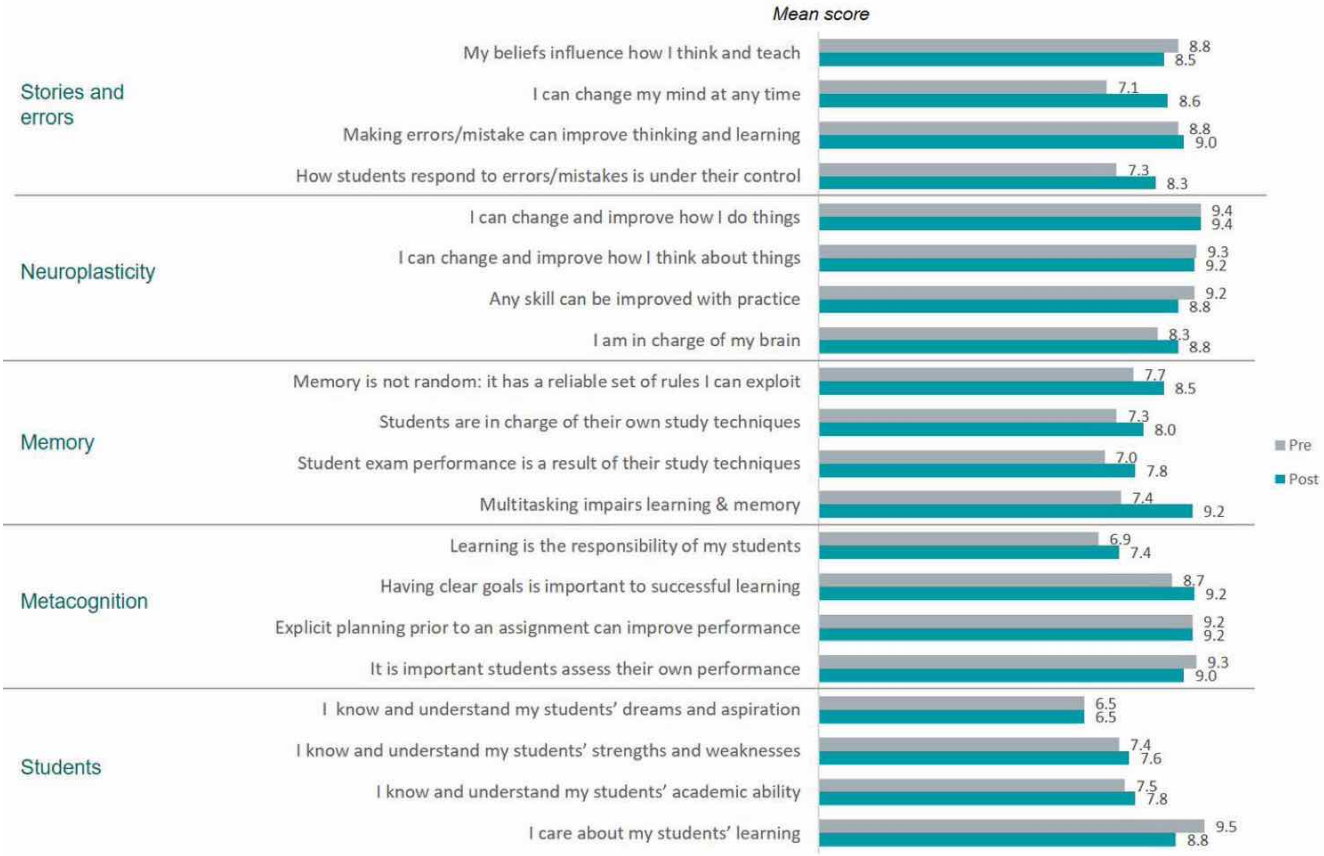
Figure 12: Mean score for agreement statements in pre and post-survey (content knowledge, ability and confidence)



Data Source:
Total Sample: Unweighted base; n=20 for both pre and post-survey
Q. Please rate how likely you are to agree or disagree with the following statements on a scale from 0 to 10. A rating of 0 means 'Strongly Disagree' and a rating of 10 means 'Strongly Agree'.

7.1.3 Teachers' mean score (attitude)

Figure 13: Mean score for agreement statements in pre and post-survey (attitude)



Data Source:
Total Sample: Unweighted base; n=20 for both pre and post-survey
Q. Please rate how likely you are to agree or disagree with the following statements on a scale from 0 to 10. A rating of 0 means 'Strongly Disagree' and a rating of 10 means 'Strongly Agree'.

7.2 Weightings and significance testing

All statistical significance testing in this report was performed using Q computer software package, which includes R statistical software integration . Analysis was conducted for each survey question by the following sub-group profiles:

1. School attended (Bayview College, Oakleigh Grammar, Plenty Valley Christian College, Ruyton Girls' School, St Michael's Grammar School, Strathcona Baptist Girls Grammar School)
2. Number of lessons attended (zero, one, two, three, four)
3. Metacognition lesson attended (lesson one, lesson two, lesson three, lesson four)
4. Net promoter score:
    a. Advocates (provided a score of 9 or 10 when asked to rate their likelihood to recommend the project)
    b. Passives (score of 7-8)
    c. Detractors (score of 0-6)
5. Level of satisfaction with project:
    a. High (provided a score of 9 or 10 when asked to rate their satisfaction with the project)
    b. Medium (score of 7-8)
    c. Low (score of 0-6)

Due to insufficient sample size, further analysis by sub-groups and statistical analysis could not be conducted for the teacher pre-survey, teacher post-survey and between the teacher pre and post surveys. The quantitative findings for this cohort needs be read with caution.

