



Centre for
Evidence and
Implementation

Implementation in Education

Findings from a Scoping Review

Prepared for Evidence for Learning (E4L)

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1. Executive Summary

Background

Programmes, practices and interventions delivered in real world service settings such as schools and classrooms often look fundamentally different from what was originally intended by their developers. Principals and teachers may decide to adapt elements of a programme; barriers in the school system may prevent a programme from being fully realised; students or their parents may reject a programme and not support its application.

What these examples have in common is that outcomes achieved from an educational intervention relate to the quality of its *implementation* rather than of the intervention itself.

Aim

This report explores the role of implementation in high quality educational practice through the research question, *What is known about the role of implementation in providing effective teaching and generating positive learning outcomes for school aged children in primary and secondary education?*

Based on a systematic scoping review, the goal was to explore whether particular implementation concepts or strategies in school settings have been shown to be effective in supporting teaching and improving student outcomes.

Results

While the initial search of the literature yielded 2,682 citations, only 36 publications were included in the final literature sample.

Eight were *implementation effectiveness studies* and reported implementation outcomes that were achieved through the test of different implementation strategies. All of these studies were conducted in the U.S. The remaining 28 studies were *implementation quality studies*, which reported on the effectiveness of interventions and included an indicator of implementation quality.

The synthesis of findings in this report focuses on the implementation effectiveness studies, since they were viewed as the best indicator of how implementation practice may affect teaching practices and student outcomes. The primary two implementation outcomes measured in these studies were *fidelity* - the degree to which an intervention was implemented as intended - and *acceptability* - the degree to which users and stakeholders of an intervention accept its relevance and importance.

Five of these studies reported on a positive relationship between the quality with which a programme was implemented and the outcomes achieved for its end-users. While one of these studies points to the importance of the principal's support for implementing a curriculum targeting student behaviour and social competence, the others primarily highlight the role fidelity plays in achieving positive student outcomes. In them, a higher level of fidelity correlates with greater achievements for students in the fields of numeracy, literacy, mental and behavioural health.

The implementation strategies utilised in these studies always included training of the personnel delivering the intervention and ongoing staff support.

Conclusion

The findings from this review confirm that implementation is a domain of interest to education science. However, the application of concepts and models developed within implementation science is emerging only slowly and is underdeveloped still - given the conceptual richness that characterises the field of implementation.

There are indications in the literature that high quality implementation contributes to improved educational services and thereby to better student outcomes. However, these indications relate to a limited number of implementation strategies - in particular, training and ongoing support - and few implementation outcomes - in particular, fidelity. Furthermore, the current knowledge base is U.S.-centric, and Australian or New Zealand based implementation focused education studies could not be identified.

Implications

The conceptual richness of the field of implementation science invites further exploration of how its concepts can be integrated and utilised both as part of high quality educational studies and of good educational implementation practice.

Within education science, this may imply the development and funding of rigorous study designs aimed at testing different approaches to implementation of evidence-based practice in classrooms, schools and school systems - in particular in Australian settings.

For educational practice, this may include the application of a broader array of implementation strategies to support the uptake of evidence in curriculum design and pedagogy; a stronger and more systematic planning of implementation activities in education - across both stages of implementation (exploration, preparation, implementation, sustainment) and its inner and outer context; or the development of a data-focused school culture in which continuous quality improvement is a natural ingredient in the daily routines of educators.

2. Introduction

2.1. Background

Programmes, practices and interventions delivered in real world service settings such as schools and classrooms often look fundamentally different from what was originally intended by their developers. Principals and teachers may decide to adapt elements of a programme; barriers in the school system may prevent a programme from being fully realised; students or their parents may reject a programme and not support its application. What these examples have in common is that they relate to the quality of the *implementation* of a programme rather than of the programme itself.

The assumption that implementation matters has gained substantial recognition over the past decades in especially those environments that aim to understand how research-informed, evidence-based practice can be successfully translated and made operational for health, social and educational services. While the belief that an effective innovation would spread by itself if sufficiently promoted by early adopters was strong until the 1980s, the move towards an evidence-based agenda first within health, and later also within the social welfare and education sectors, meant an increasing interest in purposeful and active implementation to embed effective practices in the everyday routines of service organisations.

Since the 1990s this has led to the development of implementation science and practice as a distinct field and discipline working to understand the mechanisms of high quality implementation. Within this field, implementation is generally defined as a specified set of planned and intentional activities designed to integrate evidence-based practice into real-world service settings within health and allied professions (Fixsen, Naoom, Blase, & Friedman, 2005; Mitchell, 2011). Seminal reviews in this field have demonstrated that the quality of an implementation process is related to the effect size that programmes and services have for end-users (Durlak & DuPre, 2008; Lipsey, Howell, Kelly, Chapman, & Carver, 2010) and that the purposeful utilisation of implementation strategies significantly affects the quality of an intervention and thereby its outcomes (Powell, Proctor, & Glass, 2014).

Given these early findings, the field of implementation science subsequently has seen a substantial growth in concepts, models and frameworks aiming to depict the core elements of implementation processes and to support organisations, agencies and their staff in planning for and facilitating better implementation. In less than a decade, over 60 implementation frameworks have been identified or developed (Tabak, Khoong, Chambers, & Brownson, 2012). Seventy-three different implementation strategies have been suggested as the building blocks of implementation practice (Powell et al., 2015). 601 barriers and facilitators with a potential to impact the implementation of practice have been identified (Krause et al., 2014). And 420 measures of the context, processes, and outcomes of implementation have been sourced (Lewis et al., 2015a & 2015b).

This implementation agenda is also gaining attention in the field of education where opportunities to develop teaching into an evidence-based or evidence-informed profession are increasingly discussed and promoted¹ (Durbin & Nelson, 2014); where a growing number of publications therefore focus on the topic of implementation (McLeod et al., 2016; Nordstrum, LeMahieu, & Berrena, 2017; Owens et al., 2014; Sanetti, Collier-Meek, Long, Byron, & Kratochwill, 2015); and where developers of school based interventions show greater concern for the proper implementation of their evidence-based programmes (Horner, Sugai, & Fixsen, 2017; Molloy, Moore, Trail, Van Epps, & Hopfer, 2013; Naylor et al., 2015).

¹ See for example institutions such as the UK Institute for Effective Education (<https://the-iee.org.uk/>); the Education Endowment Foundation (<https://educationendowmentfoundation.org.uk/>); or the Danish Clearinghouse for Educational Research (<http://edu.au.dk/en/research/danish-clearinghouse-for-educational-research/>)

As in other service areas, this focus on implementation is driven by an interest in examining the relation between effective teaching - using evidence-based educational practices that are embedded into sound implementation strategies - and student outcomes in the form of e.g. greater academic achievement, acquisition of transferable skills, improved behavioural health and social-emotional wellbeing, higher income etc.

The Education Endowment Foundation (EEF) has been part of this movement since 2011, as an independent charity that works to increase the uptake of evidence in education in order to improve education outcomes for school-aged children. As part of this work, the EEF supports teachers in utilising evidence in practice; engages in grant-making to enhance and test the effectiveness of promising educational practices; publishes the findings from rigorous evaluations of such practices; and supports the scale up of those that have shown an impact. In spring 2015, the EEF released a guidance report focused on 'Making Best Use of Teaching Assistance' (Sharples, Webster, & Blatchford, 2015). In releasing this type of resource, the EEF is increasingly integrating implementation aspects of educational practice in its work, and it is expected that this trend will continue.

While the EEF is located in and focused on the U.K., its approach has been translated to and applied in Australia through the 'Evidence for Learning' (E4L) initiative that is incubated by Social Ventures Australia and supported by the Commonwealth Bank and counts the EEF among its founding partners. E4L helps educators increase learning by improving the evidence of what works best and why. In acknowledging the importance of implementation to its work for disseminating and enabling the use of evidence, E4L has commissioned this scoping review.

2.2. Research Question

The primary research question guiding this review is:

What is known about the role of implementation in providing effective teaching and generating positive learning outcomes for school aged children in primary and secondary education?

In exploring this question, E4L has an interest in understanding whether particular implementation concepts or strategies in school settings have been shown to be effective in supporting teaching and improving student outcomes.

Given the character of the research question as an open, exploratory question, the method applied to answer it is a scoping review method.

3. Methodology

3.1. The scoping review method

A scoping review is a method for *mapping* a particular field of literature in both depth and breadth. It relies on systematic and transparent search strategies but differs from systematic reviews through broader inclusion criteria helping to understand what is known in a given field based on the particular research question that guides a project (Levac, Colquhoun, & O'Brien, 2010).

While narrative literature reviews often rely on preferences and a priori knowledge present in a research team, scoping reviews apply clearly described and replicable strategies for sourcing, searching and selecting publications to be included. This methodical rigour helps to avoid the biases that easily emerge from narrative literature reviews (e.g. selection bias) and thereby enhance the quality of the findings derived from the review process. In an effort to provide guidance to authors undertaking scoping reviews, Arksey and O'Malley (2005) developed a six-stage methodological framework, which has been followed as part of this review:

1. Identifying and clarifying the research question
2. Identifying relevant studies and reports
3. Study and report selection
4. Charting data
5. Collecting, summarising and reporting results
6. Consultation

In the following we will briefly introduce what and how studies were selected for this review, and how data were extracted and analysed.

3.2. Criteria for considering studies for this review

3.2.1. Type of studies

We included studies that used randomisation or quasi-random procedures to assign participants, with or without blinding. Studies that tested two types of educational interventions (instead of no treatment control group) were also included. Systematic reviews of relevant implementation studies were also included.

We only included English language articles published in peer reviewed journals.

3.2.2. Types of participants

Studies that focused on school-aged children and/or their teachers in primary or secondary schools are part of this review. This also includes school principals or coaching staff to teachers, and students in vocational education.

3.2.3. Types of interventions

Any interventions that aimed at improving student outcomes were included in this review. These could be interventions addressing students' academic achievements (such as literacy or numeracy) or their physical (through nutrition, or exercise) or mental health (centred on behaviour and social-emotional wellbeing).

3.2.4. Types of outcomes

Implementation studies in education are the focus of this review. We differed between two types of implementation evaluations:

- *Implementation effectiveness studies*
 - assess the impact an implementation outcome has on the outcomes achieved for students through the use of an educational intervention *OR*
 - test different implementation strategies against each other to evaluate whether one approach can be more effective than another in achieving positive implementation outcomes or outcomes for end-users (typically students or teachers)
- *Implementation quality studies* on the other hand examine indicators of the quality with which an intervention was implemented ('implementation quality') to understand whether it can be assumed that an intervention was properly used in practice. They do not measure the relationship between implementation quality and end user outcomes.

Proctor et al. (2010) define implementation outcomes as 'the effects of deliberate and purposive [sic] actions to implement new treatments, practices, and services' and view them as key intermediate outcomes that relate to outcomes for service end-users. They differentiate between eight implementation outcomes: (1) the acceptability of a programme; (2) the degree to which it is adopted; (3) its appropriateness, (4) costs or (5) feasibility; (6) the degree with which a programme is implemented as intended (fidelity), (7) its degree of penetration and (8) its sustainability.

With this framework as a tool, we screened the literature based on the following criteria:

- Studies had to include at least one implementation outcome
- Studies also had to report intervention-effect related outcomes

Studies that did not include any implementation-related outcomes were excluded.

3.3. Search methods for identification of studies

3.3.1. Electronic searches

The search of the literature for this review was conducted by a qualified librarian.

The search strategy included terms related to (a) implementation, (b) school-based education, and the study design. It is reported in detail in Appendix B.

We searched the following five electronic databases in October 2016: PsycINFO (Ovid), ERIC (EBSCOhost), A+ Education (Informit), Education Research Complete (EBSCOhost) and Education Database (ProQuest).

3.3.2. Data collection and analysis

The second author of this report screened the titles and abstracts of the generated citations and the first author double checked those that needed clarification. Both authors assessed the selected full texts for inclusion independently, and the first author made the final decision regarding their inclusion.

The second author extracted data from the included studies and the first author checked each extract for accuracy. Data were extracted in relation to the study design; country where the trial was conducted; year of publication; study population; study setting; the intervention and the

control condition; the implementation of the intervention; implementation outcomes; and outcomes for end-users.

Quality assessment of the included articles were not conducted due to the scoping nature of the review. Common themes arising from the studies that reported outcomes related to the implementation process were reported narratively. The studies that primarily focused on the effect of an intervention, but still reported some implementation-related outcome data, were also described, separately.

