



Unpacking the Science of Learning

An evaluation of ISV's Cognizance program

Foreword

This is an important and timely report. It highlights the experience of thousands of school students who took part in a five-year program that applied the principles of cognitive science to help them and their teachers understand how they learn, leading to positive results.

It's timely because education leaders increasingly recognise the importance of the science of learning when preparing trainee teachers for the classroom. This was highlighted in the recent report of the Teacher Education Expert Panel, set up by the Australian Education Minister, Mr Clare. Its report, released in July 2023, recommended that 'the brain and learning' be included as one of the core content areas of initial teacher education.

This report looks at the responses of students, teachers and parents involved in the Cognizance program, a collaboration between Independent Schools Victoria (ISV) and education neuroscientist Dr Jared Cooney Horvath. The program sought to help students take greater control of their own thinking, learning and self-management.

More than 4,000 students and 316 teachers from 20 schools took part in the program. This evaluation report draws on survey responses from many of them.

Student responses were overwhelmingly positive and promising. Overall, students gained a greater awareness, understanding and interest in their thinking and learning skills. The program helped to boost their confidence, leading to a more positive mindset and a greater sense of control over their academic and personal lives. These changes led to improved academic performance.

Teachers and parents also reported a high level of satisfaction with the program. Among other things, teachers felt it had improved their teaching practice and increased their confidence. Parents gained a better understanding of their children.

In summary, the survey confirms that when metacognition is effectively taught in schools, it has a significant positive effect on student learning, teaching practice and overall school learning culture.

While the Cognizance program has concluded, ISV is committed to enhancing learning outcomes in schools through the evidence-based practices that are validated in this report. In collaboration with Dr Cooney Horvath, we have drawn on the program's insights to create two online courses centred on the science of learning: one for students and another for teachers. To explore these courses further, please visit ISV's Learning Blueprint webpage at is.vic.edu.au/blueprint.



Michelle Green

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Chief Executive
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Executive summary

In recent years, there has been growing interest in evidence-based approaches to teaching and learning in Australia. The more we learn about how the brain works, through breakthroughs in neuroscience and other scientific fields, the more important it is for education to be informed by the science behind human learning.

The principles of learning science are drawn from the body of cognitive science research on how students learn. This includes how they acquire knowledge, skills and competencies and why some learning strategies work better (or worse) than others. By adopting teaching and learning methods grounded in scientific evidence, we can equip young people with the skills they need – to not just survive, but thrive in an ever-changing world.

In view of this, Independent Schools Victoria (ISV) collaborated with education neuroscientist Dr Jared Cooney Horvath to deliver the Cognizance program to help students take agency over their own thinking, learning and self-management practices.

The overall objectives of the program were to:

1. Support students' understanding of metacognition and to explore their own thinking and learning processes.
2. Enable teachers to understand the science of learning and improve their teaching pedagogy.
3. Encourage a metacognitive culture in schools, through explicitly teaching students and teachers metacognition, and continued efforts by teachers to shape a culture of learning in the classroom.

From 2018 to 2022, a total of 20 schools consisting of 4,266 students and 316 teachers participated in Cognizance. The main program was comprised of four metacognition lessons delivered to students and teachers. Other activities included teacher micro projects, a teacher course on the principles of learning (from theory to practice), teacher professional development and parent information sessions.

The purpose of this evaluation is to assess the impact, effectiveness and outcomes achieved by the program. The evaluation draws on insights from the quantitative and qualitative research conducted from 2018 to 2022. A total of 2,955 students, 316 teachers and 24 parents participated in the research.



Key findings

Student impact

- The results of the pre- and post-test revealed a statistically significant shift in students' perceptions of their learning abilities after completing the program. Specifically, there was a medium-to-large effect size observed in three key areas: understanding of memory, the value of making mistakes for learning and the negative effects of multitasking.
- Students strongly enjoyed the metacognition lessons and said they had a better awareness, understanding and interest in their thinking and learning skills. Students reported high satisfaction with the program (8.2 out of 10) and a strong likelihood to recommend the program to their peers (8.7 out of 10).
- Most students 'strongly agreed' or 'somewhat agreed' that Cognizance assisted with their learning concerns (81% in 2021 and 74% in 2022).
- Students' overall sentiment (expressed positivity or negativity) towards the program was positive (0.6). Additionally, there was a positive correlation between students' perceived level of engagement and their overall sentiment. This suggests that as student engagement in the program increased, their perceived experience towards it also increased.
- Qualitative analysis showed that students gained a deeper understanding of their brain and thinking, leading to a more positive view of learning and increased motivation to take ownership of their own learning.
- Participating in the program helped some students to develop emotional resilience, which in turn improved their ability to handle pressure and challenges.
- The program helped to boost students' confidence in their own abilities, leading to a more positive mindset and a greater sense of control over their academic and personal lives.
- Teachers observed a range of positive outcomes in their students, including increased awareness of the brain, a better understanding of learning strategies and improved metacognition skills. These changes translated into improved academic performance and a more positive attitude towards learning.

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Teacher and school community impact

- Teachers reported a high level of satisfaction with the program (8.3 out of 10) and indicated a strong likelihood to recommend the program to their friends and colleagues (8.6 out of 10). They found the professional development, staff information and parent information sessions to be engaging and useful.
- Teachers found the teacher course (Learning principles - from theory to practice) to be engaging (9.3 out of 10) and most have applied what they learned from the course (8.2 out of 10). The majority agreed that the program demonstrated an explicit and structured way to teach the science of learning. It prompted teachers to reflect on their teaching practice and to continually improve using evidence-based strategies.
- Teachers felt that the program improved their teaching practice and most indicated greater confidence in teaching and connecting with students. This sentiment was particularly evident among those who participated over a longer period.
- Most parents (83%) found the parent information session to be 'extremely useful' or 'very useful' in better understanding their child. They found that the Cognizance program had a positive impact on their child.
- Both the student and teacher cohorts found the program highly relatable and grounded in scientific evidence.
- The program created opportunities for discussion, collaboration and innovation. It also empowered schools to re-think their approach to teaching and learning.
- The program's impact was greater in schools that were more engaged, participated longer in the program and had more support from leadership.

We uncovered strong support for teaching the science of learning explicitly to students and teachers. Students who understand how they learn and can regulate their learning, thoughts and emotions are more likely to take control over their own learning, cope with pressures of normal life and develop resilience. Likewise, the teacher component of the program enabled teachers to critically engage with the building blocks of learning and how they can apply effective teaching and learning practices with students.

The program was most effective in schools that had more engagement and support from leadership, indicating the importance of a school-wide commitment to implementing evidence-based practices. The research highlights the benefits for policy makers and school leaders to strengthen the alignment between education policies and evidence-based practices to ensure quality education for all students.



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Program overview, objectives and implementation

Recognising the importance of student agency, metacognition and the science of learning, ISV has supported selected Member Schools to participate in the Cognizance Program since 2014. Since its inception, the project has been reiterated to continually improve and provide students with the skills to understand how their brain functions and enhance their learning. Since 2017, ISV has collaborated with Dr Jared Cooney Horvath – an expert in the field of educational neuroscience – to deliver the program.

Cognizance was developed primarily to understand the impact of explicitly teaching the science of learning. It was designed to help students take agency over their own thinking, learning and self-management practices. In this program, Dr Horvath explicitly teaches students how their brain works, the mechanics of memory, the patterns of attention, the imperative of errors, effective study tactics, self-management and wellbeing strategies, metacognitive skills, deep learning practices and more. Students learn the ‘whys’ and ‘hows’ that underpin learning to assist them in taking ownership of the learning process. The program also aimed to support teachers to foster metacognition practices in the classroom and build a culture of learning in schools.

The overall program objectives were to:

1. Support students’ understanding of metacognition and to explore their own thinking and learning processes.
2. Enable teachers to understand the science of learning and improve their teaching pedagogy.
3. Encourage a metacognitive culture in schools, through explicitly teaching students and teachers metacognition, and through continued efforts by teachers shaping a culture of learning in the classroom.

From 2018 to 2022, the program was implemented in 20 schools, with 316 teachers and 4,266 students participating. In each school, all students involved in the program were in Year 9. Due to the COVID-19 pandemic and associated restrictions, a combination of on-site and online sessions were conducted from 2020 to 2022. The name of participants and the breakdown of schools, teachers and students, and program activities for each year can be found in the Appendix (p.37).



Evaluation overview and method

The purpose of this evaluation is to review the program's impact and effectiveness. The following research questions were used to evaluate the program's objectives.

1. To what extent does explicit teaching of metacognition and neuroscience increase students' perception of their cognitive and metacognitive abilities?
2. Can explicit professional learning in metacognition lead to changes in teaching practice?
3. To what extent did the program impact the school and school community?

The evaluation method used quantitative pre- and post- surveys and qualitative focus groups. A review of relevant literature was also conducted to supplement the findings in this report, particularly to understand the impact of metacognition on teaching and learning. Table 1 provides a comprehensive overview of all the research activities conducted. These activities were designed to inform and improve the program where needed.

Table 1: Research activities

Year	Research activities
2018	<ul style="list-style-type: none"> • Pre- and post-survey for students and teachers. • Observation in schools. • Two focus groups (one with students, and the other with teachers) at four schools.
2019	<ul style="list-style-type: none"> • Pre- and post-survey for students and teachers. • Observation in schools. • Year 10 pre- and post- survey. • Two focus groups (one with students, and the other with teachers) at five schools. • De-brief focus group session (among all teachers).
2020	<ul style="list-style-type: none"> • Pre- and post-survey for students and teachers. • Observation in Zoom lessons. • Interview with selected students and teachers at five schools. • De-brief focus group session (among all teachers).
2021	<ul style="list-style-type: none"> • Pre- and post-survey for students and teachers. • Observation in Zoom lessons. • De-brief focus group session (among all teachers).
2022	<ul style="list-style-type: none"> • Pre- and post-survey for students and teachers. • Observation in Zoom lessons. • Parent survey.

Survey methods

Student surveys were administered to all participants twice, two weeks prior to commencement (to capture baseline data) and two weeks after completing the course. Both the pre- and post-surveys were distributed online and took approximately 10 minutes to complete. Teachers administered the surveys in the classroom to ensure students answered the survey questions with thoughtful considerations. Table 2 shows the number of students who participated in the program (population size) and who completed both the pre and post surveys (sample size) as well as the resulting margin of error for each year.

