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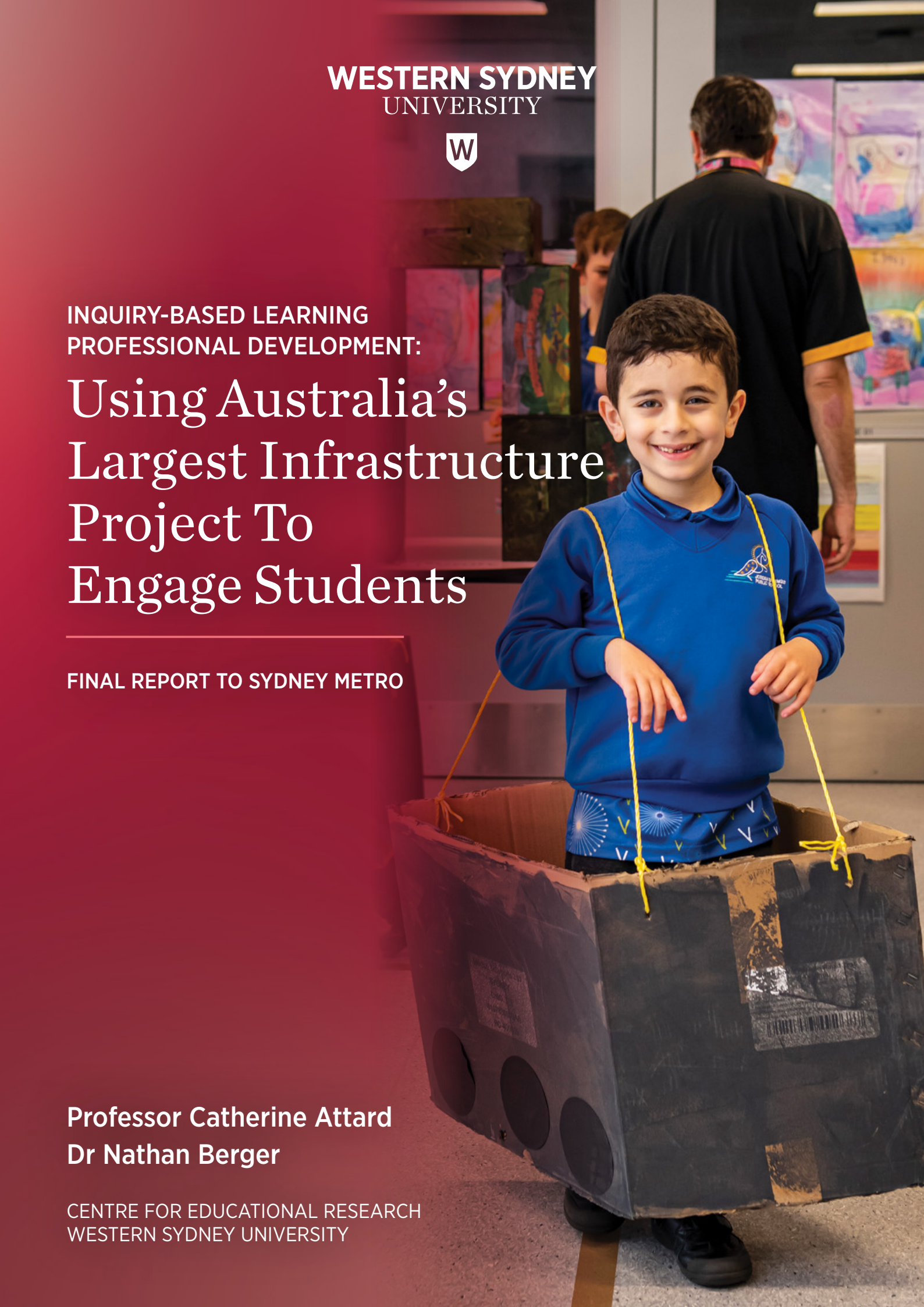

INQUIRY-BASED LEARNING
PROFESSIONAL DEVELOPMENT:

Using Australia's Largest Infrastructure Project To Engage Students

FINAL REPORT TO SYDNEY METRO

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The authors wish to express their sincere thanks to the teachers and students who volunteered to participate in this study.

Executive Summary

This report details the findings of research into the effectiveness and impact of a professional learning program for teachers funded by Sydney Metro (Transport for NSW). The program was conducted between 2021-2022 by teacher educators from the Centre for Educational Research at Western Sydney University, in partnership with Sydney Metro.

Background

Many students see what they learn at school as abstract and disconnected from their lives. This can lead to disengagement and lack of motivation during critical years of learning. Evidence suggests that one way to increase relevance is to contextualise learning so students can see how what they learn at school is present in their everyday lives and communities. Major infrastructure projects, such as Sydney Metro, provide significant opportunities to demonstrate these connections. The scale of these infrastructure projects means every curriculum area is represented and students have direct experience of the transformation infrastructure projects bring to their local communities.

There is an emerging body of research into how inquiry-based learning pedagogies which leverage industry-school partnerships contextualise the curriculum and improve student engagement. In this project, teacher educators from Western Sydney University developed and delivered professional learning to primary and secondary teachers from schools located within a 10-kilometre radius of the Sydney Metro network. Teachers used their new knowledge and skills to engage students in inquiry-projects that connected the curriculum to some aspect of the Sydney Metro project. Throughout the process, both teachers and students had unparalleled opportunities to engage with industry experts from Sydney Metro.

Research into the effectiveness of the professional learning program was conducted by researchers from the Centre for Educational Research at Western Sydney University. The research investigated the experiences of teachers, students, and industry experts.

Findings

The research found positive impacts of the professional learning program on teachers by enhancing their pedagogical repertoires. Teachers were effectively able to implement engaging inquiry-based learning programs through which students participated in curriculum-relevant learning using aspects of Sydney Metro as an authentic context for inquiry. In addition to their own growth as educators, teachers reported high levels of student interest and engagement, demonstrating the positive impact inquiry-based learning and authentic contexts has on teaching and learning.

Students were overwhelmingly positive of the experience, reporting greater levels of engagement, motivation, and interest in their learning. Students from the early years of primary school through to high school also perceived growth in important transferable skills such as collaboration, communication, and technological proficiency. Students especially appreciated the ability to engage with industry experts, to learn from them and to demonstrate their learning to an authentic, real-world audience.

Experts from Sydney Metro also reported positive experiences engaging with teachers and students. While some initially found the experience daunting, through their interactions with students they developed skills in communicating complex ideas to inexpert audiences. Experts also reported feeling inspired by the ideas generated by young people and expressed a desire to continue these interactions as a form of community consultation and engagement.

Recommendations

The following recommendations arise from the research and are provided to inform future professional learning programs based on this model of school-industry-university partnerships:

1. Due to the overwhelmingly positive response from teachers, experts, and students, and the potential to increase teacher capacity and positively influence student learning it is recommended that Sydney Metro (Transport for NSW) continue to support teacher professional learning.
2. It is recommended that support materials for both teachers and industry experts are developed to ensure the benefits of school visits are maximised. For example, a teachers' guide to assist in planning the school visit in terms of content to be covered and facilitation of the session would be of assistance. A guide for industry experts that provides a small range of engaging strategies appropriate for different age groups would also be beneficial.
3. The use of prior participants should be expanded in future iterations of the program to assist teachers in developing and teaching their units of work. Previous participants could be utilised as a mentor and additional resource for teachers to access.
4. Future research should include data from school leaders to assist in understanding how leadership could support the implementation of inquiry-based learning pedagogies.
5. The provision of a planning day for teachers should continue, however there should be an option for teachers to work off-campus and alongside academics to ensure they receive 'just in time' assistance.

1 Introduction

Sydney Metro and Western Sydney University first partnered in 2018 to deliver the highly successful *Fast Tracking the Future* professional learning program for teachers. The program was Highly Commended in the NSW Awards for Planning Excellence 2020 for Cutting Edge Research and Teaching. A second partnership commenced in 2021 to extend the reach of the program in line with the burgeoning Sydney Metro network. This report presents research into the professional learning program and its impact on participating teachers and students, as well as Sydney Metro experts who dedicated time to engaging with schools and communities.

The partnership delivered professional learning to 67 teachers from 24 schools located within a 10-kilometer radius of Sydney Metro rail corridors. The program consisted of three courses of five sessions each over the course of a school term. Teachers had sustained interactions with teacher educators from Western Sydney University as well as experts from Sydney Metro, who also visited schools and worked with students on their inquiry projects. This combination of inquiry-based learning using the authentic context of Australia's largest infrastructure project enhanced student engagement by demonstrating how their learning at school is linked with the real world.

The professional learning was developed and delivered by Professor Catherine Attard and Dr Nathan Berger from the Centre for Educational Research at Western Sydney University. In addition to the capacity to work with both school teachers and industry partners, Western Sydney University has conducted rigorous research into the impact of the professional learning. These cutting-edge findings have been disseminated to local, national, and global audiences, foregrounding the important work of both Western Sydney University and Sydney Metro.

In this report, we provide:

- An overview of the evidence underpinning our approach to teacher professional learning, inquiry-based learning, as well as how infrastructure projects provide engaging authentic contexts for teaching and learning in schools.
- A description of the professional learning course, including its structure, presenters, and participants.
- An overview of the research methods used to understand the effectiveness of the professional learning program and its impact on teachers, students, and industry experts.
- A discussion of the findings from the research, illustrated with quotes from participants to give voice to their experiences.
- Recommendations for similar programs, which are increasingly seen as respectful ways to exercise corporate social responsibility following the ground-breaking lead of Sydney Metro.

2 Background

A significant factor in promoting student engagement is enhancing the relevance of curriculum and pedagogy to students' lives outside of school (Attard et al., 2020). Evidence suggests that one way to increase relevance is to contextualise learning so that students see how what they learn at school is present in their everyday lives and in their communities (Holmes, Mackenzie et al., 2021). There is an emerging body of research into how inquiry-based learning pedagogies which leverage industry-school partnerships to contextualise the curriculum can improve student engagement (Attard, Berger, & Mackenzie, 2021). It is important that teachers are supported to implement these student-centred and contextualised learning approaches through professional learning programs and opportunities to connect with industry experts (Holmes, Mackenzie et al., 2021).

