Quality Teaching Rounds – Cost Benefit Analysis

University of Newcastle

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Deloitte Access Economics

Contents

Executive summary

Deloitte Access Economics has been engaged by The University of Newcastle (the University) to produce estimates of the cost-effectiveness and economic value of Quality Teaching Rounds (QTR). This engagement involved an assessment of cost-effectiveness from the perspective of schools and a cost benefit analysis (CBA) to measure value at a system level.

There are **few, if any, education interventions that have undergone an assessment on this basis in Australia**. QTR is also one of a small number of rigorously assessed professional development (PD) programs that have demonstrated a causal effect on improving student learning. This should be kept in mind when comparing the costs and benefits of QTR with those reported by other programs, which may utilise less rigorous evaluation and costing methodologies.

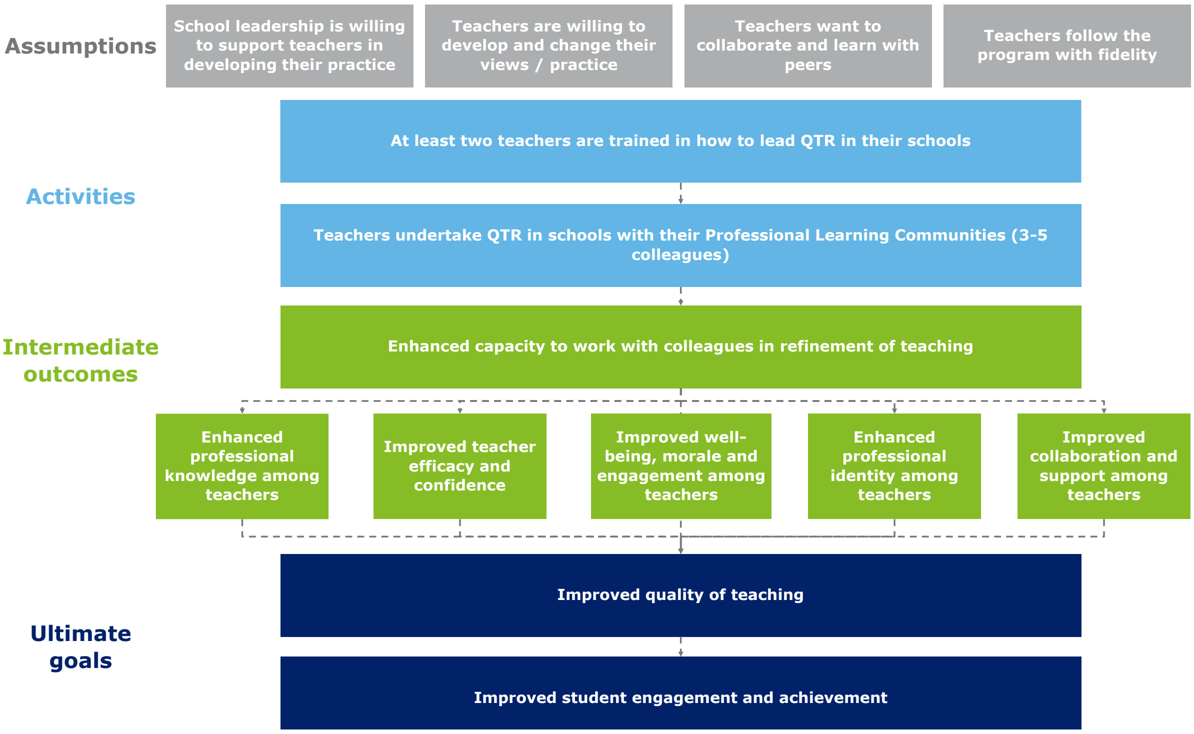
Quality Teaching Rounds

QTR has been developed by the University with support from the NSW Department of Education, ACT Education Directorate and the Parramatta Catholic Education Office.

QTR operates by training a small number of teachers during a two-day workshop, with these teachers then returning to their schools to form Professional Learning Communities (PLCs) with other teachers. These PLCs then conduct regular 'Rounds' involving lesson observations with structured analysis and discussions guided by the Quality Teaching pedagogical model.

As shown in Figure i, QTR's theory of change is underpinned by the premise that developing a deeper understanding of quality teaching will lead to improvement in the actual quality of teaching. Additionally, it poses that QTR training enables teachers to improve their teaching practice and that of their colleagues via PLCs.

Figure i: QTR theory of change



Source: University of Newcastle.

Prior empirical research into QTR has established that it can improve measures of teaching quality and teacher morale in primary and secondary schools, with effects sustained into the next school year. Related qualitative research has also demonstrated that for both beginning and experienced teachers, participation in QTR improves confidence and develops professional relationships, and that pre-service teachers compare it favourably relative to other learning experiences.

The randomised controlled trial

Estimates of impact drawn on in this report come from University analysis of a randomised controlled trial (RCT) of QTR. This RCT was also designed and administered by the University, and included 5,478 students from 125 primary schools in New South Wales in 2019. In this RCT, schools were randomly assigned to one of four trial arms:

1. **Researcher-led QTR**: Two-day workshops to train teachers in QTR were run by Laureate Professor Jenny Gore, one of the developers of QTR. Trained teachers then formed PLCs with other teachers to undertake four Rounds over the 2019 school year.
2. **Trainer-led QTR**: As above, but with trained advisers delivering the workshop.
3. **Alternative PD**: Teachers in this arm received an alternative form of PD called Peer Observation. They were supported with time and funding equivalent to the QTR groups.
4. **Control**: This arm operated on a 'business as usual' basis, free to continue their standard PD, with no additional funding or release time provided in 2019.

Schools in all arms but the control were also given $10,000 to cover the anticipated casual relief teacher costs incurred in implementing interventions in 2019. Both alternative PD and control schools were funded to implement QTR in 2020.

This report focusses on the benefits and costs of the researcher-led QTR arm, as compared to the control arm. This comparison was selected as the trainer-led QTR model is still being refined.

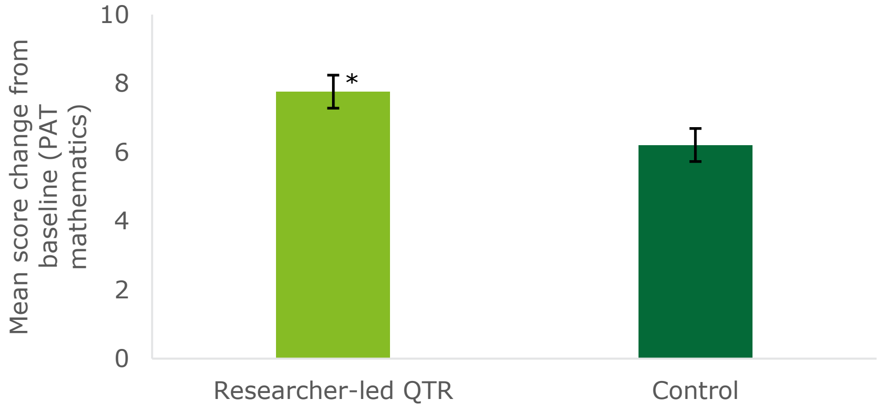
Student achievement outcomes were measured for a sample of Year 3 and 4 children in each trial arm using the Australian Council for Educational Research's Progressive Achievement Tests (PATs). Assessments were conducted in Term 2 and again in Term 4 (approximately eight months apart).

A paper describing the results of the RCT has been submitted to *Teaching and Teacher Education* and is currently under peer review. Analysis by the University, which has been independently quality assured by the RAND Corporation, is used as the basis for the benefits described in this report. The costs detailed in this report are drawn from the University's records and a survey of schools in QTR trial arms, which was designed and analysed by Deloitte Access Economics.

School level view

RCT data shows that students in researcher-led QTR schools saw an improvement in PAT mathematics scores equivalent to **an additional two months of learning** relative to those in the control group (see Chart i for results in terms of PAT score change).

Chart i: Mean score change from baseline in PAT mathematics tests, researcher-led QTR and control.



Note: Black lines indicate 95% confidence intervals. * denotes statistical significance at the 0.001 level.
Source: University of Newcastle (2020).

Students in the trainer-led QTR schools did not see a statistically significant improvement in mathematics scores relative to the control, which may be explained by a lower level of QTR implementation fidelity among teachers in this group (this model is still undergoing further refinement).

No statistically significant differences in science and reading progress were found in either the researcher or trainer-led QTR trial arms relative to the control. University analysis suggests this may be a product of much less instruction time being spent on these domains relative to numeracy, reducing the ability of any improvement in teaching practice to translate into increased learning progress.

The average cost of implementing QTR, as incurred by schools in the trial, is estimated at $3,038 per teacher / class, equating to a per student cost of $127 (24 students per class). Cost calculations are based on a PLC operating with four teachers, two of whom attended QTR training. This cost is chiefly driven by the requirement of casual teachers to be employed to facilitate time release for initial training and to conduct four Rounds over the course of the trial. Schools can run QTR at lower cost by drawing on their own staff to enable the release of teachers during Rounds, where staffing arrangements permit.

QTR compares similarly or favourably to the few other rigorously tested interventions in Australia on a cost-effectiveness basis, both relative to other interventions and Evidence 4 Learning (E4L) benchmarks. **At $127 per student, the cost of QTR is categorised as very low under E4L guidance.**

Table i shows that relative to other interventions that E4L have funded RCT evaluations of, **QTR is a relatively low-cost intervention that achieves a positive impact on student progress**.

Table i: Cost-effectiveness comparison of QTR relative to E4L funded studies.

Intervention	Detail	Outcome and effect size	Cost per student ($)
Quality Teaching Rounds	A pedagogically focused form of professional development applicable to teaching in all subjects across years K - 12.	2 months progress for primary students (mathematics).	$127
Thinking Maths	A professional learning program aimed at building teachers' capabilities to make maths learning deeper and more engaging.	2 months progress for primary students (mathematics).	$154
QuickSmart Numeracy	A small-group tuition intervention to increase automaticity in maths and reduce cognitive load.	1 month progress for primary students (mathematics)*.	$1,007

Note: * not statistically significant at conventional levels.

Source: Evidence for Learning (2020a), Deloitte Access Economics (2020).

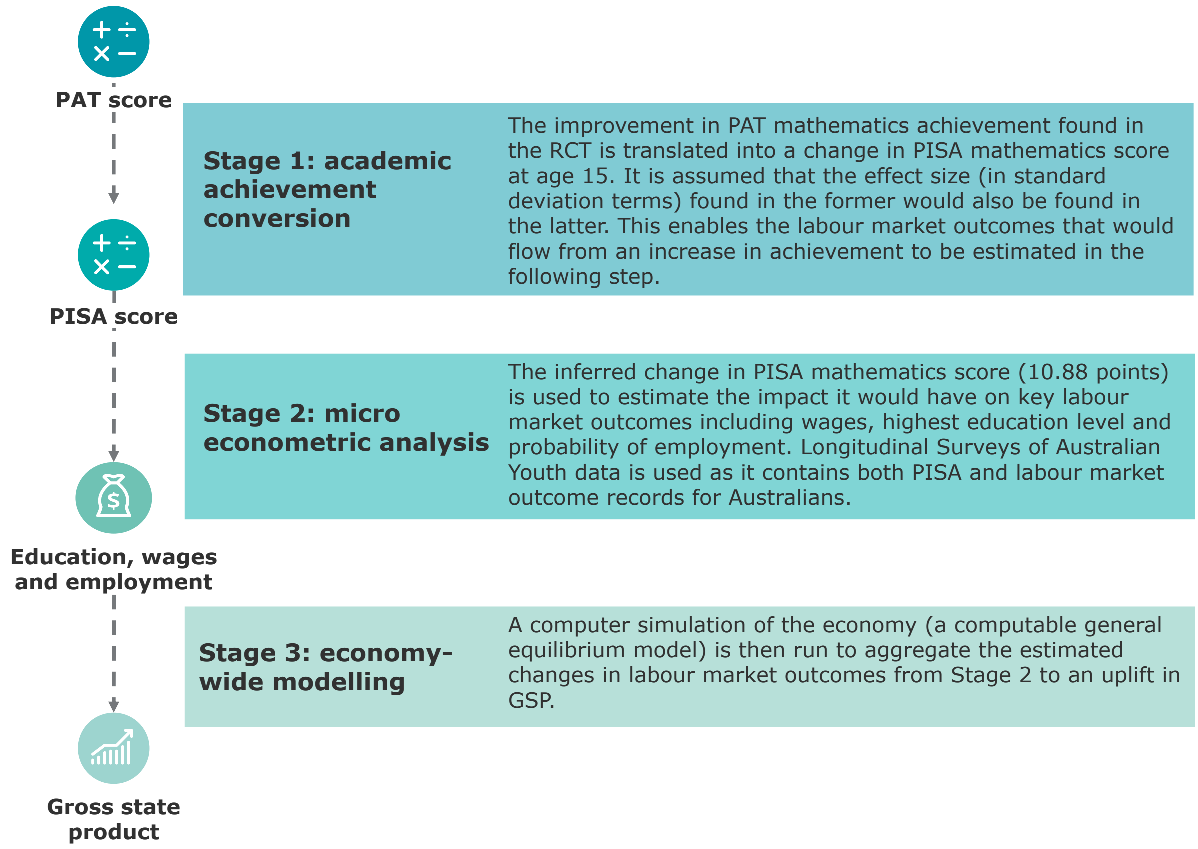
Contextualising these results against a wider set of education programs (and specifically PD programs) that operate in Australia is difficult, as few if any have been evaluated in a manner that allows causal claims of effectiveness to be made. There are also few instances of program costs being independently calculated, so **comparisons to PD programs that have not been robustly evaluated in the same way should be made cautiously**.