A total of n=2955 students completed the pre- and post-surveys between 2018-2022. Based on the total number of students who participated in this program (n=4266), the margin of error is one percent at a 99% confidence level.¹

Participating teachers were also asked to complete pre- and post-surveys. Overall, 316 teachers participated in the Cognizance program, 201 of which completed both surveys. The margin of error is four percent at a 95% confidence level.

Parents of students who participated in the program were invited to complete a survey distributed at the end of the parent information session in July 2022. A total of 24 parents completed the survey.

The survey analysis approach can be found in the Appendix (p.37).

Table 2. Margin of error for each year

	Population size	Sample size	Margin of error (95% confidence level)
2018	383	271	3%
2019	928	631	2%
2020	834	536	3%
2021	805	698	1%
2022	1316	819	2%
Total	4266	2955	1% (99% confidence level)

¹ The margin of error shows how many percentage points results will differ from the real population value. A 99% confidence level with a one per cent margin of error means that the statistic will be within one percentage points of the real population value 99% of the time. For example, if 80% of students indicated that they enjoyed the program, we can be certain that 99% of the time, between 79% and 81% indicated so. The smaller the margin of error, the more confidence we can place in the results being representative of the population.

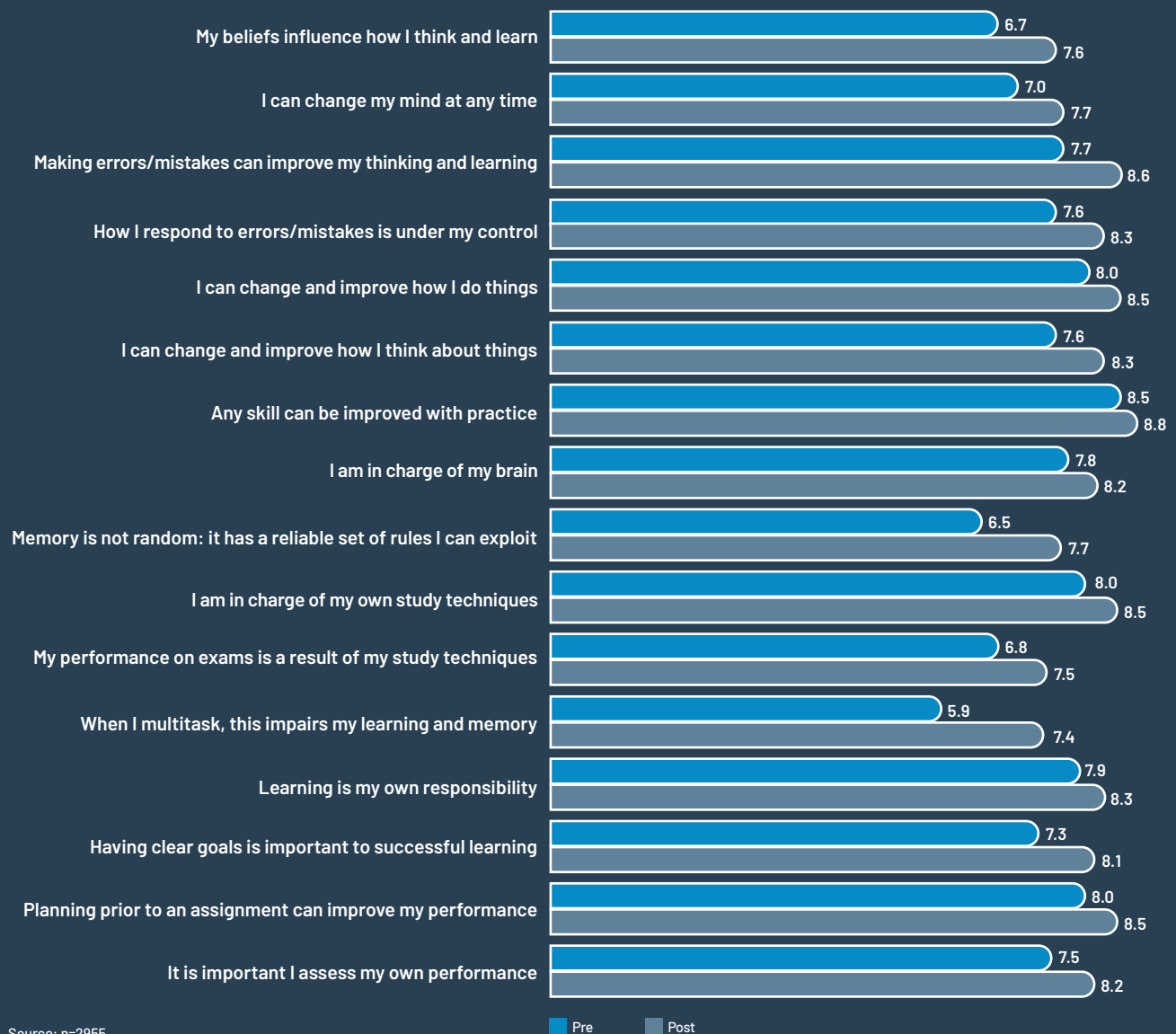
Analysis of program effectiveness

Student survey findings

Overall, the analysis revealed a statistically significant improvement in student responses for all learning attitudinal statements, as presented in Figure 1 below. Students rated higher for statements related to neuroplasticity (such as ‘any skill can be improved with practice’) and metacognition (such as ‘planning prior to an assignment can improve my performance’) in the post-survey.

While they rated all statements significantly higher in the post-survey, statements around stories and errors (such as ‘my beliefs influence how I think and learn’) and memory (such as ‘my performance on exams is a result of my study techniques’) were rated the lowest in the post-survey.

Figure 1: Mean (average) for pre- and post-surveys.



Source: n=2955

■ Pre ■ Post

Table 3 (on the next page) shows the t-test and effect size findings for each attitudinal statement and the open-ended questions. Further analysis on the measure of magnitude between two means (using Cohen's d) found a medium-to-large effect size for the statements - 'making errors/mistake can improve my thinking and learning', 'memory is not random: it has a reliable set of rules I can exploit' and 'when I multitask, this impairs my learning and memory'. This indicates that students demonstrated a significant improvement in their understanding of how memory works, and how to optimise their study strategies to enhance retention and recall. They also showed a greater appreciation for the role of mistakes in the learning process, recognising that errors can provide valuable feedback and opportunities for growth. Additionally, analysis of the open-ended questions using the assessment rubric revealed that students were significantly more able to articulate their answers and provide examples to support their argument in the post-survey than they did in the pre-survey.

The following questions were asked in both surveys:

1. Do you believe skills and intelligence are pre-determined and fixed (unchangeable)? Explain your thinking.
2. What is neuroplasticity and what does it suggest about learning?
3. If you want to deeply remember facts and ideas for a long period of time, what are some effective techniques / strategies you could use?
4. What is metacognition, and why is it important?



Table 3: Significance test and effect size findings for pre- and post-survey.

		Pre-survey		Post-survey		df	t	p-value	Cohen's d effect size
		mean	std dev	mean	std dev				
Stories and errors	My beliefs influence how I think and learn	6.7	2.5	7.6	2.3	2954	17.7	<0.001	0.4
	I can change my mind at any time	7.0	2.2	7.7	2.0	2954	15.4	<0.001	0.3
	Making errors/mistakes can improve my thinking and learning	7.7	2.0	8.6	1.6	2954	22.9	<0.001	0.5
	How I respond to errors/mistakes is under my control	7.6	2.0	8.3	1.7	2954	16.2	<0.001	0.3
Neuroplasticity	I can change and improve how I do things	8.0	1.7	8.5	1.5	2954	14.6	<0.001	0.3
	I can change and improve how I think about things	7.6	1.9	8.3	1.6	2954	16.6	<0.001	0.4
	Any skill can be improved with practice	8.5	1.7	8.8	1.5	2954	7.0	<0.001	0.1
	I am in charge of my brain	7.8	2.2	8.2	1.9	2954	9.7	<0.001	0.2
Memory	Memory is not random: it has a reliable set of rules I can exploit	6.5	2.2	7.7	2.0	2954	25.7	<0.001	0.6
	I am in charge of my own study techniques	8.0	1.8	8.5	1.6	2954	13.4	<0.001	0.3
	My performance on exams is a result of my study techniques	6.8	2.4	7.5	2.1	2954	14.7	<0.001	0.3
	When I multitask, this impairs my learning and memory	5.9	2.5	7.4	2.4	2954	26.2	<0.001	0.6
Metacognition	Learning is my own responsibility	7.9	1.9	8.3	1.7	2954	10.5	<0.001	0.2
	Having clear goals is important to successful learning	7.3	2.2	8.1	1.8	2954	19.3	<0.001	0.4
	Planning prior to an assignment can improve my performance	8.0	1.9	8.5	1.7	2954	12.2	<0.001	0.3
	It is important I assess my own performance	7.5	1.9	8.2	1.8	2954	16.9	<0.001	0.3
Open-ended questions (depth of response)		4.7	3.0	7.5	4.0	2954	47.9	<0.001	0.8

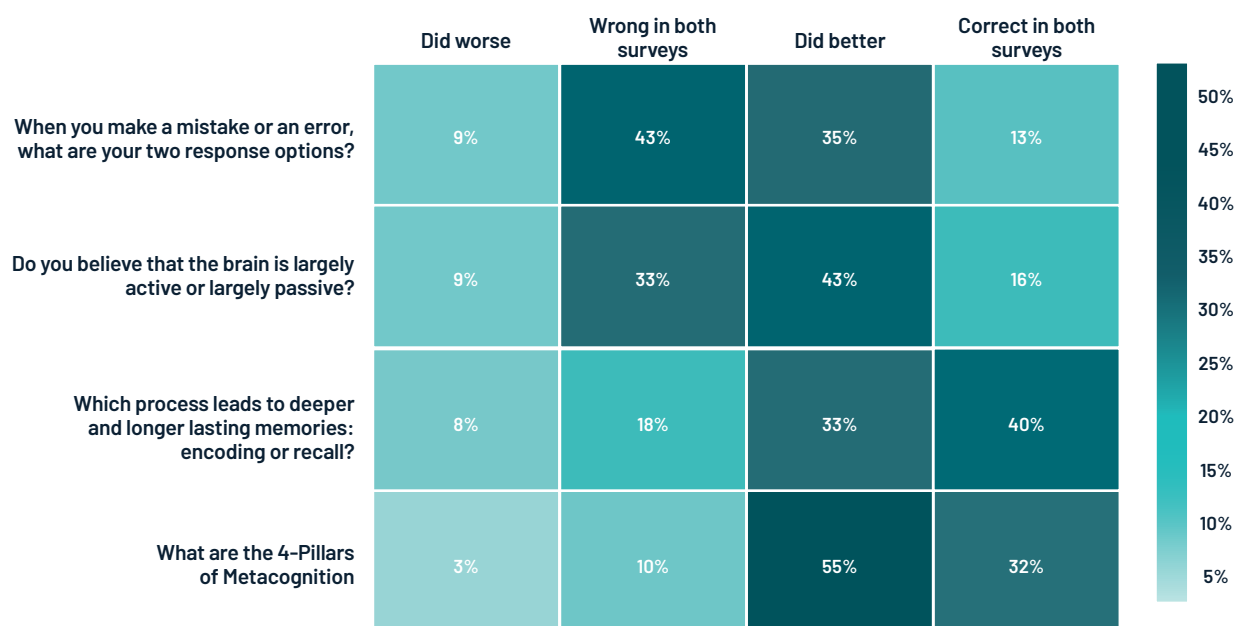
Source: n=2955

Notes: See 'survey analysis approach' in the Appendix for interpretation on significant difference and effect size.