Student engagement

Engagement in an educational sense is best defined as a student's meaningful participation in learning, rather than simply being "on task" (Attard et al., 2021). A multidimensional view of engagement in educational contexts therefore takes account of students' cognitive, operative, and affective states (Fredricks et al., 2004). Ideally, students are actively participating in their learning, deeply processing information, and genuinely valuing what they're learning (Munns & Martin, 2005). This can be characterised as students "thinking hard", "working hard", and "feeling good" about their learning. Meaningful engagement can be found in the overlap between these states (Munns & Martin, 2005).

Importantly, meaningful engagement can be fostered by teachers. Attard's (2014) Framework for Engagement with Mathematics (which also may be used more generally in other subjects) describes engagement as being influenced by two separate but interrelated aspects: pedagogical relationships and pedagogical repertoires. Pedagogical relationships encapsulate (amongst others) the elicitation and valuing of students' prior knowledge, continuous interaction between students and the teacher, and the provision of constructive feedback. Pedagogical repertoires include the provision of student choice in a variety of relevant and challenging tasks. Inquiry-based and contextualised learning, as with the Sydney Metro project, lend themselves to achieving positive pedagogical relationships and repertoires that enhance student engagement.

In our earlier research into these types of inquiry-based learning programs, we found that learning through local contexts was viewed by teachers and students as highly engaging (Attard et al., 2021). Teachers used existing pedagogical relationships to design learning sequences leveraged students' natural curiosity and investment in what was occurring in their neighbourhoods and affecting the lives of their friends and families. However, this type of learning places new demands on teachers, both in terms of adopting student-centred pedagogies and developing relationships with industry stakeholders (Holmes, Mackenzie et al., 2021). Professional learning is one way of supporting teachers in this endeavour.

Teacher professional learning

The Australian Professional Standards for Teachers require all teachers in New South Wales

to maintain their accreditation by undertaking a specified number of professional learning hours (Nielsen et al., 2020). The purpose of this requirement is to improve professional practice. Consequently, teachers seek high-quality professional learning opportunities to not only maintain their accreditation, but also to improve their curriculum knowledge and pedagogical proficiency.

Teacher educators employed by universities are a major contributor to professional learning for in-service teachers, particularly because of their unique position to co-design and deliver contextually relevant learning opportunities (Nielsen et al., 2020). Co-design in this context includes working with industry partners. Elsewhere we have argued that the combined support of universities and industry partners enhances the outcomes from professional learning (Attard et al., 2021). Teacher educators bring broad expertise in evidence-based approaches to curriculum and pedagogy, while respecting the practical knowledge and skills of schoolteachers, and industry partners provide real-world contexts through which the authenticity of student learning is enhanced.

Research has identified several factors which enhance the effectiveness of professional learning programs. Sustained professional learning that is delivered over multiple sessions is more effective than short, one-off events (Darling-Hammond et al., 2017). Providing classroom support over time recognises that pedagogical change is an evolutionary rather than revolutionary process (Desimone, 2009; Guskey, 2002). Importantly for the focus of this report, research has shown that workshop-based professional learning increases teachers' curriculum knowledge and confidence in contextualised pedagogies (Holmes, Mackenzie et al., 2021).

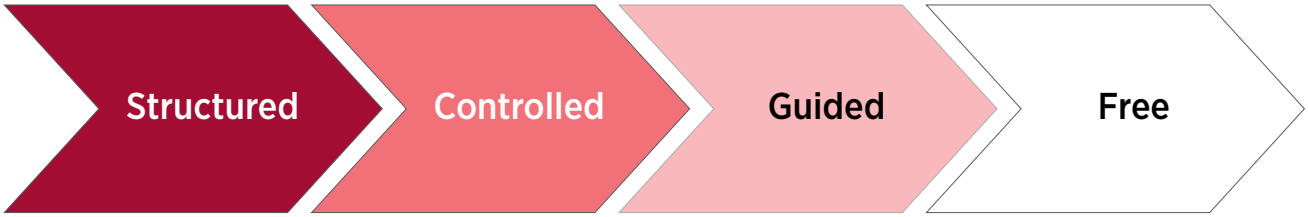


Figure 1: Inquiry continuum

Inquiry-based learning

Inquiry-based learning (IBL) or simply 'inquiry' is a constructivist pedagogical approach with roots in the classical learning theory of Dewey (1929). Constructivist approaches emphasise learning as an active and contextualised process through which students build their knowledge and understanding. This emphasis on students as active learners is contrasted by more didactic approaches which position teachers as authoritative stores of knowledge which they transmit to students as more passive learners (Wang et al., 2010).

In inquiry-based learning, teachers provide a range of carefully curated learning experiences and resources which encourage students to think, explain, challenge, and extend their ideas (Murdoch, 2021). Through inquiry, students are supported by teachers to uncover first-hand understandings by asking questions, investigating problems, and drawing evidence-based conclusions while collaborating with others (Attard et al., 2021; Wang et al., 2010; Melville, 2015). In the professional learning, teachers are acquainted with the inquiry-based learning continuum. This continuum acknowledges that inquiry may range from teacher-controlled inquiry, where learning activities and resources are directed entirely by the teacher who largely models the inquiry process, through to free inquiry, where students construct their own inquiry questions and design their own investigations into issues or problems (Fichtman-Dana et al., 2011).

The professional learning was designed to be responsive to teachers' contexts, so the inquiry continuum provided an opportunity for teachers of varying stages of proficiency with inquiry-based learning to design inquiries which had the best chance of success with their students. This is because students need to be taught how to inquire and be given developmentally appropriate opportunities to practice these skills. Working together to contextualise learning

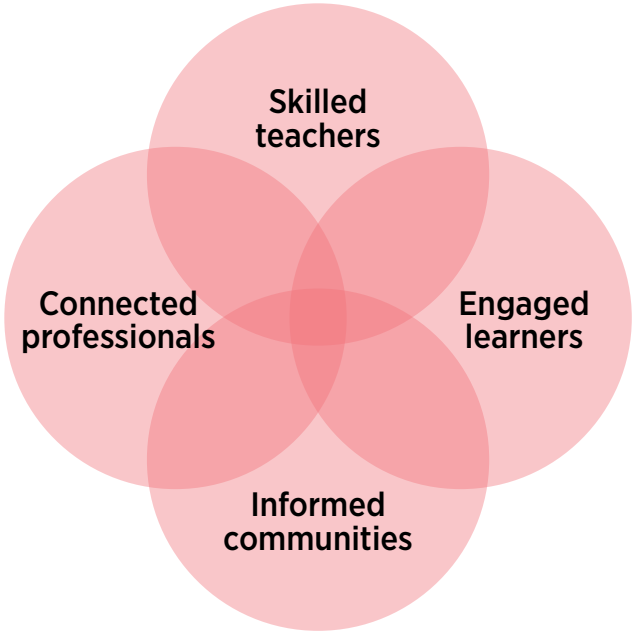


Figure 2: What can industries, universities, and schools achieve together?

Many students see what they learn at school as abstract and disconnected from their lives, leading to disengagement and reduced levels of participation in certain subjects like mathematics and science in senior high school (Holmes, Berger et al., 2021). That is, students perceive school education to be decontextualised from the real world. As such, reconnecting learning to contexts has a positive impact on interest, engagement, and achievement (Attard et al., 2021; Holmes, Mackenzie et al., 2021). School-industry and school-community partnerships "can be leveraged to demonstrate to students how their learning at school is linked with the real world" (Holmes, Berger et al., 2021, p.2).

School-industry partnerships may be established through exchange of resources, excursions to industrial facilities, and industry experts visiting schools to share knowledge (Lee et al., 2016). Despite the benefits of these partnerships, it can be difficult for teachers to foster the relationships required to fully leverage the opportunities afforded by school-industry partnerships (Holmes, Mackenzie et al., 2021). Similarly, industries often do not have sufficient expertise in education and knowledge of schooling to deliver professional learning to teachers which enables them to get the most out of school-industry partnerships for students (Attard et al., 2021). As such, universities with teacher education faculties are well-placed to support both teachers and industries effectively to leverage the affordances of their partnerships (Attard et al., 2021).

3 The Professional Learning Program

Program Participants

The professional development program was delivered several times between 2021 and 2022. A range of primary and secondary teachers from government, independent, and Catholic schools participated in the program (Table 1). Non-school-based teachers (NSBT) from the NSW Department of Education also participated in the program.

Table 1: Participating teachers

Course	School	Teachers
1 (Early 2021)	Cumberland High School	3
	Holroyd High School	1
	Homebush Public School	1
	NSW Department of Education (NSBT)	1
	Oatley Public School	3
	Warakirri College, Blacktown	1
2 (Mid 2021) *Discontinued due to COVID-19*	Australian International College	2
	Discontinued due to COVID-19	1
	Holy Family Primary School, East Granville	4
	Lane Cove West Public School	1
	St Dominic's College, Penrith	4
	The Lakes Christian College	1
	Warakirri College, Blacktown	1
	Xavier College, Llandilo	4
3 (Late 2021) *Cancelled due to COVID-19*		
4 (Early 2022)	Bellfield College	1
	De La Salle College, Ashfield	4
	Granville Boys High School	2
	NSW Department of Education (NSBT)	2
	St Anne's Catholic Primary School, Strathfield South	3
	Xavier College, Llandilo	4
5 (Mid 2022)	Greystanes High School	5
	Hilltop Road Public School	1
	Jordan Springs Public School	8
	Norwest Christian College	1
	Our Lady of the Sacred Heart, Kensington	2
	St Anne's Catholic Primary School, Strathfield South	2
	St Joseph's Primary School, Schofields	2
	The Meadows Public School	2
Total	**24 schools**	**67 teachers**

Course Structure

Each course consisted of five sessions, delivered in a mix of face-to-face and online sessions. Some scheduled face-to-face sessions were run in fully online mode where required by COVID-19 social distancing regulations. These are noted with an asterisk * below.

Session 1 – Introduction to Inquiry-Based Learning and the Sydney Metro Project

*Full day workshop at Western Sydney University's Parramatta CBD campus**

Participants were introduced to the pedagogy of inquiry-based learning. They were also introduced to the Sydney Metro Project by a Sydney Metro representative. The workshop facilitators provided an overview of the activities and expectations of participation in the professional development program. The program culminated in a set of units of work to be published and disseminated. By the end of this session, participants begun brainstorming ideas for their units of work. Participants were the task to begin drafting a unit of work in preparation for the next meeting.