4. Results

4.1. Results of the search

A comprehensive description of the databases searched and the yield is described in Appendix C. In summary, the search conducted in five electronic databases yielded 2,682 citations. Duplicates were removed, 1,990 citations were screened, and 157 full texts were retrieved to assess eligibility for inclusion. Finally, 36 publications were included, all of which are listed separately in Appendix A. Of these,

- Eight were *implementation effectiveness studies* and reported implementation outcomes that were achieved through the test of different implementation strategies (seven studies) (Artman-Meeker, Hemmeter, & Snyder, 2014; Gray, Contento, & Koch, 2015; Kam, Greenberg, & Walls, 2003; Lee, Contento, & Koch, 2013; Matsumura, Garnier, & Resnick, 2010; Rohrbach, Gunning, Sun, & Sussman, 2010; Sarama, Clements, Starkey, Klein, & Wakeley, 2008; Clarke, Bunting & Barry, 2014).
- The remaining 28 studies were *implementation quality studies*, which reported on the effectiveness of interventions and included an indicator of implementation quality. (Adamowicz, Zalewska, Majkovicz, & Zaucha, 2015; Alaimo et al., 2015; Ariza et al., 2013; Belansky et al., 2013; Brenick, Shattuck, Donlan, Duh, & Zurbruggen, 2014; Campbell et al., 2015; Clarke, Bunting, & Barry, 2014; Coleman, Shordon, Caparosa, Pomichowski, & Dzewaltowski, 2012; Davidson, Fields, & Yang, 2009; Elinder, Heinemans, Hagberg, Quetel, & Hagstromer, 2012; Gollwitzer, Eisenbach, Atria, Strohmeier, & Banse, 2006; Grandstaff-Beckers, Saal, & Cheek, 2013; Hall et al., 2012; Hartry, Fitzgerald, & Porter, 2008; James, Reddy, Ruiter, McCauley, & van den Borne, 2006; Kaimal & Jordan, 2016; Kelly, Oswald, Melnyk, & Jacobson, 2015; Lesaux, Kieffer, Faller, & Kelley, 2010; Little, Sussman, Sun, & Rohrbach, 2013; Martens, van Assema, Paulussen, Schaalma, & Brug, 2006; Sanchez et al., 2007; Smokowski et al., 2016; Sy & Glanz, 2008; Thaker et al., 2008; Vaughn et al., 2013; Volpe et al., 2013; Whittemore et al., 2013; Wijekumar, Meyer, & Lei, 2013).

4.2. Implementation effectiveness studies

Eight publications (seven studies) (Artman-Meeker et al., 2014; Gray et al., 2015; Kam et al., 2003; Lee et al., 2013; Matsumura et al., 2010; Rohrbach et al., 2010; Sarama et al., 2008; Clarke et al., 2014) can be categorised as implementation effectiveness studies, one of which was a quasi-experimental study (Kam et al., 2003) while the others were RCTs, including three cluster RCTs, where groups of students were randomised instead of individual students (Gray et al., 2015; Lee et al., 2013; Clarke et al., 2014). All eight implementation effectiveness studies examined the relationship between different implementation activities on the one hand and implementation or student outcomes on the other. These are briefly summarised in the table below.

The characteristics of these studies vary substantially.

- Populations: Three studies included middle / elementary school students (Gray et al., 2015; Kam et al., 2003; Lee et al., 2013; Clarke et al., 2014), one each pre-school students (Sarama et al., 2008) and high school students (Rohrbach et al., 2010), and two focused on teachers (Artman-Meeker et al., 2014; Matsumura et al., 2010).
- Settings: Interventions were delivered in classrooms (Gray et al., 2015; Lee et al., 2013; Rohrbach et al., 2010; Clarke et al., 2014), the entire school (Kam et al., 2003; Matsumura et al., 2010), a pre-school (Sarama et al., 2008), and a training agency (Artman-Meeker et al., 2014).

- Interventions: One study reported educational interventions aimed at improving healthy nutritional behaviours (Gray et al., 2015; Lee et al., 2013), another a substance abuse prevention programme (Rohrbach et al., 2010). Other interventions addressed children’s social or emotional development and wellbeing (Artman-Meeker et al., 2014; Clarke et al., 2014), or the prevention of aggressive behaviours (Kam et al., 2003). A literacy coaching model for teachers (Matsumura et al., 2010) and a maths curriculum with a particular implementation component were included, too (Sarama et al., 2008).

The outcomes of the interventions measured in these studies varied considerably. The randomisation took place usually at school level apart from one study (Artman-Meeker et al., 2014), in which teachers were randomised.

All implementation effectiveness studies were conducted in the United States (U.S.) Five of them - highlighted in bold in the table below - reported on a positive relationship between the quality with which a programme was implemented and the outcomes achieved for its end-users.

While one study points to the importance of the principal’s support for implementing a curriculum targeting student behaviour and social competence (Kam et al., 2003), the other four highlight the role fidelity plays in achieving positive student outcomes (Clarke et al., 2014; Gray et al., 2015; Rohrbach et al., 2010; Sarama et al., 2008). In these four studies a higher level of fidelity correlates with greater achievements for students in the fields of numeracy, literacy, mental and behavioural health.

Table 1: Implementation Effectiveness Studies

Author	Publication year	Implementation strategies	Implementation outcomes
Artman-Meeker	2014	Training + ongoing support VS training only	Fidelity
Clarke	2014	Training + ongoing support VS non-support	Fidelity
Gray*	2015	Training + ongoing support VS non-support	Fidelity
Kam	2003	Principal Support	N/A
Lee*	2013	Training + ongoing support VS non-support	Fidelity / Acceptability
Matsumura	2010	Ongoing support (coaching)	Dosage / Acceptability
Rohrbach	2010	Regular training VS comprehensive training	Fidelity
Sarama	2008	Training + ongoing support VS non-support	Fidelity

The publications marked with an * relate to the same study.

The implementation strategies utilised in these studies always included training of the personnel delivering the intervention (professional development courses, training sessions, workshops) and

ongoing staff support (coaching, web-based support, visits by trainers). The primary two implementation outcomes measured were fidelity and acceptability.

Due to the marked heterogeneity of the interventions included, outcomes reported and implementation strategies used, we decided to summarise each study narratively. In addition to this summary, an overview of core characteristics and key findings extracted from each study is provided with Appendix A.

Two publications (Gray et al. 2005; Lee et al., 2013) reported the implementation strategy of a middle-school-based nutritional curriculum intervention to improve healthy-eating habits of the middle school students. The teachers participated in professional development workshops and received ongoing support from the designers of the intervention. The outcomes measured were consumption of sweetened beverages, amount of physical activity, eating fruit and vegetables and, drinking more water. The measured outcomes related to the implementation process were fidelity, reach, acceptability and, dosage. Based on the fidelity, reach and the dosage of the intervention, three groups were created for analysis purposes; high, medium, and low teacher implementation groups.

When compared with the control group, only children in the high teacher implementation group displayed significant improvements in their health behaviours and consumed less sweetened beverages at meals, improvement in physical activity and, drinking more water. The authors concluded that the implementation process had influenced the effectiveness of the intervention and high implementation level had positively impacted the students' healthy behaviour practices measured in this study. It was also revealed that the ongoing support played an important part in improving the teachers' confidence in delivering the curriculum.

Another study (Sarama et al., 2008) evaluated the impact of the Technology-enhanced, Research-based, Instruction, Assessment, and professional Development Model (TRIAD) on developing and implementing a maths curriculum in public preschools in the U.S. The TRIAD model provides multiple forms of support for teachers, two of which - professional development sessions and in-class coaching - were implemented in this study and utilised to develop a maths curriculum and improve maths teaching practices. Teachers implemented the curriculum while receiving TRIAD support, and the effect of the intervention was assessed compared to a control group. Children who received the intervention developed by TRIAD-supported teachers reported significantly greater gains in mathematical knowledge than the control group ($p=0.000$, effect size for the TRIAD intervention 0.62). The implementation fidelity assessment revealed that TRIAD teachers taught mathematics for an average of 257 min per week, compared to the control teachers' 151 minutes. Furthermore, TRIAD means were higher than control means for the number of mathematical activities (3.6 vs. 2.8) in the classroom and their duration (15.4 vs. 12.2). Therefore, the authors concluded that compared to the control condition, higher levels of implementation fidelity resulted in consistently higher scores in the intervention, and significantly greater gains in children's mathematics achievement.

Artman-Meeker et al. (2014) compared two implementation strategies to implement the "Pyramid Model", a classroom-wide approach for fostering social-emotional development and addressing challenging behaviour. All teachers who delivered the intervention participated in a training programme (one day: six hours) but the intervention group received distant coaching sessions in addition to the normal training programme. Distant coaching sessions consisted of a video-recorded observation, an edited video clip posted on the project's website, and e-mail feedback. Each week a videographer visited the classrooms of teachers in the intervention group (training plus coaching group) and filmed 30-60 minutes of video footage. The investigator viewed the teacher's video and identified the areas that demonstrated a target Pyramid practice or a missed opportunity for a Pyramid practice. The investigator then sent a feedback through emails. The workshop only group did not receive follow-up support (i.e. feedback) on its participants' classroom teaching activities (control group). Procedural fidelity was assessed for workshop training (using a 32-item fidelity checklist), action plans (7-item fidelity form), and distance coaching (e-mail messages were coded)

but none reported significant difference between the intervention and control groups. The investigators used the Teaching Pyramid Observation Tool (TPOT) to assess the teachers' implementation of Pyramid practices in the classrooms. The measurements were made four times during the study, but no significant effect was found between the intervention and control groups. In other words, adding distance coaching to workshops did not result in greater implementation of Pyramid practices. However, workshop training plus distance coaching was associated with small but statistically significant improvements in emotional, organizational, and instructional classroom interactions ($p=0.05$). How significant this difference would be when translated into practice is unclear.

The only quasi-experimental study (Kam et al., 2003) included in this review assessed the impact of principals' support for a delinquency prevention programme and the quality of classroom implementation on outcomes. Teachers implementing the programme received training on two one-day workshops and ongoing support through weekly visits by a coordinator. The teachers delivering the intervention at school were asked to rate the quality of support by the principal. Student classroom behaviours were measured using a 31-item 6-point teacher social competence rating scale. The results indicated that when both the quality of implementation and principal support were high, students showed significantly greater reductions in aggression and behavioural dysregulation (Aggression $F [3, 157] = 3.69, p = .01$; Behaviour dysregulation $F [3, 157] = 4.62, p < .005$) and significant increases in socio-emotional competence ($F [3, 157] = 2.52, p < .06$); and on-task behaviours ($F [3, 157] = 3.44, p = .01$).

Another study (Rohrbach et al., 2010) evaluated whether comprehensive training would strengthen the fidelity of teachers implementing 'Towards No Drug Abuse' (TND), a classroom education programme targeting substance use and violence-related behaviours through the use of motivation, skills, and decision-making. The teachers from the participating schools were assigned to one of three groups: (1) comprehensive implementation support for Project TND teachers (IMP-SUPPORT) in which they received a one-day workshop conducted at the programme sites by certified Project TND trainers, a 2-hour technical assistance session that provided an overview of the web site and coaching (i.e. access to online forums and resources) and two more coaching sessions that were delivered during the delivery of the curriculum at school; (2) regular workshop training only (REGULAR); or (3) standard control group (CTRL). The workshop was intended to introduce the key concepts and skills required by the programme and build teacher self-efficacy and comfort with the programme approach. Students in the CTRL group received any drug abuse prevention activities provided directly by their school. The comprehensive training condition produced a significantly stronger effect on intentions to use drugs ($p<0.05$), a marginally significant stronger effect on cigarette use intentions ($p=0.09$), and a marginally significant greater gain in programme-related knowledge ($p=0.06$), compared to the control. Results of fidelity in the IMP-SUPPORT compared to the REGULAR group indicated higher implementation fidelity in the IMP-SUPPORT classes (mean=0.15, SD=0.87) relative to the REGULAR classes (mean= -0.22, SD=1.14; $p<0.05$). The authors concluded that a comprehensive training model, which supplemented a pre-implementation training workshop with ongoing support during the implementation process, produced stronger implementation fidelity relative to a model that included a training workshop alone.