System level view

By increasing teaching quality, QTR causes a direct benefit in the form of improved student academic achievement as identified in mathematics. This in turn is anticipated to translate into a long-term benefit to productivity when these students enter the workforce, raising gross state product (GSP) for NSW. This *monetised* benefit is captured in the headline results of this CBA.

Figure ii summarises the steps in this calculation process.

Figure ii : Steps in calculating GSP uplift from RCT results



Source: Deloitte Access Economics.

Table ii summarises the lifetime GSP uplift computed by this process on a per student basis. Additionally, it also presents on a lifetime per student basis: the cost of QTR, the net return (calculated as the difference between the present value of GSP uplift and program costs) and the ratio of the present value of lifetime GSP uplift per dollar spent on QTR.

Results are provided on the basis of both the impact of QTR being the same (in standard deviation terms) in PISA mathematics as it is PAT mathematics (the no fadeout scenario) and under a fadeout scenario whereby 75% of the impact dissipates in the years following the intervention prior to age 15 (when PISA tests occur). The 75% rate is a conservative estimate informed by meta-analyses of fadeout in early childhood education interventions.

The reported findings are expressed in ‘present value’ terms, which means future benefits and costs have been discounted to reflect the time value of money and the uncertainty of future cashflows.

Table ii: Headline per student results, present value, discounted at 3.5%

	No fadeout ($ per student)	75% fadeout ($ per student)
Lifetime GSP uplift	19,685	4,920
Lifetime wage uplift	17,075	4,270
Direct program costs*	130	130
Lifetime GSP uplift per $ of QTR cost	150	40
GSP uplift less direct program costs	19,560	4,790

Note: * direct program costs are calculated using only University provided data on the cost of running QTR workshops and the $10,000 provided per school to cover time release costs, whereas the $127 per student estimate is based on survey data.
Source: University of Newcastle data request, Deloitte Access Economics.

As shown, **for each dollar spent on QTR the lifetime GSP uplift is equal to between $40 and $150**, depending on the degree of fadeout assumed.[1] Importantly, there are also non-monetised benefits which stem from improving student academic achievement, but which are not quantified in dollar terms for the purpose of this CBA and therefore not included in the headline results. These include benefits to health, wellbeing, civic participation and interaction with the police and judicial system.

These results indicate that **QTR delivers a high level of economic return to society for the level of associated program cost**. While not being directly comparable, international studies of a range of aggregate investments in primary education typically estimate that for each dollar of investment a benefit between $8.50 and $25.40 results, with much of this variance stemming from differences in returns between developed and developing countries.

These points considered, the benefits generated by QTR represent a material return to students, schools, communities and broader society. In part, they are substantial as the returns to improving learning outcomes, even when modestly estimated, are large. The returns to education for individuals are life-long, and the returns to the broader economy compound over time.

Further, the costs associated with QTR are modest, particularly when compared to the aggregate costs associated with the schooling system more broadly. This means that only a small uplift in learning outcomes is required for the returns from QTR to be large. Indeed, **further research and analysis may be beneficial to understand the extent to which this significant return, for a modest investment cost, is scalable with a larger 'dosage' of the program**, in terms of its intensity and the length of time over which it operates. In the context of the interim nature of these results, this underlies the imperative to keep monitoring and assessing the impact of QTR and the returns generated by it.

Going forward, the University is continuing to invest in strengthening QTR by refining the trainer-led QTR model to achieve a scalable solution. Additionally, a further program of experimental research, including an independently evaluated RCT, is planned to continue to build evidence on what works in teacher professional development.

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[1] When interpreting these results, only direct program costs, as reported by the University, have been included in the analysis. Other costs not captured here include the opportunity cost of resources associated with the flow-on economic activity generated through increased labour productivity. In this regard, the lifetime wage uplift per student (which excludes the flow-on impacts to economic activity) is included above as an alternative measure of economic benefits from the program.

1 Background

Deloitte Access Economics has been engaged by The University of Newcastle (the University) to estimate the cost-effectiveness and economic value of Quality Teaching Rounds (QTR). This engagement involved:

- an assessment of the costs incurred by schools to run QTR,
- the development of estimates of the economic and wider benefits of improved student achievement, and
- the development of cost effectiveness and cost benefit estimates, at the school and state level respectively, on a per student basis.

1.1 The importance of professional development

Improving the quality of school education in Australia is a goal that all state and non-government systems strive for. Prior research by Deloitte Access Economics has found that of all school-level factors, it is teaching practice that most significantly explains variance in student achievement (Deloitte Access Economics, 2019). Accordingly, delivering high-quality professional development (PD) to teachers is a key lever in improving the quality of education within schools.

The Australian Institute for Teaching and School Leadership (AITSL) defines high-quality or effective PD as that which meets the following criteria:

A **Relevant**: assisting teachers in addressing the challenges they face in improving student learning, engagement with learning and wellbeing. It should also encourage teachers to develop solutions to persistent issues by challenging assumptions about their practice and be based on contemporary research.

B **Collaborative**: promoting teachers working together in a disciplined and structured manner, with opportunities to receive feedback on practice, and observe the practice of others.

C **Future focussed**: equipping teachers to deal with future challenges and to engage with research that challenges their thinking (AITSL, 2012).

AITSL (2012) also note that research finds that PD which contains elements of lesson observation, feedback and opportunities to practice new approaches is more effective than that which consists of discussion, lectures and field trips to other schools. Similarly, research by the OECD suggests that high-quality PD provides opportunities for active learning methods, takes place over an extended time period, involves a group of colleagues, and encourages collective learning activities or research with other teachers (OECD, 2017).

In the most recent Teaching and Learning International Survey (TALIS), nearly all teachers in Australia reported participating in PD and over 90% believed it had a positive impact on their teaching (Thomson & Hillman, 2019). Despite being viewed favourably by teachers, until recently relatively few studies have rigorously evaluated the impact of PD on student achievement. In 2007, a review for the US Institute of Education Sciences found only nine studies examining the impact of PD on student achievement from over 1,300 identified in a research scan across those studies met a standard that allows causal claims to be made (Yoon et al, 2007).

More recently, as interest in rigorous evaluation in education has grown, quantifying the impact of high-quality PD on student achievement has become possible. A 2020 meta-analysis of randomised controlled trials evaluating PD by the UK Education Policy Institute found an average effect on student academic achievement of 0.09, which roughly equates to less than one month of student learning progress (Fletcher-Wood & Zuccullo, 2020).

1.2 Quality Teaching Rounds

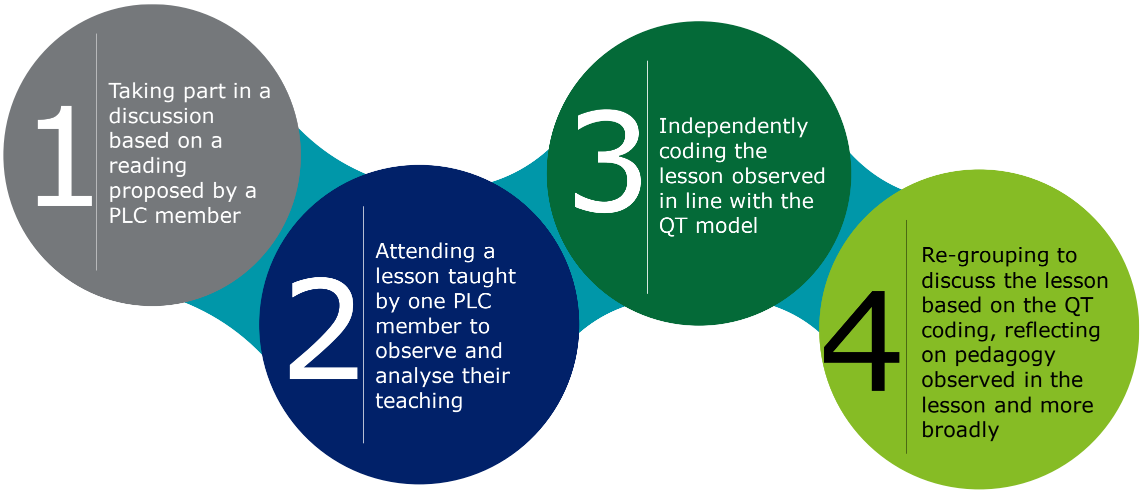
QTR is a form of teacher PD designed to bring together the benefits of professional learning communities (PLCs), the Quality Teaching (QT) pedagogical model (NSW Department of Education, 2003) and a form of teaching 'Rounds'.

PLCs provide the unit of organisation for QTR, with groups of three to five teachers regularly observing and analysing one another's teaching. The QT model provides a shared language and clear conceptual standards for quality teaching, and guides teachers to ask three key questions about their practice and that of their colleagues:

- To what extent is there evidence of intellectual quality?
- In what ways is the environment supportive of student learning?
- How can learning be made more significant or meaningful for students?

Working in their PLC, teachers implement QTR by conducting the activities described in Figure 1.1 during a single day (a 'Round').

Figure 1.1: Components of a QTR Round

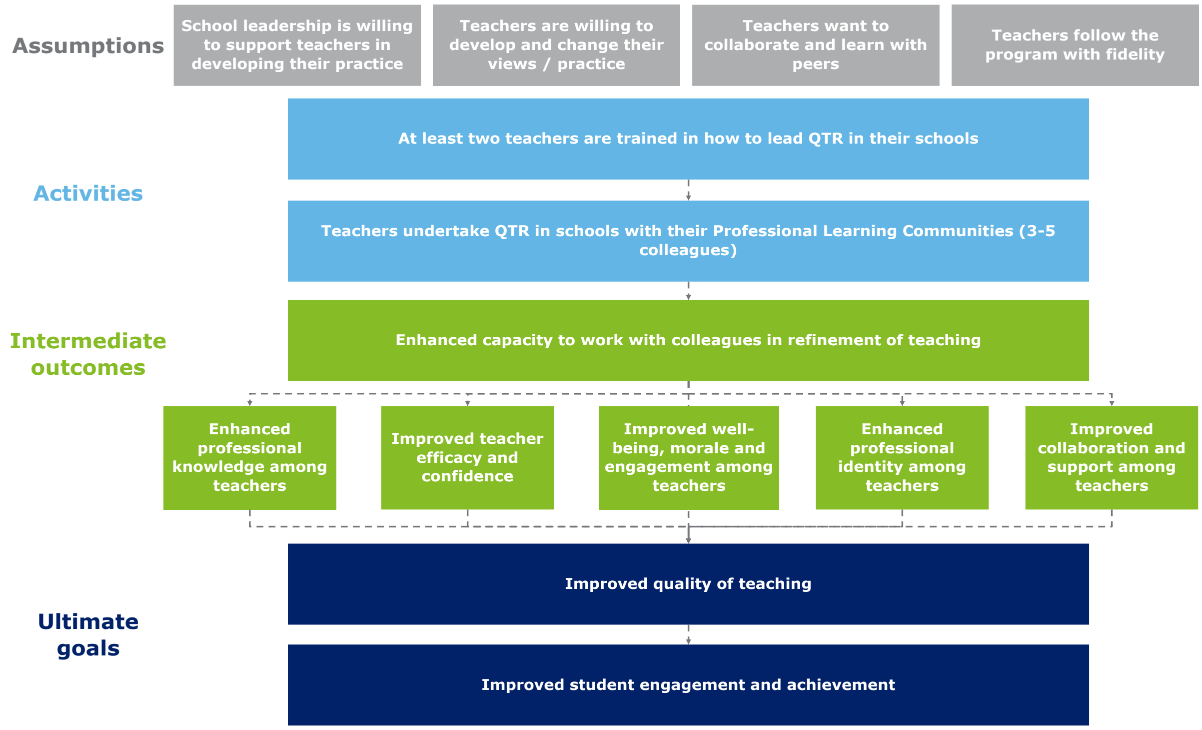


Source: Gore et al, 2016.

Adding the QT model to PLCs, alongside the clear structure of each Round, enables rigorous diagnostic professional conversations among teachers (Gore et al, 2016). As such, QTR exhibits the characteristics of high-quality PD as identified in Section 1.1.

Figure 1.2 sets out (in simple terms) the theory of change underpinning QTR. QTR's theory of change is underpinned by the premise that developing a deeper understanding of quality teaching will lead to actual improvement in the quality of teaching. Additionally, as QTR is not dependent on external expertise after the initial two-day workshop, it enables teachers within or between schools to continue to develop their pedagogical expertise and build capacity of others in a sustainable way.