Session 2 – Ask the Experts Session

*Two hours, after school session at Sydney Metro Information Centre, Campsie**

Participants visited the Sydney Metro Community Information Centre at Campsie. Here they could interact with Sydney Metro experts and view community information exhibits, including train and station models. Sydney Metro experts provided a deep dive on aspects of the project, for instance the redevelopment of Central Station, and answered questions posed by the teachers.

Session 3 – Designing a Unit of Work using an Inquiry Approach

Two hours, after school session on Zoom

Participants shared progress and received academic and peer feedback on their plans. Participants began to align activities with curriculum outcomes, general capabilities, and cross-curriculum priorities. Opportunities for expert interaction with students at school were identified and planned in consultation with Sydney Metro.

Session 4 – Implementing a Unit of Work using an Inquiry Approach

Two hours, after school session on Zoom

Participants shared progress and received academic and peer feedback on their plans. Participants began implementing and documenting their units in anticipation of completion prior to Session 5.

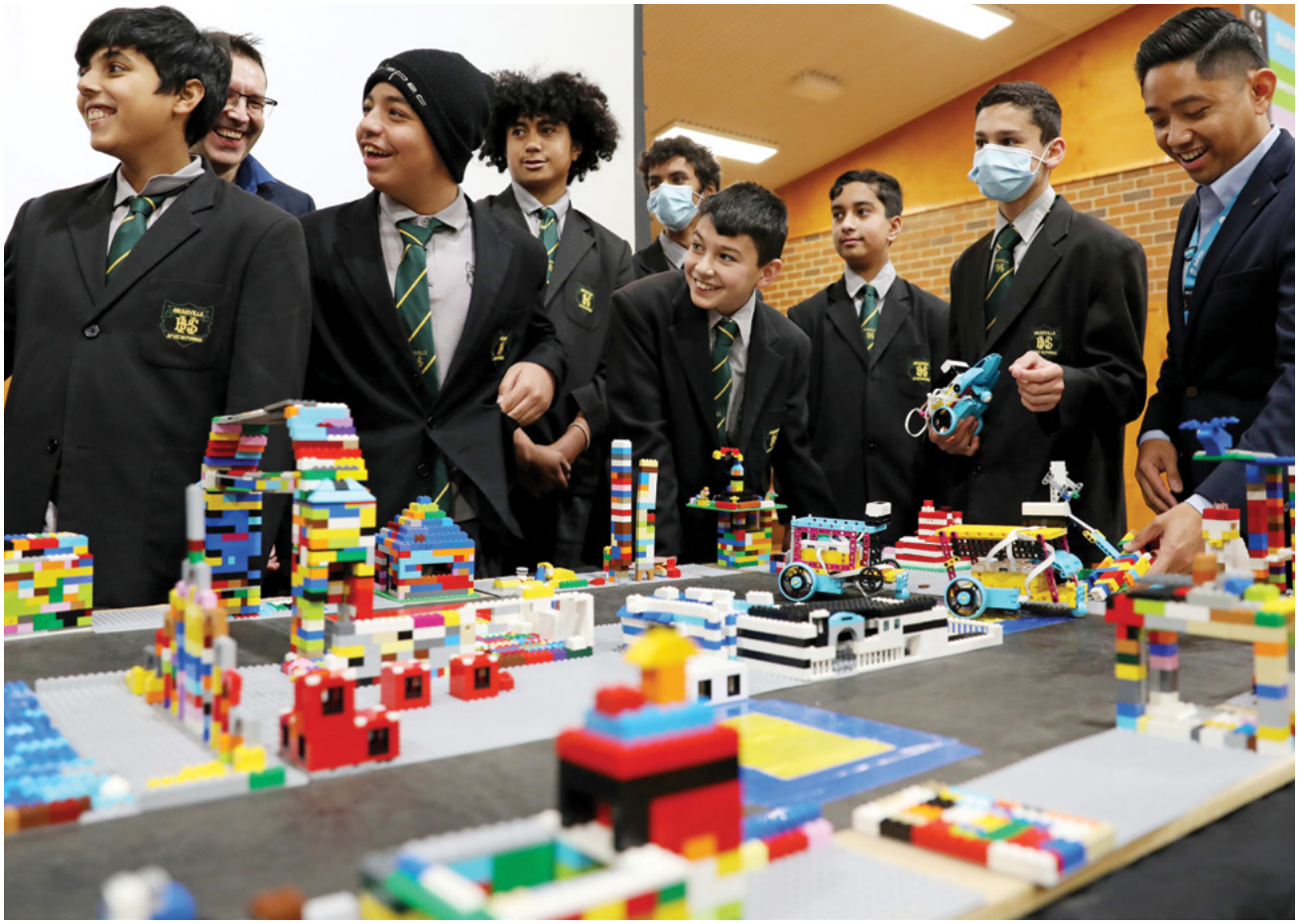
Session 5 – Presentation Day

*Full day workshop at Western Sydney University's Parramatta CBD campus**

In this final workshop, participants brought along their completed units, work samples, and other evidence to present to Sydney Metro, Western Sydney University, and other program participants. Time was set aside for participants to complete unit documentation and take part in research interviews about their experiences.

Planning Day

During the course of the program, participants had access to funding for one day of release from face-to-face teaching to allow them to plan their units of work. Teachers and schools nominated an appropriate date for this release. The payment of the release funds to schools was conditional on the completion of program outcomes.



Program Presenters

The program was primarily facilitated by teacher educators from Western Sydney University with support from a wide range of experts at Sydney Metro. Previous participants from primary and secondary schools also presented at sessions.

Western Sydney University

- Prof Catherine Attard, Professor of Primary Mathematics Education
- Dr Nathan Berger, Senior Lecturer in Secondary Education

Sydney Metro

- Tina Chin, Public Events & Education Manager
- Carolyn Hatchwell, Public Communications Coordinator
- Teresa Avila, Director, Delivery, Central Station Main Works
- Stuart Hodgson, Principal Manager, Sustainability Environment and Planning
- Angela Jeffery, Project Director for the Sydney Metro-Western Sydney Airport
- Connie Klonis, Associate Director, Design at Sydney Metro
- Alex Nicholson, Customer & Product Director for City & Southwest
- Anne Purcell, Deputy Executive Director, Communications & Engagement
- Cath Snelgrove, Senior Heritage Advisor

Past Participants

- Elise Attard, Jordan Springs Public School
- Joanne Gadaleta, Oatley Public School
- Sarah Kennedy, Oatley Public School
- Angela Rozmeta, Oatley Public School
- Catharina Simmonds, Mosman High School

Sydney Metro Experts in Schools

Western Sydney University acknowledges with thanks the many experts from Sydney Metro who engaged with teachers and students as part of the education program. Your contribution was invaluable for the success of the program and was very much appreciated by everyone involved in the program.

Timeline

The project timeline was significantly impacted by the outbreak of the COVID-19 pandemic. Western Sydney University would like to acknowledge the resilience and flexibility of teachers who participated in the professional learning program during this difficult period.

Three courses originally were scheduled to be delivered in 2021. Due to COVID-19 lockdowns and remote learning, Course 2 was discontinued, and Course 3 was indefinitely postponed. Once the COVID-19 situation stabilised, two replacement courses were run in 2022. These are labelled as Course 4 and Course 5 in the revised timeline.

		Planning	Course 1	Course 2
2020	6	Resource creation		
	7	Course site design		
	8	Collation of additional curriculum-related resource		
	9			
	10	Ethics & SERAP applications		
	11	Recruitment		
	12			
2021	1			
	2		Course 1 *Delivered as scheduled*	
	3			
	4			
	5	Recruitment		Course 2 *Commenced but discontinued due to COVID-19*
	6			
	7			
	8			
	9			
	10			
	11			
	12			
2022	1	Recruitment		
	2			
	3			
	4	Recruitment		
	5			
	6			
	7			
	8			
	9			
	10			
	11	Celebration		

Course 3	Course 4	Course 5	Research
			Data collection & analysis
Course 3 *Cancelled due to COVID-19*			
			Data collection & analysis
	Course 4 *Delivered online except for final session*		
			Writing and publishing of final report
		Course 5 *Delivered as scheduled*	

4 Research Evaluation Design and Methods

Evaluation Participants

The research evaluation drew upon the experiences of three groups: primary and secondary school teachers who participated in the professional learning program, school students who undertook inquiry-based learning guided by the participating teachers, and industry experts from Sydney Metro who engaged with teachers and students during inquiry-based learning projects. Different data gathering methods were used with each participant group in order to explore their experiences with the professional learning, inquiry-based learning using Sydney Metro as a driving context, and school-industry engagement.

Ethical Procedures

The research was conducted in accordance with the *National Statement on Ethical Conduct in Human Research 2018* and the protocol was approved by the WSU Human Research Ethics Committee (H14097), the NSW Department of Education (SERAP 2020471), and Sydney Catholic Schools (201896). All prospective participants were provided with a plain language information sheet about the research. The research was conducted with participants who gave informed consent to participate. Participation in research activities was not a compulsory component of the professional learning program. The identities of research participants are confidential.

Data Sources

Data informing this evaluation were drawn from the following sources:

- Interviews or focus groups with teachers
- Surveys of students
- Interviews of industry experts
- Classroom observations

Teacher Interviews

Teachers were invited to participate in an audio-recorded interview during the final day-long session at WSU. The interviews were conducted by the principal researchers and a research assistant. The principal researchers acknowledge the research assistance of Mr Matt Thompson in conducting some of the teacher interviews.

Interviews were conducted individually or in stage or school groups depending on how teachers engaged with the professional learning. Interviews ran for approximately 20 minutes. Interviews were professionally transcribed before analysis.

A total of 27 teachers were interviewed with representation across primary and secondary, as well as public, Catholic, and independent school sectors.

Interview questions:

1. Can you talk about your general experience participating in the professional development program?
2. Based on your experiences designing, implementing, and evaluating an inquiry-based unit of work, what are your current perceptions of teaching through an inquiry-based approach?
3. What are your perceptions about how an inquiry-based approach facilitates student access to the curriculum?
4. Can you talk about the benefits of such an approach for your students?
5. Can you talk about whether you believe the program assisted in the development of your skills in relation to inquiry-based learning?
6. Were there any unanticipated benefits or outcomes to your participation in the program for you, your colleagues or your students?
7. Can you talk about whether other teachers and/or stakeholders were involved in this project?
8. Do you have any suggestions for future iterations of the program?