In addition to four open-ended questions, students were asked the same four multiple choice questions in both surveys. The heatmap in Figure 2 provides a useful visualisation for depicting the distribution of data for all multiple-choice questions in both the pre-and post-surveys. The darker shades of green on the heatmap represent a higher proportion, as indicated in the legend on the right.

Over a third of students performed better on the post-survey compared to the pre-survey, having provided a correct answer after the program but an incorrect one before. Additionally, more than half of the students (55%) improved their performance when asked to identify the four pillars of metacognition.

Figure 2: Multiple choice analysis



Source: n=2951 – 2955

Note: Questions and answer options can be found in the Appendix.

In general, students found their experience with the program positive, impactful and meaningful. As shown in Table 4, students rated it 8.2 out of 10 for overall satisfaction and 8.7 out of 10 for their likelihood to recommend it to their peers.

Students strongly enjoyed the metacognition lessons and indicated that they had a better awareness, understanding and interest in their thinking and learning skills.

Most students also agreed that their school encourages them to take responsibility for their own learning, which reflects the program's goal of fostering self-directed learning. The mean scores for the attitudinal statements remained relatively consistent, although there was a slight decline in the 2022 scores, potentially due to the change of delivery format (the program shifted back to online lessons in the second half of the year due to Dr Horvath's unavailability).

Table 4: Average (mean) for attitudinal statements in post-survey.

Average (mean)	Overall	2018	2019	2020	2021	2022
I enjoyed the metacognition lessons provided by Dr. Jared	8.6	8.4	8.6	8.7	8.9	8.2
I have a clear understanding of the lessons provided by Dr. Jared	8.1	7.9	8.1	8.3	8.4	7.9
I have a better awareness and understanding of my thinking and learning skills as a result of the program	8.1	7.3	8.2	8.2	8.4	7.8
I am interested in continuing to explore about my brain and my learning skills	7.9	7.4	8.0	8.0	8.2	7.7
My school encourages me to be responsible for my own learning	8.0	NA	NA	8.0	8.2	7.8
In my school, I am encouraged to develop my thinking and reasoning skills	7.6	NA	NA	7.6	7.7	7.4
I have applied what I learned from the metacognition lessons	7.2	6.8	7.4	7.3	7.5	6.9
In my school, I am encouraged to think deeply about the important ideas I'm being taught	7.3	NA	NA	7.3	7.4	7.1
I have been practising self-assessment in the last few months	6.9	NA	NA	6.9	7.1	6.7
My teachers helped me with my thinking and learning abilities in the past few months	6.5	6.0	6.4	6.6	6.8	6.5
I enjoyed the post-lesson reflection questions/activities	6.2	5.2	5.8	6.3	6.8	6.4
Overall satisfaction with program	8.2	8.0	8.4	8.3	8.6	7.8
Likelihood to recommend program	8.7	8.4	9.1	8.7	9.1	8.2

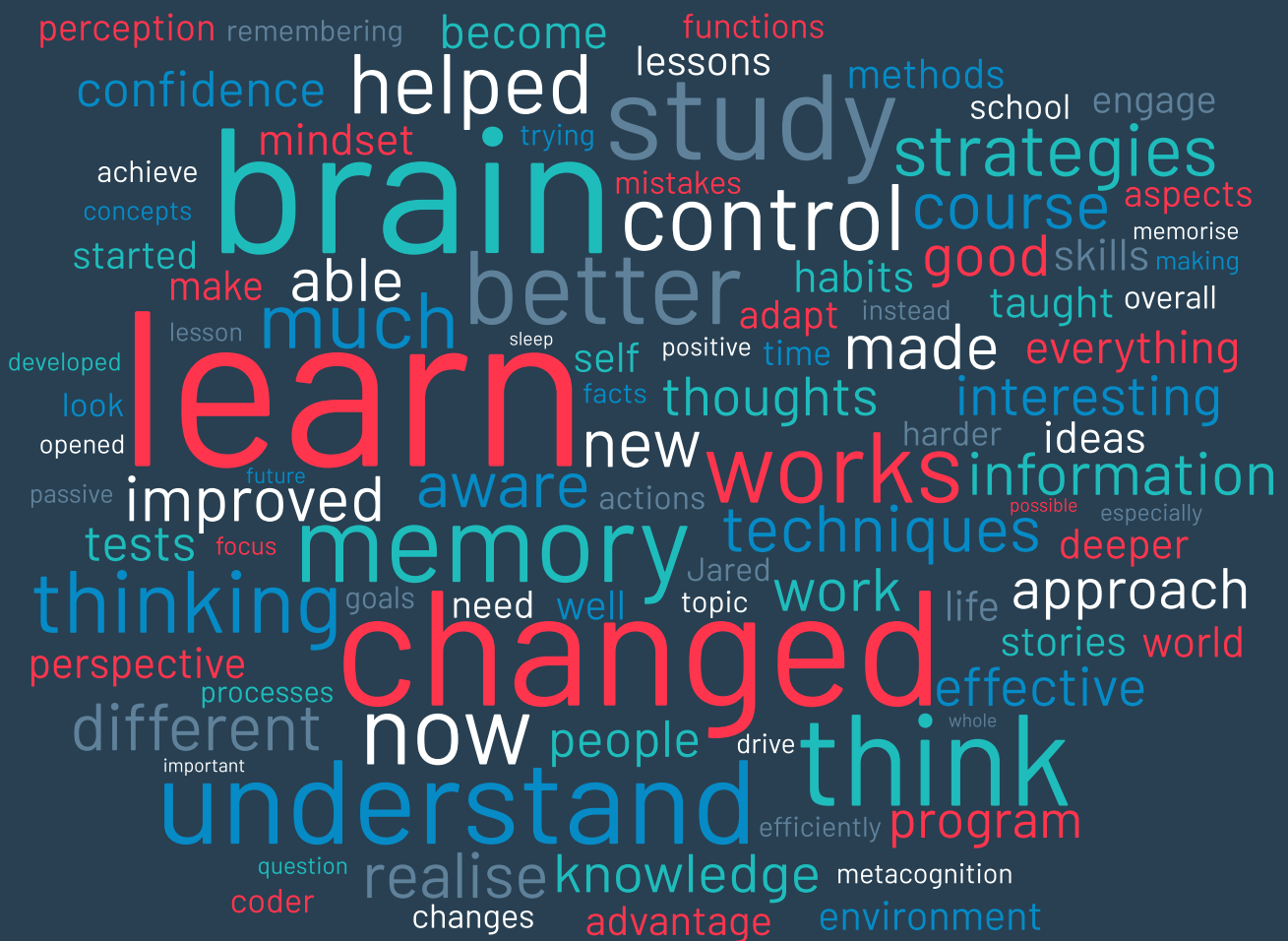
Source: n=1954-2683

Note: 'NA' included when question is not asked for the year

Students' responses were overwhelmingly positive when asked 'How has your thinking changed (if at all) as a result of this program?'. The sentiment analysis revealed a positive overall sentiment score of 0.6, indicating a largely positive emotional response.

The word cloud generated from their responses included common words such as 'learn', 'changed', 'brain', 'understand', 'think' and 'study', suggesting that the program had a significant effect on students' learning, cognitive processes and study habits.

Figure 3: Word cloud (students)



Source: n=2955

The Cognizance program successfully addressed students' misconceptions about skills and intelligence being predetermined and fixed by providing them with a better understanding of the science of learning.

Students' qualitative responses revealed that the program had a profound impact on their understanding of their brain and thinking, leading to increased confidence in their learning abilities. The program successfully addressed students' misconceptions about skills and intelligence being predetermined and fixed by providing them with a better understanding of the science of learning. As a result, many students reported a heightened awareness of their own learning journey, and some have started implementing high impact strategies to prepare for exams.

"After this program, I have more hope that I have the potential to [grow] and achieve my goals. My approach to learning has changed as I have learnt many tips on doing well of assessments. I think that my brain is extremely cool and fascinating!"

"This course has allowed me to be able to understand the basics as to how the brain works and from this, I now know the best ways to learn effectively. Spreading the course over a certain period of time and in an engaging way, entertained me and educated me at the same time about utilizing my time and how to prepare in advance for school."

"I know more about how my brain works and it helps because it makes me think if something doesn't work try another method because they are all different."

"It has given me a new bout of motivation as I know how to approach learning. I know how to make more achievable goals and that learning is a process."

By learning about how their brain works and how to optimise their learning strategies, students felt empowered and motivated to engage more actively in the learning process. The majority of students reported adopting a growth mindset, recognising that their brain is malleable and that they can adapt their thinking and behaviour to improve their performance. Furthermore, students expressed a strong interest in continuing to explore this topic, suggesting that the program had sparked a lasting curiosity about the science of learning.

"...It has also changed the way I view learning as a whole and to always see failure as a potential to adapt rather than sulk. I also understand why I may not have had the best experience with my memory being very sluggish and how to change that."

"This course is very interesting and really extends and challenges my understanding to the brain. I am now more open to step out of my comfort zone and maybe I have more potential of which I haven't discovered yet."

"I am now more aware, about my brain and mind, and I am really surprised and interested about it. This program has sparked interest for neuroscience and psychology and philosophy."

While social-emotional development was not a primary goal of the program, students have reported feeling more confident and in control of their emotions and mental health as they developed self-awareness and agency to cope with social challenges.

"...I struggle a bit with anxiety and overwhelming thoughts, so the idea that I can reflect on my own brain and have a go at calming my thoughts was quite helpful."