Figure 1.2: QTR theory of change

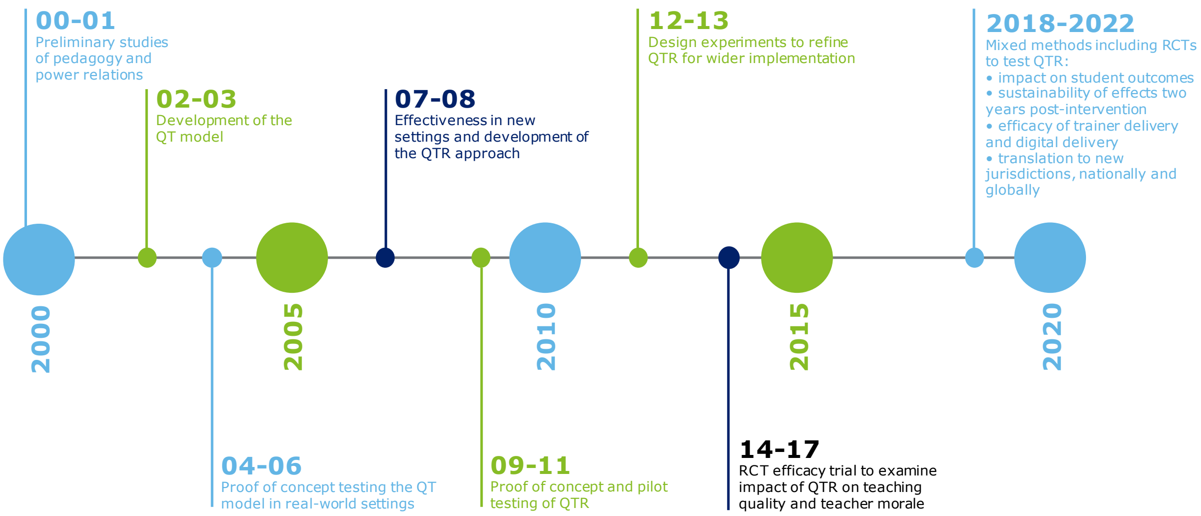


Source: University of Newcastle.

Prior empirical research into QTR has established that it can improve measures of teaching quality and teacher morale in both primary and secondary schools, with effects sustained six months later and in a new school year (Gore et al, 2017). Related qualitative research has demonstrated that for both beginning and experienced teachers, participation in QTR also improves confidence and develops professional relationships (Gore & Rickards, 2020; Bowe & Gore, 2017), and that pre-service teachers compare it favourably relative to other learning experiences (Prieto et al, 2015). Working with colleagues from across the school, QTR has also been found to generate fresh insights about pedagogy and students, enhance collegiality and lead to ongoing professional collaboration (Gore & Rosser, 2020),

QTR's development has been led by the University, with support from the NSW Department of Education, ACT Education Directorate and the Parramatta Catholic Education Office. Figure 1.3 charts the progression of this research.

Figure 1.3: Timeline of QTR research program



Source: Gore (2018).

A new research program associated with this initiative began in mid-2018 funded by the Paul Ramsay Foundation, with support from the NSW Department of Education. This research program aims to both test and scale QTR, with a series of randomised controlled trials (RCTs) planned to provide robust evidence of the program's effect on student and teacher outcomes.

Since 2018, more than 1,600 teachers in approximately 710 schools have engaged with QTR.

1.3 Measuring the cost and effect of QTR

For this study, benefit and cost data is drawn from an RCT of QTR in NSW primary schools run by the University in 2019.[2] The University collaborated with the NSW Department of Education to recruit government primary schools across the state for this trial.

125 schools ultimately participated. The mean school ICSEA was 994. 43% of schools were rural.

Schools were randomly assigned to one of four trial arms:

1. **Researcher-led QTR PD**:
   a) In this arm, teachers formed PLCs to undertake four QTR Rounds.
   b) Prior to commencing Rounds, teachers from each school participated in a two-day workshop to prepare them for conducting QTR within their school. This provided background information on QTR, highlighting the intention and importance of each component of the approach (i.e., PLCs, readings, observation, individual coding, group discussion). Teachers were provided opportunities to practise the QT coding process and participate in simulated Rounds using sample video-recorded lesson extracts.
   c) These workshops were delivered by Laureate Professor Jenny Gore who led the development of QTR with colleague Dr Julie Bowe.
2. **Trainer-led QTR PD**:
   a) This arm was implemented as above, apart from workshop delivery being carried out by advisers who were experienced teachers recruited and trained by the University's QTR researchers.
3. **Peer observation time-equivalent PD ('alternative PD')**:
   a) Teachers in this arm participated in an alternative form of PD called Peer Observation.
   b) As with the two QTR intervention groups, teachers were funded to attend a two-day workshop to prepare them to undertake Peer Observation in their schools using guidelines developed by AITSL.
4. **PD-as-usual wait-list control ('control')**:
   a) This arm operated on a 'business as usual' basis, free to continue their standard PD, with no additional funding or release time provided in 2019.

Schools in all arms but the control were given $10,000 to cover the anticipated casual relief teacher costs incurred in implementing interventions in 2019.[3] Schools in both the control and alternative PD trial arms were also funded to implement QTR in 2020.

This report focusses on the benefits and costs of the researcher-led QTR arm, as compared to the control arm. This comparison was selected as the trainer-led QTR model is still being refined (see Section 2.1 for further detail).

Student academic achievement outcomes were measured in Term 1 of the school year and at an eight-month follow-up time point (Term 4). The sample was formed from Year 3 and 4 children

[2] The study was designed to run over two years, with a second cohort of schools engaging in the trial during 2020. Due to the impact of Covid-19, the second cohort of schools is scheduled to participate in the RCT in 2021. Once data are available from this second cohort, analysis of the trial results will be re-run on the expanded sample.
[3] The $10,000 was provided to allow two teachers to attend training (2 teachers x 2 days = 4 funded release days) and to allow four participating teachers to be released from class to carry out a full set of Rounds across the intervention period (4 teachers x 1 day per Round x 4 Rounds = 16 funded release days). The same amount was provided to schools in the alternative PD trial arm.

(one – two classes per participating school). Teacher level outcomes (surveys of morale and efficacy, and observations of the quality of teaching) were also captured.

In line with Consolidated Standards of Reporting Trials (CONSORT) protocol, all schools completed baseline assessment prior to receiving their randomly determined group allocation. Randomisation, data handling and analysis were subjected to independent oversight by RAND Corporation to ensure the study was undertaken and reported in line with CONSORT protocols. Analysis by the University shows the sample was balanced at the school level at randomisation.

A paper describing the results of the RCT has been submitted to *Teaching and Teacher Education* and is currently under peer review. Analysis by the University, which has been independently quality assured by the RAND Corporation, is used as the basis for the benefits described in this report. The costs detailed in this report are drawn from the University's records and a survey of schools in QTR trial arms, which was designed and analysed by Deloitte Access Economics.

1.4 Report structure

The remainder of this report is structured as follows:

- Chapter 2 provides a school-level view on the benefits and costs of QTR, with a focus on describing the extent of staff engagement required, and the relative cost-effectiveness of the intervention.
- Chapter 3 delivers a system-level view of the net benefit of QTR, focussing on both its economic value and broader non-monetary benefits, taking NSW as a case study, while presenting the results on a per student basis.

2 School level results

This section of the report presents the benefits and costs of QTR from the school perspective.

Benefits consist of the improvement in teaching quality and teacher morale, as well as the increased academic achievement experienced by students (in mathematics). Costs are those schools report as incurred to run QTR, both on a cash and staff-time basis. Both benefits and costs are estimated on the basis of the group of schools that took part in the randomised controlled trial described in Section 1.3.

The relative cost-effectiveness of QTR is benchmarked against other interventions, where data are available, to give some perspective on the relative return on investment of this intervention. Few PD interventions worldwide (and no others in Australia) have undergone both an experimental evaluation and independent costing exercise, so relevant comparisons are limited. Care should be taken in assessing QTR costs and benefits reported to those cited by other interventions where the rigour of analysis is not disclosed.

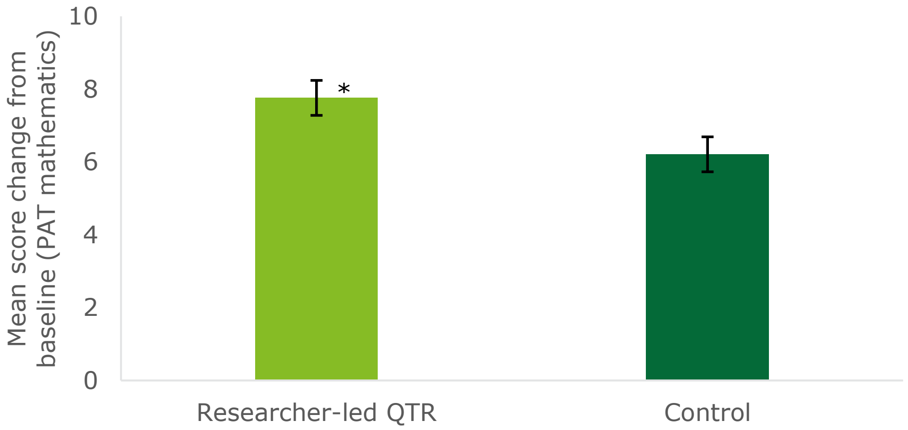
2.1 Benefits to students and teachers

The recent RCT of QTR provides evidence of a positive impact on student academic achievement (see Section 1.3 for further detail on the study design).

This analysis explored whether student achievement in reading, mathematics and science improved when teachers participated in QTR (exposing their students to QT informed practice over an eight-month period). Student achievement was measured using the Australian Council for Educational Research's Progressive Achievement Tests (PATs), which are commonly used in education research and schools for student evaluation. PATs were administered at both the start (Term 1) and end (Term 4) of the school year.

This analysis shows that students taught by teachers in the researcher-led QTR arm saw an improvement in PAT maths scores equivalent to an additional two months of learning relative to those in the control group over the course of the eight-month intervention period. In standard deviation terms, the difference between the two groups represents an effect of 0.117.[4] Chart 2.1 shows the mean PAT score change.

Chart 2.1: Mean score change from baseline in PAT mathematics tests, researcher-led QTR and control.



Note: Black lines indicate 95% confidence intervals. * denotes statistical significance at the 0.001 level.

Source: University of Newcastle (2020).

[4] This is reported in terms of Hedge's g. Detail on how the effect size and months of learning measures are calculated can be found in the study's trial protocol (Miller et al, 2019).

No statistically significant changes were detected in the mathematics domain for trainer-led QTR schools compared to control schools.[5] No statistically significant differences in science and reading progress were found in both researcher- and trainer-led QTR schools compared to control schools.[6]

Secondary outcomes measured in the RCT suggest that an improvement in teaching quality may sit behind the increase in mathematics progress. Analysis of lessons using the Quality Teaching model (which codes lesson quality using 18 elements each judged on a 1-5 scale) shows that teachers in the researcher-led QTR arm improved their lesson codes by an average of 0.24 scale points over the course of the trial (0.46 standard deviations). QT coding was performed by researchers who were blind to the trial arm of the teachers they assessed.

Additionally, QTR's benefits to teachers were captured in this study. While there was no statistically significant difference from the control group in terms of perceived efficacy or engagement, teacher morale did improve over the course of the trial in the researcher-led QTR group.

2.2 Cost of delivery

There are two main costs to running QTR in a school. First, the cost of staff members attending the initial two-day workshop (workshop fees, transport and accommodation costs, and casual teachers to cover time release). Second, QTR requires further time release of teaching staff (which can incur casual teacher costs) for Rounds to be conducted. There are no ongoing program fees.

The experimental conditions under which schools in the RCT implemented QTR mean the costs they incurred must be contextualised to provide a clear picture of the financial and staff time commitment this program involves.

QTR schools in the RCT attended the initial training workshop free of charge and were given $10,000 to cover the estimated cost of hiring casual teachers to enable teacher release for both the workshop (release for two teachers) and for four Rounds (release for four teachers per Round). In the RCT, two teachers per school were advised to attend the initial workshop and then form a four-person PLC with another two colleagues who did not attend the workshop.

The sections below describe the costs schools incurred using data collected by a survey of schools in the QTR arms of the RCT (see Appendix C for detail on the school survey). 62% of QTR trial arm schools responded. The survey was primarily administered to test if schools incurred costs as expected by the University and to check if there were any substantial additional costs that were not anticipated.

2.2.1 Initial costs

The initial cost of QTR comes in the form of the two-day training workshop. Schools in the RCT were not charged a fee to attend this, though it would normally cost $750 per attending teacher.