Student Surveys

Parent/carer permission was sought for students to respond to a short survey upon completion of inquiry-based learning units of work. The survey was distributed in both digital and paper formats. The survey was mostly qualitative and asked open-ended questions about students' experiences with learning about Sydney Metro using the inquiry-based learning approach. Responses to the survey were anonymous. Data entry for the paper surveys was performed by the principal investigators.

A total of 127 surveys were received from 108 primary and 19 secondary students. Year groups ranged from Kindergarten to Year 7. There were 64 responses from girls and 63 from boys.

Survey questions:

1. How old are you?
2. What year (grade) are you in?
3. What is your gender?
4. How much did you know about the Sydney Metro project before learning about it at school?
    a. Had not heard of it
    b. Had heard of it but didn't really know what it was about
    c. I knew a lot about the Sydney Metro project
5. Did you talk about the Sydney Metro project with people outside school when you were learning about it?
    a. Yes, I talked about Sydney Metro with: (please specify)
    b. No
6. What did you like most about the way you learned?
7. Name four things you learned about the Sydney Metro project that are important to you.
8. Do you think the things you learned will be useful in other areas? How?
9. What surprised you about your learning?
10. Would you like to learn in this way more often?
11. If you had to change anything about the way you learned about the Sydney Metro project, what would you change and why?
12. What effect do you think the Sydney Metro line will have on your life now and in the future?
13. How do you think the Sydney Metro project will affect your community?
14. Do you have any feedback for your teacher in regard to your work on the Sydney Metro project?

Expert Interviews

A particularly innovative aspect of this iteration of the research was interviewing industry experts from Sydney Metro who had engaged with teachers and students through the inquiry-based learning process. This came about through discussions between the principal investigators and Sydney Metro about the wider impacts (i.e., beyond teachers and students) that the project seemed to be having. The interviews were conducted by a research assistant. The principal researchers acknowledge the research assistance of Mr Matt Thompson in conducting the expert interviews.

Interviews were conducted individually via Zoom video conferencing software and ran for approximately 20 minutes. The audio of the interviews was professionally transcribed before analysis.

A total of 6 experts were interviewed with representation from a range of industries involved in the design and construction of the Sydney Metro.

Interview questions:

1. Please tell us about your engagement with teachers, students, and schools as part of their inquiry-based learning unit on Sydney Metro. What was your role and what did it entail?
2. How was this experience for you as an industry expert/stakeholder? What did you take away from the experience?
3. How do you think your involvement was received by teachers, students, and schools? What did they take away from the experience?
4. What are the benefits (for you and your organisation) from engaging with teachers, students, and schools?
5. What are the key factors that enable or hinder stakeholder engagement with teachers, students, and schools?
6. Is there anything else you'd like to tell us about your experience?

Classroom Observations

The principal researchers observed inquiry-based learning lessons in action in 8 classrooms at 5 schools. One or both researchers observed classes depending on availability at the times nominated by schools. These naturalistic observations involved the researchers sitting in the classroom, typically at the back of the room, and watching the teachers and students engaging in inquiry-based learning. The principal researchers made free notes about the pedagogical strategies employed by the teachers throughout the lesson.

Lessons were not audio or video recorded. The researchers' notes were the only record of the lesson. The principal researchers discussed their observations and compared notes. The notes were then analysed and discussed within Attard's Framework for Engagement as well as emergent themes.

Data Analysis

Data from the interviews with teachers and experts, student surveys, and classroom observations were analysed to identify emerging themes in response to the research questions. These are explored in the next section.

5 Program Results

The aim of this professional learning program was to develop the capacity of primary and secondary teachers to develop and deliver learning experiences using an inquiry-based learning approach. The purpose of using the Sydney Metro infrastructure project was to provide a real-life context for teachers and students while building community awareness and engagement with the project. The following section presents the evaluation results organised in response to the evaluation questions:

1. How did the Sydney Metro Phase 2 professional development program influence the implementation of inquiry-based learning?
    a. *What are the perceived and observed influences of the professional development on teacher practice?*
    b. *What are the perceived influences of the professional development on student learning and engagement?*
2. How did teachers and experts perceive the impact of expert involvement in the inquiry-based learning projects?

Data drawn from teacher and industry expert interviews, classroom observations, and student surveys were analysed to address the above questions. Data from each group of research participants (teachers, students, and industry experts) has been aggregated to protect the identity of participants. The following section presents the evaluation results organised in response to the research questions.

Influences on teacher practice

Data from participating teachers and classroom observations indicated a range of positive influences on several aspects of teacher practice, including what and how they planned for teaching and learning and ways they were able to work with colleagues to achieve the program outcomes.

Influence on Planning

Notably, the professional learning program appeared to have influenced how teachers utilised curriculum documents in a more integrated manner in their planning of the inquiry units. While this practice may be common in primary school contexts, it is less typical in secondary schools. This opportunity to teach collaboratively across a range of curriculum areas was valued by some of the secondary teachers, as evidenced in this quote:

Yeah, how easy it actually was to get our syllabuses all to fit together. Then teaching them of course there's new appreciation of what we do, and the fact that we're in a high school context in that time, we've been talking about all day, it works. (Secondary teacher)

Teachers also felt the inquiry approach led to a more open-ended way of planning, allowing them to take a more flexible approach as opposed to the more traditional way of planning all elements of a unit of work prior to implementation.

I'm no longer just closed minded where this is a teaching, learning sequence. This is what we need to achieve by the end of the term or by the end of the week, it's more about, okay, what could we achieve by the end? You could achieve more, you could achieve less, but you could possibly achieve things that you possibly wouldn't have thought about as well. I think that's what changed and it is okay. It's okay. It's wonderful. (Secondary teacher)

This also resulted in teachers learning how to 'backfill' their unit documentation as the unit evolved, which also illustrates a shift to a more student-directed and responsive practice:

In terms of myself, I learned a lot about the content, what's happening around us, how to implement it into my teaching, how to develop a program, and how to just be alongside the students instead of in the forefront. I had to kind of pull myself back and take a step aside instead of being in the front, which is good. (Secondary teacher)

The student-centred and open-ended nature of planning for inquiry pedagogies also provided opportunities for teachers to reflect upon and evaluate their teaching throughout the process as opposed to evaluation that typically occurs on completion of a unit of work. This flexibility allowed teachers to be more responsive to the needs of the students, as demonstrated in the following quote:

...our ability to reflect on each lesson was something that I developed just alongside [colleague] and [colleague], because we were each able to see things and point things out that not only worked well and even looking at student work samples, but things that we could improve on in our next lessons or things that we could address as well. (Primary teacher)

Increased teacher collaboration

A feature of the professional learning program was the promotion of collaboration, which occurred amongst the participating teachers, industry experts, and students. For most teachers, planning and teaching was conducted collaboratively and this was considered by the interviewed teachers to be a significant benefit of the program. However, increased collaboration is not without challenges, as experienced by this secondary teacher:

I think instead of us each coming away with a unit ourselves, we had to work collaboratively on one unit that we could implement, which, it was pros and cons really. It presented a lot of advantages in that collaborative environment, but then I've come away with a unit I can't necessarily use with my own cohort at the moment but have developed those skills so that I can still go and develop another program based on it.

Teachers reported the high levels of collaboration led to more positive outcomes for students because of the increased opportunities to share and build upon ideas: "Two minds are better than one. More than two is even better. Not always. I feel that, then you're getting the best outcome, because you just, you got it all in there" (Secondary teacher). In addition, the collaboration amongst teachers provided a strong example for students, and this was evidenced in several classroom observations where teachers engaged in team-teaching across multiple class groups.

And collaboration was the key for kids, for the community, for us as teachers. And we collaborated as a whole school to develop our program, which then gave everyone access and expertise from different people, and I guess it allows for continued learning from each other. (Primary teacher)

The opportunities for teachers to collaborate with industry experts was highly valued. This collaboration assisted the teachers in addressing the needs and interests of their students, particularly in cases where the inquiries were student driven. The following quote highlights how knowledge gaps (for teachers and students) were able to be addressed through collaboration with experts:

Not every kid's gonna do the same thing, but the kids learn from each other. They might become a specialist, dive deep in one particular area, but still see how that fits into all the other things that kids have done. I think I don't have a problem, in that sense, with kids meeting the outcomes in lots of different ways. The challenge is always how you support them to do that when they have so many different things. That's one reason why the experts were important. They had knowledge that we did not have. Remember, we were talking to someone else right back at the beginning, and we're saying, "Sometimes, you just don't know what you don't know." After the experts came, we were like, "Oh, my goodness. We know so much more now". (Primary teacher)

Of note is the amount of collaboration that resulted from a whole-school approach to inquiry-based learning. In this case, teachers from each stage and including a support unit of a primary school participated in the professional learning program. This group of teachers then worked with non-participant colleagues to design and implement an inquiry-based unit across the entire school (approx. 1000 students). Although the school had some previous experience with inquiry-based learning approaches, this was the first time they had attempted to conduct the same inquiry across the school. The following quote illustrates the challenges and success of such collaboration:

I guess we've all dabbled in inquiry based learning and all of the things that come with it, but to do it at such a large scale is a completely different skill because we had to actually communicate not only as grade coordinators, but also as a school community, and figure out how we're going to teach it, and what we were going to include, and how we were going to do that with limited resources, and then just make it all work and be seamless I guess from stage to stage. And that's been a massive challenge but also a massive benefit of the program, I think. (Primary teacher)

While there were perceived benefits to the increased levels of collaborations at this school, there were also challenges in ensuring all teachers were invested in and committed to the work:

I did have quite a bit of pullback or how is this going to work? And then sickness on top of everything and just the daily stuff that gets thrown in, but it really taught me how to have those conversations with staff members that aren't challenging the person. They're challenging the idea that's happening. (Primary teacher)

The increased collaboration that occurred throughout the program assisted the teachers in developing and reflecting upon their inquiry-based pedagogies, which will now be discussed.