Based on a cluster randomised design, Clarke et al. (2014) assessed the effectiveness of different strategies for implementing an emotional wellbeing program - Zippy's Friends - for school-aged children between five and eight years. The program was implemented in 52 classes (1st grade) across 44 schools in Ireland. Schools were randomly assigned to two different approaches to fidelity: they either had to fully adhere to program instructions or could use these as a resource and adapt them as needed. Teachers completed the emotional literacy checklist and a programme fidelity checklist at regular intervals. Results from the study mirrored that high teacher fidelity in delivering the programme was related to improved emotional literacy in children post intervention ($p<0.001$).

Finally, Matsumara et al. (2010) investigated the effect of a school's pre-existing social resources on the implementation of a comprehensive literacy training programme. This program, Content-Focused Coaching (CFC), was developed for elementary school teachers and aimed to improve the quality of instructional practices and student learning. It implies intensive and ongoing professional development for teachers to improve their knowledge base, instructional skills, and ability to work effectively with colleagues. The study focused on how the principal leadership, school-level norms for teachers' professional community, and participant characteristics could influence implementation of CFC. 96 teachers from 29 schools in the U.S. were involved in this study. Fifteen schools received a CFC-trained coach and 14 schools continued with the professional development resources that were already present. The teachers who received coaching and the coaches who trained them were surveyed after one year. Teachers in the CFC schools reported significantly greater emphasis than comparison teachers on planning and instruction ($p < 0.05$), help during lesson enactment ($p < 0.05$), and building knowledge of the theory behind effective reading comprehension instruction ($p < 0.05$). Principal leadership was identified as a key resource supporting implementation of the programme and positively predicted greater teacher participation in coaching activities.

4.3. Implementation quality studies

An additional 28 studies could be categorised as implementation quality studies. They often retrospectively assessed the quality of the implementation of an educational intervention to ensure that it had been properly delivered as part of a trial. These studies did not examine the relationship between the quality of an implementation, its outcomes or the outcomes achieved for end-users. They are descriptive in character rather than explanatory. We summarise them briefly in the following.

Out of the 28 studies,

- 20 were conducted in the U.S. (Alaimo et al., 2015; Belansky et al., 2013; Brenick et al., 2014; Coleman et al., 2012; Davidson et al., 2009; Grandstaff-Beckers et al., 2013; Hall et al., 2012; Hartry et al., 2008; Kaimal & Jordan, 2016; Kelly et al., 2015; Lesaux et al., 2010; Little et al., 2013; Sanchez et al., 2007; Smokowski et al., 2016; Sy & Glanz, 2008; Thaker et al., 2008; Vaughn et al., 2013; Volpe et al., 2013; Whittemore et al., 2013; Wijekumar et al., 2013)
- Eight studies came from Ireland (Clarke et al., 2014), the UK (Campbell et al., 2015) Spain (Ariza et al., 2013), Sweden (Elinder et al., 2012), Poland (Adamowicz et al., 2015), Germany (Gollwitzer et al., 2006), South Africa (James et al., 2006) and the Netherlands (Martens et al., 2006).

Multiple **implementation measures** were applied in these studies:

- 23 reported the use of a fidelity measure to assess the degree to which an intervention had been delivered appropriately (Ariza et al., 2013; Belansky et al., 2013; Brenick et al., 2014; Campbell et al., 2015; Clarke et al., 2014; Coleman et al., 2012; Davidson et al., 2009; Elinder et al., 2012; Grandstaff-Beckers et al., 2013; Hall et al., 2012; Hartry et al., 2008; James et al., 2006; Kaimal & Jordan, 2016; Kelly et al., 2015; Lesaux et al., 2010; Little et al., 2013; Sanchez et al., 2007; Smokowski et al., 2016; Sy & Glanz, 2008; Vaughn et al., 2013; Volpe et al., 2013; Wijekumar et al., 2013).
- Three reported on the adoption of the intervention (Campbell et al., 2015; Thaker et al., 2008; Whittemore et al., 2013)
- Three on its reach (Alaimo et al., 2015; Campbell et al., 2015; Wijekumar et al., 2013).
- Five measured the dose of the intervention (Alaimo et al., 2015; Campbell et al., 2015; Hall et al., 2012; Smokowski et al., 2016; Sy & Glanz, 2008)

The studies utilised a broad range of **implementation strategies**

- 19 applied training as an implementation strategy (Alaimo et al., 2015; Ariza et al., 2013; Brenick et al., 2014; Campbell et al., 2015; Clarke et al., 2014; Davidson et al., 2009; Elinder et al., 2012; Gollwitzer et al., 2006; Grandstaff-Beckers et al., 2013; Hall et al., 2012; Hartry et al., 2008; James et al., 2006; Kaimal & Jordan, 2016; Kelly et al., 2015; Lesaux et al., 2010; Little et al., 2013; Thaker et al., 2008; Vaughn et al., 2013; Volpe et al., 2013; Whittemore et al., 2013).
- Seven studies applied ongoing support (Clarke et al., 2014; Davidson et al., 2009; Grandstaff-Beckers et al., 2013; Hall et al., 2012; Kaimal & Jordan, 2016; Lesaux et al., 2010; Whittemore et al., 2013),
- Two studies used structural change (Belansky et al., 2013; Volpe et al., 2013) and another two studies focused on the provision of a manual (Gollwitzer et al., 2006; James et al., 2006).
- Seven studies did not explicitly report on any implementation strategy (Adamowicz et al., 2015; Coleman et al., 2012; Martens et al., 2006; Sanchez et al., 2007; Smokowski et al., 2016; Sy & Glanz, 2008; Wijekumar et al., 2013)

Finally, **four** implementation quality studies also identified **facilitators and barriers to implementation** (Gollwitzer et al., 2006; Hall et al., 2012; Kaimal & Jordan, 2016; Volpe et al., 2013).

5. Discussion

5.1. The role of implementation in education studies

This scoping review identified eight publications related to seven studies that examined the relationship between the quality of an implementation and its outcomes for either the implementation quality itself or for recipients of educational programmes. It identified further 28 implementation quality studies that descriptively assessed the quality of the implementation with which different educational practices had been implemented as part of trials.

These studies provide insights into the status of implementation science and practice in education. Trends present in the material are:

- *Fidelity* is the implementation outcome most acknowledged and measured in education studies. Fidelity describes to what degree an intervention has been implemented as intended by its developers. Fidelity can relate to structural aspects such as dosage and intensity (e.g. correct number of sessions, correct length of treatment) or training and continuous support (educators were trained as planned and received the necessary supervision), but it can also refer to more dynamic aspects related to e.g. the relationship between an educator and a student and describe whether the intervention was delivered sufficiently strengths-based, student-centred etc. (Boller et al., 2014). The concept of fidelity is present in the majority of both types of implementation studies and appears to be acknowledged as a relevant concept in education science.
- *Training* and *ongoing support* are the most dominant implementation strategies reported on in education studies. While training typically refers to single or multiple days of workshop activities, ongoing support involves additional resources provided to educators through experts and virtual technologies
- The effectiveness of different implementation strategies and their impact on implementation and student outcomes has only been tested in very few rigorous studies. Implementation - if addressed at all - is still primarily examined through process evaluations, many of which are conducted retrospectively rather than formatively.
- Implementation informed educational research is primarily conducted in the U.S. As part of this review, no Australian studies could be identified.

5.2. Core Concepts in Implementation Science

When comparing these trends to the current developmental stage of implementation science, there is a striking difference between the conceptual richness of the science and the limited use of these concepts within educational practice.

In the following we will introduce four commonly used concepts from implementation science and subsequently use these to provide suggestions for how to enrich educational implementation practice - and thereby research - with implementation focused thinking and knowledge.

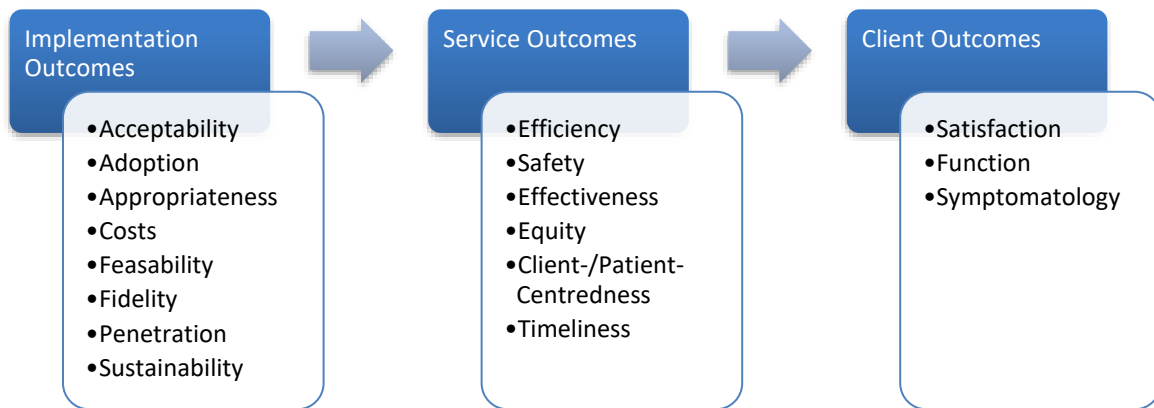
5.2.1. Implementation Outcomes

As highlighted above, with the development of implementation science a new type of outcome has been introduced, labelled as *implementation outcomes*.

These outcomes - the acceptability of a programme; the degree to which it is adopted; its appropriateness, costs or feasibility; the degree with which a programme is implemented as

intended (fidelity), its degree of penetration and its sustainability - have been integrated into a conceptual framework within which they precede and thereby affect the quality of service delivery - e.g. the quality of teaching - and the outcomes for students (Proctor et al., 2011). This framework is presented in the diagram below.

Figure 1: Proctor’s conceptual framework for implementation outcomes



In pointing to the importance of thinking about implementation outcomes, this framework is a helpful tool for practice to consider the implementation quality requirements of an intervention, and how these requirements relate to other outcomes already defined for an educational programme or practice.

5.2.2. Implementation frameworks

Implementation Science also has incubated the development of an abundance of implementation frameworks. Tabak et al. (2012) identified 61 of these “... strategic or action-planning models that provide a systematic way to develop, manage, and evaluate interventions ...” (p.337), 12 of which are particularly developed to support the implementation of evidence based practice within different real world settings.

Scientists sometimes differ between action frameworks on the one hand and explanatory implementation frameworks on the other. While action frameworks include a set of integrated implementation concepts assumed to be important to apply and pay attention to when planning, preparing, facilitating and evaluating an implementation process, explanatory implementation frameworks are developed as heuristics to think through potential barriers and facilitators that may influence an implementation and therefore help understand the process which a system, an organisation or staff are involved in. Two of these frameworks are briefly introduced in this section.

The Active Implementation Frameworks (AIF) are a collection of five basic concepts recommended to include in daily implementation practice to succeed with the sustainable uptake of evidence. The AIF was developed from a multidisciplinary perspective and is described as applicable within different human services, including education (Fixsen et al., 2005). See the box below.

The National Implementation Research Network (NIRN) has developed the **Active Implementation Framework (AIF)** since 2005. In its current version, the AIF consists of five basic assumptions:

1. Implementation depends on *usable intervention criteria*. Programs and practices need to be fully operationalized so implementation support can be tailored and adherence to program and practice requirements measured continuously.
2. Implementation takes place in *stages*. An implementation process goes through four stages: exploration, installation, initial implementation, and full implementation.
3. Implementation needs to be embedded into a strong infrastructure of implementation **drivers** to enable the development of required competencies, leadership and organisation and system support for the implementation.
4. Implementation should be driven by data-informed *improvement cycles*.
5. *Implementation teams* should support and drive an implementation. They build local and system wide implementation capacity and are accountable for moving practices and programs through the different stages of an implementation process.

(Metz & Albers, 2014)

The Consolidated Framework for Implementation Research (CFIR) has a strong position in health-related implementation research but is increasingly gaining attention in other human service sectors as well. Based on an analysis of the components of 19 other implementation models and theories, the CFIR synthesises common constructs assumed to affect implementation, e.g. the readiness of an organisation, its climate or culture, or its leadership. These and multiple other constructs are assigned to five different implementation domains:

- The characteristics of the intervention itself
- The inner setting of an implementation, e.g. the organisational structure of a single school or other educational institutions, the levels of inner cohesion and integration, communication etc.
- The outer setting, e.g. legislation, funding structures, policy initiatives and agendas etc.
- The characteristics of the individuals involved in an implementation, e.g. the knowledge, skills, values and attitudes of teachers, principals, consultants, students or parents
- The process of the implementation itself, e.g. the resources available for implementation, its prioritisation through regular follow up, assessment etc.

