

ABSTRACT

Child-centred disaster risk reduction: can disaster resilience programs reduce risk and increase the resilience of children and households?

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Introduction

There has been increasing research and policy focus internationally on the role of child-centred disaster risk reduction and resilience, including disaster risk reduction and resilience education programs for children and youth. This paper summarises national and international developments following the signing of the *Sendai Framework for Disaster Risk Reduction 2015-2030* (SFDRR).

To summarise pre-SFDRR developments (Ronan 2015a, b), including over the SFDRR predecessor, the *Hyogo Framework for Action 2005-2015* (HFA), much progress has been made in CC-DRR policy, practice and research. Moving from only one study published pre-2000, research has grown exponentially, including research on the effectiveness and implementation of CC-DRR education programs. Well over half of the 146 countries self-reporting during the HFA documented DRR being included in their national curriculum at one or more levels (primary, secondary, university and professional programs). Comprehensive, evidence-informed guidance on the development of programs was also provided through UNICEF and UNESCO (2013). This has been accompanied by a proliferation of CC-DRR-infused education programs, and other initiatives, in schools and community settings (UNESCO and UNICEF 2012), accompanied by a large number of related resources available through the UNISDR's Prevention Web website.

A background review completed for UNISDR, commissioned by UNICEF and UNESCO (Ronan 2015b), also confirmed DRR curriculum and training are featuring more prominently in national policy across an increasing number of reporting countries. In the Australian context, school-based disaster resilience education programs have been included within Australia's guiding disaster policy, the *National Strategy for Disaster Resilience* (COAG 2011). International progress includes attempts at national roll-out of disaster resilience education in a few countries (e.g. Turkey, Philippines and Indonesia), including in New Zealand 'What's the Plan, Stan?' (see Johnson *et al.* 2014b).

There has been an increasing research and policy focus internationally on the role of child-centred disaster risk reduction and resilience (CC-DRR), including disaster risk reduction and resilience education programs for children and youth. This paper summarises developments and emphasises current progress and challenges. While research has increased in the past 15 years, there are significant research gaps, including those regarding the effectiveness of programs and their relatively patchy implementation. How to solve these problems has been the focus of a world-first national program of research funded by the Bushfire and Natural Hazards CRC. Building on international and national research to date, this paper focuses on the question of 'how can we create, evaluate, implement and scale up CC-DRR programs that work over time, including during disasters and into adulthood, to reduce risk and increase resilience for children, youth, schools, households and communities?' This includes a guiding model for research and use, and a set of research-informed tools either developed or being developed to facilitate further progress.

The development of a policy and practice framework, Comprehensive School Safety (CSS) is facilitating comprehensive CC-DRR infusion within schools. The CSS Framework is seeing increased prominence in New Zealand and Australia (a review of progress is covered in Ronan 2015b, see also Amri *et al.* 2016, Ronan 2015a).

Moving forward: intended outcomes and goals

Public policy initiatives tend to organise around a set of principles, intentions, values and beliefs that are held and advocated for by various bodies (e.g. advocacy groups and political entities). When there is sufficient support for a set of values, these can be enacted through various means at different political levels. The enactment of those values is codified through a set of actions, including measures and practices, designed to realise the set of principles (Page 2008). Thus, the SFDRR is first a set of values and principles agreed upon by 189 countries linked to disaster risk reduction and building the resilience of nations and communities to disasters. Based on these values, a set of outcomes and goals have been established that begin to operationalise these values. As articulated in the SFDRR, the major outcome to be realised by 2030 is the following:

The substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries (p. 6).

From this general outcome, the following specific seven global targets have been established (SFDRR 2015, pp. 7-8):

- Substantially reduce global disaster mortality by 2030, aiming to lower average per 100,000 global mortality between 2020-2030 compared to 2005-2015.
- Substantially reduce the number of affected people globally by 2030, aiming to lower the average global figure per 100,000 between 2020-2030 compared to 2005-2015.
- Reduce direct disaster economic loss in relation to global gross domestic product by 2030.
- Substantially reduce disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities, including through developing their resilience by 2030.
- Substantially increase the number of countries with national and local disaster risk reduction strategies by 2020.
- Substantially enhance international cooperation to developing countries through adequate and sustainable support to complement their national actions for implementation of this framework by 2030.