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[5] The absence of increased mathematics learning progress among the trainer-led QTR taught students indicates that further development of the train-the-trainer model is required. Though the trainers did receive significant preparation before delivering QTR workshops, they had not delivered a workshop to teachers prior to those delivered in this trial. An assessment of intervention fidelity (as measured by research assistants attending Rounds and coding them relative to a set fidelity criteria checklist) showed that teachers who had received training from QTR trainers averaged 55% fidelity in their execution of Rounds. Teachers who received researcher-led QTR training averaged 81% fidelity. This fidelity gap may explain the difference in mathematics outcomes between groups. Further development of the trainer-led QTR model will be undertaken by the University in advance of the 2021 extension to this study.

[6] This may be explained by teachers spending significantly less time on reading and science instruction relative to mathematics in RCT schools. A self-report survey of schools conducted by the University during the RCT showed that the mean number of hours spent on reading instruction was 35% to 40% (depending on trial arm) of that spend on numeracy. Science received even less instruction time, at 15% to 25% of the hours spend on numeracy.

Nine-in-ten schools in the RCT employed casual teachers to enable release for staff. Of these schools, the majority employed a casual teacher for two days per staff member attending.[7] The cost of casual staff was, on average, in line with the four days of release funding provided, which assumed a daily casual staff cost of $500.[8]

Half of all schools in the RCT did not incur any travel or accommodation expenses in attending the training workshop, with the remainder incurring a wide range of costs between $3 and $2,500 per attending staff member. Schools outside metropolitan areas tended to record higher accommodation and travel costs. Across all schools (including those that did not incur any cost), the average amount spent was $325 per attending staff member.

Approximately one-in-five schools in the RCT noted they incurred other additional costs in attending the training workshop, chiefly for printing, which ranged between $2 and $25 per attending staff member. Across all schools (including those without any additional costs), the average amount spent on non-travel costs was immaterial ($2 per attending staff member).[9]

In addition to the financial costs incurred by schools, staff time was also drawn upon to prepare for the training at both the teacher and senior leadership team level. On average, teachers attending the initial workshop spent three hours on associated preparation and administrative tasks. Approximately one in four teachers did not report undertaking any preparation or administrative tasks in relation to the training. Eleven hours was the highest reported amount of preparation and administrative work by a teacher.

2.2.2 Ongoing costs

The primary ongoing cost of QTR is the cost of casual staff to cover release time during Rounds. Almost one-in-six schools in the RCT reported not incurring any costs in relation to staff cover, suggesting they may have sourced cover internally. The modal average was 16 days of casual teacher time, which aligns with the $8,000 provided by the University to enable one PLC of four teachers to run four Rounds over the course of the RCT.[10]

Less than one in five schools in the RCT incurred any other ongoing costs, with those that did reporting these were immaterial and chiefly related to printing and stationery.[11]

An average of eight days per teacher was reported for time staff spent engaging in QTR over the course of the trial. This was reported to consist of:

- Time spent undertaking Rounds and preparing for them (creating a schedule for the day, selecting a reading etc.)
- Reading in preparation for the Rounds
- Incidental conversations related to QTR in the days before and following Rounds
- Training teachers who did not attend the initial QTR training workshop.

Principals and deputy / assistant principals reported some support for teaching staff involved in QTR was necessary, chiefly consisting of helping to arrange casual teachers on days Rounds occurred, making any necessary timetable adjustments to facilitate Rounds, and providing general support and encouragement to teaching staff.

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[7] A small number of schools using casual teachers employed them for less than two days per attending staff member, which suggests that some of the staff attending did not require cover, either as they did not have a teaching role, or because the school had capacity to cover their absence internally.
[8] The modal casual rate was $500 per day, with a range spanning $400 to $599.
[9] These figures exclude one outlier school which incurred $125 per attending staff member due to printing, extended leave costs, and other resources.
[10] Over one-third of schools reported using 16 days of casual staff time. A very small number of schools (12% of the sample) used more than 16 days of casual teacher time to release staff, and just under a third reported using less than 16 days. However, the survey did not clearly capture how many PLCs and teachers this casual release time supported, so an average (across all levels of casual teacher usage) cannot be provided.
[11] One school (the same school noted in footnote 10) did incur significantly higher costs, but no explanation was provided of what these were in relation to. Another school incurred a cost of $400 in catering across all their staff, but as this is quite discretionary it is excluded from analysis.

2.2.3 Overall costs for a representative school

Table 2.1 summarises the costs of participating in QTR under the conditions of the RCT, for a representative school. Costs are produced on the basis of:

- **Per classroom / teacher** – this is arrived at by examining the reported cost of QTR for a PLC of four teachers, two of whom would have attended the initial training. As such, the costs incurred in relation to the initial training are spread across four teachers (even though only two attend the training). The casual teacher costs are based on using 4 days to cover the initial training, and 16 days to enable release for the Rounds themselves, as funded by the University and observed as the modal average in the survey. The $10,000 total cost is spread across four teachers.
- **Per student** – this is arrived at by dividing the per classroom cost by 24, which was the average number of students per class in the RCT.

Table 2.1: Overall cost of QTR participation, representative school

	Cost per classroom / teacher ($)	Cost per student ($)
Workshop fees	375	16
Accommodation and transport to workshop *(inc. meals and parking)*	163	7
Casual teacher costs	2,500	104
Total cost	**3,038**	**127**

Note: this excludes printing and other resource costs, but the school survey suggests these were largely immaterial at $2 per teacher.

Source: Survey conducted by Deloitte Access Economics (2020).

Note that as teachers can use the QTR training received in future years to benefit other students, the long-term per class and per student cost will be substantially lower.

It is also important to note that the costs described in this section are for an ideal and comprehensive version of QTR in a primary school context as per the RCT's requirements. In a non-experimental setting, schools have more freedom to implement a less intensive version of QTR that requires less staff time and/or teacher cover, though it is unclear whether the same improvement in student progress in mathematics could be expected under such an approach.

As secondary school teachers engage with larger numbers of students, the cost per student is likely to be different.

2.3 Contextualising the results

Contextualising the relative cost-effectiveness of an education intervention is useful as it allows schools and others to assess interventions against one another on a value-for-money basis.

However, one limitation of this approach is that few studies exist in Australia which capture an intervention's impact on student achievement in a rigorous manner. The cost of the program or intervention may also not be reported and, if it is, likely not independently calculated to ensure the full cost (including casual teacher cost) is captured. Comparisons to PD programs that have not been robustly evaluated in the same way should be made cautiously.

The best available basis for comparison comes from several Evidence for Learning (E4L) funded evaluations of school interventions in Australian schools. Table 2.2 summarises the interventions evaluated, alongside their impact (months of progress) and cost per student.

Table 2.2: Cost-effectiveness comparison of QTR relative to E4L funded studies.

Intervention	Detail	Outcome and effect size	Cost per student ($)
Quality Teaching Rounds	A pedagogically focused form of professional development applicable to teaching in all subjects across years K - 12.	2 months progress for primary students (mathematics).	$127
Thinking Maths	A professional learning program aimed at building teachers' capabilities to make maths learning deeper and more engaging.	2 months progress for primary students (mathematics).	$154
QuickSmart Numeracy	A small-group tuition intervention to increase automaticity in maths and reduce cognitive load.	1 month progress for primary students (mathematics)*.	$1,007

Note: * not statistically significant at conventional levels.
Source: Evidence for Learning (2020a), Deloitte Access Economics (2020).

QTR compares similarly or favourably to the few other rigorously tested interventions in Australia on a cost-effectiveness basis, both relative to other interventions and E4L benchmarks. At $127 per student, the cost of QTR is classified as very low under E4L (2020b) guidance.

3 System view

This section of the report presents a cost benefit analysis (CBA) of QTR in order to assess its economic value, for comparison to alternative investments, at a system/jurisdictional level. Both benefits and costs are estimated based on the group of schools that took part in the randomised controlled trial described in Section 1.3.

3.1 Cost benefit framework

CBAs are often undertaken to support government and commercial investment decisions. The rationale for using a CBA as a decision-making tool is that public and private funds are not unlimited and need to be directed towards their highest and best use.

A CBA compares the total costs of a policy, program and/or investment with the total benefits, in a discounted cashflow framework. 'Discounting' both benefits and costs to a common 'present value' is necessary given they are incurred over different time horizons. The discounting applied reflects the time value of money and uncertainty of future cashflows.

The headline results of the CBA take the form of a net benefit (benefits minus costs) and a ratio of benefits to costs, both expressed in present value terms. A positive net benefit indicates that the discounted benefits of a program or policy are greater than the discounted costs. This would suggest value in further supporting and investing in such a policy. Similarly, a ratio of benefits to costs of greater than one indicates that the discounted benefits stemming from a policy are greater than the discounted costs required to generate those benefits.

Defining an alternative scenario and base case is a critical component of a CBA. Defining the two scenarios allow the costs and benefits arising in the alternative scenario to be measured against the base case. This ensures that only benefits and costs which can be reasonably attributed to the policy or program are included in the analysis.

In this CBA, the base and alternative case specifications are drawn from the RCT described in Section 1.3. The PD-as-usual wait-list control arm forms the base case. The researcher-led QTR arm forms the alternative case. All benefits and costs referred to in this study are drawn from a comparison between schools in these two trial arms.

Results are presented on a per student basis. Presenting results on this basis is appropriate given the study aims to inform decisions to invest in QTR, where the number of students who might be involved may vary.

Due to difficulties in reliably and consistently monetising benefits, not all benefits are included in the headline results. In many cases, significant, non-monetised benefits are relevant and must be considered in decision-making. This report reviews evidence for these benefits to provide a more holistic account.

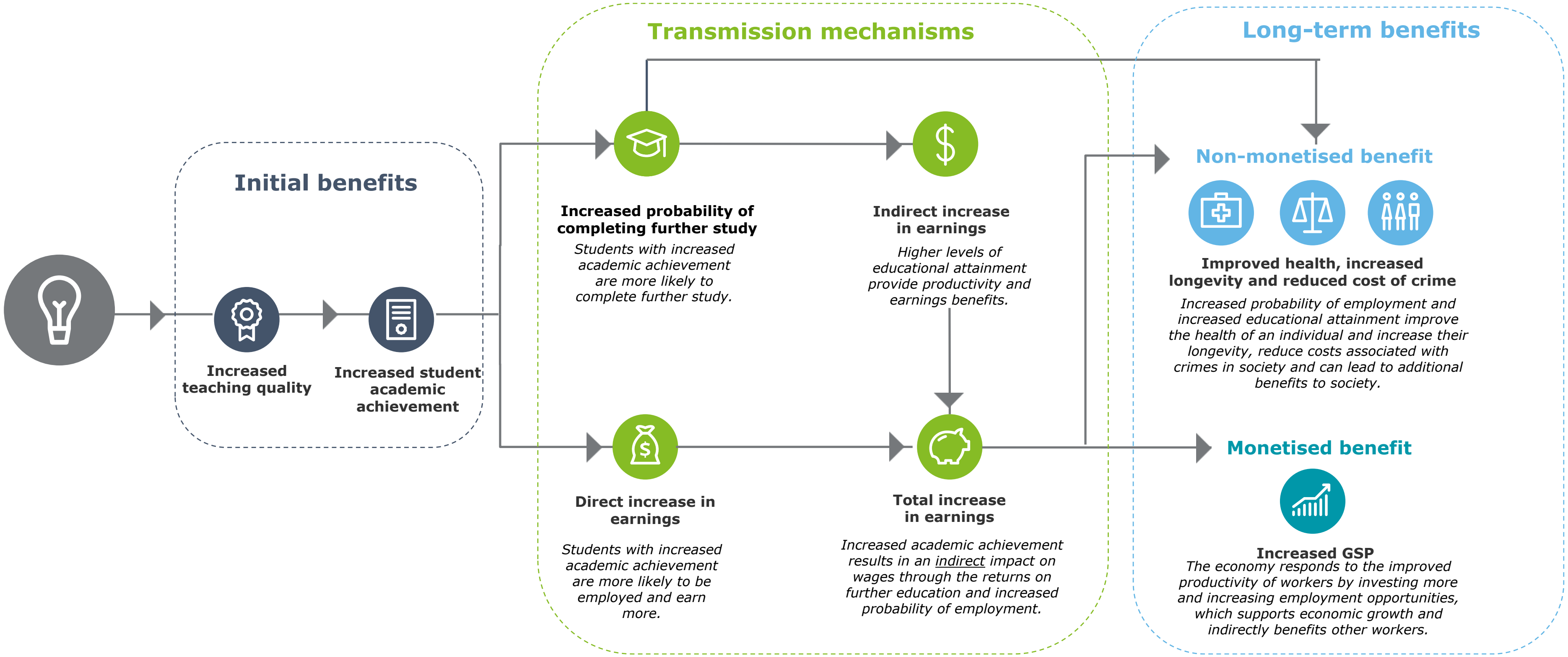
QTR may also reduce teacher turnover and absenteeism as a result of the increase in morale noted in Section 2.1. However, as an empirical link between these measures has not been established, no quantification of these potential benefits can take place.

3.2 Estimating benefits

By increasing teaching quality, QTR causes an initial benefit in the form of improved student academic achievement. This in turn can be associated with a long-term benefit to productivity when these students enter the workforce, raising gross state product (GSP). This *monetised* benefit is captured in the headline results of this CBA. There are also *non-monetised* benefits arising from an increase in student achievement which cannot be consistently estimated.