As such, the CFIR provides an analytical map against which implementation projects can be analysed and explained.

It is important to emphasise that the empirical evidence base for implementation frameworks is scarce still. Few studies have tested frameworks as tools to support implementation practice and assessed how they help to increase the quality of an implementation, its pace or its cost effectiveness (Albers & Mildon, 2016).

However, such frameworks are widely applied as analytical tools to structure, plan, analyse and steer implementation processes, and as such they can be a valuable starting points for thinking thoroughly through an implementation process at any of its stages (Metz & Albers, 2014). Also, the development of implementation frameworks appears not to have stopped. New frameworks emerge (Pfadenhauer et al., 2017) and existing frameworks are continuously analysed and refined (Kirk et al., 2016), which makes this part of implementation science worth examining on a regular basis.

5.2.3. Implementation strategies

While implementation frameworks provide the ‘big picture’ for the conceptualisation of implementation science and practice, they contain few immediately actionable steps that can be directly translated into practice.

In 2013, this situation began to change with the development of the concept ‘implementation strategies’ (Powell et al., 2014; Powell et al., 2015; EK. Proctor, Powell, & McMillen, 2013). They have been defined as ‘methods or techniques used to enhance the adoption, implementation, and sustainability’ of a programme or practice (EK. Proctor et al., 2013). In a comprehensive attempt to define all strategies available to researchers, managers and practitioners of implementation through an expert informed DELPHI study, Powell et al. (2015) identified 73 of these strategies. They include actions and behaviours as diverse as

- access new funding
- change physical structure and equipment
- create new teams
- develop and implement tools for quality monitoring
- facilitate implementation processes across stakeholders
- obtain formal commitments
- promote ongoing consultation
- use data experts
- use train-the trainer strategies
- work with educational institutions

For schools, this menu of implementation strategies can function as a resource for the development of implementation plans, their targeted realisation over several stages of an implementation, their continuous monitoring and improvement, and their evaluation.

Approaches to further develop these implementation strategies and to promote their use in practice and their evaluation through research have been suggested (Bunger et al., 2017; Powell et al., 2015). These approaches provide opportunities to systematically and purposefully select, operationalise and apply implementation strategies within education settings.

5.2.4. Measuring Implementation

Given the introduction of distinct implementation outcomes highlighted in section 4.2.1, there has been an increasing interest in developing and identifying valid and reliable implementation measures helping in assessing e.g. the implementation climate in an organisation; the degree to which an evidence-based practice is adopted over time; the level of fidelity with which an intervention is implemented by staff; or the costs of an implementation process, to name just a few focus points for measuring an implementation.

One of the core projects that has helped to progress the overall knowledge about existing implementation measures has been the Society for Implementation Research Collaboration Instrument Review Project (Lewis, Fischer, et al., 2015; Lewis, Stanick, et al., 2015). While having identified more than 420 measures to date, the project also revealed that few instruments are of high quality and psychometrically sound. However, the development, testing and consolidation of implementation measures and their dissemination through repositories is progressing (Aarons, Ehrhart, & Farahnak, 2014; Ehrhart, Aarons, & Farahnak, 2014; Ehrhart, Torres, Wright, Martinez,

& Aarons, 2016; Rabin et al., 2016) thus providing enhanced opportunities to measure specific implementation constructs systematically.

Simultaneously, the debate about enhancing the development of ‘pragmatic measures’ for dissemination and implementation practice is progressing. Measures with high quality psychometric properties developed for research purposes can be burdensome to implement in real world settings where time, human and financial resources are scarce and evaluation processes need to be integrated in busy schedules and existing work routines. The concept of pragmatic measures was introduced to meet the assessment needs of service providers rather than of researchers. Their core characteristic is a high level of feasibility in real world settings. While still meeting validity and reliability requirements, pragmatic measures should also be perceived as relevant and important by their stakeholders, be brief and inexpensive to use, and actionable in practice (Glasgow & Riley, 2013). Recent implementation-focused publications reflect an interest in enhancing the development of such pragmatic measures (Beidas et al., 2016; Finn, Torres, Ehrhart, Roesch, & Aarons, 2016) some of which overlap with the education sector (Arora et al., 2016).

Implementation outcomes, frameworks, strategies and measurements are only a selection of concepts that dominate the scholarly debate and activities within implementation science. However, they represent some of the ‘big and prominent discussions’ that have been present for several years and therefore can be considered as well established. Given the absence of implementation focused literature in the field of education science, they provide well-developed starting points for discussing how implementation science may be utilised to progress education science and practice. This is the focus of the following section.

5.3. Improving Implementation in Education

Implementation Science has emerged out of an interest in understanding the mechanisms of effectively applying evidence-based practice in real world settings. Its origins are in health and a large share of the influential scientific literature has been authored by North American scholars. Taken together, this has created a strong focus on program and guideline implementation and raised the criticism, especially in social work and education, that implementation science follows a rather linear and rational logic incompatible with complex practice environments and that it presents too simplistic an approach in that it views front-line staff as pure deliverers of manualised programs, thereby depriving them of professional discretion and autonomy (Addis, Wade, & Hatgis, 1999; Davies, 2003; Petersén & Olsson, 2014; Shahjahan, 2011; Webb, 2001).

Dismissing evidence based practice and implementation science by pointing to the fact that educators are instructors of people and not deliverers of programs, and that schools and classrooms are rather complex settings would be equally simplistic. Such an argument denies the fact (a) that program implementation is only one pathway towards greater uptake of evidence in educational practice; and (b) that the foundation of evidence-based practice consists of more than best available evidence - this evidence always must be combined with professional expertise and client preferences, as mirrored in the diagram below (Haynes, Devereaux & Guyatt, 2002, p. 36-38).

Figure 2: The integration of knowledge in evidence-based practice



What does this mean for educational practice?

Educators with an interest in increasing students' learning by integrating evidence of what works best and why in classrooms and school can choose several - and also combine - different pathways towards more evidence in education.

Evidence-based programmes - such as for example School Wide Behavioural Interventions and Supports (SWPBIS) (McIntosh, Mercer, Nese, Strickland-Cohen, & Hoselton, 2016) - provide one pathway towards increasing the use of evidence in education. It consists of pre-defined and ready-made programmes that have been scientifically tested. If well-developed, their effectiveness is documented in several trials, some of which have been conducted by independent researchers, who are not involved with the programmes' developers; the sample sizes of studies were sufficiently large to achieve statistical power, and results sustained even after long-term follow up. Often, these programmes come as packages of distinct practices that are described in manuals, training and implementation guides, educators can use when implementing the programme. The application of evidence-based programmes in schools has grown in recent years, especially in the U.S., where surveys indicate that close to 47% of middle schools used an evidence-based drug use prevention curriculum in 2008. However, this evidence-based approach is typically still not the preferred approach, and the thoroughness and quality with which these programs are used varies substantially (Mihalic & Elliott, 2015). Within these settings, implementation science offers insights into how to apply and adapt programmes effectively and how to improve their quality for the benefit of students (Horner et al., 2017; Schaper et al., 2016; Tobin et al., 2012).

However, ready-made programmes are only one type of intervention that can promote the uptake of evidence in schools and classrooms. They tend to have a specific and at times narrow scope and therefore are not always able to meet the diverse needs of all students in primary, secondary or other educations. Instead, the ability of educators to acknowledge and value research, to identify evidence, to appraise its quality and to skilfully integrate it into educational practice needs to be developed, simply because the majority of interventions applied in classrooms and school will to some degree be home grown, locally developed and dependent on the professional discretion of individual or groups of teachers, principals and consultants. Also under these circumstances, implementation science has a lot to offer educators. Its tools and instruments can contribute to the systematic improvement of educational practice and support the learning and professional development of the teaching profession.

The sections below sketch initial ideas about how insights from implementation science can inform educational improvement, whether in implementing a manualised program or in day-to-day teaching and learning.

Implementation of evidence is a long-term process - not an event

It is important to acknowledge that implementation happens in stages and unfolds over a period. It cannot be considered as a single event taking place when the decision to adopt a new educational intervention has been made. Implementation begins *before* this adoption decision and it lasts for a long time *after* this decision.

There is striking agreement across several implementation frameworks in conceptualising implementation as a stage-based process, and the most common approach is four-phased. This is visible, for example, in the EPIS framework, which is depicted below in a simplified version - (Aarons et al., 2010). Its name is derived from the implementation stages upon which it relies.

Table 2: Implementation phases of the EPIS framework

Implementation Phase	Exploration	Preparation	Implementation	Sustainment
Outer Context	Socio-political Context Funding Client Advocacy Inter-organizational Networks	Socio-political context Funding Client Advocacy Inter-organisational networks	Socio-political context Funding Inter-organisational networks Intervention developer engagement Leadership	Socio-political context Funding Public-academic collaboration
Inner Context	Organisational characteristics Individual adopter characteristics	Organisational characteristics Leadership	Organisational characteristics Innovation-values fit Individual adopter characteristics	Organisational characteristics Fidelity monitoring and support Staffing

In the four-phased approach, implementation begins with ‘exploration’. In this phase, schools or teams identify a particular challenge or problem they want solve and identify available evidence-based solutions to meet this challenge. A needs assessment may be part of this phase. The school or team considers the strengths and weaknesses of different approaches, their fit with the concrete school context and thereby get to a decision on what practice, program or intervention to adopt.

This leads the school or team into ‘preparation’, sometimes also called ‘installation’. The focus of this phase is on getting ready for implementation by thoroughly examining the planned intervention and its requirements. The practice may need to be further described, logic models refined and necessary changes thoroughly considered. Training may need to be held, data systems established and installed, and new staff recruited.

When preparation is finished, the school or team moves into ‘initial implementation’. This is a vulnerable phase in which the new practice to be implemented in the classroom or school will be applied for the first time. To begin with, even highly experienced educators and administrators may feel awkward because new behaviours and structures need to be learned, old habits set aside, and a feeling of ‘incompetence’ accepted for a little while. The focus of this phase therefore is on quality assurance and quality improvement. Data will be collected and experience gathered while applying the new practice, and this information will be used to understand the most immediate and crucial implementation barriers and facilitators. Problem solving - in efforts to address implementation barriers - is another core activity of this phase.

After having gained familiarity with the new practice and sufficient competency in applying the practice in different situations and with different students, a process of routinisation sets in and the school or team moves into 'full implementation'. It may be that the focus in this phase is on consolidating the practice further in its current context, but full implementation can also mean that an implementation that previously was contained to a single team in a school now is expanded to also entail other teams or units at a school or even further schools. In the EPIS framework, the term 'sustainment' describes this phase.

The stage-based thinking may give the impression that implementation is a rather lean and smooth process. However, anyone with implementation experience knows that implementation can be full of surprises, setbacks and changes of direction. Schools or teams trying to implement a new practice may find themselves with unsolvable problems or unintended outcomes during preparation and therefore move back to exploration. Unexpected staff turnover may force a school from full implementation back to preparation. Changes in leadership or policy agendas may overturn the decisions made in exploration and end to an implementation process that has hardly begun. To keep these dynamics in mind while progressing an implementation can be helpful in managing frustrations - setbacks and barriers are natural ingredients of an implementation.

There are no fixed timelines for a good implementation process. Its length and duration will depend on the innovation itself - its complexity, adaptability and readiness for use - and the context into which it will be embedded, be that a single classroom, a school or an entire school system. However, it is not unusual to spend 2-4 years on an implementation process (Forgatch et al., 2013).

What also becomes transparent through a framework like the EPIS is that the importance and weight of different factors and actors changes between different implementation phases. While the socio-political context and funding structures and availability are of continuous importance in the environment surrounding the implementation (outer context), the actors important to a stage differ. For example, while parent advocacy or the influence of teacher associations and other sector interest groups may affect the exploration and installation phase, their weight decreases when an implementation has begun. Similarly, in the inner context, the characteristics of the implementing school or unit will be of equal importance across all phases but the importance of leadership is assumed to be greater during installation than in the sustainment phase.

Other frameworks may be equally helpful for the teaching profession (Albers & Mildon, 2016). One framework that has gained some attention in educational settings (Coleman & Hendricker, 2016) is the Getting to Outcomes (GTO) approach (Wandersman et al., 2000). While it focuses primarily on creating a strong evaluation culture, it also integrates implementation components and can clearly support an implementation process in school settings.