To achieve these outcomes the SFDRR's primary goal is to:

Prevent new and reduce existing disaster risk through the implementation of integrated and inclusive economic, structural, legal, social, health, cultural, educational, environmental, technological, political and institutional measures that prevent and reduce hazard exposure and vulnerability to disaster, increase preparedness for response and recovery, and thus strengthen resilience (SFDRR 2015, p. 7).

Thus, the focus of the SFDRR is squarely on prevention, mitigation and preparedness, while also accounting for the entire disaster cycle. To achieve outcomes and this main goal, a set of actionable behaviours, or Priorities for Action (PFA), were established. These are:

1. Understanding disaster risk.
2. Strengthening disaster risk governance to manage disaster risk.
3. Investing in disaster risk reduction for resilience.
4. Enhancing disaster preparedness for effective response, and to 'Build Back Better' in recovery, rehabilitation and reconstruction.

Across the PFA's, numerous recommendations for participatory public education are made, including by providing formal, informal and civic education strategies that are nationally-based yet tailored to specific localities. As stated in the SFDRR, to contribute to 'a culture of prevention and education on disaster risk...and advocate for resilient communities,' an 'inclusive and all-of-society disaster risk management which strengthen the synergies across groups' is necessary. Groups noted in particular include children and youth. Emphasising their role as 'agents of change,' they 'should be given the space and modalities to contribute to disaster risk reduction' that are aligned with 'legislation, national practice and educational curricula' (SFDRR 2015, p. 20).

The National Strategy for Disaster Resilience (NSDR)

The NSDR (COAG 2011) revolves around the organising theme of disaster risk reduction being a 'shared responsibility' between government and the community; one that promotes a 'culture of disaster resilience.' An important exemplar reflecting shared responsibility is the following:

Providing information and warnings is important but educating people how to act on their knowledge is equally important (p. 10).

Main NSDR principles that support these themes include:

- understanding risks (section 3.2)
- empowering individuals and communities to exercise choice and take responsibility (section 3.5)
- reducing risks in the built environment (section 3.6)
- supporting capabilities for disaster resilience (section 3.7).

Two additional principles facilitate these outcomes:

- Partnering with those who effect change (section 3.4).
- Communicating with and educating people about risks (section 3.3).

Shared responsibility through partnerships, including those that link emergency management agencies with community networks, can promote the outcomes and facilitators:

Knowledge, innovation and education can enhance a culture of resilience at all levels of the community and should contribute to a continual cycle of learning... Knowledge is fundamental to enabling everyone in the community to determine their hazards and risks, and to inform preparation and mitigation measures' (p. 9)

'Existing community structures and networks are used to promote and enhance disaster resilience (p.10).

A primary community node is one that revolves around a local school system that links children and youth with households that are embedded within other community networks. The NSDR itself stresses both participatory and educational outcomes as key to developing shared responsibility and a culture of disaster resilience:

Risk reduction knowledge is included in relevant education and training programs, such as enterprise training programs, professional education packages, schools and institutions of higher education (p. 8).

More recently, the Australian Institute for Disaster Resilience has started to implement a strategy to develop and deliver national initiatives to teach disaster resilience in Australian schools.

CC-DRR: policy-practice-research guiding model

At both international and national levels there is policy agreement on the role of partnering with those who effect change and the role of education in promoting a culture of prevention, mitigation, preparedness and resilience. Children and youth are most at-risk in disasters for both physical (WHO 2011) and psychological effects (Norris *et al.* 2002). They are also identified in the SFDRR as 'agents of change'. These two accord with main rights of children and youth according to the United Nations *Convention on the Rights of the Child*; the rights of protection and participation. Thus, there is a set of policy-based, value-driven rationales, supported by research findings that strongly support the important role for young people in community disaster risk reduction and resilience promotion.