"I had been struggling with and am continuing to struggle with mental health issues and beforehand I felt quite hopeless. After this program, it has helped me to realise that I am in control of myself and am able to do things to help improve me."

"At the beginning of the course, I was always stressing and was nervous, however after the sessions I'm still stressed out and nervous but not as much as I was before the sessions."

The program has empowered students to take control of their learning and become more self-directed in their academic pursuits. Some felt more positive about their academic and personal trajectory.

"I have realised that I control my learning and my actions more and that my brain is flexible, and I can steer my life in the directions I want to. I have learnt better ways to learn and better prepare myself when I struggle."

"I have been more focused in learning and thinking. I have been able to achieve more, and focus more, into what I am supposed to be doing, and I have a better view on life as a whole, as now I have confidence to do things that I never thought I could achieve, and I am grateful for that."

"I think I understand now how complex everything is, and I'm even more interested in the way the mind works now. The things we learnt about in terms of who drives this machine, along with sleep and emotions were especially interesting, and inspired me about how much there is to learn and appreciate about being alive."

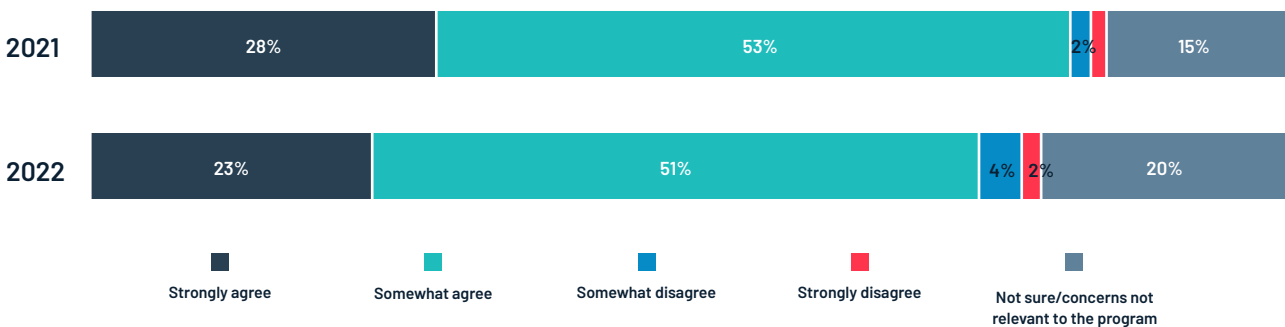


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There is also evidence that the program assisted students with their learning concerns. In the pre-survey, students were asked to identify their main concerns when it comes to learning. Analysis of these responses shows that students' concerns were primarily related to lack of motivation and focus, difficulty with remembering facts, distractions, fear of failure and time management.

In the post-survey, students were presented with their own answer to the question about their main learning concerns, followed by the question: "To what extent do you agree or disagree that the program has assisted with your learning concerns?" As shown in Figure 4, most students 'strongly agree' or 'somewhat agree' that the program has assisted with their learning concerns (81% in 2021 and 74% in 2022). Only a small proportion of students indicated that their concerns were not relevant to the program.

Figure 4: Likelihood to agree or disagree that the program assisted with learning concerns.



Source: n=660 (2021), n=727 (2022)

Note: Question only asked for those who provided a valid answer in the pre-survey on learning concerns.

Note: Percentages may not add up to 100% due to rounding.

By analysing students' responses to "What are some of your main learning concerns?" (asked in the pre-survey) and "How has your thinking changed (if at all) as a result of the program?" (asked in the post-survey), we found that the program had a direct and positive impact on some students. Examples of students' responses below suggest that the program was effective in addressing their learning concerns and providing them with the necessary tools and strategies to improve their learning outcomes.

Students' learning concerns and how their thinking has changed after the program.

Pre-survey What are some of your main learning concerns?	Post-survey How has your thinking changed as a result of the program?	School
"That I won't be able to study effectively."	"I can now figure out how to study according to my learning needs and my learning capacity."	Waverley Christian College
"That I won't remember how to do things and that I'll get things wrong and won't be able to learn from my mistakes and disappoint my mum."	"I have learned that it is okay to get things wrong and that it's good to get things wrong because it allows you to learn further."	Southern Cross Grammar
"My main concerns to learning would be organising my time wisely. For example, if an assignment was due in a week, I'd plan ahead so I would do a little a day instead of all of it on the last day."	"It has encouraged me to be more organised with my time so that I can perform as best as I can on things like tests."	Plenty Valley Christian College
"When it comes to learning, I become nervous when I'm about to sit an assessment as I stress too much and I'm afraid of forgetting important notes that I need to know to be able to sit this assessment."	"At the beginning of the course I was always stressing and was nervous, however after the sessions I'm still stressed out and nervous but not as much as I was before the sessions."	Ilim College
"Some of my main concerns when it comes to learning is not being able to remember the information or put it to use."	"I'm more aware of what happens in my brain and how I can remember things better. This can all help me with my studies."	Ilim College

Further analysis was conducted on the number of lessons attended by students, which revealed a positive correlation with several variables, including satisfaction, likelihood to recommend the program, impact on learning concerns and students' sentiment. These findings suggest that the more lessons a student attended, the more likely they were to report

higher levels of satisfaction, recommend it to others, agree that it assisted with their learning concerns, and express positive sentiments about the program. Therefore, attending a greater number of lessons appears to have a direct and positive impact on students' overall experience and outcomes.

Table 5: Metrics by total lessons attended.

Key metrics	Total lessons attended				
	None	1	2	3	4 or more*
Overall satisfaction (mean)	5.0	6.7	7.0	7.7	8.0
Likelihood to recommend program (mean)	6.4	6.8	6.3	7.4	8.0
% Nett Agree 'program assisted with learning concerns' (row %)*	1%	3%	4%	21%	72%
Sentiment score	0.3	0.3	0.5	0.5	0.7

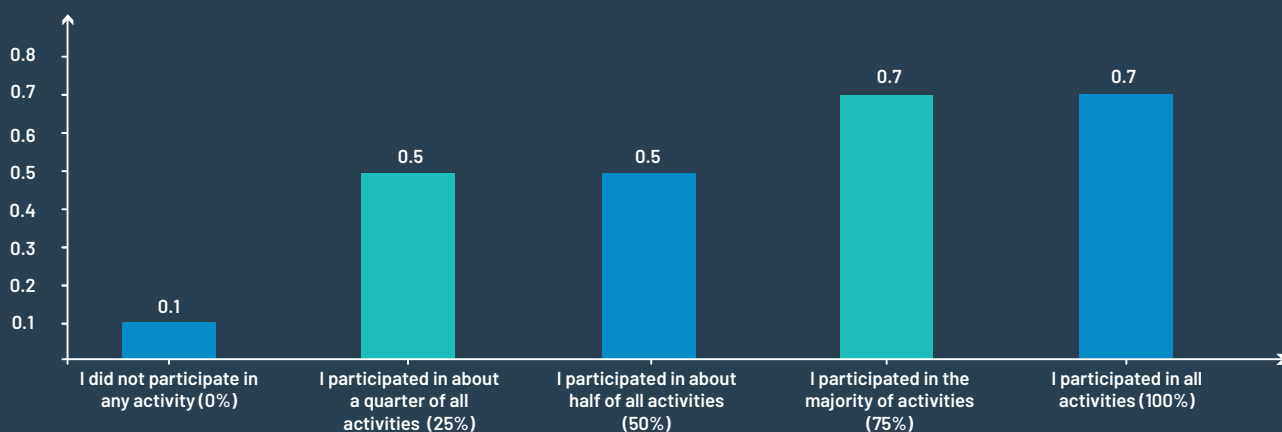
*4 or more - 2020 and 2021 had session 5 (follow-up discussion),
% may not add to 100% due to rounding

Similarly, a positive correlation was observed when analysing students' perceived level of engagement in the program and their overall sentiment. Figure 5 shows that the more students participated in the course, such as by attending the lessons or completing the reflection questions, the higher their overall sentiment towards the program.

The survey findings and qualitative research conducted with students clearly demonstrate that the program has successfully achieved its aims. The program has increased students' understanding of metacognition and enabled them to explore their own thinking and learning processes. By providing students with a foundation in neuroscience-based learning strategies, the program has empowered them to take control of their own learning and to approach academic challenges with confidence and resilience. Overall, the program was highly successful in promoting metacognition and improving students' learning outcomes.

“By providing students with a foundation in neuroscience-based learning strategies, the program has empowered them to take control of their own learning and to approach academic challenges with confidence and resilience.”

Figure 5: Sentiment scores and engagement in the program



Parent survey findings

Parents of students who participated in the program were invited to complete a survey, which was distributed at the end of a parent information session in July 2022. The survey shows that parents found the Cognizance program to have a positive impact on their child. Some parents indicated that they had already observed a difference in their child, while others said that it was still too early to tell. When asked what skills, knowledge or attitudes they hope to see in their child, parents mentioned that they would like their child to have more confidence, motivation, resilience and agency in their learning. Parents rated their likelihood to recommend the Cognizance program an 8.0 out of 10.

"I am so so glad that my son's school is part of this programme..."

Parents who observed changes in their child after participating in the program reported noticing more positive behaviour, increased motivation to learn about the brain, a change in study patterns and improved emotional self-regulation.

"I really have noticed just over the holidays a big change in his emotional regulation."

"My daughter is very positive this term."

"They are trying to "commit" to study time."

"Perhaps more motivation and interested in the concepts of the brain."

The majority of parents (83%) found the information session to be 'extremely useful' or 'very useful' in helping them better understand their child. They noted that it was insightful, engaging and easy to understand. Additionally, they expressed an interest in learning more about this topic and receiving guidance on how to further support their child in this area.

"Was a wonderful session - I think all parents and kids should know this stuff."

"It is very well presented and [a] very interesting insight to handling kids/teenagers."

"Very interesting. Theory needs to be put into practice and that's the challenge. How do we apply the science into the messy, everyday life."

The findings show that parents were generally satisfied with the program and its impact on their child.



Teacher survey findings

Teachers were generally satisfied with their experience (8.3 out of 10) and likely to recommend the program to their friends or colleagues (8.6 out of 10). Most teachers found the staff information session, PD sessions and parent information sessions to be engaging. Teachers were also interested in continuing to explore more about the brain and learning skills after participating in the program.

Table 6 shows the mean scores for the attitudinal statements asked in the post-survey, which remained relatively consistent.

Table 6: Average (mean) for attitudinal statements in post-survey.