How this thinking can be further operationalised in different implementation projects depends again on the particular innovation and its context. It is important to note that the requirements of an implementation change over time. Implementation plans, structures and activities should therefore be viewed from a dynamic rather than a static perspective. This implies revisiting them on a regular basis, keeping them flexible, and using the information derived from implementation practice to tailor them continuously to the what is happening in the schools and classrooms.

Considering the Intervention: What to implement? And how?

With the concept of stages in mind, it becomes clear that good implementation already begins during exploration. It commences when educators identify an educational challenge and consider how they can best meet it. The core of this consideration is the intervention or the educational practice they plan to use in the classroom or the school.

Students cannot benefit from an instructional practice they do not receive, and educators cannot apply a practice that is not clearly defined. Surprisingly often, though, practices and programs used in classrooms and schools are hardly described, their goals not clearly defined and their theory of

change not articulated. Their application, therefore, may vary from teacher to teacher, and the educational outcomes they achieve may not meet the initial expectations.

Spending sufficient time on considering the rationale behind an educational practice, on working through how this rationale aligns with current best evidence, and on identifying and developing the core components of the practice is therefore a highly relevant investment during the exploration stage of an implementation process. While theories of change or logic models are one aid to utilise in this phase, repositories of evidence-based practice are another and provide guidance on current best evidence in different areas of the educational sector. Australian examples of such repositories are Evidence for Learning's Teaching and Learning Toolkit² and the Evaluation Repository developed by the NSW Centre for Education Statistics and Evaluation³. International examples are the Best Evidence Synthesis (BES) Programme developed by the New Zealand Ministry of Education⁴; Evidence4Impact, developed by the Institute for Effective Education at the University of York⁵; Evidence for ESSA, developed by the Center for Research and Reform in Education at Johns Hopkins University School of Education⁶; and the U.S. Department of Education's What Works Clearinghouse⁷.

The detailed development of the educational and pedagogical content of a practice will also force educators to consider how to best implement this practice, including, for example, the setting in which it will be delivered; the desirable behaviours of educators when applying the practice with students; the intensity and dosage with which it should be delivered; or the training required to be sufficiently prepared for applying the practice. In other words, detailing the 'what' almost automatically leads educators to also detail the 'how' and thereby move into the field of implementation requirements.

These requirements include considerations about fidelity. As highlighted above, 'fidelity' describes the degree with which an intervention has been implemented as intended by its developers. It is a concept that has gained attention in education, but given the progress implementation science has made in understanding the role of fidelity for practice, its use and operationalisation in education is not yet well developed. More sophisticated approaches to the development of fidelity criteria can be found in the literature (Boller et al., 2014; McLeod et al., 2013) and used to promote tailored and adaptable fidelity frameworks for educational practice that can be integrated in robust processes of continuous quality improvement, one of the core activities in good implementation practice.

Continuous Quality Improvement

Continuous Quality Improvement (CQI) has long been a standard in the healthcare industry (Blumenthal & Kilo, 1998; Rubenstein et al., 2014) and is slowly gaining ground in other human service professions as a process of '*planning to improve a product or process, plan implementation, analysing and comparing results against those expected, and corrective action on differences between actual and expected*' (Lorch & Pollack, 2014, p. e97066).

CQI refers to the process of systematically and continuously collecting and reviewing data about the implementation of an educational program, practice or intervention. Its purpose is to identify opportunities for improving implementation and thereby to deliver better educational services to students and improve their educational outcomes. CQI emphasises an ongoing or continuous process of improvement and evaluation typically based on a plan-do-study-act (PDSA) cycle driven thinking as mirrored in the diagram below.

² <http://evidenceforlearning.org.au/the-toolkit/>

³ <https://www.cese.nsw.gov.au/cese-sites/evaluation-repository>

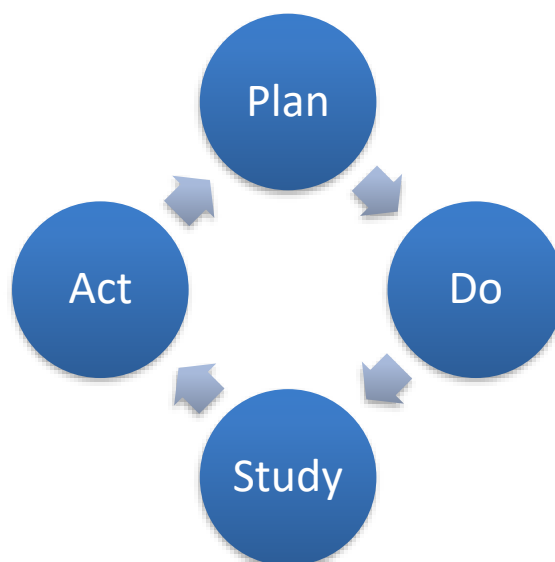
⁴ <https://www.educationcounts.govt.nz/topics/BES>

⁵ <http://www.evidence4impact.org.uk/about.php>

⁶ <https://www.evidencefoessa.org/>

⁷ <https://ies.ed.gov/ncee/wwc/>

Figure 3: The Plan-Do-Study-Act (PDSA) cycle



Any type of educational practice - be that an empirically supported, evidence-based program or a locally developed, evidence-informed practice - can be prepared and implemented based on a CQI driven logic. An important precondition for enabling CQI in school settings is a data-focused culture that supports staff at all levels of a school system in both generating, reporting and utilising data as a natural part of their educational practice. First indicators of this thinking are visible in not only education science (Le Mahieu et al., 2017; Derrick-Mills et al., 2015; Kaufman et al., 2014) but also in practice where organisations such as the Carnegie Foundation for the Advancement of Teaching⁸ advocate for the use of improvement science - a sister to implementation science - in education (bryk et al., 2015). These are promising examples of a culture shift towards a stronger focus on the use of data to inform educational practice design and development.

Supporting front-line staff

Using data and evidence to inform practice; planning the implementation of evidence in classrooms and schools systematically; applying new pedagogical methods, techniques, instruments or measures; or leading educational change processes from an implementation-informed perspective - processes like these depend on not only organisational but also individual behaviour change.

After having been trained in a new practice, both newly graduated and highly experienced educators often struggle when trying to apply the new knowledge in the classroom. That simple single-exposure training is not sufficient to achieve this practice change has been well-known for some time (Lyon et al., 2010; Joyce & Showers, 2002). Simultaneously, the role of ongoing staff support in enabling change processes has been increasingly examined - as reflected by the few implementation effectiveness studies identified through this review.

This support - provided through continuous feedback, supervision, coaching, practice observation and other techniques - has shown to be important for implementation processes in a range of human service settings, including education (Kennedy et al., 2017; Goense et al., 2015; Bearman et al., 2013; Nadeem et al., 2013; Barwick et al., 2012; Becker & Domitrovich, 2011; Jamtvedt et al.,

⁸ <https://www.carnegiefoundation.org/>

2006). It should therefore be considered when planning for implementation in classrooms and schools.

The duration, dosage and form in which ongoing support is provided to educators may vary depending on the educational practice that is being implemented. Ongoing support can rely on peer-based structures only; on internal supervisors; additional external expert consultants; on regular direct observation of classroom practice; audio- or video tapes or on other data collected as part of continuous quality improvement processes that involve faculty, parents and students.

Implementation leadership

In recent years, the field of implementation science also has paid increasing attention to the role of leadership for the successful uptake of evidence in human service practice. While there is a general agreement that leadership is important, the empirical evidence base is developing only slowly (Reichenpfader et al., 2015). However, first studies examining implementation leadership confirm a relationship between the presence of leadership in an organisation and its implementation climate (Brimhall et al., 2015), implementation success (Palinkas & Aarons, 2011) and the sustainment of evidence-based practice (Aarons et al., 2016).

Aarons et al. (2016) highlight the role of transformational leadership for the inner context of an implementation. This type of leadership is characterised by three core behaviours:

- Creating a vision for the uptake of evidence in the school or educational system;
- Engaging faculty and other staff in this vision and its realisation;
- Being a role model in realising the vision.

The latter point implies that principals, leaders of educational departments and other managers should ‘walk the talk’ and continuously acknowledge, request, enable, facilitate and display the behaviours that reflect an evidence focus: for example, to actively use data and science in developing educational practice and curricula; to apply concepts from evidence-based practice and implementation science, like the ones presented in this report, in planning the uptake of evidence in classrooms and schools; or to advocate and champion the use of evidence in all school matters. In displaying this type of leadership, the argument goes, front line staff will receive clear signals about what is expected from them but also feel supported in actively applying evidence in educational practice.

It is important to keep in mind that leadership can be exercised in many ways and is not limited to formal authority. Principals, department heads and regular staff can provide implementation leadership through their behaviour and support the uptake of evidence through role modelling, championing or opinion leadership (Valente & Pumpuang, 2007; Greenhalgh et al., 2004; Lockock et al., 2001).

Enhancing Education Science

The three sections above outline several concepts that have emerged through implementation science and have the potential to enhance the quality of implementation practice in education. This final section circles back to the field of education science and the still limited presence of implementation science in high quality studies. While the interest in implementation science in education clearly has grown, this interest has not yet led to a considerable amount of empirical research focused on testing the effectiveness of different implementation strategies, for example, for implementing a particular classroom based educational practice; for supporting teachers in their uptake of evidence through professional development; or for providing principals with implementation-informed executive coaching. Given the contained environment of school settings, which provide good opportunities for randomisation processes at the teacher, team, classroom or

school level, there is an abundance of opportunities to conduct relevant trials that test concepts from implementation science that have yet to be examined.

Implementation science is not a stranger to education science. However, the fact that the majority of implementation effectiveness studies were focused on interventions targeting the mental or behavioural health of students rather than their academic achievements indicates that the field of education science has yet to fully embrace this new discipline and utilise the opportunities it provides to improve educational outcomes for students.

This is particularly relevant for Australia. No studies conducted in Australia or New Zealand could be identified for this review, making the enhancement of an education-focused implementation science even more important in this country.

5.4. Limitations

This review has limitations that are important to keep in mind when interpreting results and implications.

Firstly, while the scoping review method is considerably more rigorous than a standard literature review, it is not as comprehensive as a full systematic review. In order to accelerate the review process, we imposed some restrictions: We searched a limited number of databases for literature - these included the most important databases within education but there may still be education studies we missed; we did not search for grey literature; and we did not contact authors of included papers or content experts for further or ongoing studies. As a result of these necessary limits, there may have been studies that were missed in this review.

Secondly, this review is based on a screening of English literature only. Educational studies are of great interest to a range of countries in which English is not the main language, and we may therefore have missed studies written in other languages that could have been relevant to include in this review.

Finally, the field of implementation science is a young discipline still and its overall evidence base is in development. Implementation frameworks, strategies or other concepts have not undergone comprehensive and rigorous empirical testing, and their translation and use within educational settings require caution and a critical, analytical view from their users. Just like evidence-based practice, the application of implementation science should always be embedded into a framework of continuous quality improvement through which implementation interventions are examined, measured and evaluated.

6. Conclusion

This review explores what is known about the use of implementation strategies in the field of education to enhance learning outcomes for school-aged children.

The findings from this review confirm that implementation is a domain of interest to education science. However, the application of concepts and models developed within implementation science is emerging only slowly and is underdeveloped still.

There are indications in the literature that high quality implementation contributes to improved educational services and thereby to better student outcomes. However, these indications relate to a limited number of implementation strategies - in particular, training and ongoing support - and few implementation outcomes - in particular, fidelity. Furthermore, the current knowledge base is U.S.-centric, and Australian or New Zealand based implementation focused education studies could not be identified.

The conceptual richness of the field of implementation science invites further exploration of how its concepts can be integrated and utilised both as part of high quality educational studies and of good educational implementation practice.

Within education science, this may imply the development and funding of rigorous study designs aimed at testing different approaches to implementation of evidence-based practice in classrooms, schools and school systems - in particular in Australian settings.

For educational practice, this may include the application of a broader array of implementation strategies to support the uptake of evidence in curriculum design and pedagogy; a stronger and more systematic planning of implementation activities in education - across both stages of implementation (exploration, preparation, implementation, sustainment) and its inner and outer context; or the development of a data-focused school culture in which continuous quality improvement is a natural ingredient in the daily routines of educators.