Another convergence between the SFDRR and NSDR is the importance of linking policy with research and practice. As a result, the linkages between policy, practice and research are important to keep in mind when trying to solve any societal problem (deLeeuw, McNess & Stagnitti 2008), including those related to DRR (see Figure 1). This includes identifiable frameworks

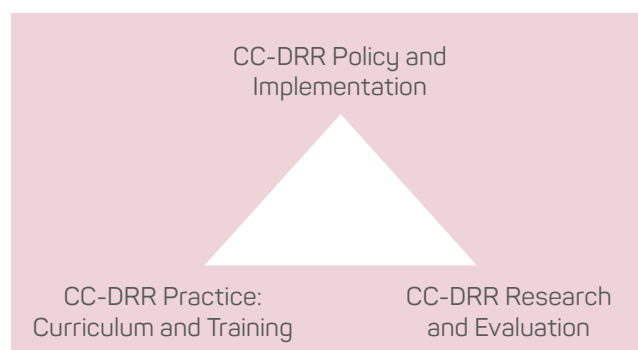


Figure 1: The Policy-Practice-Research nexus.

and means to transfer research-produced knowledge into policy and practice (Redman *et al.* 2015).

With this more generic policy-practice-research model in mind, a guiding model for CC-DRR research that incorporates this nexus has been developed. Figure 2 shows the two major issues of scoping and review. International scoping (Ronan 2015b, Ronan *et al.* 2015) and national scoping (via a Bushfire and Natural Hazards CRC-funded project) have identified the core themes of CC-DRR and disaster resilience education (DRE) research. The two main themes, or problems-to-be-solved, are ensuring the effectiveness of CC-DRR/DRE initiatives and facilitating CC-DRR/DRE policy and practice implementation.

CC-DRR effectiveness: promise and unintended consequences

With over 40 studies published, both correlational and experimental findings support CC-DRR initiatives. In particular, disaster resilience education programs that focus on DRR and resilience have been shown to produce beneficial outcomes for children, youth and households (Amri *et al.* 2016, Johnson *et al.* 2014a, Ronan *et al.* 2015). At the same time, many challenges remain. For example, evaluations tend to focus primarily on knowledge-based outcomes versus more skill- or action-based DRR and resilience outcomes. Evaluations are often carried out by academic evaluators and not as an intrinsic part of program monitoring and evaluation (Johnson *et al.* 2014a, Amri *et al.* 2016). Another issue is that programs tend to have a 'key safety messages' emphasis (IFRC 2013), often focusing on the key prevention, mitigation, preparedness, response-related behaviours that reduce risk.¹ These key messages can have an all-hazards focus (e.g. develop and practice a family emergency plan) or a more specific hazard focus (e.g. for bushfires, house fires, floods, cyclones and storms, drought and earthquakes). There is now no question, based on findings to date, that such a focus can produce beneficial outcomes, including increased knowledge, reduced hazard fears, more realistic risk perceptions, and increased family and household preparedness (Haynes & Tanner 2015, Mitchell *et al.* 2008, Ronan & Johnston 2003, Johnson *et*

¹ These are also referred to as 'action-oriented key messages for DRR'.