Average (mean)	Overall	2018	2019	2020	2021	2022
I found the staff information session by Dr. Jared engaging	9.1	NA	NA	9.5	9.2	8.7
I found the PD/teacher sessions provided by Dr. Jared useful	8.9	7.9	8.6	9.2	9.3	NA
I found the parent information session by Dr. Jared engaging	8.8	NA	NA	8.8	9.0	8.8
I am interested in continuing to explore about the brain and learning skills	8.7	8.7	8.5	9.1	8.7	8.5
I received support from Dr. Jared when needed throughout the program	8.6	8.7	8.6	8.8	8.5	8.2
I found the student reflection questions/activities useful	8.0	NA	NA	8.3	7.9	7.8
The program allows me to achieve an explicit and structured way to teach the science of learning	8.0	7.3	7.8	8.2	8.2	8.1
I found the materials/activities in isLearn (ISV's online learning platform) useful	7.9	NA	NA	8.0	8.1	7.8
I received support from Independent Schools Victoria when needed throughout the program	7.9	8.4	8.0	7.6	7.9	8.1
I saw a positive impact in my students as a result of the program	7.7	7.8	7.9	7.7	7.6	7.4
Overall satisfaction with program	8.3	8.4	8.1	8.6	8.6	7.9
Likelihood to recommend program	8.6	8.4	8.6	8.9	9.0	8.1

Source: n=20-58

Note: 'NA' included when question is not asked for the year

ISV initiated a digital course using the isLearn platform in 2020 during the lockdown period. The main aim of this initiative was to enable teachers to continue sharing ideas and discuss any challenges encountered in the program.

Table 6 (p.23) shows that the majority of teachers agreed with the statement 'I found the materials/ activities in isLearn (ISV's online learning platform) useful' with mean scores of 8.0, 8.1, and 7.8 in 2020, 2021, and 2022 respectively. The teachers found the online course valuable and engaging as it allowed them to revisit the learning materials at any time.

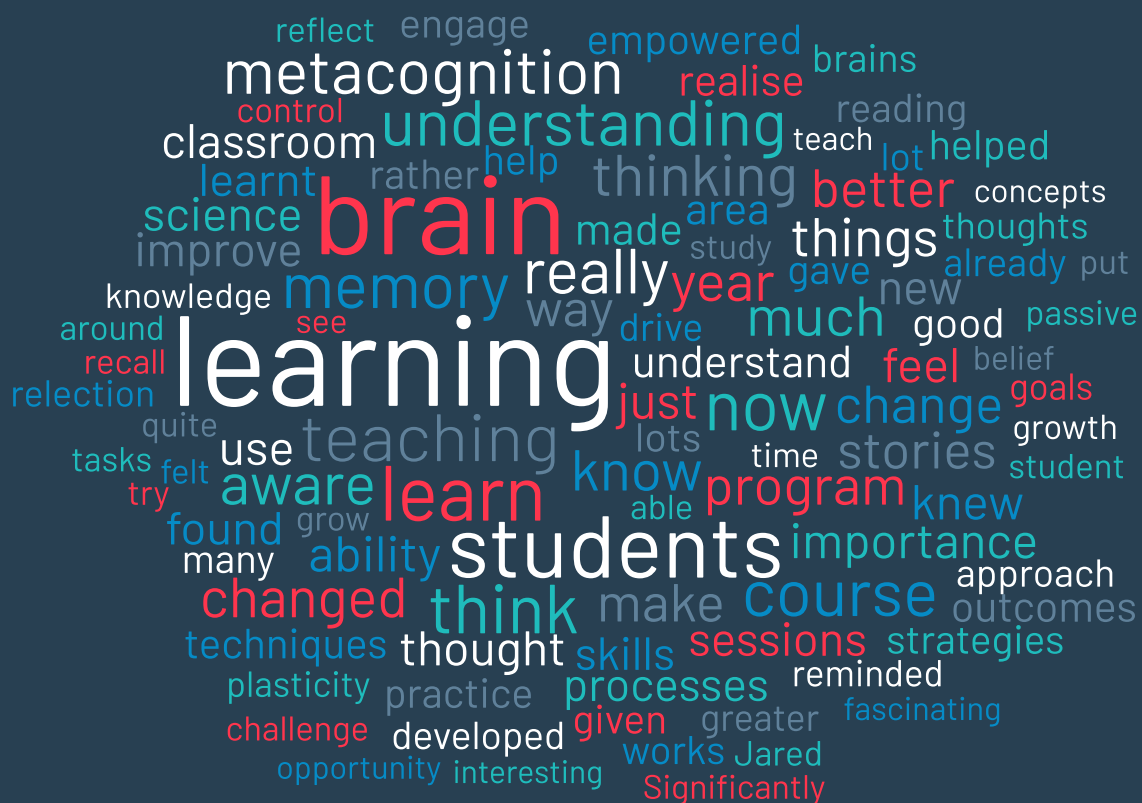
"The cognizance online course was very well structured and supported with video instruction. I really valued and appreciated being able to view the videos at a personal suitable time. The impact of remote learning was significant on finding the time and desire to extend screen time for learning."

"I was familiar with the program and the isLearn, as I was doing it for the second year. The isLearn was great as a learning platform - clear instructions and easy to navigate. I was able to remember and apply what I have learned much more second time around... It demonstrates to me how important it is to revisit the learning material - also for students. It was as engaging and fascinating to learn from Jared. He is a wonderful mentor, lecturer and inspiration, whether online or in person."

When asked about their interest in a self-paced digital course on the science of learning and metacognition in the classroom, over half of the teachers (55%) were keen to know more. Figure 6 displays a word cloud generated from responses to the question 'How has your thinking about teaching, learning, and your practice changed (if at all) since the beginning of this course?' Common words such as 'learning', 'brain', 'memory', 'students', 'thinking' were used, suggesting that the program had made an impact in these areas.

Qualitative responses revealed that most teachers were highly satisfied with the program. They observed a positive impact on their students and their own teaching practice, as well as the school.

Figure 6: Word cloud (teachers)



Source: n=201

Impact on students

Teachers reported a positive impact on their students as a result of the program, including increased awareness of the brain, better understanding of learning strategies and metacognition skills. Students also recognised the importance of having a growth mindset and taking control of their own learning.

"The increase in the students' self-efficacy towards learning is palpable. In both of the years we've run Cognizance, particular students have completely changed their mindset towards the challenge of learning..."

"Giving students a language to use when talking about their learning and having evidence-based strategies that we can give them and they know will work if they engage. Sort of taking the curtain down and looking inside. Getting students to believe they have control. A very empowering thing to give students."

"It provides an opening to challenge students on the ownership they can take over their own learning. It changes the focus from not always being about the teachers teaching, but to the students focus/attitude/etc... This shows them how they can impact their own learning."

Some teachers found that the program has supported students in adapting to challenging times during the pandemic. Student agency and self-regulation proved to be important skillsets during the remote learning environment.

"This program was exactly what our students needed at this point in their remote learning journey, and they responded really positively..."

The change in students' engagement, motivation and beliefs were observed even after the program as students entered the senior years. Cognizance has also changed the culture of learning in some schools.

"...Some students can be caught in a headspace based on past comments and experiences, they know that they are not pigeonholed/stereotyped and they can grow as learners even if they struggled in the past. Seeing our students as they move up into year 10 and also 11, remember what they have learned and apply it!! To believe in themselves and their capabilities."

"Students and staff are all exposed and can take something from this, discuss it, refer to it so that it becomes part of the culture of learning."

"Embedding metacognition into the culture of the school. It's great to hear the students talking with each other about how they think, and imparting these truths to older and younger students."

"The increase in the students' self-efficacy towards learning is palpable. In both of the years we've run Cognizance, particular students have completely changed their mindset towards the challenge of learning."

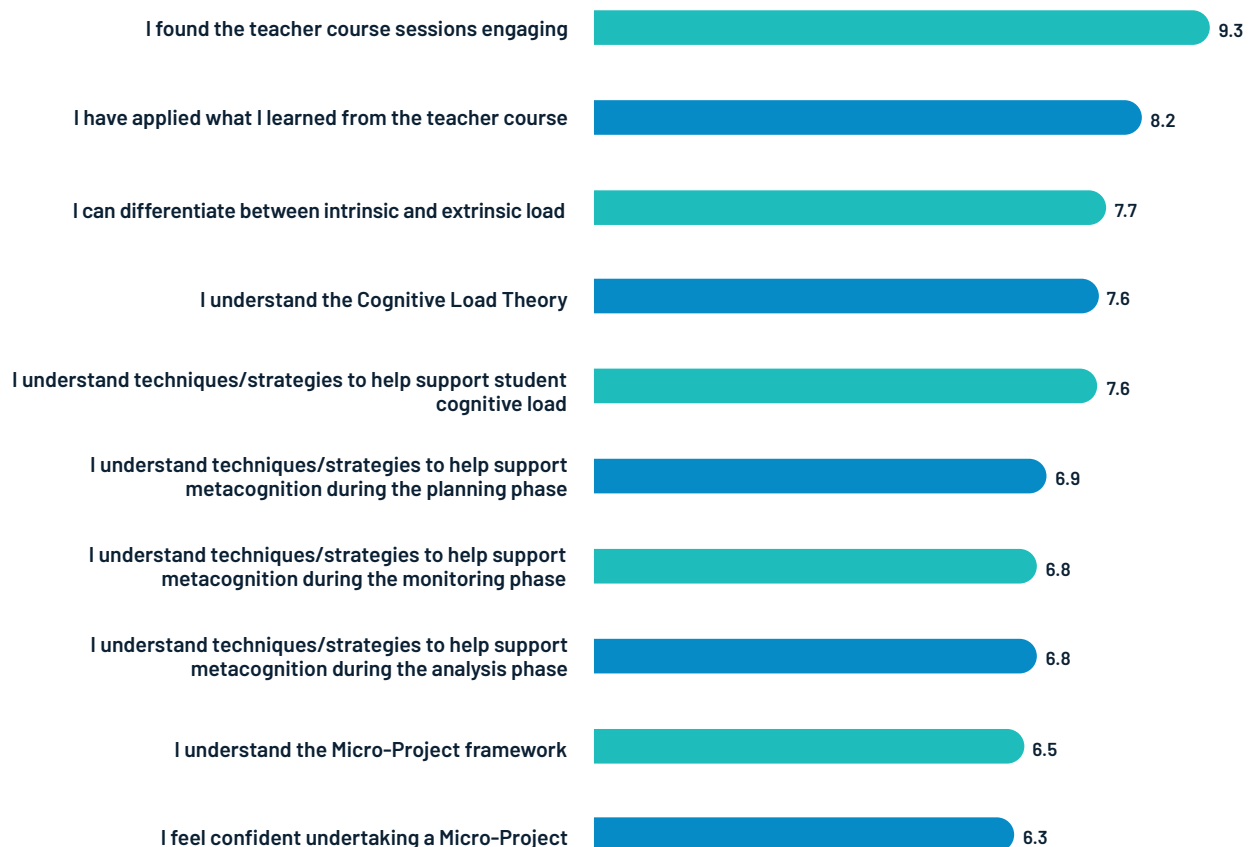
Impact on teaching practice and schools

In 2021, ISV offered the teacher course (Learning principles - from theory to practice) to supplement teachers' understanding of the science of learning. The course aimed to help teachers explore deeper issues of human learning (beyond what the students learn during Cognizance) and consider how these apply to practice. The teachers learned about concepts such as intrinsic load, extrinsic load and transfer, as well as how to combine explicit instruction with guided inquiry to support students in developing executive functions. Figure 7 below shows that most teachers found the course to be engaging (9.3 out of 10) and have been able to apply what they learned (8.2 out of 10).