The students, the teachers, and the experts have all come together. It couldn't have happened without all of those parties being involved (Secondary teacher)

Influence on pedagogy

Data from interviews and classroom observations provide evidence that teachers' pedagogies shifted to a more student-centred approach because of the professional learning program. The implementation of an inquiry approach led some teachers to hand over some control of the learning to the students, allowing the students to determine, to varying degrees, the direction of their inquiries. The amount of student control was dependent upon the model of inquiry (structured, controlled, guided, or free) adopted by the teachers, as described by Fichtman-Dana (2011). Below are two examples of teacher comments relating to the shift to student-centred practices across primary and secondary school contexts:

It taught me how to just be more focused on student-led inquiry. It taught me how to develop lessons that contributed to collaboration, questioning, critical thinking. It really did push me as a teacher in the way that I conducted my lessons and how the students were involved in the process of their learning. (Secondary teacher)

I guess the freedom to do inquiry-based learning kind of allowed us to tailor our learning to the individual. (Primary teacher)

Due to the increase in student-centred practices, the teachers found their roles evolved to that of facilitator. In this role teachers guided and scaffolded students' inquiries, working alongside their students, as demonstrated in these quotes:

We can guide, but then we go, "How can you find that information?" and it's just turning that onus and the responsibility onto the students to go and locate it for themselves, and kind of make their own meaning of it. (Secondary teacher)

It kind of opened my eyes as an educator, not that I wasn't aware of this, but it kind of really brought home the fact that as a primary school teacher you don't have to be an expert in every field, through inquiry based learning you can tie all elements of the curriculum together and allow the kids to kind of teach themselves and you facilitate. So I guess there's not as big of a focus on being a math genius, and a science genius, and knowing all the answers because sometimes it's really powerful to know that you don't have all the answers, but you can help the kids facilitate coming to their own understanding of the content. (Primary teacher)

Another impact of the shift to a more student-centred approach was the ability, in one case, to allow students to form groups according to their interests and pursue a broad range of inquiries within an over-arching inquiry question. Lesson observations conducted at this particular school revealed three class groups of students who were provided with generic scaffolds such as laminated sets of peer-feedback prompts. The teachers were observed to be checking in on individual groups of students throughout the lessons, with questions like "can you fill me in on where you're at?" (observation notes), to ensure students were on task. This practice allowed the teachers to reflect on how the increase in student control influenced student engagement, as evidenced here:

I think for me it was about getting out of my comfort zone and realizing that teacher directed learning is so much just one aspect of how we can teach the students,and realizing how much that student centred learning and student directed learning and that them making the choices actually affects how engaged they are in what they're learning. (Primary teacher)

The following quotes from students provide evidence of the success of this approach, indicating they valued the freedom to direct their own learning by following personal interests:

It helps me learn more because it is free and I have the choice. (Student, Year 4)

I like that instead of the teacher telling us what we do we got to choose the path and topic. (Student, Year 4)

I like to be in control of what I learned. (Student, Year 5)

The changes in pedagogy resulting from participation in the professional learning program also resulted in teachers feeling they had more freedom and flexibility within their planning and teaching, allowing new opportunities to differentiate learning and tailor to individual student needs.

And I think as teachers we have such a perception of how things need to be taught, but when you hand that control over to the kids and the kids take the content and run with it where they want to it opens your classroom up to pretty much anything. And it's still teaching the content we have to cover, and it's still teaching, we're teaching off outcomes but we're not teaching it in that one size fits all approach that we sort of have in our brain that we need to follow (Primary teacher)

Additional perceived benefits of the PL program

According to the teachers, there were several other benefits of participation in the professional learning program in terms of their professional skills. Not surprisingly, teachers felt they had strengthened their knowledge and skills regarding the inquiry-based learning approach and they recognised the benefits of such an approach, as articulated by this secondary teacher: "I feel that this could be something that we could run each year for the next few years because it'll be still relevant and cutting edge and inspiring to the kids".

An unexpected outcome of the program was the engagement of teachers who were not participants. In several cases, participating teachers worked with their non-participant colleagues to collaboratively design and teach their unit of work. In such cases, participants shared the information from the program sessions with their colleagues. An unintended impact of this is the development of leadership skills amongst these particular participants, which was beneficial in terms of increasing the impact of the program as illustrated in the following quote:

...it's given, I guess, our staff a new way to look at teaching. I guess it's given myself a new way to facilitate leadership and showing other people, "Well, I've had experience on how to create it. I've had an experience on what's needed, what's required." So I could pass those skills on for myself, which then in turn helps teachers grow their capacity, which then grows into other teachers. (Primary teacher)

A further benefit, which was briefly mentioned earlier, was the opportunity to work in multi-disciplinary and inter-disciplinary ways as a direct result of teacher collaboration. When this occurred, teachers felt they no longer had to be expert in all areas. Rather, they were able to tap into the knowledge of their collaborating colleagues. In addition, this allowed teachers to gain a deeper understanding of the links across curriculum areas which in turn helped them to assist their students, as demonstrated by the following quote:

We were sitting there going, "We didn't intend for this to happen" but we just let it go because they were having such powerful conversations and realizing that they need to start working together because the misconceptions and the problems in stage 6 chemistry and physics can be traced back to other misconceptions in maths. A lot of it is really simple ratios and stuff like that. That was a really interesting, unintended consequence. (Secondary teacher)

A final benefit of the program was increased engagement and motivation for some of the participants, which was evident from teacher interviews, classroom observations, and teacher participation in the program sessions:

I can see the potential, and this give me motivation in not giving up on providing the opportunities to the student. I'll be happy to continue on with using project-based learning to teach or implement into my teaching. (Secondary teacher)

Influences on student engagement

When it was Sydney Metro time, it was like the kids were buzzing, we were buzzing. The school was a buzzing place because everything was happening around it and discussions are happening probably at dinner tables and out in the playground. And when they're moving around, when we're moving around, it just encompasses a lot of things, I think (Primary teacher)

While the goal of the professional learning program was to increase teacher capacity to implement inquiry-based learning, the ultimate aim was to improve student engagement and outcomes in education. While improvements in learning outcomes were not measured in this research, evidence was gathered from teacher and expert interviews, student surveys and lesson observations that indicated high levels of student engagement at cognitive, operative and affective levels and improvements in pedagogical relationships that led to improved pedagogical repertoires (Attard, 2014).

The increased student control over learning that is an inherent aspect of inquiry-based learning appears to have been a contributor to improved student engagement, as evidenced in the previous section. This was also noted by one of the visiting experts, who made this comment:

I felt that that the engagement was very good as far as the kids, giving them an opportunity to explain to me what I was showing them as far as the various items of protective equipment. Again, for probably the most part the teachers pretty much gave the kids freedom to make their own inquiries for the most part, there wasn't really any directing from them, per se. (Industry expert)

Students overwhelmingly reported feelings of engagement and fun in their inquiry-based learning. These feelings stemmed from positive perceptions of inquiry-based learning processes. In particular, students were aware of their teachers acting more as 'guides on the side' rather than 'sages on the stage' in the inquiry process.

I would like to learn [this way] more [often] as you don't have to present in a way you don't want to, for example if you don't want to do a worksheet you can make a model train instead. (Year 5 student)

I like that instead of the teacher telling us what we do, we got to choose the path and topic. (Year 4 student)

Evidence of cognitive engagement was also apparent from several sources. Students were observed by their teachers to be more willing to invest in their work, illustrating the importance of high engagement as a gateway to improved learning:

Because it is so engaging, there's the entry point for that student to connect to the curriculum. Often, that has a flow-on effect to their other learning areas, and it can create a student who starts to enjoy education. They like to come to school, they like to come to class, and they like to get there on time. I'm talking about students that might have a high rate of truancy or partial truancy. It's very motivating to the students. (Secondary teacher)

Further evidence of students' investment in their inquiry learning is illustrated in this comment about a student who went above and beyond the requirements of the unit of work:

I've got another student who has been going to the public library every weekend, and he's borrowing books on trains to understand how trains work. Yeah, just the amount of interest it's generated has been probably the biggest thing. (Primary teacher)

The inquiry approach, combined with input from within and outside the school via the industry experts, resulted in evidence of students making connections between learning content and their own personal lives, which is an important element of engaging repertoires. The following comment was made by an industry expert who had worked with a group of students at a primary school: "But they were definitely very engaged in understanding and wanting to understand the benefits with regards to the project and what it meant for their local community and themselves and their families". In addition, teachers noticed that students were thinking about their learning beyond the timetabled lessons, within and outside the school. The following is one of several examples of students having conversations about their inquiry in the school playground:

They're the ones that are coming up to me in the corridor and in the playground saying, "Hey, I've found this out," or "I've been reading further," or "I actually spoke to my uncle, and it turns out he works on the Sydney Metro himself." And one of the students came in with a Sydney Metro hat on that they'd gotten from somewhere. And they'd gone on the train on the weekend with their grandparents. And they come back, and they tell you all about it. And I think that the proof really lies in that, in and of itself. That they're actually interested, and they want to know more about it. And then that gives us the leverage to teach them the things that we actually have to teach them. (Primary teacher)

There were also several anecdotes of students sharing their learning with their families, which is evidence of operative and affective engagement, as illustrated here:

And just from my class I had some of the kids—because we had watched all four episodes of the Sydney Super Tunnel and they then asked for their parents to watch it with them so I had quite a few parents come up to me and say, "I've been watching that documentary and we love it." And the parents themselves were educating themselves about the Sydney Metro and how that all works, so they were keen and interested to then go to the expo and see the outputs. So that was a really positive influence the children had on their parents. (Primary teacher)

Survey data (Figure 3) confirmed that most students (69%) spoke with other people about their inquiry-based learning projects using Sydney Metro. The most common responses were immediate family (parents/carers and siblings) and friends, who may also have been engaged in the projects at the school.

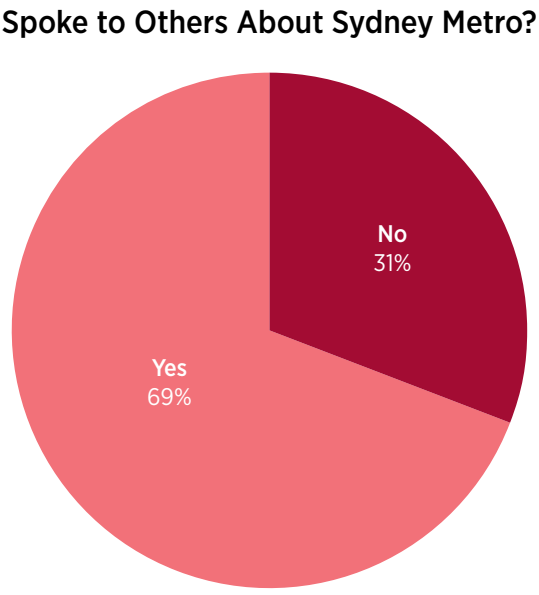


Figure 3: Student survey responses to: "Did you talk about the Sydney Metro project with people outside school when you were learning about it?"