The mechanisms through which these benefits eventuate are depicted in Figure 3.1. Each is described in further detail in the following sections.

Figure 3.1: Flow from QTR intervention to monetised and non-monetised benefits



Source: Deloitte Access Economics.

3.2.2 Monetised long-term benefits

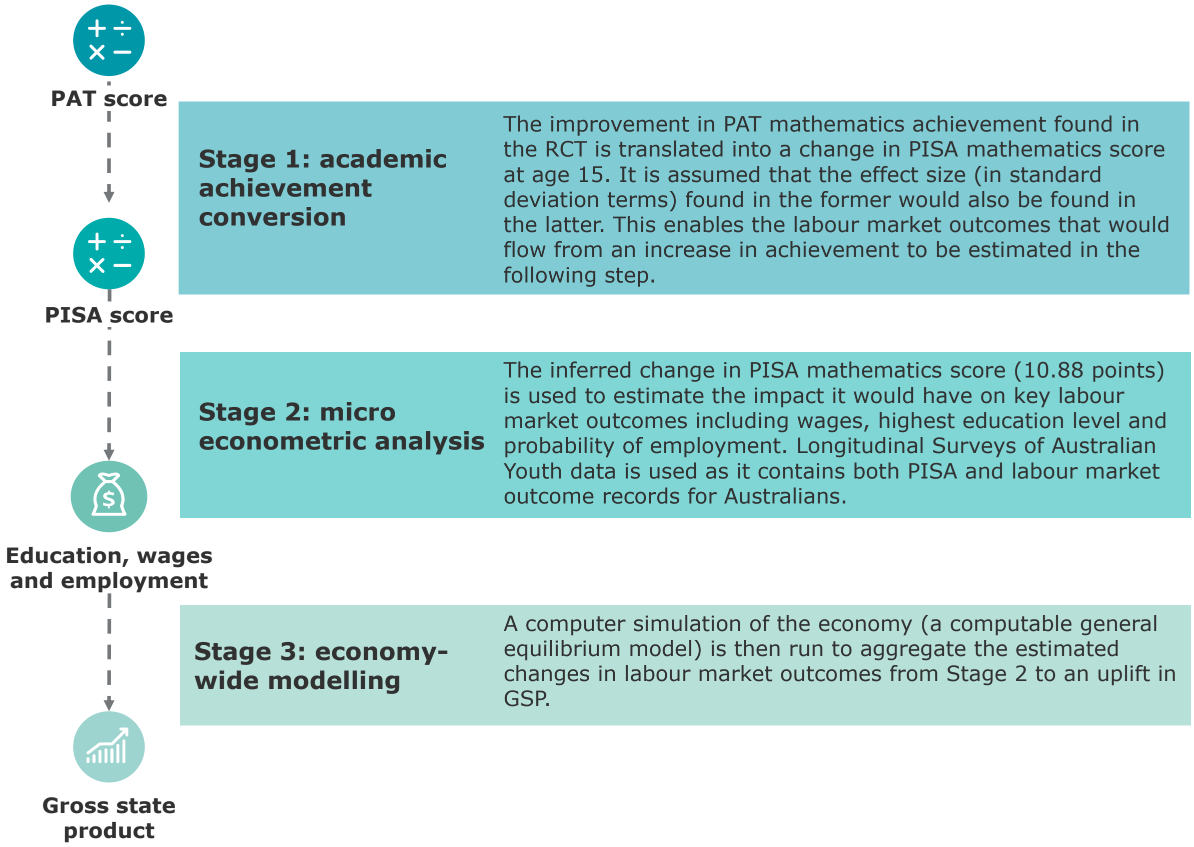
The headline benefit detailed in this CBA is the uplift in GSP resulting from an increase in student academic achievement.

While estimates in research literature provide a guide to the relationship between student academic achievement and labour market outcomes (e.g. wages and probability of employment), adopting an empirical approach enables more precise estimation. This CBA takes advantage of data from the Longitudinal Surveys of Australian Youth (LSAY) which capture both student academic achievement and labour market outcomes (specifically, wages, educational attainment and probability of employment).[12]

This enables more precise estimation of the impact of improved academic achievement on labour market outcomes, which in turn is fed into the Deloitte Access Economics Regional General Equilibrium Model (DAE-RGEM), a model simulation of the Australian economy that is used to predict responses to policy changes. The DAE-RGEM aggregates the estimated improvements in labour market outcomes to calculate the resulting uplift in GSP.

As shown in Figure 3.2, there are three stages in estimating this uplift: 1) converting PAT scores to PISA scores, 2) measuring the impact of an increase in academic achievement on key transition mechanisms and 3) aggregating these impacts into an uplift in GSP.

Figure 3.2: Steps in calculating GSP uplift from RCT results



Source: Deloitte Access Economics.

[12] LSAY uses large, nationally representative samples of students at school to collect information about education and training, work, financial matters, health, social activities and related issues. In this analysis the 2003, 2006 and 2009 cohorts have been used.

Stage 1

In this stage, the impact of QTR on student mathematics achievement in Years 3 and 4 is converted to an impact on achievement in the OECD's Programme for International Student Assessment (PISA) mathematics test.[13]

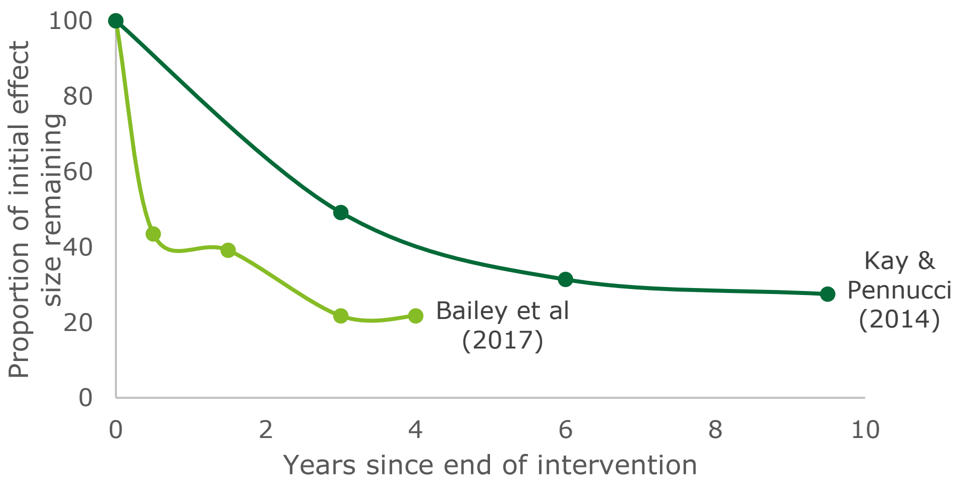
PISA mathematics scores are used because prior research indicates that mathematics proficiency has a stronger relationship to future outcomes than scores in other subjects (Deloitte Access Economics, 2016). This conversion is required in order to describe how an improvement in achievement can influence labour market outcomes which, for the actual sample of primary-age students in the QTR RCT, will not be observed for many years. As LSAY includes both PISA test scores and labour market outcomes, the impact of improving the former on the latter can be estimated using Australian specific and contemporary data.

Ideally, the change in PAT mathematics performance in Years 3 and 4 would be converted to a change in PISA scores by an empirical process or using the outputs of prior research. Unfortunately, there is no published reporting or data that enables this to occur.[14] Instead, this report assumes the mathematics effect size found in the RCT (0.117 standard deviations) will carry through to PISA mathematics performance (see Section 2.1 for further detail). Converting the effect size on this basis would see PISA mathematics scores rise by 10.88 points.[15]

However, this conversion approach may overstate the long-run impact of receiving eight months of tuition from a QTR trained teacher. There is now considerable evidence that the positive impact of education interventions in the early and primary years fades over time, though the reasons for this are still debated.[16]

Chart 3.1 summarises the results of two meta-analyses which looked at fadeout in early childhood education interventions. Each point represents the average percentage reduction in the effect size found at the end of the intervention, for a given number of years following the end of the intervention.

Chart 3.1: Residual effect size of early childhood education interventions over time



Source: Bailey et al (2017); Kay & Pennucci (2014).

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13 PISA assessments test students' skills and learning progress in reading, mathematical and scientific literacy at age 15 (including students from years 9, 10 and 11).

14 As the 2015 LSAY cohort captures both NAPLAN and PISA test performance, converting PAT performance to NAPLAN as an intermediary step was also considered. However, again no data or research is available to facilitate this conversion.

15 Converting the effect size across the distributions applies the effect size to the standard deviation for PISA mathematics scores. This is estimated to be 93 points across the participating OECD countries for PISA 2015 mathematics scores (Thomson et al, 2017).

16 See Bailey et al (2017) for a summary of research literature on fadeout in education interventions.

With an interval of approximately 6.5 years between the age children in the RCT sat post-intervention PATs and would sit PISA tests, the literature summarised in Chart 3.1 suggests that the effect size may decline over this period by 70% to 80%.[17] Taking the midpoint, a fadeout rate of 75% is applied, corresponding to an improvement in PISA mathematics of 2.72 points.[18]

The remainder of this chapter presents results using both the unadjusted and the fadeout adjusted change in PISA mathematics score.

Stage 2

The second stage directly measures the impact of improved student academic achievement on labour market outcomes using LSAY data. An improvement in academic achievement is estimated to cause the following changes:

- A direct improvement in wages due to higher productivity
- An increased probability of being employed (increasing labour supply)
- An increased likelihood of completing both secondary school and further study, which enhances both wages (productivity) and probability of being employed (labour supply).

Econometric analysis of the LSAY data shows that the relationship between mathematics achievement and the above outcomes is positive. Table 3.1 shows the degree to which the PISA mathematics achievement improvement (with no fadeout assumption) calculated in Stage 1 impacts on these labour market outcomes. It is found that:

- The improvement in PISA mathematics score is correlated with a shift to higher levels of educational attainment, with Bachelor degree level qualifications replacing those at the Certificate III/IV level in particular.
- Both the probability of employment, and the wage earned when employed, increase.

Table 3.1: Impact of a 10.88 point improvement in PISA mathematics score on labour market outcomes.

Change in likelihood of highest educational attainment (% point change)	
High school or Certificate I/II	-0.13
Certificate III/IV	-0.61
Diploma or advanced diploma	-0.17
Bachelor degree	1.17
Postgraduate degree	0.13
Change in wages (% point change)	
Hourly wage	0.23
Change in employment outcomes (% point change)	
Employment probability	0.17

Source: Longitudinal Surveys of Australian Youth 2003, 2006, 2009; Deloitte Access Economics.

[17] Though children receiving the QTR intervention in the RCT this study draws on are several years older than those who received the interventions in Chart 3.1, the presence of the fadeout effect through primary school years suggests that it would also apply to interventions administered in the primary years.
[18] An alternative approach to handling fadeout is to assume that the effect size seen in the RCT can be maintained in PISA by continuing the intervention throughout the rest of school (incurring the cost of doing so in each year). Sensitivity analysis in Section 3.4.1 presents results under this assumption.

While these changes cannot be interpreted as strictly causal, the richness of LSAY data enable most other influencing factors to be controlled for, reducing the bias of resulting estimates.[19]

Analysis of LSAY data also shows that when a fadeout assumption of 75% is applied to the PISA score change, the improvement in labour market outcomes reduces proportionally.

Further information on the analytical method of this stage is contained in Appendix A.

Stage 3

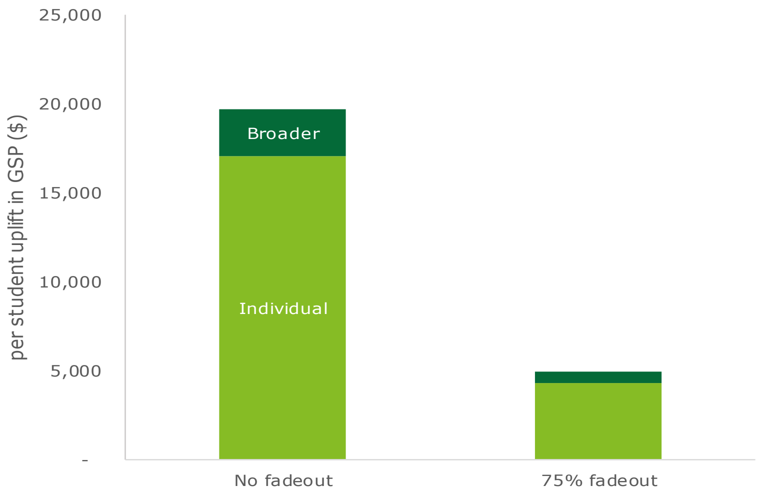
When labour productivity and labour supply increase, industry responds by increasing the number of people employed and investment in capital. This leads to growth in the economy, as measured by an uplift in GSP.