Teachers were able to understand the concepts behind the science of learning and showed confidence in implementing and adapting these strategies to guide student learning.

"Teacher sessions were very insightful in being able to link some of the theory explained by Dr Jared into what I already do as well as new lines of working with students. I found the examples and stories Dr Jared gave very useful in being able to see how metacognition can be supported in the classroom and not as daunting of a concept to try."

Figure 7: Average (mean) for teacher course



Source: n=27-30

*Note: Low sample size, read with caution.

“Jared was an engaging presenter and helped to identify teacher practices that don’t work as much as practices that do work. While Jared presented a lot of theory the most helpful parts is how that theory gets put into practice so the more examples that Jared can provide can help us to think through how we might be able to apply what is presented.”

While the majority of teachers found the course to be useful, a minority reported that they struggled to complete the exercises due to an increased workload during COVID-19 lockdowns. These teachers also indicated that they were less engaged in the isLearn digital course.

“It’s been another big year. Bouncing in and out of lockdown. I probably didn’t give it the time it deserved but the content is so applicable to our everyday trade. It is so powerful as it gives me and the students a language and process to use when it comes to listening, revising, learning in the classroom.”

“The Cognizance online course in isLearn (ISV’s online learning platform) was a well-structured program but my engagement was somewhat limited unfortunately due to the COVID-19 situation and my associated increased workload.”

Teachers reported that the program had a positive impact on their teaching practice. The majority of teachers acknowledged that the program provided an explicit and structured approach to teaching the science of learning. They found the lessons useful, as they were able to learn new strategies and reinforce existing ones to enhance student learning. For instance, some teachers began delivering lessons in shorter periods to reduce cognitive load, while others reminded students of lessons learned, such as the significance of making mistakes and using study techniques to prepare for exams. Teachers also appreciated the use of evidence-based data and the science of learning.

“I explicitly include insights from the program in all my classes especially with respect to the value of making mistakes and how learning is reinforced.”

“This program seemed particularly useful to guide pedagogy and learning because of its basis in scientific evidence. It was very clear, engaging and pitched at an appropriate level.”

“Personally, this is an area I have studied for a while, so it was mostly reinforcement of HOW to pass these metacognitive skills along in the classroom.”

The program has encouraged teachers to reflect on their teaching practices and continuously improve by using evidence-based strategies. This is especially evident when the teacher course was offered.

“The course has prompted me to continue thinking about the best ways to promote learning and to consider and reflect on teaching strategies to ensure they are effective.”

“I am more conscious of the exercises I assign to accompany my teaching, and found the micro-project beneficial.”

“It has helped me when documenting my learning intentions and success criteria to really hone-in on what I am trying to achieve for the lesson, be it knowledge building, skill development, collaborating, understanding...”

“I have been more mindful and interested in employing innovative and research-based strategies based on my understanding of meta cognition and neuro plasticity. It has made me more optimistic about teaching students who struggle with literacy and numeracy.”

“ This will form a critical component of our learning and teaching philosophy as a whole school, and has already become significantly more widespread since we started the [Cognizance] program.

As metacognition focuses on a learner's growth as an indicator of learning rather than grades, teachers have reported feeling more confident in their teaching abilities and better able to understand their students' needs.

“I know I have a greater confidence in classroom teaching now. I think the open and easier dialogue between myself and students is better, where exploration of science has a wider context and involves students' own experiences more. This creates a good framework for adopting new ideas, retaining concepts and putting learning to practical and contextual use for the students. My own enthusiasm as a teacher is also increased at the prospect of shared learning.”

“It was a revelation. I think several colleagues thought so too. The complex world of adolescents and their brain development gave great insights into seeing patterns of behaviour in students. I believe it has helped me communicate with students better and respond to their learning needs in an improved way. How I respond to poor classroom behaviour is done in more thoughtful and measured ways, in having a better understanding of what might produce those behaviours.”

Cognizance has fostered opportunities for discussion, collaboration and innovation in schools, even among teachers who were not directly involved. It has inspired teachers to improve their teaching methods and encouraged students to enhance their learning skills. Additionally, the program has empowered some schools to re-evaluate their approach to teaching and learning at the school level.

“Schoolwide attention being paid to how our students can achieve their best results is empowering.”

“This will form a critical component of our learning and teaching philosophy as a whole school, and has already become significantly more widespread since we started the program before my time here.”

“...We can see the story changing about what learning is and how effective learning takes place. Our school is situated in a semi-rural locality that generally has a negative view of learning and academics. These lessons are helpful in changing that view.”

There was a shared excitement and ownership about the process of learning and metacognition among students, parents and teachers. The staff-wide session delivered to all teachers in the school and the parent information session may have encouraged this.

“By opening this project up to staff, students and parents, there is a buzz of excitement around Cognizance - which for many is such an elusive but crucial concept. Our students, staff and teachers are excited to understand how they learn and teach, which we see translating into a passion for school...”

“Shared understanding between parents, students and teachers. Shared excitement in the learning - was great to see teachers who had heard the staff room buzz come to the student sessions, even if they were not participating directly in the project.”

“ Ongoing support in professional learning and implementation of the science of learning can benefit teachers in cultivating and embedding a culture of learning in their schools.

The program had a greater impact on schools that participated across multiple years. Qualitative responses show that teachers who were involved for several years were more likely to cite increased confidence and successful implementation of course content.

“This is the third year I have done the course and I am getting better each time at implementing strategies and techniques garnered from the course.”

“...I feel a complete change on the overall approach to teaching and learning at the school must be driven at the whole school level to maximise its effectiveness...”

“I would like to incorporate many of the elements that I learnt from this program to my practice, but I do not think the current curriculum would facilitate that...I could possibly use some of the strategies mentioned simultaneously with visible thinking routines and other activities.”

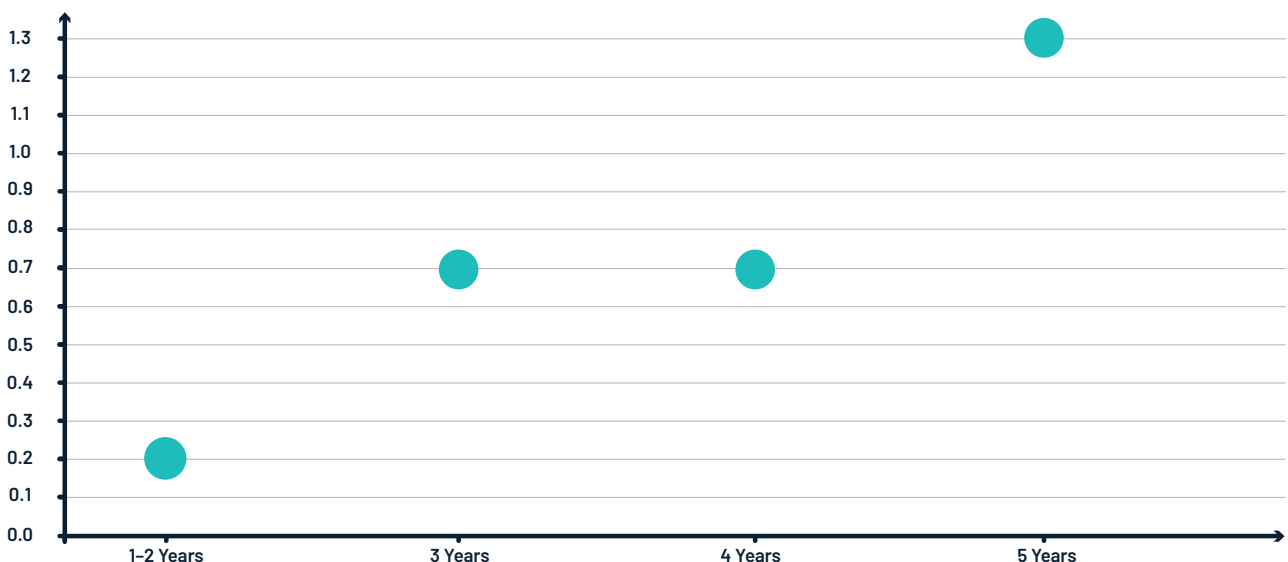
Further analysis observed that there was a positive correlation between teachers' overall sentiment and the length of their school's participation.

Figure 8 illustrates that the longer a school participated in the program, the higher the overall sentiment of their teachers when they were asked about how the program (if at all) changed their thinking about teaching, learning and their practice.

The analysis suggests that ongoing support in professional learning and implementation of the science of learning can benefit teachers in cultivating and embedding a culture of learning in their schools. Some schools have documented the benefits they observed in their students and how they continued using the science of learning in their teaching practice. Additionally, ISV's interviews with some schools during the pandemic highlighted that both teachers and students greatly benefited from this program during that challenging time. These case studies can be found in the Appendix (p.37).

Overall, the Cognizance program has achieved its aims for teachers and schools, enabling teachers to understand the science of learning and improving their teaching pedagogy and encouraging a metacognitive culture in schools.

Figure 8: Sentiment score and schools' length of involvement in the program



Discussion

This section provides a summary and interpretation of findings for each research question outlined in the study.

To what extent does explicit teaching of metacognition and neuroscience increase students' perception of their cognitive and metacognitive abilities?