As articulated in the Framework for Engagement (Attard, 2014), the foundation for engagement is the development of strong pedagogical relationships between teachers and their students. The open-ended and student-centred nature of inquiry learning led to more opportunities to differentiate learning. Primary and secondary teachers learned more about their students and their learning interests including the background skills and knowledge individual students bring to classrooms, as articulated in the following quotes:

You get to learn more about a student because they have this opportunity to be creative and show skills that maybe they don't get to—when he has to sit in a class and sit still and be quiet, he just can't do that, and he doesn't ever get to show that side of him...That particular student, socially, that was a positive moment for him because other students were able to see, perhaps for the first time, that he's actually got some skills and he can actually do some great things. (Secondary teacher)

I think I learned more about the kids. When you're so focused on teaching the content, you get lost in trying to connect with the kids. When you read their inquiry questions, you find out more about what they value and what they feel is important to them. Not only just my kids, but kids from other classes, you get to know them as well and build that relationship. So I feel like that just taught me the importance of connecting with those kids and understanding what they want to inquire about, what they feel is important to themselves as learners. (Primary teacher)

The reciprocity between positive pedagogical relationships and engaging pedagogical repertoires is also evident in the data collected. Teachers' inquiry practices led to a deeper understanding of student needs, which in turn led to practices that were more tailored to cater to the students, leading to more confident learners, as described in the quote below from a primary teacher:

I think we'd all agree that some of the students surprised us with the depth of their knowledge and their ability to engage with the learning. By using the enquiry-based approach they were able to demonstrate that which they may not have been able to in the more traditional form of schooling and having the work written into a book. This was completely different and having the expo where they could showcase their learning, I think that's given them some skills for future success 'cause they've felt they were successful, they've developed confidence in a belief in their own abilities, so I think it's allowed them to engage with the curriculum in a way that they couldn't access before (Primary teacher)

Not surprisingly, the real-life context of the Sydney Metro and the connections made to the curriculum via teachers' engaging repertoires made the learning more relevant for students. The following quote is representative of many comments made by participants:

I think this gave a really, I think it facilitated a lot of access to that more realistic and authentic working scientifically skills that actually relates more to what a scientist would really do. (Secondary teacher)

I think it's a really important part of operationalizing what kids learn, and making it real world. I think that's really important. (Primary teacher)

Data gathered from students and classroom observations confirms the teachers' perceptions of improved student engagement. During observations, primary and secondary students were noted to be highly engaged, displaying operative engagement due to the collaborative nature of inquiry-based learning. Student survey responses (Figures 4 and 5) also provided evidence of their engagement, as illustrated in the following examples:

I liked how they teached us in a fun and understandible way. (Year 4 student)

It was really fun and engaging. (Year 5 student)

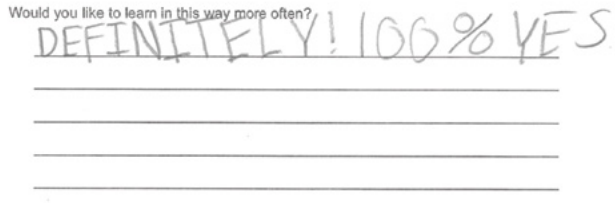


Figure 4: Student survey response 1

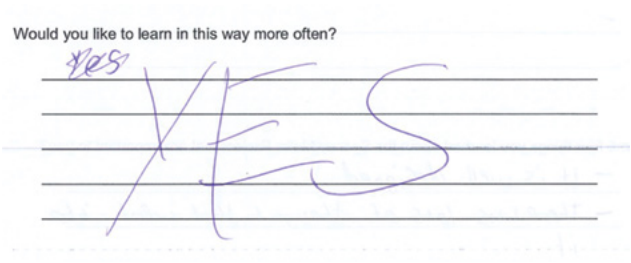


Figure 5: Student survey response

The high levels of engagement also appeared to have resulted in some students considering their future career aspirations, as articulated in the quote below from a primary school teacher:

They [the parents] said how much it's just reengaged them [students] and made them think about what they want to do when they leave school and whether they're actually going to remember what they've learnt as part of this process for years to come. Like they'll look back and go—if they're on a Metro train well they'll go, "We learnt about this in primary school, like ten years ago".

As noted in the previous section, the high levels of engagement evident in the data was not limited to the students. The data also provides some evidence of the reciprocal nature of engagement. Engaged teachers led to engaged students, and vice versa, as illustrated in the following two quotes:

I was really struggling with getting them engaged in things because now we're used to being at home and getting to do what we want or tasks that we can pick and not really worry about. So I was struggling with that and this unit has honestly been the highlight of my year. I would actually say that only because the engagement levels that I have seen and I'm learning from my students, which is massive. (Primary teacher)

The kids could see we were passionate about it. So then they were, I felt like my pod group, a lot of my kids were very excited, "Oh, we're doing the Sydney Metro again". (Primary teacher)

Influences on student learning

The inquiry-based teaching that resulted from the professional learning program appears to have influenced student learning in several ways. Students improved their knowledge across a range of curriculum areas, they improved their soft skills, and their knowledge and awareness of the Sydney Metro system, which will impact the lives of most of these students, was significantly increased. According to the student survey responses, there was an even split between students who had some or a lot of knowledge about the Sydney Metro (50%) (Figure 6) and those who had not heard of Sydney Metro (50%) before commencing their inquiry-based learning projects.

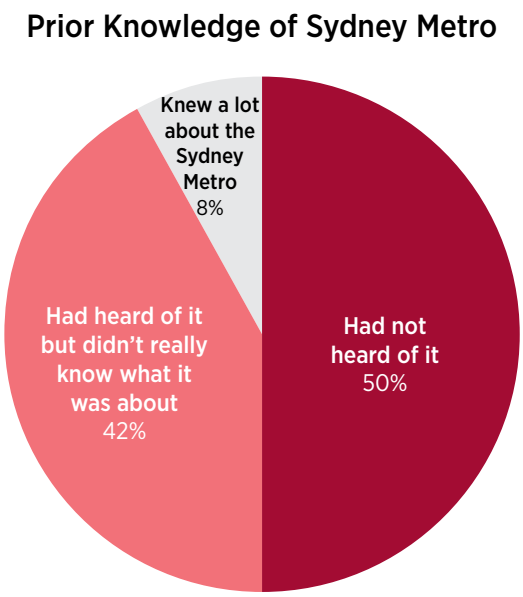


Figure 6: Student survey response "How much did you know about the Sydney Metro project before learning about it at school?"

Developing knowledge through inquiry

During interviews, teachers spoke about how the inquiry-based approach provided opportunities for students to access curriculum knowledge and make connections between the curriculum knowledge and its application in the real world. The following quotes exemplify this sentiment:

I think in terms of accessing the curriculum, I think it is really important to access it in terms of the kids seeing how it's about the real world. I think that's what makes it really, really powerful as a method... I think in that way it also facilitates that expansion of their understanding, that, hey these aren't little pockets of knowledge; it's all connected. Yeah, that's where the authenticity comes in because it's starting to have them make the connection between what they're learning at school and the wider world... (Secondary teacher)

I think once the students start to understand that mathematics, and English, and science aren't standalone subjects that you do for an hour and then you move on, that they interconnect and that there's really powerful learning there, and it allows you to open up the curriculum in a lot more ways. (Primary teacher)

Teachers also spoke about how the inquiry approach improved the learning of students who would ordinarily struggle with their learning via more traditional teaching practices:

She is generally a student that struggles and is actually coming and asking me how to improve her research skills and stuff. I'm seeing that translate over into other subjects, particularly in her writing that's slowly starting to improve because she's becoming more confident from what she's reading, from this project. (Primary teacher)

Developing soft skills through inquiry

Students reflected that inquiry-based learning with Sydney Metro improved their collaboration and communication skills. What students said about working in groups with others reflected the seminal ideas of Vygotsky's sociocultural learning theory and demonstrated how student-centred learning develops important skills beyond subject knowledge and skills. The following quotes synthesise the student reflections: "I like that we got to work in groups and discuss ideas with each other" (Year 7 student), and "By studying Sydney Metro, I got to learn how to collaborate with people that I didn't know" (Year 5 student). Data gathered from teachers confirmed the students' perceptions:

So I guess for our kids we do have a lot of ELD students, and the amount of collaboration and communication that we've had come out of this unit in particular I think has strengthened their skills in communication so much more, as well as all of the other students as well. So we've definitely seen a lot more collaboration between the students. We've seen I don't know, just their imaginations go wild because they've got the world. There is no, no, you can't do that, we need to do this. (Primary teacher)

I think the students learned a lot about collaboration, learning how to work with other students of different capabilities, or different aspirations, or ideas. So, I think they learned a lot about themselves. They learned a lot about their thinking. They learned a lot about how to think. So, that was really nice to see. (Secondary teacher)

Importantly, students saw future value in the knowledge and skills developed through their inquiry-based learning. Students recognised the process as developing their critical reflection skills. They also wrote about enhanced flexibility, curiosity, and ability to ask questions and take on feedback. These soft skills and attitudes were linked through to high school, post-secondary education, and work. For example: "Working together [was important] because I will use it in the future" (Year 5 student), "Having teamwork and time management is vital for university and high school so it is good to develop the skills at a young age" (Year 5 student), and "I learned how to research and look for information better. I have also learned to work more collaboratively. These are great skills to apply in a workplace situation" (Year 7 student).

Student perceptions of the inquiry-based learning approach

Teachers reported positive student perceptions of inquiry-based learning, as evidenced in the following quotes:

...they all said that they loved this style of learning. The reason being was that they were able to take direction in ...where they wanted to head with the project and the type of end product they wanted to produce. (Primary teacher)

So for me it's such a deeper way of teaching. I said to the children, "Would you prefer me to stand up the front of the class and then give you worksheets to complete? Or would you prefer this style of learning in the future?" and they all went, "We want this, when's the next one?" So they're very much—so much more engaged in this particular approach, provided that the topic is something is relevant to them. And I really do feel that for us as a school to be able to implement this particular project on the topic of Sydney Metro was something—was a really good way to capture them and engage them and show them those links to a real-life scenario. (Primary teacher)

Despite generally favourable views of inquiry-based learning, students reflected on some of the challenges they faced learning in this way. Time constraints and the ability effectively to manage their own time frequently were nominated as challenges. Amongst students who commented about time issues, many students asked for more time. However, other students commented that they had too much time and a "smaller time limit it would've been more focused" (Year 5 student). Demonstrating the lack of consensus around this topic, another student at the same school commented: "I don't want to change anything, I think that the length was perfect, the ingredients within was wonderful and the project was just perfect in every aspect in my opinion" (Year 5 student).