The DAE-RGEM is used to estimate this uplift using the results from Stage 2 as inputs. The application of this productivity shock in the DAE-RGEM allows for the estimation of economy-wide effects on capital investment, employment and economic growth over an extended time horizon (see the accompanying box for further detail on the DAE-RGEM). In this case, the shock takes effect for 45 years as those who benefit from QTR progress through the workforce.[20]

Results from the DAE-RGEM are displayed in Chart 3.2. This shows the present value of the per student lifetime GSP uplift (discounted at a rate of 3.5%) resulting from the improvements in labour market outcomes calculated in Stage 2. The GSP uplift is comprised of a direct benefit to the individual (higher lifetime wages) and broader benefits to society in the form of increased taxation revenue for the federal government, increased returns to other factors of production (e.g. capital) and improvements to the wages of other workers (who have not benefited from QTR) due to productivity spill overs.[21] Of the total GSP uplift, 87% is estimated to accrue to the individual while the remainder accrues as a broader benefit. It is found that:

- Where no fadeout is assumed, the per student lifetime GSP uplift is estimated to be $19,690, where $17,075 accrues to the individual and $2,615 accrues as a broader benefit to society.
- With a 75% fadeout rate assumed, the per student lifetime GSP uplift is estimated to be $4,920, with $4,270 accruing to the individual and $655 to broader society.

Chart 3.2: Lifetime GSP uplift per student (present value, discounted at 3.5%), accruing to the individual and broader society.



Source: Deloitte Access Economics.

[19] Additionally, estimates may partially reflect the positional benefit of being academically ahead of one's peers.
[20] Due to the increased probability of additional education, it is assumed that on average QTR-treated students enter the workforce aged 20 years. The retirement age is assumed to be 65 years of age.
[21] The economy responds to increased productivity resulting from increased student academic achievement by increasing investment and employment. This supports economic growth and indirectly impacts other workers.

CGE modelling: an introduction

The DAE-RGEM is a large scale, dynamic, multi-region, multi-commodity computable general equilibrium (CGE) model of the world economy with bottom-up modelling of Australian regions. The model allows policy analysis in a single, robust, integrated economic framework. It projects changes in macroeconomic aggregates such as GSP, employment, export volumes, investment and private consumption. At the sectoral level, detailed results such as output, exports, imports and employment are also produced.

The DAE-RGEM is used here to model the impact of increased academic achievement on the NSW economy. This section provides a brief introduction to CGE modelling and an overview of the assumptions taken when using this model.

The CGE model framework is best suited to modelling the impact of policies on the national economy and the regions within. The framework accounts for resourcing constraints and opportunity costs, and is used to model changes in prices and the behaviour of economic agents in response to changes in economic and policy conditions. That is, a key feature of CGE models is that they link the supply and demand in each sector to other sectors in the economy, such that a shock to one sector flows through to all other sectors.

Further, goods in each sector are produced by factors of production (such as labour and capital). An increase in the quantity or quality (i.e. productivity) of these factors increases the productive potential of the economy, with different effects on different sectors depending on their relative reliance on each factor.

CGE models compare a baseline scenario where a proposed program or policy *does not* occur with an alternative scenario where it *does.* In this case, the program is QTR, which generates an increase in student achievement and in turn labour market outcomes. Households in DAE-RGEM provide labour in return for wages. The actual wage rate they receive reflects the marginal product of labour (that is, the incremental value a unit of labour increases production by).

A policy or project may affect the economy through both changes in labour supply and changes in the productivity of workers in the workforce. Ultimately, the final economic impact results from both the increase in hours worked and the increase in output per hour worked. The DAE-RGEM captures the increased level of labour supply, in comparison to the baseline, as a result of the policy input into the model.

In the baseline, the productivity of labour is projected to grow over time and, in conjunction with improved productivity in the use of other factors like capital, drive forecast growth in the economy. Against this baseline growth it is possible to simulate the economy-wide impact of additional growth in labour productivity, with this productivity increase parameterised by the econometrically estimated increase in wages, employment probability and educational attainment.

The details of this modelling are discussed further in Appendix B.

The use of GSP in a cost-benefit analysis of this nature is not without its limitations. GSP is a measure of economic output. However, it is not strictly a measure of net economic benefit, since it does not explicitly account for the cost of economic production (that is, the resource costs associated with production). It is very reasonable to use GSP in the way it has been in the analysis presented in this report. However, under some circumstances, additional measures would be required to fully account for resource costs.

At the same time, there are circumstances under which the revenue utilised to fund the program would have additional costs associated with it. The most common instance of this would be if the program was funded by government, in which case the additional cost associated with raising taxation revenue – or the opportunity cost of other foregone expenditure – would need to be accounted for.

3.2.3 Non-monetised long-term benefits

In addition to the long-term monetised benefits, improving academic achievement is also associated with the production of broader improvements to welfare.[22]

Existing literature tends to assess the effect of completing qualifications (e.g. high school) on broader welfare rather than estimating the impact of improving student academic achievement (as measured by performance in standardised assessments). However, as described in Section 3.2.2, an improvement in mathematics achievement of the scale caused by QTR increases the likelihood of completing more advanced levels of education. As such, prior literature concerning the benefits to completing university, vocational and high school level qualifications is of relevance.

Lamb and Huo (2017) quantify the costs associated with those not completing high school in terms of welfare payments, costs of crime, and health outcomes. They find the lifetime fiscal cost to Australian taxpayers and the government per early school leaver is $334,600. Additionally, there is a social cost of $616,200 per early school leaver in the form of increased crime and use of social services.

Further welfare improvements to higher educational attainment are summarised below.

Personal health

- OECD (2014) found that 90% of Australian adults with tertiary education reported they were in good health, compared to 84% of those with upper- or post-secondary non-tertiary education, and 76% of those without upper secondary education. While this correlation does not control for income effects and may raise questions of causality (e.g. more economically well-off, healthier individuals receive higher levels of education), analysis suggests that improvements in health follow education and that this holds true even when effects, such as income or parents' education, are controlled for (McMahon, 2009).
- Fletcher and Frisvold (2009) found that attending college is associated with an increase in the likelihood of accessing preventive care after controlling for health insurance, income, assets, sex and gender.
- An analysis of Australian data has found that university graduates have an average Body Mass Index 0.5 points lower than non-graduates (Savage and Norton, 2012).
- It is also estimated that those with university education live five to seven years longer in Western economies (Grossman, 2006).
- In value terms, McMahon (2009) estimates the additional longevity arising from a university education to be worth USD $484 per year of higher education in 2007.

Personal wellbeing

- Di Tella et al. (2003) found that a university education contributes directly to happiness even when secondary effects such as health and income are controlled for.
- Australian university graduates were found to have better workplace relationships, feel more connected to their local community, and have higher acceptance of other religions and races than non-graduates. These relationships can have a positive effect on overall happiness, as well as benefit society via increased social cohesion and connectivity (Savage and Norton, 2012).
- However, given links between the factors that influence happiness, some studies have found there to be no direct contribution aside from the secondary effects (Helliwell, 2003).
- Stanwick et al (2006) found several social benefits from VET educational attainment including psychological wellbeing, increased confidence, self-esteem, feelings of control and socialisation.

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[22] Studies attempting to establish a link between education and broader welfare benefits suffer from issues relating to reverse causality (that is, where higher levels of health cause greater levels of educational attainment) and omitted variable bias (that is, where some third unobserved factor—such as income or cultural background—simultaneously drives higher levels of education and health outcomes). Additionally—specifically with respect to health benefits—there is mixed evidence as to this link between education and welfare improvements. With these considerations in mind, the benefits in this section have not been included in the CBA calculations.

Personal finance

- Studies have also found that university graduates are able to more efficiently manage financial assets compared with those who did not complete higher education, even after controlling for income levels. The total savings from the efficient choices made by university graduates have been estimated equivalent to $856 USD in 2007 per year of college (McMahon, 2009).

Civic participation and crime rates

- US research indicates that educational attainment has large and statistically significant effects on subsequent voter participation and support for free speech, and that additional schooling appears to increase the quality of civic knowledge as measured by the frequency of newspaper readership (Dee, 2004).
- The Australian Institute of Health and Welfare (2010) found that Australian prison entrants aged between 25 and 44 years had lower levels of educational attainment than the general population of this age bracket. Prison entrants aged 25 to 34 had a Year 12 completion rate of 14% (compared to 63% for the general population), while about 36% to 37% of prison entrants in this age group completed schooling to Year 9 or less (4% to 8% of wider population).

3.3 Monetised costs

QTR requires the training of teachers as well as their participation in a set of Rounds. The start-up cost to participate is a two-day workshop which incurs administration, facilitator and venue costs, as well as a cost to cover the teaching duties of those attending (teacher supply cover). Ongoing costs also occur as a result of teachers being released to participate in Rounds.

Table 3.2 provides a breakdown of these costs. All data has been obtained from the University of Newcastle and is based on the implementation of QTR under the conditions of the researcher-led trial arm in the RCT. Costs may vary between schools, and further information on cost variation is discussed in Section 2.2.

Note that costs presented in Table 3.2 differ from those in Section 2.2. This is due to the costs in this section reflecting the resources made available to schools in this experimental trial, which are purely a product of the cost to the University in running the QTR workshops and the $10,000 provided to each school to facilitate time release of staff. In contrast, the cost calculation in Section 2.2 is based on the actual costs incurred by the sample of schools in the trial, and it puts this amount in per student terms by assuming there are 24 students per class.

Table 3.2: Breakdown of QTR costs

	Cost ($)
Start-up: cost of setting up QTR in schools (initial training)	
QTR workshop delivery Including: Facilitator cost (31%), venue hire and catering (40%), travel costs (7%) and administration costs (22%)	18,175
QTR workshop administration This captures the cost of University staff time in arranging the workshop.	2,655
Teacher supply cover Calculated based on the amount schools were funded for (rather than spent).	64,000
Ongoing costs: cost of running QTR in schools after initial training	
Teacher supply cover Calculated based on the amount schools were funded for (rather than spent).	256,000
Overall cost	340,830
Per student cost*	130

Note: *A total of 2,626 students were in the researcher-led QTR trial arm, which is used to calculate the per student cost.
Source: University of Newcastle data request, Deloitte Access Economics.

It should be noted that these costs are the average cost of QTR run with full fidelity. Subsequently the average cost presented here is likely to be higher than the average cost incurred by schools under non-experimental conditions.

3.4 Cost benefit analysis results

Table 3.3 summarises the results from the previous sections in this report on a per student basis. Additionally, it presents the net return (calculated as the difference between the present value of the lifetime GSP uplift and program costs), and the ratio of the present value of lifetime GSP uplift per dollar of direct program cost.

As shown, for each dollar spent on QTR, the lifetime GSP uplift per head is equal to $150 (no fadeout) or $40 (75% fadeout).

Table 3.3: Headline per student results, discounted at 3.5%

	No fadeout ($ per student)	**75% fadeout ($ per student)**
Lifetime GSP uplift	19,685	4,920
Lifetime wage uplift	17,075	4,270
Direct program costs	130	130
Lifetime GSP uplift per $ of QTR cost	150	40
GSP uplift less direct program costs	19,560	4,790

Source: University of Newcastle data request, Deloitte Access Economics.

When interpreting these results, it should be emphasised that only direct program costs, as reported by the University, have been included in the analysis. Other costs not captured here include the opportunity cost of resources associated with the flow-on economic activity generated through increased labour productivity. In this regard, the lifetime wage uplift per student (which excludes the flow-on impacts to economic activity) is included above as an alternative measure of economic benefits from the program.

More generally, the results should be viewed cautiously, and as a guide, as they do not include benefits that cannot be monetised (as detailed in Section 3.2.3) and are sensitive to underlying assumptions including discount rates and fadeout rate. Section 3.4.1 tests the results presented above to changes in key assumptions.

3.4.1 Sensitivity Analysis

In calculating the results presented above, several underlying assumptions are used to form the central case. This section tests the sensitivity of the results to changes in these assumptions.

The first sensitivity tested is the method used to calculate the benefit. In Section 3.2, GSP uplift is estimated using econometric modelling drawing on both LSAY data (to calculate the impact on labour market outcomes arising from improved mathematics achievement) and the DAE-RGEM (to estimate the impact on GSP the change in labour market outcomes causes).

An alternative method to calculate a monetised benefit is an approach previously used in Hanushek et al. (2014), which found that a one standard deviation increase in student academic achievement leads to a 14% increase in lifetime earnings. This implies that the 0.117 standard deviation increase in mathematics achievement found in the RCT would lead to an increase in lifetime earnings of 1.6%. This is slightly larger than the combined lifetime earnings benefits generated from the econometric analysis of LSAY data presented here – however, it utilises data from another 22 countries and so is less applicable to the Australian context. Further, it does not incorporate broader spill over returns to the economy from improved human capital through higher levels of educational achievement, which is subsequently captured in the DAE-RGEM model utilised in this study.