The concept of metacognition, otherwise known as “thinking about thinking”, was evident in both quantitative and qualitative responses. By providing students with a language of learning and teaching them to be metacognitive, they were able to consider academic concepts and articulate the process of learning. Students reported that they have a better awareness of their learning strengths and limitations, and a strong desire to take ownership of their own learning to achieve their goals.

Students have shown metacognitive knowledge and metacognitive regulation. When students use these strategies, they understand themselves as learners, they understand a given task and they understand a variety of strategies and how to use them in a variety of situations.¹ These self-regulation skills or stop-and-think abilities are known as executive functions. As the term implies, students with this ability have agency over their thoughts and actions.² As students develop the ability to self-regulate, it increases their self-satisfaction and motivation to continue improving their learning methods. Students who can regulate their learning have a greater chance of becoming resilient and adaptive, allowing them to troubleshoot problems and propose creative solutions.³

The findings of this study also highlight the impact on students' agency over their emotions and wellbeing. Previous research has shown that teaching metacognitive skills and strategies can have a positive impact on mental health and wellbeing. As students gain insights into the impact of emotions, feelings and their own inner psychological makeup, they learn to manage emotions like anxiety and stress.⁴ Students who can manage and regulate their emotions experience more positive social relationships at school, which in turn increases their level of engagement and academic motivation.⁵

In the long term, these transferable skills help students move towards independence, interdependence, self-awareness and self-efficacy, which are powerful skills for them to flourish in different contexts.⁶ As metacognition is not innate, the insights, awareness and executive functioning skills taught in this program will continue to have a profound impact on students if they continue to apply them in school and real-world settings.

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

The understanding of the learning process and metacognitive skills not only benefited students but also helped teachers to improve their teaching practices. The program activities designed for teachers, such as the teacher course on employing the principles of the science of learning and micro-projects, supported them in achieving an explicit and structured way to teach the science of learning. This allowed teachers to adapt their teaching styles to foster self-regulated learning, as they began to understand their students' metacognitive, motivational and behavioural contexts. For instance, teachers reported guiding students in taking ownership of their learning by identifying strategies to support them to achieve their learning goals, provide opportunities for self-reflection and work with students to monitor their learning.

It is highly important for teachers to understand metacognition themselves to effectively teach and instruct it to their students. Additionally, teachers should be able to regulate their own actions to support their students' self-regulation.⁷ While many metacognitive strategies are likely already in teachers' repertoires, consciously modelling metacognitive behaviour is necessary to create an environment that supports students in becoming aware of their own thinking.⁸

Previous research has found that teachers with a relatively low sense of metacognition are less likely to incorporate such strategies in the classroom, even when they receive detailed professional development on metacognition.⁹ As using metacognitive activities and modelling metacognitive approaches require a conscious effort to develop, it is unsurprising to find that teachers who have participated in this program for a longer period were more likely to express positive impacts on their teaching practice.

Teachers in this study demonstrated a significant improvement in their ability to effectively apply key concepts from the science of learning to their teaching practice. The program encouraged teachers to reflect on their teaching and use scientifically informed strategies in the classroom. Most teachers expressed a desire to continue learning about the brain and learning skills, and to incorporate metacognition as a key part of their teaching practice. They also showed increased confidence and optimism in using metacognitive strategies with their students. It is therefore important to support teachers in their metacognitive development to equip them with the science of learning and empower their students.

To what extent did the program impact the school and school community?

The program has sparked excitement and discussion about the process of learning and metacognition in participating schools. The evaluation showed that a metacognitive school culture is more likely to develop if there is shared commitment and collaboration among the school community – a culture where teachers co-design learning opportunities for students to exercise authentic agency in their own learning, students are interested in their own learning and parents support their child in this journey.

Previous research found evidence that teaching and learning metacognitive skills and knowledge can add value when a cross-curricular approach towards metacognition is taken across a school or a school system.¹⁰ Additionally, a holistic approach that considers the whole child within a whole school and a whole community context is needed to activate higher-order cognitive development in students. Figure 9 details four interrelated systems that need to work together to support students' major developmental needs. These include effective instructions that support metacognitive abilities, supportive environmental factors, strong support networks and social emotional development.¹¹

A metacognitive school culture is more likely to develop if there is shared commitment and collaboration among the school community – a culture where teachers co-design learning opportunities for students to exercise authentic agency in their own learning, students are interested in their own learning and parents support their child in this journey.

Figure 9: Practices aligned with the science of learning and development.



Note: Image from "Applied Developmental Science, 24(2), 97-140" by D.H Linda, Flook, L., C.H. Channa, Barron, B & Osher, D. (2020) Implications for educational practice of the science of learning and development. <https://doi.org/10.1080/10888691.2018.1537791>

This program was designed to involve the whole school community through student lessons, teacher professional development, teacher course, school-wide staff sessions and parent information sessions. It has demonstrated significant benefits for students and teachers in developing metacognitive skills and a culture of learning. Additionally, schools that have a higher engagement and longer participation in this program were found to benefit immensely.

In these schools, the development and use of metacognition was not seen as an 'extra' task adding to teachers' or students' workloads, but intrinsic to their existing teaching and learning activities. This suggests that a metacognitive culture in school requires environments, structures and practices attuned to students' learning and developmental needs.

Conclusion

When metacognition is explicitly and effectively taught in schools, there is a significant positive effect on student learning, teaching practice and overall school learning culture – as our evaluation of this program strongly attests.

When schools implement metacognition systematically across the curriculum, it creates an evidence-informed culture within the school community. The program played a key role in establishing a functional commonality of language, concepts, goals and practices.

The evaluation has identified several potential limitations that should be noted. In future evaluations, it may be valuable to focus on measuring the longer-term impact of teaching metacognition, measuring impact beyond self-reporting tools and including a control group in the study. Despite these limitations, the evaluation has shown the program's potential to equip students with skills such as cognitive flexibility and agency, while also positively contributing to their self-awareness of mental health and wellbeing. It may be beneficial for future programs to consider incorporating specific lessons on the science of mental health to support a more holistic approach to learning, as children's development is shaped by interactions among various domains, including physical, psychological and emotional processes.

As highlighted earlier, it is crucial for teachers to have sufficient support and resources to bridge the gap between research and practice. Policy makers and school leaders can play a vital role in this by aligning education policies with evidence-based practices. This could include:

- Preparing beginning teachers to deeply understand the concepts behind the science of learning
- Supporting ongoing professional development to enable scientifically informed teaching practice
- Aligning pedagogy around a coherent vision of whole child development, learning and teaching.

In this environment, teachers and school leaders will be better equipped to support students in reaching their full potential.

ISV is committed to enhancing learning outcomes in schools through evidence-based practices validated in the report. In collaboration with Dr Jared Cooney Horvath, we have used insights gained from Cognizance to create two online courses centered on the science of learning: one tailored for students and another for teachers. Our aim is to provide students and teachers with accessible online resources, enabling them to leverage evidence-based approaches for more effective learning and teaching. To explore these courses further, please visit ISV's Learning Blueprint webpage: is.vic.edu.au/blueprint



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Developed in collaboration with award-winning cognitive neuroscientist, Dr Jared Cooney Horvath.

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Appendix

Survey analysis approach

Students were asked to rate 16 learning attitudinal statements relating to four topics on a 0-10 scale (0=Strongly Disagree and 10=Strongly Agree) in the pre- and post-surveys. The average duration between the surveys was around four months. ISV did not create a 'control group' for the interest of all students participating in the Cognizance program. Therefore, repeated measure/paired t-tests were used to compare the mean difference between the pre- and post-survey results. A statistically significant score is determined by looking at the p-value (p). If $p < 0.05$, a statistically significant finding is concluded and the null hypothesis (no difference in the population between pre- and post-surveys results) is rejected. Cohen's D effect size was calculated as well to measure the magnitude of the observed effect between two means and to mitigate sensitivity of significance testing influenced by sample size. Cohen suggested that an effect size of $d=0.2$ is considered small, 0.5 is medium and 0.8 is large.

Students were asked the same four open-ended questions in both surveys. ISV ranked each student's open-ended response for 'depth' using a 0-3 scale. Depth was assessed by two independent raters: a pooling of key vocabulary score (0=no relevant vocabulary words present, 1=one relevant vocabulary words present, and so forth), and depth and consideration of responses score (0=no answer/ don't know, 1= no consideration beyond what was learned during the course, 2= conceptualises a relevant argument but lacks clear support, 3= supports a valid argument using evidence). Open-ended questions were averaged to determine a final pre and post 'depth' score. The rubric used to assess students' responses can be found on page 35. Additionally, students were asked the same four multiple choice questions in both the pre-and post-surveys. The questions and answer options can be found on page 36.

In addition to the pre- and post-surveys, students were asked to rate (on a 0-10 scale) statements relating to their perceived effectiveness of the program in the post-survey. This includes questions about what they have learned, their interest in the science of learning, as well as their satisfaction and likelihood to recommend the program.

Student sentiment (expressed positivity or negativity) to the open-ended question 'how has your thinking changed (if at all) as a result of the program?' was calculated using statistical software to provide an insight of their experience. Sentiment analysis is a method to quantify the tone of written text where each open-ended response received a numeric sentiment score (generally, this is represented on a scale of -1 to 1). Natural language processing (NLP) also identifies when a sentiment has been negated (i.e., "not good" would generate a score of -1 instead of 1). For a large survey sample (such as this), the efficiency gained in using sentiment analysis outweigh the loss of accuracy from coding.

The analysis of post-survey attitudinal statements and sentiment analysis were also conducted for the teacher survey.

Open-ended questions – rubric for assessment

Each student's response was assessed using the following rubric consisting of two parts - the utilisation of content knowledge and deep consideration of relevant issues.

	Utilisation of Content Knowledge		Deep Consideration	
Criteria	Uses more than two words	Score	Supports a Valid Argument (they use some form of evidence to support the argument being made)	Score
		3		3
	Uses two words	2	Conceptualises a Relevant Argument, but lacks Clear Support (they make an argument, but supply no supporting evidence – simply opinion)	2
		1		1
Uses one word	0	Answers Question (at least there's ink on paper: answers typically <10 words)	0	
Uses zero words		N/A or Don't know		
Indicator	Relevant Vocabulary Words / Key Concepts (See below)		Conceptualizes & Supports Argument	
Capability	Employs Knowledge of Material		Thinks Deeply about Issue	

Relevant Vocab Words / Concepts used for 'Utilisation of content knowledge':

Q1 and Q2: 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; Neuroplasticity; Plastic; Metacognition; Theta mode; Theta; Pathway; Recode; Malleable; Elasticity; Habits.