The particular timetabling constraints faced by secondary teachers were sometimes mentioned by students as an issue, particularly when students missed other classes because teachers collapsed classes across timetable lines to buy additional project time: "The amount of time we had and the period/class we missed out on. We have an assignment in that class" (Year 7 student), and "I would change the time schedule because I feel like the metro sessions clashed with our classes a lot" (Year 7 student). It should be noted, however, such decisions were made by teachers with the support of their school executive and were not required by Western Sydney University or Sydney Metro.

Some students found working with other students particularly challenging, with negotiating equitable contribution from different group members a particular source of frustration. One girl in Year 4 noted that "sometimes I feel ashamed I am the only one doing the most important things". However, experiencing these sorts of difficulties – and being reflective about one's own contribution to a group dynamic – are important developmental experiences for children and adolescents.

Throughout the survey, students commended their teachers for trying something new and providing students an opportunity to engage with inquiry-based learning, for example, "Thank you, teachers, for coming up with this topic of learning" (Year 5 student), and "They are doing a lot to help us and I appreciate everything they're doing" (Year 5 student).

The impact of expert involvement

The involvement of Sydney Metro industry experts as an additional resource was an integral element of the professional learning program. Access to experts was offered to all program participants and the nature and level of engagement varied from school to school. Typically, the experts visited schools early in the inquiry process to provide information and respond to student questions. Some experts provided very specific assistance, where others provided broader knowledge of the Sydney Metro project, and this was mostly dependent on the nature of the student inquiries and the openness of the inquiry. In some cases the experts returned to the schools upon completion of the inquiries to provide feedback on student work. The following quotes provide additional insight into the nature of expert engagement:

I went out there and just provided some, I guess insights and assisted students with a project that they were working on to develop a precinct or a place around, you know, I'm guessing a place of their choosing. So, they came up with a scenario that if we were to have a, the students and the teachers came up with a scenario that if there were to be a Metro station in [suburb], what makes a good precinct around that. So, I guess came from a perspective and tried to provide some information and assistance to get the students thinking about what are the kind of stakeholders and who are the kind of people you need to talk with to make a good station and make a good precinct. And so yeah that was sort of I guess the extent of my involvement. (Industry expert)

Benefits to the industry experts

For me personally, it has been great. The benefits are like, I cannot stop listing them, making them aware because not a lot of people understand what we do. (Industry expert)

During interviews, the experts were asked to discuss the perceived personal benefits of their engagement in the professional learning program. Several experts felt their involvement was a way of 'giving back', feeling a sense of intrinsic reward, as articulated in the following quote which is representative of the sentiments of the group:

I think that its intrinsic satisfaction, that you feel like you're giving back. Passing some knowledge. It was very challenging because I wasn't really asked many construction questions for me, but you're still giving back, and you're still being able to help as best as possible. So, there's a huge intrinsic value of, I guess being it. Yeah. I'm not a teacher, but yourself as a teacher, I'm sure you'd understand, you know, like you're passing on knowledge, and what could be more valuable than knowledge. (Industry expert)

The experts also felt their work was providing a legacy, and that their involvement instilled a sense of agency within the students they worked with:

I really did like to see the innovation within the schools, and the encouragement of innovation. I think that's one of our key values, innovation, and to see that as the driving in the next generation was really rewarding for myself. And to see that, knowing that they could feel that there is, they can feel part of that change so they can always put an idea there and we said all of that's fantastic, we could consider that, or consider that because there were some fantastic presentations. So, yeah, for me it was quite rewarding to be able to see schools involved and teachers involved in a project that's going to be transforming for them and their families. (Industry expert)

Other personal benefits cited by the interviewed experts include improvements to presentation skills and opportunities to translate experts' work for different audiences, which was highly valued, as evidenced in this quote:

I found it to be something different that I'd never done before so it sort of helped me develop my skills in how to approach a different audience that I generally wouldn't need to approach in my day to day work. You have to sort of use a very different tactic when working with, you know, students at the age of whatever they are in year five and six. It's like 11 or 12, so you have to use some different methods in your presenting and, sort of, yeah, educating skills but that's something I probably need to work on and it's a skill that I think for the most part they were pretty happy we were there... (Industry expert)

Benefits to Sydney Metro

Broader benefits to Sydney Metro were varied. The industry experts valued students as important stakeholders. They also saw value in students' ideas, as evidenced in this quote:

...it was really, really good from a Sydney Metro perspective as a way to see how schools can get involved with some really good ideas, and also some really good suggestions about Aboriginal art and incorporating that within a design and putting that as part of the place making areas. (Industry expert)

The experts also spoke about the importance of being able to showcase the depth and breadth of the Sydney Metro project to improve community understanding and increase the use of public transport in the future:

I found it valuable. Personally, I just thought it's great to see that sort of the values what we share at Sydney Metro sort of working their way into the educational system early on because I think, just personally, if transport for New South Wales have a greater vision of sort of driving more people to public transport and using more active transport like walking, cycling, as opposed to just being solely dependent on cars, then that sort of thinking does need to be established earlier, at the root level, you know...(Industry expert)

Additional perceived benefits to Sydney Metro included the creation of goodwill beyond the students to their families and the broader community, the engagement provided the experts with fresh perspectives of their work, and the engagement was an opportunity to build aspirations for future work in the transport industry, as quoted here:

...another benefit to us is that it could open up opportunities for the future, you know, students' willingness to want to work in the transport industry, or the engineering industry, the safety industry, whatever it might be. So, I think if we can be more involved, even in that sort of decision-making time around students' life where, you know, thinking about a career path and that's an opportunity where we could slide into. (Industry expert)

Perceived impact of industry expert engagement

But for me it was really good. I would recommend it, and I was impressed, I was impressed with their knowledge and it was good to see. I don't think I was that smart when I was in year 7. So yeah, it was really good. I was impressed and it gave me a bit more hope for the future that these kids are really learning quite well. And there's a really positive interest for things so I guess that was, that was really the biggest one is that gave me a lot of hope. I was as happy, that's what I took out of it, in that sense. (Industry expert)

In this section we explore the perceived impacts of expert engagement in the program from the experts and teachers. Both groups agreed that the inclusion of industry experts in the program was a positive experience. Experts believed they had a positive influence on student learning and were impressed with the quality of student thinking, as evidenced in the following quote:

I was quite impressed if, like I was just very impressed with how much, with how seriously the students took the project. And also their knowledge of how we as Metro sort of operate. You know, they seem to be a good understanding so, that makes me think that well perhaps you know, Sydney Metro is doing quite well in that educational space...I just found that I found I was quite surprised and pleased with the level of interest in what was being discussed, you know, as opposed to, again, my childhood which was Healthy Harold rocked up and kids would lose their socks. These kids were genuinely interested in what we had to say. (Industry expert)

Similarly, the teachers highly valued the input provided by the industry experts. They noted the passion and enthusiasm of the experts and felt the real-world connection for students was highly beneficial, providing additional knowledge and nuanced understandings that students would not find using typical search strategies. The following quotes from primary and secondary teachers synthesise these sentiments:

The most important bit for me was being told that we had access to experts. And we were able to get that real world connection for our students. The students are actually talking to a real person. They're actually not just diving into a website and finding facts and Googling it. They've actually got the opportunity to talk to someone who worked within it. And it's not talking to a teacher, it's not talking to somebody who's in the education sphere. They're talking to an engineer. They're talking to someone who is involved in the signaling of a train. And they can talk about what their job actually is and what their difficulties and what their experience has been like. And that's really powerful for those students. (Primary teacher)

Because there's not been one person we've spoken to from Sydney Metro who hasn't absolutely loved and been really passionate about what they're doing and they really believe in it, and they really see the value in it. I think that's just been so exciting to be able to bring that attitude to the students. (Secondary teacher)

Further, the input from industry experts allowed teachers to cater to the diversity of learners more thoroughly by providing additional knowledge to both the students at school and their teachers during the professional learning sessions, as explained in this quote:

The challenge is always how you support them to do that when they have so many different things. That's one reason why the experts were important. They had knowledge that we did not have. Remember, we were talking to someone else right back at the beginning, and we're saying, "Sometimes, you just don't know what you don't know." After the experts came, we were like, "Oh, my goodness. We know so much more now." (Primary teacher)

The fact that we could get access to those experts makes a big difference to our students and to us, because they have knowledge that we don't have, and they also provide a really sort of authentic and meaningful audience for the kids. They want to create something that's high quality. They want to impress them. Want to impress all of you. (Primary teacher)

Perceived barriers and challenges to expert engagement

Although the engagement of industry experts was an overwhelmingly positive experience, there were some barriers and challenges that were noted by the experts and teachers. One expert spoke about a lack of confidence as a barrier preventing colleagues from becoming involved in the program:

There are a lot of people within the organization that are hesitant to volunteer for these sorts of things, unfortunately. I think it's just out of their comfort zone perhaps, it's trying that different thing, it's you know, a little bit of stress is always a good thing, but a lot of people don't like to take on that sort of a challenge. (Industry expert)

Another cited a lack of time as a barrier for some. Additional challenges noted by the experts were the potential for missed opportunities in scenarios where only one teacher at a school is interested in using Sydney Metro as a stimulus for inquiry, and the potential for others to decline participation due to some public negative perceptions of the Sydney Metro project.

Other challenges related to practical aspects of engagement with schools, including a desire for more guidance in relation to the specific areas of interest to be discussed. In this case, the industry experts were engaged with a school very early in their inquiry, so the information required was quite broad as opposed to other cases, where the required information was more specific.

Challenges to the engagement of industry experts were only reported by teachers at one school. These challenges related specifically to the practicality of having the experts speak to a school of over 1000 students ranging from Kindergarten to Year 6, as articulated below:

The biggest feedback we got from colleagues is that one of the experts that we had for the K to twos, it was probably too much. So they were just sitting there afterwards and he had done this amazing speech. It was university styled and all the kids are just sitting... It's straight over their heads. So for that type of thing, and I mean, that is us just taking it on for K to six as well, which is something that we might need to think about next time that we do it too, or just organize really specifically, that these guests are going to be for these stages. (Primary teacher)

While the number of challenges and barriers to expert engagement were minimal, future planning should consider ways to address them to ensure all parties experience the maximum benefit of such engagement.