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Appendix A Included studies

Studies on Implementation Effectiveness

#	Citation
1	Artman-Meeker, K., Hemmeter, M. L., & Snyder, P. (2014). Effects of Distance Coaching on Teachers' Use of Pyramid Model Practices. <i>Infants & Young Children: An Interdisciplinary Journal of Early Childhood Intervention</i> , 27(4), 325-344.
2	Gray, H. L., Contento, I. R., & Koch, P. A. (2015). Linking Implementation Process to Intervention Outcomes in a Middle School Obesity Prevention Curriculum, "Choice, Control and Change". <i>Health Education Research</i> , 30(2), 248-261.
3	Kam, C.-M., Greenberg, M. T., & Walls, C. T. (2003). Examining the role of implementation quality in school-based prevention using the PATHS curriculum. <i>Prevention Science</i> , 4(1), 55-63.
4	Lee, H., Contento, I. R., & Koch, P. (2013). Using a Systematic Conceptual Model for a Process Evaluation of a Middle School Obesity Risk-Reduction Nutrition Curriculum Intervention: "Choice, Control & Change". <i>Journal of Nutrition Education and Behavior</i> , 45(2), 126-136.
5	Matsumura, L. C., Garnier, H. E., & Resnick, L. B. (2010). Implementing Literacy Coaching: The Role of School Social Resources. <i>Educational Evaluation and Policy Analysis</i> , 32(2), 249-272.
6	Rohrbach, L. A., Gunning, M., Sun, P., & Sussman, S. (2010). The Project Towards No Drug Abuse (TND) Dissemination Trial: Implementation fidelity and immediate outcomes. <i>Prevention Science</i> , 11(1), 77-88.
7	Sarama, J., Clements, D. H., Starkey, P., Klein, A., & Wakeley, A. (2008). Scaling up the Implementation of a Pre-Kindergarten Mathematics Curriculum: Teaching for Understanding with Trajectories and Technologies. <i>Journal of Research on Educational Effectiveness</i> , 1(2), 89-119.
8	Clarke, A.M., Bunting, B. & Barry, M.M. (2014). Evaluating the Implementation of a School-Based Emotional Well-Being Programme: A Cluster-Randomised Controlled Trial of Zippy's Friends for Children in Disadvantaged Primary Schools, <i>Health Education Research</i> , 29(5), 786-798

Studies on Implementation Quality

#	Citation
1	Adamowicz, K., Zalewska, M., Majkowicz, M., & Zaucha, J. M. (2015). Evaluation of the Impact of Different Types of Health Education on the Adoption and Preservation of Prohealth Attitudes in Preventing Cancer in Juveniles Younger than 18 Years. <i>Journal of Cancer Education</i> , 30(3), 432-438.
2	Alaimo, K., Carlson, J., Pfeiffer, K., Eisenmann, J., Paek, H.-J., Betz, H., . . . Norman, G. (2015). Project FIT: A School, Community and Social Marketing Intervention Improves Healthy Eating Among Low-Income Elementary School Children. <i>Journal of Community Health</i> , 40(4), 815-826.
3	Ariza, C., Perez, A., Sanchez-Martinez, F., Dieguez, M., Espelt, A., Pazarin, M., . . . Nebot, M. (2013). Evaluation of the effectiveness of a school-based cannabis prevention program. <i>Drug and Alcohol Dependence</i> , 132(1-2), 257-264.
4	Belansky, E. S., Cutforth, N., Chavez, R., Crane, L. A., Waters, E., & Marshall, J. A. (2013). Adapted Intervention Mapping: A Strategic Planning Process for Increasing Physical Activity and Healthy Eating Opportunities in Schools via Environment and Policy Change. <i>Journal of School Health</i> , 83(3), 194-205.
5	Brenick, A., Shattuck, J., Donlan, A., Duh, S., & Zurbriggen, E. L. (2014). Empowering children with safety-skills: An evaluation of the Kidpower Everyday Safety-Skills Program. <i>Children & Youth Services Review</i> , 44, 152-162.
6	Campbell, R., Rawlins, E., Wells, S., Kipping, R. R., Chittleborough, C. R., Peters, T. J., . . . Jago, R. (2015). Intervention fidelity in a school-based diet and physical activity intervention in the UK: Active for Life Year 5. <i>The International Journal of Behavioral Nutrition and Physical Activity</i> Vol 12 Dec 2015.
8	Coleman, K. J., Shordon, M., Caparosa, S. L., Pomichowski, M. E., & Dziewaltowski, D. A. (2012). The healthy options for nutrition environments in schools (Healthy ONES) group randomized trial: Using implementation models to change nutrition policy and environments in low income schools. <i>The International Journal of Behavioral Nutrition and Physical Activity</i> Vol 9 Jun 2012.
9	Davidson, M. R., Fields, M. K., & Yang, J. (2009). A Randomized Trial Study of a Preschool Literacy Curriculum: The Importance of Implementation. <i>Journal of Research on Educational Effectiveness</i> , 2(3), 177-208.
10	Elinder, L. S., Heinemans, N., Hagberg, J., Quetel, A.-K., & Hagstromer, M. (2012). A participatory and capacity-building approach to healthy eating and physical activity-SCIP-school: A 2-year controlled trial. <i>The International Journal of Behavioral Nutrition and Physical Activity</i> Vol 9 Dec 2012.
11	Gollwitzer, M., Eisenbach, K., Atria, M., Strohmeier, D., & Banse, R. (2006). Evaluation of Aggression-Reducing Effects of the "Viennese Social Competence Training". <i>Swiss Journal of Psychology</i> , 65(2), 125-135.
12	Grandstaff-Beckers, G., Saal, L. K., & Cheek, E. (2013). Investigating Treatment Fidelity and Social Validity of a Peer-Mediated Postsecondary Reading Intervention. <i>Reading Psychology</i> , 34(4), 336-354.

#	Citation
13	Hall, W. J., Zeveloff, A., Steckler, A., Schneider, M., Thompson, D., Pham, T., . . . McMurray, R. G. (2012). Process Evaluation Results from the HEALTHY Physical Education Intervention. <i>Health Education Research</i> , 27(2), 307-318.
14	Hartry, A., Fitzgerald, R., & Porter, K. (2008). Implementing a Structured Reading Program in an Afterschool Setting: Problems and Potential Solutions. <i>Harvard Educational Review</i> , 78(1), 181-210,278-279.
15	James, S., Reddy, P., Ruiter, R. A., McCauley, A., & van den Borne, B. (2006). The impact of an HIV and AIDS life skills program on secondary school students in Kwazulu-natal, south Africa. <i>AIDS Education and Prevention</i> , 18(4), 281-294.
16	Kaimal, G., & Jordan, W. J. (2016). Do Incentive-Based Programs Improve Teacher Quality and Student Achievement? An Analysis of Implementation in 12 Urban Charter Schools. <i>Teachers College Record</i> , 118(7), 1-34.
17	Kelly, S. A., Oswald, K., Melnyk, B. M., & Jacobson, D. (2015). Comparison of Intervention Fidelity between COPE TEEN and an Attention-Control Program in a Randomized Controlled Trial. <i>Health Education Research</i> , 30(2), 233-247.
18	Lesaux, N. K., Kieffer, M. J., Faller, S., & Kelley, J. G. (2010). The effectiveness and ease of implementation of an academic vocabulary intervention for linguistically diverse students in urban middle schools. <i>Reading Research Quarterly</i> , 45(2), 196-228.
19	Little, M. A., Sussman, S., Sun, P., & Rohrbach, L. A. (2013). The Eeffects of Implementation Fidelity in the "Towards No Drug Abuse" Dissemination Trial. <i>Health Education</i> , 113(4), 281-296.
20	Martens, M., van Assema, P., Paulussen, T., Schaalma, H., & Brug, J. (2006). Krachtvoer: Process Evaluation of a Dutch Programme for Lower Vocational Schools to Promote Healthful Diet. <i>Health Education Research</i> , 21(5), 695-704.
21	Sanchez, V., Steckler, A., Nitirat, P., Hallfors, D., Cho, H., & Brodish, P. (2007). Fidelity of Implementation in a Treatment Effectiveness Trial of Reconnecting Youth. <i>Health Education Research</i> , 22(1), 95-107.
22	Smokowski, P. R., Guo, S., Wu, Q., Evans, C. B., Cotter, K. L., & Bacallao, M. (2016). Evaluating dosage effects for the positive action program: How implementation impacts internalizing symptoms, aggression, school hassles, and self-esteem. <i>American Journal of Orthopsychiatry</i> , 86(3), 310-322.
23	Sy, A., & Glanz, K. (2008). Factors Influencing Teachers' Implementation of an Innovative Tobacco Prevention Curriculum for Multiethnic Youth: Project SPLASH. <i>Journal of School Health</i> , 78(5), 264-273.
24	Thaker, S., Steckler, A., Sanchez, V., Khatapoush, S., Rose, J., & Hallfors, D. D. (2008). Program characteristics and organizational factors affecting the implementation of a school-based indicated prevention program. <i>Health Education Research</i> , 23(2), 238-248.
25	Vaughn, S., Roberts, G., Klingner, J. K., Swanson, E. A., Boardman, A., Stillman-Spisak, S. J., . . . Leroux, A. J. (2013). Collaborative Strategic Reading: Findings from Experienced Implementers. <i>Journal of Research on Educational Effectiveness</i> , 6(2), 137-163.
26	Volpe, S., Hall, W., Steckler, A., Schneider, M., Thompson, D., Mobley, C., . . . Ghormli, L. (2013). Process evaluation results from the HEALTHY nutrition intervention to modify the total school food environment. <i>Health Education Research</i> , 28(6), 970-978.
27	Whittemore, R., Chao, A., Jang, M., Jeon, S., Liptak, T., Popick, R., & Grey, M. (2013). Implementation of a School-based Internet Obesity Prevention Program for Adolescents. <i>Journal of Nutrition Education & Behavior</i> , 45(6), 586-594.
28	Wijekumar, K., Meyer, B. J. F., & Lei, P. (2013). High-fidelity implementation of web-based intelligent tutoring system improves fourth and fifth graders content area reading comprehension. <i>Computers & Education</i> , 68, 366-379.

Characteristics and findings of implementation effectiveness studies

Study	Country	Study aim	Study design	Population	Educational Intervention	Implementation Intervention	Implementation Outcomes	Educational Outcomes
Artman-Meeker (2014)	U.S.	To compare the effects of 2 professional development approaches on teachers' implementation of the Pyramid model	RCT	33 Head Start teachers from 9 Centres	The Pyramid Model, a classroom-wide approach for fostering social-emotional development and addressing challenging behaviour	Intervention group: 1-day training in the Pyramid model + distance coaching sessions. Control group: 1-day training only	There was no statistically significant effect associated with the professional development intervention and TPOT scores (used to measure teachers' use of Pyramid practices) across time, $F(3, 90) = 0.4, p = .8$; experimental condition, $F(1, 30) = 0.0001, p = .9$. There was a small but significant effect for classroom interaction quality for the intervention group (Wilk's $\lambda = 0.7, F(3, 29) = 2.9, p = .05$) as measured with CLASS (Classroom Assessment Scoring System)	Not reported.
Clarke (2014)	Ireland		Cluster RCT	Children in first grade (aged 7-8 years) in 52 classes from 44 schools (N0766 children)	Zippy's Friends, an international school-based emotional and mental well-being programme. Zippy's Friends has six modules centred around a set of stories about a group of children, their families, friends and an imaginary stick insect called Zippy. The modules focus on themes: (i) feelings; (ii) communication; (iii) making and breaking relationships; (iv) conflict resolution; (v) dealing with change and loss; (vi) general coping skills. The program consists of 24 sessions	Intervention group 1: Teachers were asked to implement the programme as faithfully as possible. Intervention group 2: Teachers were requested to use the programme as a resource. They could decide which parts of the programme they would implement and could combine this programme with other curriculum resources. Teachers in both intervention groups attended a 2-day training workshop and during implementation were supported through school visits and group meetings	The results indicate that there was no significant difference in programme fidelity between the two intervention groups. Programme fidelity was high among both groups. Path analysis revealed that after controlling for clustering and all factors restricted to being equal across the time points, programme fidelity had a significant impact on the Emotional Literacy subscale scores at post-intervention ($P < 0.001$).	Path analysis revealed that the programme had a significant positive effect on children's emotional literacy skills. Post-intervention results from the Emotional Literacy Checklist showed a significant increase in the intervention group's subscale scores on self-awareness, self-regulation, motivation and social skills when compared with the control group ($P < 0.01-0.05$).