Another assumption that influences the present value calculation of costs and benefits is the discount rate. In earlier sections a real discount rate of 3.5% is used. A rate of 7% is often used, but a lower rate is justified for education projects as they are more social than financial investments.[23] As the choice of discount rate can have a considerable impact on the net return, sensitivity analysis based on 7% and 1.5% discount rates is also reported. Table 3.4 presents the results with a higher (7%) and lower (1.5%) discount rate. As shown in the Table 3.4, the lifetime GSP uplift per dollar spent on QTR is positive and relatively high regardless of the discount rate, ranging from $15 to $70 per student (based upon a 75% fadeout rate).

Table 3.4: Results under different discount rates (75% fadeout rate)

	$ per student, discounted at 1.5%	**$ per student, discounted at 3.5%**	**$ per student, discounted at 7%**
Lifetime GSP uplift	8,865	4,920	2,010
Direct program costs	130	130	130
Lifetime GSP uplift per $ of QTR cost	70	40	15
GSP uplift less direct program costs	8,740	4,790	1,880

Source: University of Newcastle data request, Deloitte Access Economics.

Throughout this report results have been reported assuming either no fadeout in the initial academic achievement improvement or a 75% fadeout. Another approach is to assume that the increase in mathematics achievement can be sustained if students benefit from QTR in every year of school between when PAT tests were collected (Years 3 and 4) and when PISA tests are administered (on average in Year 10). Under this assumption, the ongoing costs of QTR are incurred in each of these interim years.[24] The result of this approach is shown in column three of Table 3.5, alongside the no and 75% fadeout assumptions (all using a discount rate of 3.5%). Incurring ongoing costs each year still results in a positive lifetime GSP uplift per dollar spent on QTR.

Table 3.5: Results under different fadeout assumptions, discounted at 3.5%

	Fadeout ($ per student)	**No fadeout ($ per student)**	**Costs each year ($ per student)**
Lifetime GSP uplift	4,920	19,690	19,690
Direct program costs	130	130	690
Lifetime GSP uplift per $ of QTR cost	40	150	30
GSP uplift less direct program costs	4,790	19,560	18,995

Source: University of Newcastle data request, Deloitte Access Economics.

[23] For further detail on why a lower discount rate is justified in this context see Gort et al (2018).
[24] To calculate the overall cost under this scenario, the ongoing portion of the per student cost (casual teacher cost to cover release for four Rounds each year) is assumed to be incurred in each year from Years 3 and 4 through to Year 10. This amount is then discounted back to a present value (using a 3.5% rate).

Across all sensitivity tests undertaken the ratio of lifetime GSP uplift per dollar spent on QTR remains positive. Even with the most conservative of these sensitivities (a fadeout of 75% and a 7% discount rate), the ratio of lifetime GSP uplift per dollar spent on QTR is still substantial at 15.

These results indicate that QTR delivers a high level of economic return to society for the level of associated program cost. While not being directly comparable, international studies of a range of aggregate investments in primary education typically estimate that for each dollar of investment a benefit between $8.50 and $25.40 results, with much of this variance resulting from differences in returns between developed and developing countries (Psacharopoulos et al, 2004).

As a further example, Deloitte Access Economics research on the returns to higher education indicates a $3 return to government for every $1 invested in teaching and learning, and a $5 return to government for every $1 invested in university research (Deloitte Access Economics, 2020). These returns are in themselves material, when compared to benefit-to-cost ratios generally. For example, at the UK Department for Transport, projects are considered to have 'high' or 'very high' ratios of benefits to costs when, for every $1 invested, there is a return of $2 or more (Atkins et al, 2017).

These points considered, the benefits generated by QTR represent a material return to students, schools, communities and broader society. In part this is because the returns to improving learning outcomes, even modestly estimated, are substantial. The returns to education for individuals are life-long, and the returns to the broader economy compound over time.

Further, the costs associated with QTR are modest, particularly when compared to the aggregate costs associated with the schooling system more broadly. This means that only a small uplift in student learning outcomes is required for the returns from QTR to be large. Indeed, further research and analysis may be beneficial to understand the extent to which this significant return, for a modest investment cost, is scalable with a larger 'dosage' of the program, in terms of its intensity and the length of time over which it operates. In the context of the interim nature of these results, this underlies the imperative to keep monitoring and assessing the impact of the program and the returns generated by it.

Going forward, the University is continuing to invest in strengthening QTR by refining the trainer-led QTR model to achieve a scalable solution. Additionally, a further program of experimental research is planned to continue to build evidence on what works in teacher professional development in multiple contexts.

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Appendix A Modelling economic outcomes

This appendix sets out in detail the approach used in the economic benefit modelling. In modelling the impact of student academic achievement on economic benefits, data is used from the Longitudinal Surveys of Australian Youth (LSAY). LSAY follows young Australians for ten years from their mid-teens to mid-twenties, observing educational and labour outcomes. Each year an additional wave of students is added to the pool of those observed.

Data

Using LSAY data, the primary variables used include educational outcomes, labour market outcomes, student assessment scores from the PISA dataset, and individual specific demographic factors.

Table A.1 sets out the sample size and attrition rates observed in the three cohorts of LSAY data used.

Table A.1 Sample attrition in LSAY

	LSAY 2003		LSAY 2006		LSAY 2009	
	Sample	**% of wave 1**	**Sample**	**% of wave 1**	**Sample**	**% of wave 1**
2003	10370	100%				
2004	9378	90%				
2005	8691	84%				
2006	7721	74%	14170	100%		
2007	6658	64%	9353	66%		
2008	6074	59%	8380	59%		
2009	5475	53%	7299	52%	14251	100%
2010	4903	47%	6316	45%	8759	62%
2011	4429	43%	5420	38%	7626	54%
2012	3945	38%	4670	33%	6541	46%
2013	3741	36%	4223	30%	5787	41%
2014			3839	27%	5082	36%
2015			3563	25%	4529	32%
2016			3343	24%	4037	28%
2017					3518	25%

Source: Longitudinal Surveys of Australian Youth 2003, 2006, 2009.

For this analysis data is pooled across the three cohorts of data. This assists in generating reliable estimates of the relationship between academic achievement and labour market outcomes.

Empirical strategy

There are four separate stages to mapping increased academic achievement through to aggregated economic outcomes. The first three stages directly measure the impact of academic achievement on key transition mechanisms (education attainment, wages, and employment) between education and economic outcomes. The empirical strategy for these first three stages is provided in this section.

Educational attainment

The first stage of the modelling involves estimating the impact of PISA scores on educational attainment, controlling for other factors that may influence educational attainment. A multinomial logit is used to estimate each individual's propensity of being in each educational attainment category (where each educational attainment category references highest qualification). The educational outcomes modelled are:

- not completing high school
- a high school qualification or a certificate I or II
- a certificate III or IV
- a diploma or advanced diploma
- a Bachelor degree
- a postgraduate qualification (including graduate certificates and graduate diplomas).

The estimation equation is:

$$\Pr(Education_{it} = k) = \frac{\exp\,(\gamma_{0,k} \;+\; \gamma_{1,k} PISA_i \;+\; \boldsymbol{\gamma}_k \boldsymbol{X}_{it})}{1 + \sum_{k=1}^{K} \exp\,(\gamma_{0,k} \;+\; \gamma_{1,k} PISA_i + \boldsymbol{\gamma}_k \boldsymbol{X}_{it})}$$

Where:

- $Education$ is the highest level of educational attainment for individual i at time t
- $k \in K$ is a specific educational attainment from K possible outcomes
- $PISA$ is the PISA score of individual i at age 15
- $\boldsymbol{X}$ is a vector of student and school level characteristics, which may influence educational attainment.

Since the model is a nonlinear function of its parameters, the marginal effect of an increase in PISA scores is calculated as:

$$\frac{\partial \Pr(Education_{its} = k)}{\partial \; PISA_{i,s}} = \Pr_{itk} \left[\gamma_{1,k} - \frac{\sum_{k=1}^{K} \gamma_{1,k} \exp\,(\gamma_{0,k} \;+\; \gamma_{1,k} PISA_i \;+\; \boldsymbol{\gamma}_k \boldsymbol{X}_{it})}{1 + \sum_{k=1}^{K} \exp\,(\gamma_{0,k} \;+\; \gamma_{1,j} PISA_i + \boldsymbol{\gamma}_k \boldsymbol{X}_{it})} \right]$$

Estimation is restricted to individuals who are not currently studying, as their current maximum level of educational attainment does not reflect their characteristics.

The marginal effect of a one point increase in PISA on educational attainment can be interpreted as the percentage increase in the likelihood of entering a specific educational category *k* compared to the base category of not completing high school.

Wages

The second stage is the estimation of the impact of higher PISA scores on wages. An 'augmented Mincer equation' is used to describe the relationship between PISA scores and wages. This equation, built on Mincer's (1974) seminal work into the effects of education on wages, is provided below:

$$\ln wage_{it} = \beta_0 + \; \beta_1 PISA_i + \sum_{k=1}^{K} \delta_j Education_{kit} + \boldsymbol{\beta} \boldsymbol{Z}_{it} + \epsilon_{it}$$

Where:

- $wage$ is the hourly wage of individual i at time t
- $PISA$ is the PISA score of individual i at age 15
- $Education$ is the highest level of educational achievemen
- $\boldsymbol{Z}$ is a vector of student and school level characteristics, which may influence wages.

Estimated coefficients from the above equation are used to identify the *direct* effect of PISA scores – that is, the impact of academic achievement on the wage offer.

In order to estimate the *indirect* effect of PISA scores – the impact of academic achievement on improving qualification attainment, resulting in higher wages – the effect of PISA scores through education needs to be estimated.

If the relationship between education and PISA was linear in its parameters, this estimation could be simply performed as a nested OLS regression. However, since education is a categorical variable and estimated by a multinomial logit model, the relationship is highly nonlinear, as shown:

$$E[\ln \mathrm{w}\,|X] = \beta_0 + \beta_1 \ln PISA + \sum_{k=1}^{K} \delta_k P_s(Education_k = k) + \boldsymbol{\beta}\mathbf{Z}$$

In response to these nonlinearities, a prediction analysis is used to estimate the indirect and total effects of PISA. The steps applied are described as follows:

1. Estimate the multinomial logit model of educational achievement. The estimation sample removes individuals currently studying.
2. Obtain the predicted probabilities for each educational achievement level using the estimates from step 1.
3. Estimate the augmented Mincer equation by OLS regression to identify the *direct* effect of PISA scores on wages, including controls for the effect of educational attainment. The estimation sample is restricted to individuals who are employed, but not studying.
4. Simulate wages using the predicted probabilities from step 2 of each level of educational attainment.
5. Repeat step 2, using the PISA score distribution implied by each scenario.
6. Simulate new wages using the predicted probabilities and inflated PISA scores from step 5.
7. Calculate the average difference between the two predicted wage results (step 4 and 6). This difference can be interpreted as the estimated total effect of an increase in PISA score on wages, as step 6 includes both changes to PISA scores and educational achievement.

A simulation based approach to estimating the total effect of PISA scores on wages is required due to the complexity of the model, the effect of education choice is highly nonlinear and depends on the characteristics of each individual. The goal of computing the *expected* difference in wages across the sample implies that using the difference in predicted probabilities from the multinomial logit model, as described above, is necessary to remove errors in educational choice.

Employment

The effect of PISA on employment outcomes is measured in the third stage of the modelling. In modelling employment outcomes, all individuals in the sample are split into one of two categories: employed or unemployed. Those not in the labour force are excluded from the sample. Given the nature of the data (being binary and categorical), the model selected to estimate the relationship between PISA scores and employment is a probit model.

Probit models are commonly used to estimate the propensity of binary outcomes – that is, events or choices that have only two possible outcomes. Nonlinear probit models have important advantages over linear estimation methods, as they ensure that predicted probabilities remain within the range of zero to one.

The propensity of an individual being employed is estimated using a probit model that can isolate the effect of PISA scores and control for other explanatory characteristics. The estimation equation is given by:

$$\Pr(Employed_{its} = 1) = \Phi(\alpha_0 + \alpha_1 PISA_i + \boldsymbol{\alpha}\boldsymbol{X}_{it})$$

Where:

- $Employed$ is a dummy variable which equals one if individual i at time t is employed and equals zero if they are unemployed

- $PISA$ is the PISA score of individual i at age 15
- $\boldsymbol{X}$ is a vector of explanatory variables
- Φ is the standard normal cumulative distribution function.

Since the probit model is nonlinear in its parameters, the marginal effect of a one point increase in PISA scores is calculated by:

$$\frac{\partial \Pr(Employed_{its} = 1)}{\partial PISA_{is}} |_{\boldsymbol{X}_{it}} = \phi(\alpha_0 + \alpha_1 PISA_i + \boldsymbol{\alpha X}_{it})\alpha_1$$

Where ϕ is the standard normal probability density function.

The equation is solved using maximum likelihood using only the sample of individuals in the labour force and not concurrently studying. Students are removed from the sample as their employment status does not accurately reflect their characteristics at this point in time, and is likely to introduce bias.

The same simulation approach discussed above for wages is used in the scenario analysis for the employment outcomes to ensure the effect on employment accounts for changed educational attainment.