6 Summary

This research evaluation of the Sydney Metro teacher professional development project sought to address the following questions:

1. How did the Sydney Metro Phase 2 professional development program influence the implementation of inquiry-based learning?
    a. What are the perceived and observed influences of the professional development on teacher practice?
    b. What are the perceived influences of the professional development on student engagement and learning?
2. How did teachers and experts perceive the impact of expert involvement in the inquiry-based learning projects?

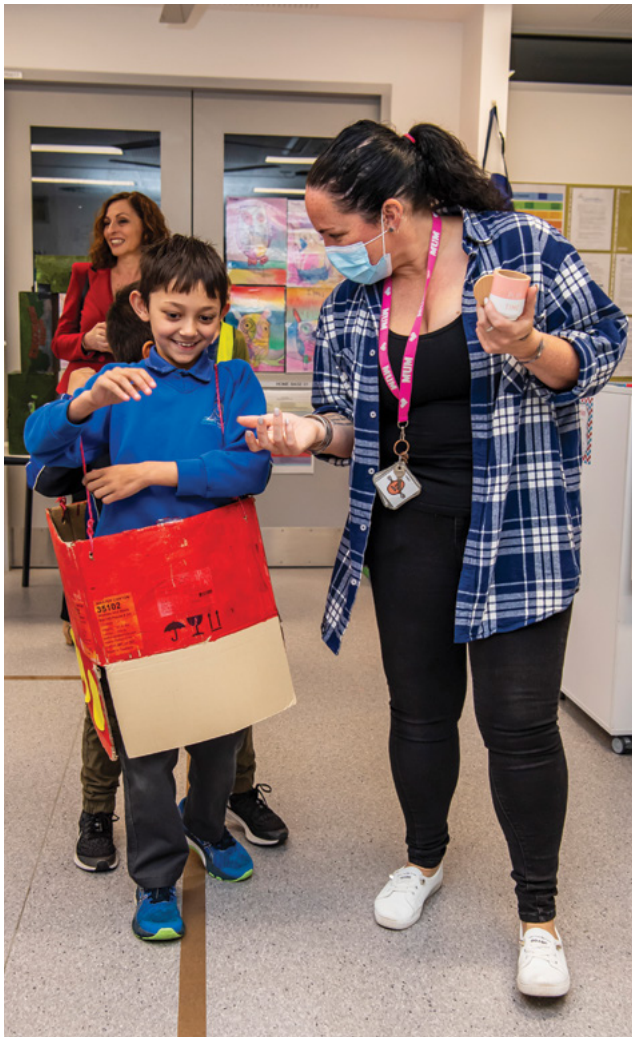
The following is a summary of the findings presented in the previous sections in response to the research questions.

How did the Sydney Metro Phase 2 professional development program influence the implementation of inquiry-based learning?

What are the perceived and observed influences of the professional development on teacher practice?

The influence of a sustained period of professional learning via a sequence of face-to-face and online sessions influenced teacher practice in the following ways:

- The program influenced the ways teacher planned their units of work. Planning was more flexible and responsive to student needs and in many cases was conducted across more than one curriculum area.
- Teachers planned in a more student-centred and student-controlled way. Learned tended to be driven at varying degrees, by student interest.
- Planning for teaching became a more collaborative process.
- Teachers found more opportunities to evaluate throughout the teaching of the unit, rather than just on conclusion of the unit.
- Teachers learned to collaborate with external experts and this became incorporated in their practices
- Teachers became facilitators of student learning
- The program increased teachers' engagement



What are the perceived influences of the professional development on student engagement and learning?

Engagement
The program influenced student learning and engagement in the following ways:

- The student-centred nature of inquiry learning and increased levels of student control and choice over their learning contributed to increased engagement.
- Students were invested in their learning, evidenced by conversations with others and activities that extended beyond the classroom and beyond the school.
- The development of strong pedagogical relationships as a result of engaging inquiry pedagogies increased engagement.
- The real-life context of the Sydney Metro and the connections made to the curriculum via teachers' engaging repertoires made the learning more relevant for students.
- Some students developed career aspirations as a result of their learning and engagement in the Sydney Metro unit of work.

Learning
Student learning was influenced in these ways:

- Students increased their knowledge and awareness of the Sydney Metro project and its impact on communities.
- Students were able to access the school curriculum in meaningful ways due to the real-life context.
- Students made connections across and within curriculum areas.
- A range of soft skills such as collaboration, problem-solving and critical thinking were developed as a result of the inquiry approach.

How did teachers and experts perceive the impact of expert involvement in the inquiry-based learning projects?

Experts
Industry experts perceived the impact of their involvement as follows:

- Experts experienced personal benefits such as the development of personal presentation skills and opportunities for translation of their work.
- The experts experienced a sense of intrinsic reward, and of 'giving back'.
- Experts saw their work as legacy.
- The experts believed there were broader benefits of their engagement for Sydney Metro. For example, they heard fresh ideas from students, they felt it was beneficial to showcase the Sydney Metro project, and they valued the opportunity to encourage career aspirations amongst students.

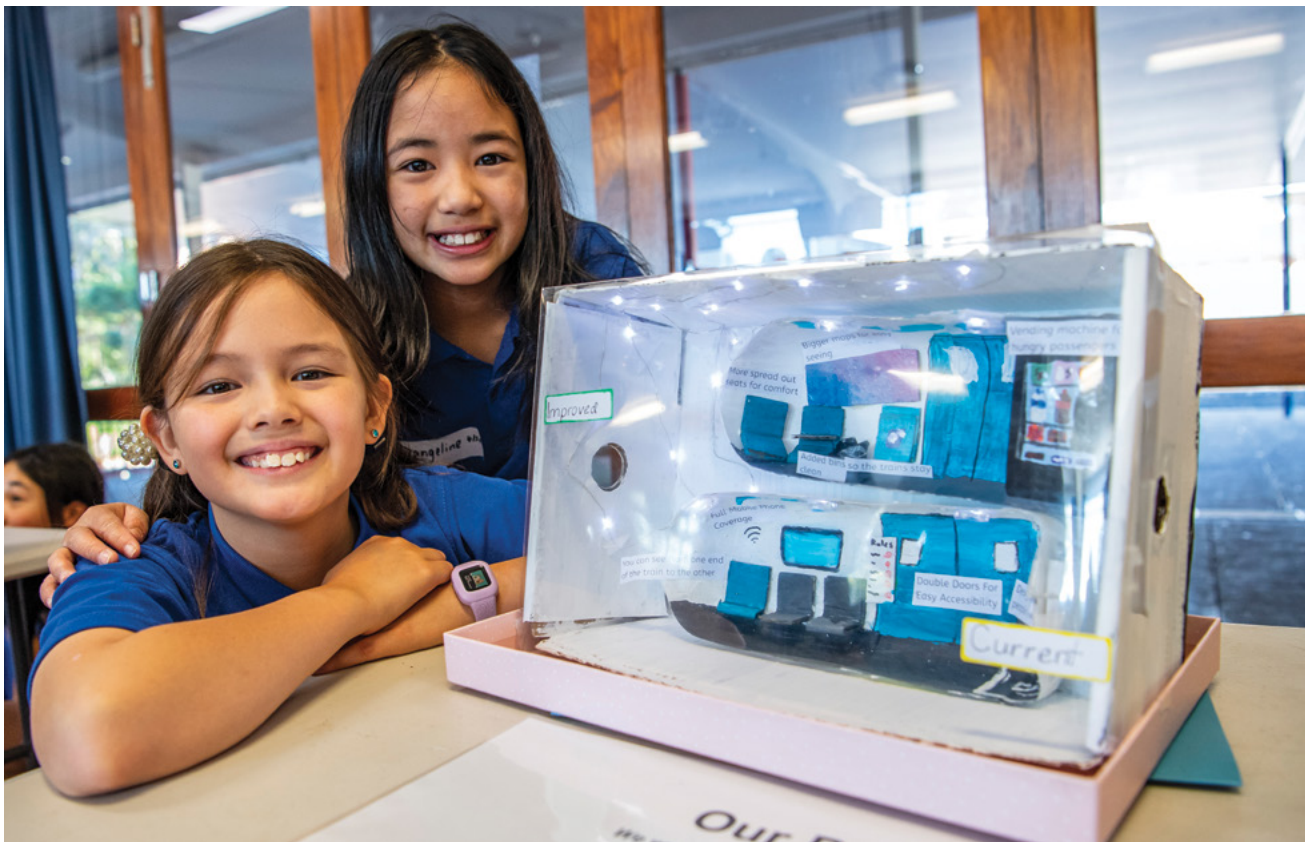
Teachers
Teachers perceived the impact of industry engagement in the following ways:

- The experts assisted teachers and their students in gaining new knowledge about Sydney Metro that was relevant to their inquiries.
- Teachers viewed the expert input as a valuable resource.
- Teachers found the experts provided real-world connections to the curriculum for students.
- The expert input assisted teachers in addressing student needs.

Recommendations

The following recommendations are drawn from the research evidence and from the observations and experiences of the team who facilitated the professional learning program. They are provided to inform future professional learning programs involving Sydney Metro or other entities considering similar programs:

1. Due to the overwhelmingly positive response from teachers, experts, and students, and the potential to increase teacher capacity and positively influence student learning it is recommended that Sydney Metro (Transport for NSW) continue to support teacher professional learning.
2. It is recommended that support materials for both teachers and industry experts are developed to ensure the benefits of school visits are maximised. For example, a teachers' guide to assist in planning the school visit in terms of content to be covered and facilitation of the session would be of assistance. A guide for industry experts that provides a small range of engaging strategies appropriate for different age groups would also be beneficial.
3. The use of prior participants should be expanded in future iterations of the program to assist teachers in developing and teaching their units of work. Previous participants could be utilised as a mentor and additional resource for teachers to access.
4. Future research should include data from school leaders to assist in understanding how leadership could support the implementation of inquiry-based learning pedagogies.
5. The provision of a planning day for teachers should continue, however there should be an option for teachers to work off-campus and alongside academics to ensure they receive 'just in time' assistance.



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