Study	Country	Study aim	Study design	Population	Educational Intervention	Implementation Intervention	Implementation Outcomes	Educational Outcomes
Gray (2015)					implemented over one academic year.	by health promotion specialists. Control group: The control schools were given no direction and thus implemented the existing curriculum as usual.		
	U.S.	To assess how the effectiveness of the CCC curriculum differs, based on high, medium, and low implementation when compared with the control group; and to assess the linear relationships between process components and student outcomes	Cluster RCT	Students from 10 public middle schools (mean age 12 years). 5 schools, 20 classes and 562 students were in the intervention and 5 schools, 21 classes and 574 students in the control condition.	'Choice, Control and Change' (CCC), a nutrition curriculum to improve the energy balance related behaviours of students. The curriculum aims to increase the consumption of fruits, vegetables, and water; and the physical activity of students while decreasing the intake of sweetened beverages, packaged snacks, fast food; and of leisure screen time. The curriculum consists of 24 lessons and is taught by science teachers in science classes most school days over 8-10 weeks. The control group received the regular science curriculum.	Intervention group: Professional development consisting of workshops and on-going support. Control group: No support.	Fidelity ('Faithfulness to the Curriculum') was measured with a classroom observation form and trained classroom observers completed the forms. The range of scores was 62-93% (mean of 76%). 'Lesson Completion': range 60-93% (mean 70%). Teacher implementation was calculated by combining 'Faithfulness to the Curriculum' and 'Lesson Completion'. Reach: 'Student Engagement': range 49-100% (mean 72%); 'Classroom Management': range 33 to 100% (mean 67%). 'Student Engagement' and 'Classroom Management' determine whether students receive the curriculum ('Student Reception') or not. 'Student Satisfaction': mean 2.9 (± 0.9) on the 4-point scale.	Students from the 'high teacher implementation' classes significantly consumed fewer sweetened beverages at meals (P=0.001) and with snacks (P=0.003), packaged snacks (P=0.016) and fast food value/combo meals (P=0.047). They also consumed smaller sizes of sweetened beverages at meals (P<0.001) and with snacks (P=0.012) and fast food (P=0.001), compared with control students. There was no significant difference in any eating behaviour outcomes between medium 'Teacher Implementation' classes and control group. Both medium and high 'Teacher Implementation' groups showed significant improvements in physical activity and screen time behaviour outcomes when compared with the control group (P<0.05).
Kam (2003)	U.S.	To assess whether principals' support for the PATHS curriculum and the quality of its implementation	Quasi-experimental study	The original study included 350 1 st grade students from 6 elementary schools (3 intervention & 3	'Promoting Alternative Thinking Strategies' (PATHS) - a delinquency prevention curriculum to reduce aggression and promote social	No particular strategies were applied. The interest was to understand whether principal support could elevate outcomes in	Not reported.	Significant main effects were found for principal support and between the effects of principal support and implementation in the

Study	Country	Study aim	Study design	Population	Educational Intervention	Implementation Intervention	Implementation Outcomes	Educational Outcomes
		improve students' behavioural outcomes		control). This implementation study focuses on the 13 intervention classrooms only (164 students).	competence of elementary school-aged children in urban and rural contexts.	schools that implemented the PATHS with high quality. The PATHS Coordinator and her supervisor were asked to independently rate principal support for the implementation of PATHS. Two measures were used in the study: (1) Quality of principal support for PATHS, and (2) Quality of support for the PATHS technical assistance team. For both measures, a scale from 1 (Not supportive at all) to 4 (Very supportive) was used.		changes in all four domains: Aggression (F [3, 157] = 3.69, p = .01); behaviour dysregulation (F [3, 157] = 4.62, p < .005); social-emotional competence (F [3, 157] = 2.52, p < .06); on-task behaviours (F [3, 157] = 3.44, p = .01). The results indicated that when both the quality of implementation was high and principal support was high, students showed significantly greater reductions in aggression and behavioural dysregulation, and significant increases in emotional competence, when compared to students in the school with the lowest principal support.
Lee (2013)	U.S.	To examine the quality of the implementation of the 'Choice, Control and Change' (CCC) curriculum trialled in Gray, 2015 (summarised above).	Cluster RCT (process evaluation linked to Gray, 2015 above)	Students from the 5 intervention schools, including 20 classes and 562 students.	'Choice, Control and Change' (CCC), a nutrition curriculum to improve the energy balance related behaviours of students. The curriculum aims to increase the consumption of fruits, vegetables, and water; and the physical activity of students while decreasing the intake of sweetened beverages, packaged snacks, fast food; and of leisure screen time. The curriculum consists of 24 lessons and is taught by science teachers in science classes most school days over 8-10 weeks. The control	See Gray, 2015 above.	Fidelity / Teacher implementation: Faithfulness to the curriculum was measured by trained research staff with a classroom observation form, which included a quantitative scale. Mean 76%; Lesson completion: 70%; The percentage of each of the five-phased learning cycle covered in the classroom: Questioning (57%); Experimenting (89%); Searching (81%); Theorizing (71%); Applying to Life (52%). Reach: Trained research staff with a classroom observation form measured student engagement (mean 72%)	See Gray, 2015 above.

Study	Country	Study aim	Study design	Population	Educational Intervention	Implementation Intervention	Implementation Outcomes	Educational Outcomes
					group received the regular science curriculum.		and classroom management (mean 66.5%), both of which were used to determine whether students received the curriculum.	
Matsumura (2010)	U.S.	To assess how a school's participation in the Content Focused Coaching (CFC) program influences teachers' experience of literacy coaching; and how contextual factors in schools influence the school-level implementation of the CFC program.	RCT	96 teachers from 29 elementary schools (15 interventions and 14 control schools). The teachers taught English language learning students from low-income families.	The 'Content Focused Coaching' (CFC) program for literacy coaching. CFC is delivered by a CFC-trained coach. It provides intensive and ongoing professional development to teachers aimed at improving their knowledge base, instructional skills, and ability to work effectively with teachers. Principals and central-office leaders participate in the professional development sessions along with coaches.	Intervention group: Schools were assigned to receive a CFC-trained coach Control group: Schools were assigned to continue with the literacy coaching resources that were standard for the district.	Dosage: Frequency of teacher participation in coaching. Teachers in the CFC schools significantly ($p < .001$) increased their overall participation in coaching from the previous year prior to the onset of the CFC program, whereas comparison teachers maintained the same level of participation in coaching. Teachers in CFC schools were more positive that being observed by a coach and having a coach model lessons in their classrooms were useful activities for improving their practice ($p < .05$ and $p < .001$). Teachers in the CFC schools reported significantly greater emphasis on planning and instruction ($p < .05$), help during lesson enactment ($p < .05$), and building knowledge of the theory behind effective reading comprehension instruction ($p < .05$) than comparison teachers.	Not applicable
Rohrbach (2010)	U.S.	To test whether comprehensive training would strengthen the fidelity of teachers implementing the	RCT	2,983 students (mean age 14.8 years) and 60 teachers from 65 high schools. 22 schools in the IMP-	The 'Towards No Drug Abuse' (TND) program, a classroom education programme targeting substance use and violence-related	Intervention group 1 = REGULAR: 1-day-workshop delivered by certified TND trainers. Intervention group 2 = IMP-SUPPORT: 1-day	Fidelity was measured based on classroom observations and the use of a 7-point-rating scale to score classroom process, quality of	Net increase in knowledge in program conditions together when compared with control condition: 12%. When students in both

Study	Country	Study aim	Study design	Population	Educational Intervention	Implementation Intervention	Implementation Outcomes	Educational Outcomes
Sarama (2008)		Towards No Drug Abuse (TND) program and thereby outcomes - when compared with standard training.		SUPPORT, 21 schools in the REGULAR, and 22 schools in the CTRL condition	behaviours using a motivation, skills, and decision-making approach. 12 lessons must be implemented over 4 weeks.	workshop + web-based support (=access to online forum and resources), on-site coaching (= 2 sessions immediately after lessons 5 and 9 of the curriculum), technical assistance (2 hrs to provide overview of web resources and coaching sessions) from the TND team. Control group = CTRL: Standard care, no TND	delivery, and perceived student acceptance. When comparing fidelity in the comprehensive with the regular training condition, the results indicated higher implementation fidelity in the comprehensive condition classes (mean=0.15, SD=0.87) relative to the regular training condition classes (mean= -0.22, SD=1.14; p<0.05).	intervention conditions combined were compared to control students, there was a significant net program effect on cigarette, marijuana, and hard drug use intentions (p's<0.05). In addition, there was a significant overall program effect on three of the four belief constructs, including pro-drug myths (p<0.01), immorality of drug use (p<0.01), and health-as-a-value (p<0.05), and a marginally significant effect on the fourth belief construct, addiction concern (p<0.10).
	U.S.	To measure the impact of professional development and fidelity on the implementation of the evidence-based TRIAD intervention (Technology-enhanced, Research-based, Instruction, Assessment, and professional Development) model for pre-K programs for low-income children.	RCT	25 public preschool and Head Start classrooms (13 experimental, 12 control), including 25 teachers, and 209 children (average age = 4.3 years).	The TRIAD intervention model (Technology-enhanced, Research-based, Instruction, Assessment, and professional development), a pre-kindergarten mathematics curriculum with a particular implementation approach (see implementation intervention).	Intervention: The TRIAD model. The TRIAD provides multiple forms of support for teachers, two of which were implemented in this study. (1) Professional development (training) sessions for teachers = 1.5 day of training; distance education video meetings, discussion with project staff and interactions with peers, 2 hrs of hands-on experience with the curriculum, videos of best practice. (2) Coaching for teachers: Minimum 1 visit by coaches to teachers per month focused on encouraging participation, monitoring, planning, reflection and reinforcement. Control	Classroom teaching practices and environment were assessed using two instruments, Fidelity of Implementation (Fidelity) and Classroom Observation of Early Mathematics – Environment and Teaching (COEMET). COEMET's T-scores showed a significant treatment effect, F(1, 23)= 7.14, p = .014, MSE = 78.23, but no significant main effect for time and no significant treatment × time interaction. The TRIAD group had the higher scores. TRIAD means were higher than control means for number of mathematical activities (3.6 vs. 2.8) and duration (15.4 vs.	Children's mathematical knowledge (measured with the Research-based Early Mathematics Assessment (REMA): The TRIAD group made significantly greater gains than the control group (p=0.000, effect size for TRIAD = .62). The TRIAD condition was not noticeably more effective than the control condition in the areas of comparing shapes, transformations, and measurement but had somewhat higher means in recognition of number and subitising, arithmetic, and patterning.