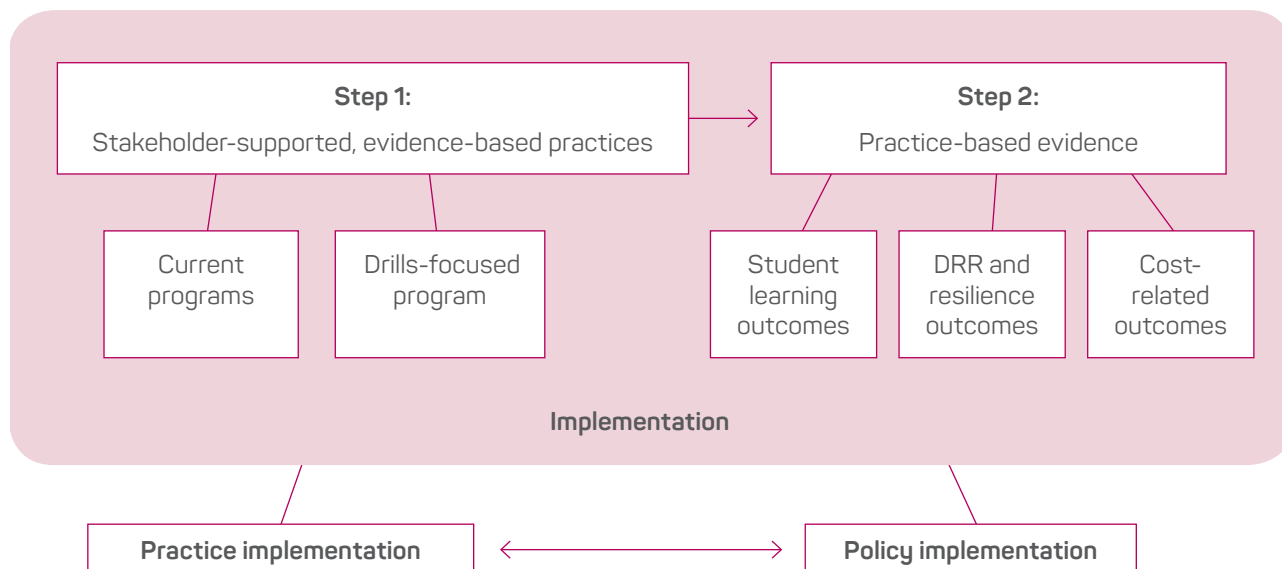


Figure 2: Guiding model for CC-DRR research.

al. 2014a). Additional research has identified some active aspects of DRE programs. Factors that predict increased household preparedness include:

- increased child and youth DRR- and emergency-management-focused knowledge
- involvement in an increased number of DRE programs
- recent DRE program involvement
- guiding children to talk with parents about what was learned, including child-parent interactive homework (Ronan & Johnston 2001, 2003, Ronan, Crellin & Johnston 2010).

Another factor is supporting children to research problems and talk to community leaders and local officials about root causes and risk reduction measures (Haynes & Tanner 2015). However, at the same time, in the face of these promising outcomes, there is little empirical evidence of how DRR and resilience benefits extend into response and recovery. The handful of experimental and time-series-designed studies done to date have used pre-post approaches, thus limiting findings to immediate benefits (Johnson *et al.* 2014a, Haynes & Tanner 2015). Research that follows cohorts over time is essential to understand the long-term effectiveness of these programs during and following a hazardous event.

While findings to date support that learning key safety messages can confer benefits, this focus may have unintended consequences. In different studies, it has been shown that education programs can improve knowledge of what to do in the event of a hazardous event (Johnson *et al.* 2014a). However, while children may know a correct set of responses, two studies (Ronan *et al.* 2001, Johnson *et al.* 2014) have shown that these same children can also endorse a range of incorrect DRR responses. In some instances, a majority of children may at the same time endorse incorrect responses (Johnson 2014). Such findings demonstrate that while children may know a correct key safety message, they

also believe that other behaviours that raise risk are also correct. Thus, research has demonstrated that children may lack of clarity about which behaviours are the ones that will keep them safe. Additional research shows that children who participate in DRE programs tend to have reduced fears of hazards and increased DRR-related confidence. However, one study has demonstrated that confidence increases do not correspond to knowledge increases (Amri *et al.* 2016). In that study, 71 per cent of the child participants indicated confidence in what to do to be safe in disasters. However, only 4 per cent of the overall sample had DRR knowledge in the high range category, whereas 96 per cent had knowledge in the low to medium range categories. Another example of unintended consequences are field observations in Nepal during the 2015 earthquakes by Paci-Green and colleagues (2015), who concluded:

Notably, school staff in all three Rasuwa schools indicated that some school children that had been taught drop, cover and hold ran back into collapsing stone houses to crawl under tables and beds. The students did not understand how to protect themselves while outside. They stayed inside stone houses, when perhaps they could have exited, as there had been no instruction about how to protect themselves in the most prominent housing type – stone construction (Paci-Green, Pandey & Friedman 2015, p. 17).