Tests of significance were conducted between key groups of interest at the 95 per cent confidence level and are reported where appropriate. Where significance testing has occurred between more than two categories within a group, such as the name of school attended, significance testing has been used to tests one category against the average of the other categories, i.e. against the total excluding itself.

A 'significant difference' means that we can be 95 per cent confident that the difference observed between the two samples reflects a true difference in the population of interest, and is not a result of chance. Significant differences are reported where relevant and appropriate throughout the report.

Categorical variables used as profiles in this report, such as name of school attended were tested using Pearson's Chi-Square Test of Independence. The test is based on a cross tabulation tables, with cases classified in relation to the categories in each variable.

The independent samples t-test is used to compare the mean score on some continuous variable of two different groups of people or conditions. For example, in this survey, independent paired samples t-test are used to explore if there was a significant difference in the mean scores for each course agreement statement between the pre-survey and post-survey. If the value obtained in the Sig. (2-tailed) column is equal or less than 0.05, we can say that there is a significant difference in the mean scores between the two tests.

Pearson correlation coefficient test (r) was used to measure the dependency or relationship between two variables. In in this report, this test was conducted to establish if there was a relationship between the level of satisfaction and total number of lessons attended.

7.3 Rubric used to score open-ended questions

	Utilisation of Content Knowledge		Deep Consideration	
Criteria		Score		Score
	Uses more than one word	3	Supports a valid argument (they use some form of evidence to support the argument being made)	3
	Uses one word	2	Conceptualises a relevant argument, but lacks clear support (they make an argument, but supply no supporting evidence – simply opinion)	2
	Uses zero words	1	Answers questions (at least there's ink on paper; answers typically <10 words)	1
Indicator	Relevant vocabulary words / key concepts (see below)		Conceptualises and supports argument	
Capability	Employs knowledge of material		Thinks deeply about issue	

Q1. Do you believe skills and intelligence are pre-determined and fixed (unchangeable)? Explain your thinking and **Q2. What is Neuroplasticity and what does it suggest about learning?**

Relevant Vocab Words / Concepts: Hacking; Modularity; Controller; Coder; Predictor; Bottom-Up; Top-Down; Stories; Errors; Mistakes; Engage; Avoid; Error-Alarm; Mindset; Concepts; Updating; Plasticity; Neuron; Synapse; Epigenetics; Genius; Half-Brainers; No-Brainers; Sharon Parker; Goggles.

Q3. If you desire to deeply remember facts and ideas for a long period of time, what are some effective techniques / strategies you could use? and **Q4. What is Metacognition, and why is it important?**

Relevant Vocab Words / Concepts: Stories; Errors; Mistakes; Error-Alarm; Attention; Elaboration; Linking; Multitasking; Cramming; Spacing; Consolidation; Sleep; Forgetting-Curve; Reminiscence; Stochastic Resonance; Context; State; Encoding; Recall; Access; Review; Re-Written; False memories; Pomodoro; Senses; Highlighting; Summary; Overlearning; Flashcards; Feedback; Metacognition; Aspirations; Purpose; Goals; Analyse; Assess; Adapt; AI; SMART; Goldilocks; Calendar.

7.4 Answer options and answer for multiple-choice questions

Students answered four multiple-choice questions in this section of the survey. The correct answer for each question is underlined in the answer options below.

Q1. When you make a mistake or an error, what are your two response options?

a. <u>Engage or Avoid</u>
b. Break or Fix
c. Assess or Adapt
d. Recall or Recognition

Q2. Do you believe that the brain is largely ACTIVE (determines and drives our thoughts/behaviours) or largely PASSIVE (simply responding to and reflecting our thoughts/behaviours)?

a. Active
b. Passive

Q3. If you desire to deeply remember facts and ideas for a long period of time, what are some effective techniques / strategies you could use?

a. Encoding
b. Recall

Q4. What are the four Pillars of Metacognition?

a. Ask, Answer, Write and Recall
b. Stop, Listen, Think and Wonder
c. Aspire, Analyse, Assess and Adapt
d. Diet, Exercise, Sleep and Relationships

7.5 Assumptions and limitations

The below are some methodological limitations to this study.

1. The extent of improvements as a result of the project is based on participant's observation and perception.
2. No control group was created to test the impact of the project.
3. Intervention was coincided with the passing of time, and therefore it is difficult to attribute any observed effect to the intervention. Therefore, variations within students were not taken into account.
4. As only 13 out of 22 teachers completed both the pre and post-survey, the quantitative findings for this cohort needs to be read with caution.
5. The pre and post-survey test for the student survey was conducted with the assumption that there is a normal distribution for each course agreement question. As a large set of sample was used for analysis, n=271, it is reasonable to assume a normal distribution.

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