Q3: 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; Meta-Cognition; Aspirations; Purpose; Goals; Analyse; Assess; Adapt; AI; SMART; Goldilocks; Calendar, Spreading, Retrieve, Associate, Chunking, Pairing; Connecting; Revisit; Revise; Reflect; Relate; Engage; Mistake; Repetition; Repeating; Rehearse; Break; Cue Cards; Repeat; Link; Connect; Repeatedly; Revision

Q4. 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; Meta-Cognition; Aspirations; Purpose; Goals; Analyse; Assess; Adapt; AI; SMART; Goldilocks; Calendar, Awareness; Owning; In-Control; Connecting; Reflect; In-Charge; Scrutinise; Recognise; Evaluate; Monitor; Adjust; Aware; Analysing; Evaluating; Control; Coding; Hacking

Multiple choice questions

Students were asked the following questions in the pre-survey and post-survey.
The correct answer for each question is underlined and bolded.

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

- A. **Engage or Avoid**
- 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. Which process leads to deeper and longer lasting memories: encoding (putting memories into the brain) or recall (taking memories out of the brain)?

- A. Encoding
- B. **Recall**

Q4. What are the 4-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

Cognizance program participation

Year	Total school	Total teachers and students	Program activities
2018	6 schools	383 students 22 teachers	<ul style="list-style-type: none"> • Student metacognition course • Teacher micro-project • Teacher PD sessions (before and after the program) • School-wide staff session at each school • Parent information session at each school
2019	10 schools	928 students 47 teachers	<ul style="list-style-type: none"> • Student metacognition course • Student metacognition course - Year 10 students • Teacher micro-project • Teacher PD sessions (before and after the program) • School-wide staff session at each school • Parent information session at each school
2020	11 schools	834 students 63 teachers	<ul style="list-style-type: none"> • Student metacognition course and follow up discussion • Teacher micro-project • Teacher PD sessions (before and after the program) • School-wide staff session at each school • Parent information session at each school • isLearn Cognizance digital course
2021	13 schools	805 students 90 teachers	<ul style="list-style-type: none"> • Student metacognition course • Teacher micro-project (digital badge via Credly) • Teacher PD sessions (before and after the program) • School-wide staff session at each school • Parent information session at each school • Teacher course (from theory to practice) • ISV isLearn Cognizance digital course
2022	14 schools	1316 students 94 teachers	<ul style="list-style-type: none"> • Student metacognition course • Teacher PD sessions (before and after the program) • School-wide staff session at each school • Parent information session (online) • isLearn Cognizance digital course

Participating schools

- Bayview College
- Camberwell Girls Grammar School
- Genazzano FCJ College
- Gilson College
- Goulburn Valley Grammar School
- Hillcrest Christian College
- Ilim College
- Lakeside Christian College
- Melbourne Girls Grammar
- Mountain District Christian School
- Oakleigh Grammar
- Plenty Valley Christian College
- Ruyton Girls' School
- Southern Cross Grammar
- St. Michael's Grammar School
- Strathcona Baptist Girls Grammar School
- The Geelong College
- Waverley Christian College
- Wesley College
- Yeshivah Beth Rivkah



Cognizance – Student program

Student metacognition course

Four, 90-minute sessions were presented to Year 9 students and participating teachers, taking place over Term 1, 2 and 3. A minimum of one-week gap between each session was placed to ensure that students had time to complete their post-reflection questions. The sessions were delivered on-site at each school except for 2020–2022 where a mix of on-site and online Zoom sessions were delivered. Online sessions were used during the pandemic lockdown and the second half of 2022, due to Dr. Horvath's unavailability. The session structure was as follows:

Session 1: Get your Mind Right (Stories and Errors)

- How the brain makes sense of reality.
- The true power of our stories and the impact of these stories on learning, errors and mistakes.

Session 2: Master the Hardware (Plasticity)

- The brain is not 'fixed' – rather, it is malleable.
- All skills and ideas are open to us, and the 'machine' will adapt to whatever we ask from it.

Session 3: Gaming the System (Memory)

- Six key principles of how memory works and how each principle aligns with students' own study and learning practices.
- Facilitated by teachers (with Dr. Horvath's guidance).

Session 4: Owning your Learning (Metacognition)

- Students are in control of their learning.
- What is required to take control of and master their learning?

Follow-up discussion (only offered in 2020)

- Concepts of transfer and deep learning.
- Students discuss their experience of the project and share any observations or changes in learning.

Student post-reflection journal/brain book

Schools were given short post-session reflection questions to consolidate students' learning. Several reflection questions were asked following each session – the night of the session, 72 hours after and a week after. This gave students time to think a bit deeper about relevant ideas and apply concepts beyond each session. Schools could decide how they would like their students to complete the reflection questions, such as using a physical journal (brain book) or integrated within the school's Learning Management System.

Student metacognition course – Year 10 students

In 2019, a 90-minute metacognition course was conducted for Year 10 students with the aim of consolidating their learning. The lesson began with a review of the Year 9 student course and then proceeded to teach further topics related to metacognition, such as foundational learning, near versus far transfer, concept formation and agency over learning.

Cognizance - Teacher program

Each school was invited to include a maximum of ten Year 9 teachers, including the project leader, to participate in the program. Most project leaders were school leaders (such as Head of Teaching and Learning and Head of Curriculum or Deputy) who were responsible for leading and guiding other teachers. This included gathering them for a briefing and de-briefing after each lesson and ensuring accountability. Participating teachers were involved in the following activities:

Teacher PD sessions

Participating teachers attended two professional learning sessions, facilitated by Dr. Horvath, before and after the Cognizance program. The pre-program session, held during Term 1, was conducted at the ISV office, except for the last three years when it was held online due to the pandemic. During this session, Dr. Horvath taught various metacognition topics, such as learning principles and how to conduct micro-projects. At the end of the project, which takes place in mid-Term 4, all teachers were invited to a de-brief session to explore the project's outcomes and their own learnings.

Teacher micro-project

A big part of teaching is creatively adapting to different classes, students and situations. As teachers come up with and try new techniques (for specific purposes), micro-projects allow them to explicate and document these inventions, changes and ideas. Micro-projects are snapshots of what they are already doing everyday as a teacher. Teachers were asked to conduct micro-projects as part of this program, with Dr. Horvath's guidance. In 2021, ISV provided a digital badge for teachers if they were successful in completing the criteria below.

- Engage in professional learning in the Teachers course: Learning Principles sessions.
- Complete and submit a short action research project (pre-made micro-project).
- Complete and submit a self-made iteration of the pre-made micro-project.
- Teacher course (Learning principles - from theory to practice)



Leigh Gridley, VCE teacher
Oakleigh Grammar

Teacher course

(Learning principles – from theory to practice)

ISV introduced a teacher course in 2021 that focused on learning principles based on feedback from research with teachers in the program's early years. The aim was to help teachers explore deeper issues of human learning, beyond what their students learn during Cognizance, and consider how these principles apply to classroom practice. Through a quick and simple micro-project framework, teachers were taught to test, iterate and share novel strategies with each other. The goal was to employ science of learning principles to influence decision-making in the classroom. The course included six one-hour sessions delivered by Dr. Horvath:

Section 1: Cognitive load theory and micro-projects

- Optimising intrinsic load – explore the foundations of Cognitive Load Theory (CLT) and learn strategies to optimize intrinsic load.
- Reducing extraneous load – explore and consider strategies to reduce extraneous load while teaching.
- Micro-projects – explore how to implement CLT in teaching practice through micro-projects.

Section 2: Metacognition: Plan, monitor and evaluate

- Planning – outline different aspects of preparation and discover specific techniques and strategies that can help students tap into the power of planning.
- Monitoring – consider some specific techniques and strategies to help students tap into executive functions.
- Analysing – learn about techniques and strategies to help students embrace the reflection aspect of metacognition.

ISV isLearn Cognizance digital course

The need for a learning community during the pandemic led to the development of a digital course that was offered to participating teachers from 2020 to 2022. All participating teachers were invited to enrol to the course. It was designed using Canvas with modules for both the student and teacher stream. It included announcements, program overview, course outline, course materials (such as videos and reflection), resources (such as student posters and further reading), digital badge requirements, Year 10 lesson video, and discussion forums. Teachers were encouraged to participate in the discussion forum to collaborate with teachers from other schools to share knowledge, experiences and resources on metacognition.



School-wide staff session

At each school, a 60-90-minute session was facilitated by Dr. Horvath for the school-wide staff. The aim of this session was to introduce a metacognition culture in the school and discuss the importance of metacognition in teaching and learning. Project leaders worked with Dr. Horvath to co-design the agenda, highlighting the school's strategic areas and learning needs. The session served as an opportunity for teachers to learn about the relevance of metacognition in education and to explore ways of integrating metacognitive strategies in their teaching practices.

Parent information session

A 60-90 minute parent information session was held on-site in all schools every year except in 2022 where it was conducted online. ISV provided a **parent information session letter** to schools to advertise the session in their communication platforms. The session was facilitated by Dr. Horvath and attended by parents of participating students. ISV encouraged schools to invite their broader and local school community as well to attend the session to increase a culture of metacognition in the community.

The aim of the session was to inform parents of the Cognizance program and to explore metacognition and the teenage brain. The sessions were tweaked to accommodate the school's vision and focus areas where needed, but overall, they explored how the brain develops, how things change during adolescence and early adulthood, how (and why) teenagers think differently to adults. These sessions also considered ways we can support them academically, emotionally and cognitively.

Case study

The following case studies highlight participating teacher and student experiences in the program and their perception of its impact in teaching and learning.

Organisation and weblink	Topic	Details
Independent Schools Victoria https://vimeo.com/523604809	Insights into metacognition and the brain for independent learning.	Interview with Dr. Horvath, and students and teachers from Camberwell Girls Grammar, Oakleigh Grammar, Beth Rivkah Ladies' College, Goulburn Valley Grammar School, and The Geelong College
Goulburn Valley Grammar School https://gvgs.vic.edu.au/2020/11/17/cognizance-tools-for-learning/	Cognizance tools for learning article.	A case study highlighting teachers' experience in this program.
The Geelong College http://www.clri.com.au/upload/Annual%20Report%202021.Final.ec757486-5.pdf	Annual report 2021, Neuroscientist in residence (pg. 7-13).	Overview of the program and a showcase of ISV's research for this school.
Genazzano FCJ College https://www.genazzano.vic.edu.au/the-science-of-learning/	The Science of Learning article.	A case study highlighting teachers' experience in this program.



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