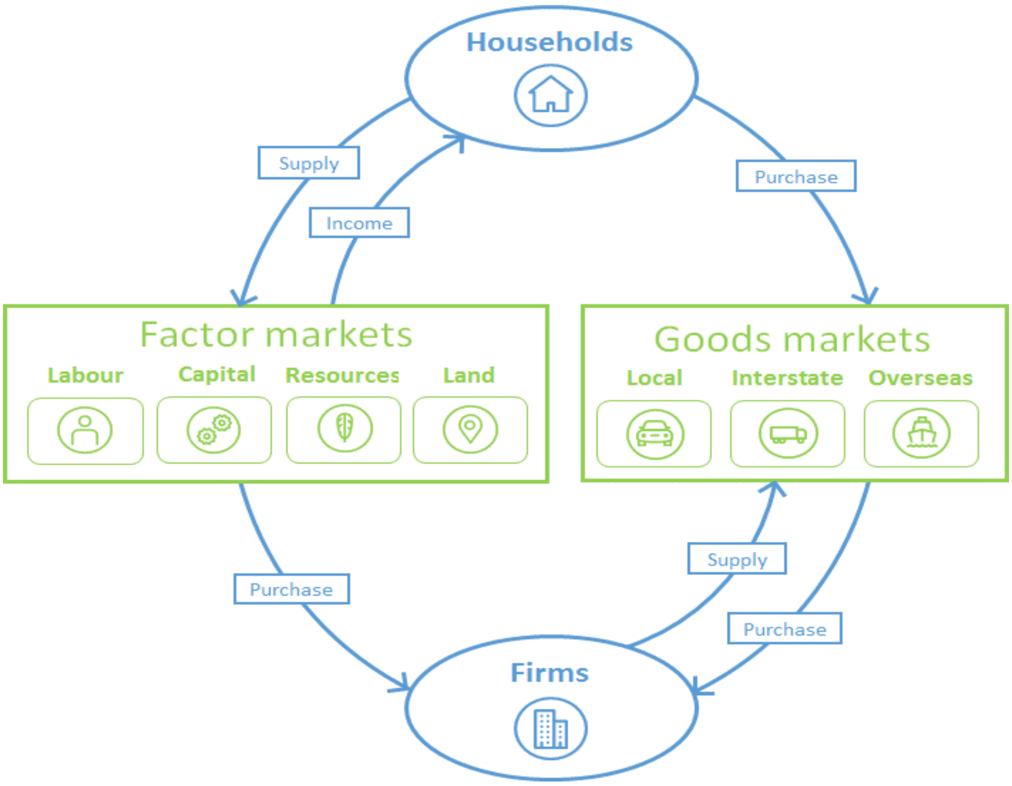
Appendix B Computable General Equilibrium Model

The Deloitte Access Economics Regional General Equilibrium model (DAE-RGEM) is a large scale, dynamic, multi-region, multi-commodity computable general equilibrium (CGE) model of the world economy with bottom-up modelling of Australian regions. The model allows policy analysis in a single, robust, integrated economic framework. This model projects changes in macroeconomic aggregates such as GDP, employment, export volumes, investment and private consumption. At the sectoral level, detailed results such as output, exports, imports and employment are also produced.

The model is based upon a set of key underlying relationships between the various components of the model, each which represent a different group of agents in the economy. These relationships are solved simultaneously, and so there is no logical start or end point for describing how the model actually works. However, these relationships can be viewed as a system of interconnected markets with appropriate specifications of demand, supply and the market clearing conditions that determine the equilibrium prices and quantity produced, consumed and traded.

Figure B.1 is a stylised diagram showing the circular flow of income and spending that occurs in DAE-RGEM. To meet the demand for products, firms purchase inputs from other producers and hire factors of production (labour and capital). Producers pay wages and rent (factor income) which accrue to households. Households spend their income on goods and services, pay taxes and put some away for savings.

Figure B.1: Stylised figure of the DAE-RGEM



DAE-RGEM is based on a substantial body of accepted microeconomic theory. Key assumptions underpinning the model are:

- The model contains a 'regional consumer' that receives all income from factor payments (labour, capital, land and natural resources), taxes and net foreign income from borrowing (lending).
- Income is allocated across household consumption, government consumption and savings so as to maximise a Cobb-Douglas (C-D) utility function.
- Household consumption for composite goods is determined by minimising expenditure via a constant differences of elasticities (CDE) expenditure function. For most regions, households can source consumption goods only from domestic and imported sources. In the Australian regions, households can also source goods from interstate. In all cases, the choice of commodities by source is determined by a constant ratios of elasticities substitution, homothetic (CRESH) utility function.
- Government consumption for composite goods, and goods from different sources (domestic, imported and interstate), is determined by maximising utility via a C-D utility function.
- All savings generated in each region are used to purchase bonds whose price movements reflect movements in the price of creating capital.
- Producers supply goods by combining aggregate intermediate inputs and primary factors in fixed proportions (the Leontief assumption). Composite intermediate inputs are also combined in fixed proportions, whereas individual primary factors are combined using a CES production function.
- Producers are cost minimisers, and in doing so, choose between domestic, imported and interstate intermediate inputs via a CRESH production function. Primary factors of production are also chosen (through a CES aggregator) and substitution between skilled and unskilled labour is allowed (again via a CES function).
- The supply of labour is positively influenced by movements in the real wage rate governed by the elasticity of supply.
- Investment takes place in a global market and allows for different regions to have different rates of return that reflect different risk profiles and policy impediments to investment. A global investor ranks countries as investment destinations based on two factors: global investment and rates of return in a given region compared with global rates of return. Once the aggregate investment has been determined for Australia, aggregate investment in each Australian sub-region is determined by an Australian investor based on Australian investment and rates of return in a given sub-region compared with the national rate of return.
- Once aggregate investment is determined in each region, the regional investor constructs capital goods by combining composite investment goods in fixed proportions, and minimises costs by choosing between domestic, imported and interstate sources for these goods via a CRESH production function.
- Prices are determined via market-clearing conditions that require sectoral output (supply) to equal the amount sold (demand) to final users (households and government), intermediate users (firms and investors), foreigners (international exports), and other Australian regions (interstate exports).
- For internationally traded goods (imports and exports), the Armington assumption is applied whereby the same goods produced in different countries are treated as imperfect substitutes. But, in relative terms, imported goods from different regions are treated as closer substitutes than domestically produced goods and imported composites. Goods traded interstate within the Australian regions are assumed to be closer substitutes again.
- The model accounts for greenhouse gas emissions from fossil fuel combustion. Taxes can be applied to emissions, which are converted to good-specific sales taxes that impact demand. Emission quotas can be set by region and these can be traded, at a value equal to the carbon tax avoided, where a region's emissions fall below or exceed their quota.

Below is a description of each component of the model and key linkages between components.

Households

Each region in the model has a so-called representative household that receives and spends all income. The representative household allocates income across three different expenditure areas - private household consumption; government consumption and savings – to maximise a C-D utility function.

The representative household interacts with producers in two ways. First, expenditure is allocated across household and government consumption, sustaining demand for production. Second, the representative household owns and receives all income from factor payments (labour, capital, land and natural resources) and net taxes. Factors of production are used by producers as inputs into production along with intermediate inputs. The level of production, as well as supply of factors, determines the amount of income generated in each region.

The representative household's relationship with investors is through the supply of investable funds – savings. The relationship between the representative household and the international sector is twofold. First, importers compete with domestic producers in consumption markets. Second, other regions in the model can lend (borrow) money from each other.

Producers

Apart from selling goods and services to households and government, producers sell products to each other (intermediate usage) and to investors. Intermediate usage is where one producer supplies inputs to another's production. For example, coal producers supply inputs to the electricity sector.

Producers interact with investors where capital is an input into production. Investors react to the conditions facing producers in a region to determine the amount of investment. Generally, increases in production are accompanied by increased investment. In addition, the production of machinery, construction of buildings and the like that forms the basis of a region's capital stock, is undertaken by producers. In other words, investment demand adds to household and government expenditure from the representative household, to determine the demand for goods and services in a region.

Producers interact with international markets in two main ways. First, they compete with producers both in overseas regions for export markets and in their own region's market. Second, they use inputs from overseas in their production.

Sectoral output equals the amount demanded by consumers (households and government) and intermediate users (firms and investors) as well as exports.

Intermediate inputs are assumed to be combined in fixed proportions at the composite level. The exception to this is the electricity sector that is able to substitute different technologies (brown coal, black coal, oil, gas, hydropower and other renewables) using the 'technology bundle' approach developed by ABARE (1996).

The supply of labour is positively influenced by movements in the wage rate governed by an elasticity of supply (assumed to be 0.2). This implies that changes influencing the demand for labour, positively or negatively, will impact both the level of employment and the wage rate. This is a typical labour market specification for a dynamic model such as DAE-RGEM. There are other labour market 'settings' that can be used. First, the labour market could take on long-run characteristics with aggregate employment being fixed and any changes to labour demand would be absorbed through movements in the wage rate. Second, the labour market could take on short-run characteristics with fixed wages and flexible employment levels.

Investors

Investment takes place in a global market and allows for different regions to have different rates of return that reflect different risk profiles and policy impediments to investment. The global investor ranks countries as investment destinations based on two factors: current economic growth and rates of return in a given region compared with global rates of return.

Once aggregate investment is determined in each region, the regional investor constructs capital goods by combining composite investment goods in fixed proportions, and minimises costs by choosing between domestic, imported and interstate sources for these goods via a CRESH production function.

International

Each of the components outlined above operate, simultaneously, in each region of the model. That is, for any simulation the model forecasts changes to trade and investment flows within, and between, regions subject to optimising behaviour by producers, consumers and investors. Of course, this implies some global conditions that must be met, such as global exports and global imports, are the same and that global debt repayment equals global debt receipts each year.

Cohort size

The economic impact of increased student academic achievement modelled as part of this project are based on improvements for only a subset of the population. The size of these cohorts has been estimated using Australian Bureau of Statistics (ABS) Census. Cohort sizes are estimated for New South Wales. The cohort size is the assumed number of 18-year-olds in 2019. For simplicity, the cohort of 18-year-olds is assumed to stay the same size over the forecast (i.e. no deaths, births or migration are assumed). The assumed cohort sizes are provided below. The cohort size is approximately at 90,000, representing 2.6% of the NSW workforce.

Modifications for this engagement

In order to better capture the impact of the policy intervention as a shock, a modification has been made to DAE-RGEM for this engagement.

In most cases one representative agent in each region provides labour. Labour is assumed to be one homogeneous factor which is used by each sector of the economy in proportion with their demand. The best way to think of this is a representative agent is also a worker who is employed in each industry and the proportion of the time spent in each industry is determined by the wage that is offered with one final market-clearing wage determining an optimal split between industries. For example, the representative worker may spend 70% of their time working in service industries like other business services and the remaining 30% spent between manufacturing and primary products like agriculture and mining.

One issue with this standard approach is that it does not account for different occupation types. For example, service industries may require more managers and professionals whereas miners may require more technical trades-people. Another issue is that it does not account for the fact that workers differ in skill type (proxied by education level). Going back to the previous example, there isn't just one representative worker but in fact many types, with a combination required to produce output in each industry.

To overcome this issue, drawing on detailed census data, the underlying database of DAE-RGEM has been modified to accommodate workers of different occupation and skill types. A corresponding change to the structure of DAE-RGEM has been made so that firms can draw on these different types of workers in producing output.

The modification employed allows the modelling of a shift in the composition of the workforce – informed by the econometric analysis – where workers upskill moving from lower levels of qualification (like high school) to higher level (like undergraduate). This is accompanied by an across the board lift the productivity of all workers that is informed by the predicted increased in real wages of the treated and the fraction of the workforce they would account for.

The results presented explicitly account for the ability of workers to migrate between regions, including after they have upskilled and become more productive (i.e. the outcomes of the policy intervention). Although testing has shown this does not change the conclusion of the report, it does play a role in muting the gain seen in regional areas as workers there move to metropolitan areas to take up higher paid jobs.

Appendix C Schools cost survey

In undertaking analysis on the costs associated with Quality Teaching Rounds (QTR), Deloitte Access Economics conducted a survey of schools. The survey was hosted on Qualtrics and distributed by the University of Newcastle (the University), however data from the survey was collected by Deloitte Access Economics. The survey was sent to schools in the researcher-lead QTR randomised control arm (in total 63 schools) to align with the costs and benefits used in the cost benefits analysis calculations in presented in this report.

The survey questions were designed by Deloitte Access Economics with input from the University and focused on the time and financial cost associated with the two-day workshop and any ongoing commitments to QTR throughout the eight months of the trial. Over the five weeks for which the survey was open 62% of schools responded to the survey.

Approximately half of the respondents were from a rural location (relative to 43% of schools being rural in the entire sample).

Limitation of our work

General use restriction

This report is prepared solely for the use of the University of Newcastle. This report is not intended to and should not be used or relied upon by anyone else and we accept no duty of care to any other person or entity. The report has been prepared for the purpose of set out in our letter of engagement dated 8 November 2019. You should not refer to or use our name or the advice for any other purpose.

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