Study	Country	Study aim	Study design	Population	Educational Intervention	Implementation Intervention	Implementation Outcomes	Educational Outcomes
						group: Maths curriculum as usual.	12.2). TRIAD teachers reported teaching mathematics for an average of 257 min per week, compared to the control teachers' 151 min. High levels of fidelity of implementation resulted in consistently higher scores in the intervention classes on the observation instruments and significantly and substantially greater gains in children's mathematics achievement in the intervention group (effect size = .62)	

Appendix B Search strategy

Ovid PsycINFO

Run Date: 4th October 2016

Set	Terms	Results
1	((implement* or disseminat*) N2 (framework* or model* or plan* or approach* or strateg* or protocol* or guideline* or manual* or concept* or principle* or program* or policy or policies or intervention*)).ti,ab.	26,041
2	((primary or secondary or high or middle or elementary or vocational* or special* or K 12 or further or VCAL) N5 (school* or student* or child* or young people or adolescen* or youth or educat*)) or ((community or technical or "2 year" or "two year") N1 college)).ti,ab.	223,585
3	((randomi* or randomly or (random* adj control*) or RCT or trial* or "control group*" or "evaluation stud*" or "study design" or (statistical* adj significan*) or "double blind" or doubleblind or placebo or "meta anal*" or metaanaly* or "systematic review*" or econometric or "propensity score matching" or heckman* or "instrumental variable*" or "natural experiment*" or bayesian or "comparison group*" or (treat* adj group*) or (wait* adj list*) or (control* adj condition*) or "quasi ex*" or quasiex*).ti,ab.	388,935
4	1 AND 2 AND 3	734

ERIC EBSCOhost

Run date: 4th October 2016

Set	Terms	Results
1	TI (((implement* or disseminat*) N2 (framework* or model* or plan* or approach* or strateg* or protocol* or guideline* or manual* or concept* or principle* or program* or policy or policies or intervention*))) OR AB (((implement* or disseminat*) N2 (framework* or model* or plan* or approach* or strateg* or protocol* or guideline* or manual* or concept* or principle* or program* or policy or policies or intervention*)))	392,62
2	TI (((primary or secondary or high or middle or elementary or vocational* or special* or K 12 or further or VCAL) N5 (school* or student* or child* or young people or adolescen* or youth or educat*)) or ((community or technical or "2 year" or "two year") N1 college))) OR AB ((((primary or secondary or high or middle or elementary or vocational* or special* or K 12 or further or VCAL) N5 (school* or student* or child* or young people or adolescen* or youth or educat*)) or ((community or technical or "2 year" or "two year") N1 college)))	345,441
3	TI ((randomi* or randomly or (random* adj control*) or RCT or trial* or "control group*" or "evaluation stud*" or "study design" or (statistical* adj significan*) or "double blind" or doubleblind or placebo or "meta anal*" or metaanaly* or "systematic review*" or econometric or "propensity score matching" or heckman* or "instrumental variable*" or "natural experiment*" or bayesian or "comparison group*" or (treat* adj group*) or (wait* adj list*) or (control* adj condition*) or "quasi ex*" or quasiex*)) OR AB ((randomi* or randomly or (random* adj control*) or RCT or trial* or "control group*" or "evaluation stud*" or "study design" or (statistical* adj significan*) or "double blind" or doubleblind or placebo or "meta anal*" or metaanaly* or "systematic review*" or econometric or "propensity score matching" or heckman* or "instrumental variable*" or "natural experiment*" or bayesian or "comparison group*" or (treat* adj group*) or (wait* adj list*) or (control* adj condition*) or "quasi ex*" or quasiex*))	514,47
4	S1 AND S2 AND S3	666

A+ Education (Informit)

Run Date: 13th October 2016

Line 3 and 4 needed to be modified from the original search design for this search to run in Informit. It was necessary to divide the results in to four sets (lines 8-11) in order for the results to be processed by Informit.

Set	Terms	Results
1	implement* %2 framework* OR implement* %2 model* OR implement* %2 plan* OR implement* %2 approach* OR implement* %2 strateg* OR implement* %2 protocol* OR implement* %2 guideline* OR implement* %2 manual* OR implement* %2 concept* OR implement* %2 principle* OR implement* %2 program* OR implement* %2 policy OR implement* %2 policies OR implement* %2 intervention*	6,101
2	disseminat* %2 framework* OR disseminat* %2 model* OR disseminat* %2 plan* OR disseminat* %2 approach* OR disseminat* %2 strateg* OR disseminat* %2 protocol* OR disseminat* %2 guideline* OR disseminat* %2 manual* OR disseminat* %2 concept* OR disseminat* %2 principle* OR disseminat* %2 program* OR disseminat* %2 policy OR disseminat* %2 policies OR disseminat* %2 intervention*	106
3	(primary OR secondary OR elementary OR vocational* OR high OR middle OR special OR "k 12" OR further OR vcal) AND (school* OR student* OR child* OR "young people" OR adolescen* OR youth OR educat*)	102,519
4	"community college" OR "technical college" OR "2 year college" OR "two year college"	496
5	randomi* OR randomly OR (random* %1 control*) OR RCT OR trial* OR "control group*" OR "evaluation stud*" OR "study design" OR (statistical* %1 significan*) OR "double blind" OR doubleblind OR placebo OR "meta anal*" OR metaanaly* OR "systematic review*" OR econometric OR "propensity score matching" OR heckman* OR "instrumental variable*" OR "natural experiment*" OR bayesian OR "comparison group*" OR (treat* %1 group*) OR (wait* %1 list*) OR (control* %1 condition*) OR "quasi ex*" OR quasiex*	5,343
6	3 AND 5	3,317
7	4 AND 5	16
8	6 AND 1	190
9	6 AND 2	4
10	7 AND 1	0
11	7 AND 2	0

Result sets 8 and 9 were exported to EndNote.

Education Research Complete (EBSCO)

Run Date: 13th October 2016

#	Query	Results
S4	s1 and s2 and s3	565
S3	randomi* or randomly or (random* adj control*) or RCT or trial* or "control group*" or "evaluation stud*" or "study design" or (statistical* adj significan*) or "double blind" or doubleblind or placebo or "meta anal*" or metaanaly* or "systematic review*" or econometric or "propensity score matching" or heckman* or "instrumental variable*" or "natural experiment*" or bayesian or "comparison group*" or (treat* n1 group*) or (wait* n1 list*) or (control* n1 condition*) or "quasi ex*" or quasiex*	80,940
S2	((primary or secondary or high or middle or elementary or vocational* or special* or "K 12" or further or VCAL) n5 (school* or student* or child* or young people or adolescen* or youth or educat*)) or ((community or technical or "2 year" or "two year") n1 college)	557,702
S1	((implement* or disseminat*) n2 (framework* or model* or plan* or approach* or strateg* or protocol* or guideline* or manual* or concept* or principle* or program* or policy or policies or intervention*))	25,164

Education Database (ProQuest)

Run Date: 13th October 2016

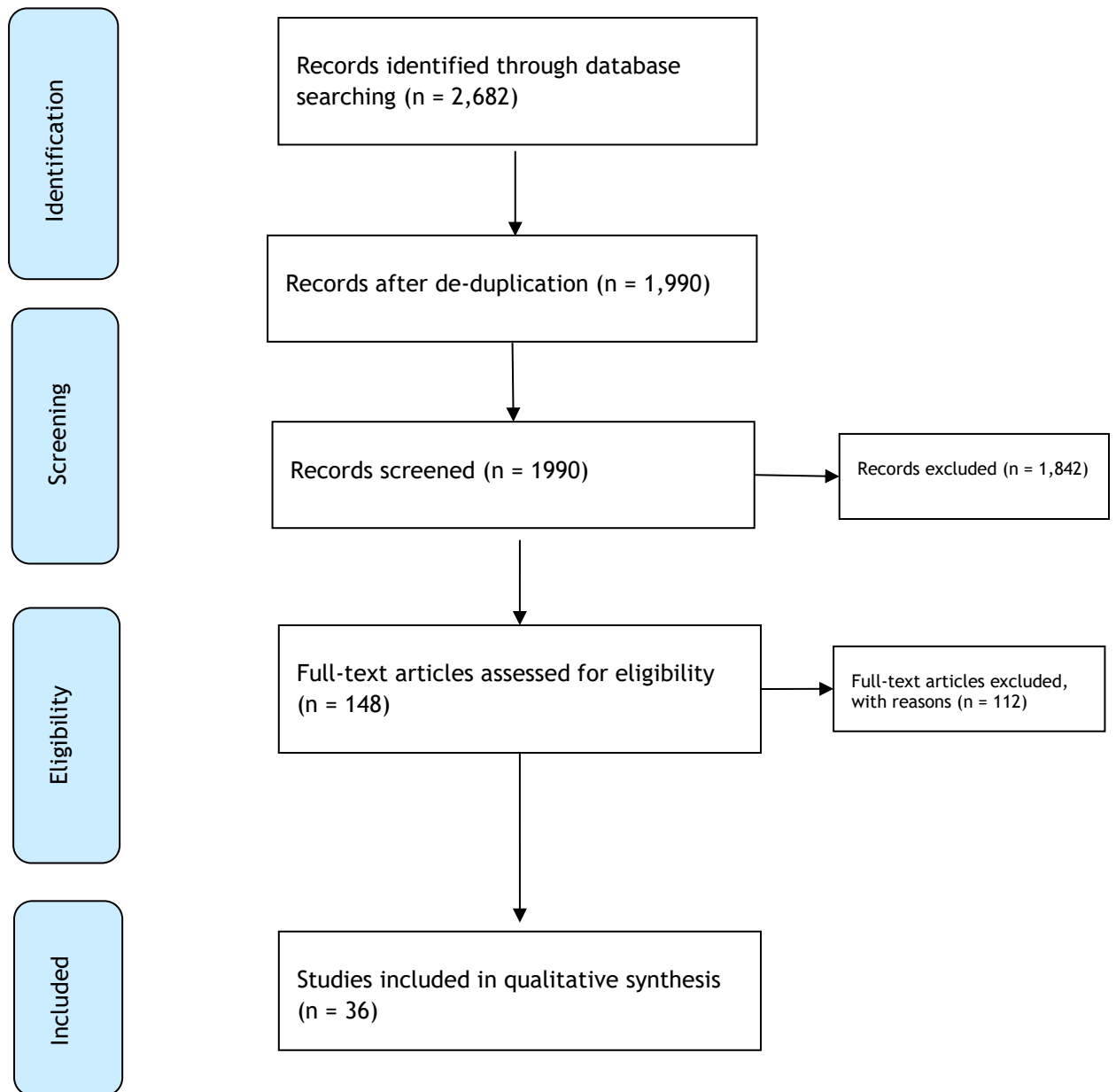
Search strategy modifications were made to enable search completion on the ProQuest search engine. The PsycInfo search strategy created timeout errors as displayed below.

Set	Terms	Results
1	(implement or implemented or implementation or implementing or implements or disseminate or dissemination or disseminated or disseminating or disseminates) n/2 (framework or frameworks or model or models or modelling or modeling or modelled or modeled or plan or plans or planning or planned or approach or approaches or strategy or strategic or strategies or strategize or strategise or protocol or protocols or guideline or guidelines or manual or manuals or concept or concepts or conceptual or principle or principles or program or programs or programme or programmes or programming or policy or policies or intervention or interventions)	14,600
2	(primary or secondary or high or middle or elementary or vocational or vocationally or special or specialist or "k 12" or further or vcal) n/5 (school or schools or schooling or student or students or child or children or childhood or "young people" or adolescent or adolescence or youth or education or educational or educating or educated)	477,140
3	(community or technical or "2 year" or "two year") n/1 college	31,952
4	randomi* or randomly or (random n/1 control*) or rct or trial or trials or trialling or trialled or "control group" or "evaluation stud*" or "study design" or (statistical n/1 significan*) or (statistically n/1 significan*) or "double blind" or doubleblind or placebo or "meta anal*" or metaanal* or "systematic review" or econometric or "propensity score matching" or heckman* or "instrumental variable*" or "natural experiment*" or bayesian or "comparision group" or "comparison groups" or "comparison grouping" or (treat n/1 group) or (treatment n/1 group) or (treat n/1 groups) or (treatment n/1 groups) or (wait n/1 list) or (wait n/1 lists) or (waiting n/1 list) or (waiting n/1 lists) or (control n/1 condition) or (control n/1 conditions) or (controlled n/1 condition) or (controlled n/1 conditions) or "quasi ex" or "quasi experiment" or "quasi experimental" or quasiex or quasiexperiment or quasiexperimental	52,080
5	2 OR 3	496,069
6	1 AND 5	5,155
7	6 AND 4	525
		2 items removed automatically by ProQuest as duplicates (523 exported)

Appendix C Search results

Database	Run Date	Items Retrieved
PsycInfo (Ovid)	04th October 2016	734
ERIC (EBSCO)	04th October 2016	666
A+ Education (Informit)	13th October 2016	194
Education Research Complete (EBSCO)	13th October 2016	565
Education Database (ProQuest)	13th October 2016	523
LearnTechLib	13th October 2016	NA (Strategy could not be run in this database)
Sub Total		2682
Duplicates		692
Total		1,990
Full Texts		148
FINAL INCLUDED	Implementation studies	8 publications
	Effectiveness studies	28 publications

Appendix D PRISMA Flow Diagram



Our mission

We are dedicated to using the best evidence in practice and policy to improve the lives of children, families and communities facing adversity.

How we achieve this

We work with a diverse range of key stakeholders who want to achieve social impact for children and families facing adversity. We bring specialist skills in:

- Supporting sustained change in the behaviour of systems, organisations and individuals. We put a strong emphasis on supporting and strengthening the core components of effective program implementation.
- Providing knowledge translation to policymakers, and relevant stakeholders, so they can access - and use - research for evidence-informed decision-making.
- Program design - selecting and creating evidence-informed programs and services to achieve outcomes for children, family and communities.
- Conducting rigorous evaluations, and assessing the long-term effect of outcomes.

Working with us

Through national and international collaborations, we conduct a range of activities to achieve our mission.

Centre for Evidence and Implementation

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