Consistent with these field observations, larger group-based research on earthquake key safety messages has been carried out. In the context of school drills-related education programs,² Johnson and co-authors found that almost 100 per cent of children knew the correct key message for earthquakes (drop, cover, hold) at both pre- and post-testing. At the same time, a majority (three-quarters) of the sample of over 500 children and

² This research focused on school drills related to the International initiative, 'ShakeOut'. At: www.shakeout.org/home.html.

youth endorsed running to a doorway as another option. With research showing that 'movement during shaking' is a key risk factor, perhaps even the strongest, for injury and death (Johnston *et al.* 2014), this action should no longer be recommended. Another finding in that study was that only about 20 per cent of children were aware that drop, cover and hold prevented falling. Similarly, as demonstrated in Towers (2015) in a bushfire context, children may be able to correctly recite key messages about safe response behaviours, but their understanding of the purpose and function of those behaviours is often misconceived.

One of the implications of this line of research is that education programs, and school drills, that focus only on standard messages, including routine 'rote' drilling actions, may not be reducing risks for children and youth to the extent necessary (Ronan *et al.* 2015).

The items included here, when endorsed, were verified through a series of questions (who, what, where, when, who was responsible) to ensure a planning or practice factor was undertaken. This verification procedure was completed based on research that has demonstrated that participants, adults, children and youth, may endorse having undertaken certain DRR planning and practice actions or knowledge acquisition (e.g. a home emergency plan, knowing correct DRR safety steps) but that, when queried in more depth, actually have not done or incorporated them (Ballantyne *et al.* 2000, FEMA 2010). Those studies indicate that only around 15 per cent who endorse some planning and practice factor actually enacted or incorporated the factor. In the FEMA research, about 15 per cent of children who endorsed having a home safety plan appeared actually to have completed such an activity with parents (FEMA 2010).

The way forward

Based on findings, moving beyond a focus on key messages and routine drilling procedures is warranted. Education research demonstrates that a focus on knowledge and skills development through participatory, interactive, experiential learning formats can confer enhanced benefits, including related to DRR and resilience (Haynes & Tanner 2015, Ronan & Towers 2014). A study carried out in Canberra (Webb & Ronan 2014) used an approach incorporating elements based on theory and research that produced highly significant changes in knowledge, skills, home preparedness and a reduction in fears of hazards. For example, in the brief four-session program, parents of the children and youth involved reported an average increase of just under six additional preparedness and risk mitigation activities undertaken at home between pre- and post-testing. Children were found to demonstrate about 40 per cent pre-post gain in both recognition (multiple choice)

and recall knowledge (listing important DRR steps). These are possibly the biggest gains reported to date in the published literature. In addition, related to skill development, children and youth had significant gains in verified 'planning and practice' factors (e.g. 'have you and your family planned and practiced what to do in an emergency?').

Another example that used a problem-solving approach was that of Haynes and Tanner (2015). This study investigated the use of child-centred participatory video as a tool for engaging and empowering young people in disaster risk reduction and climate change adaptation. The action research involved a multi-stage process of training, film-making and participatory screening workshops with communities and government officials in the Philippines. The film-making process was iterative, enabling children to investigate, learn and discuss issues with members of their family, community and decision-makers. Similarly the screening workshops were designed to gather community input and generate collaboration between young people and adults around measures to reduce risks. The project generated a number of positive outcomes from increased knowledge of the children and their communities to various tangible mitigation measures, including the installation of shelving to ensure that school materials are stored above maximum flood heights, and policy to address and enforce a reduction in illegal mining and deforestation, which was increasing the flood risk. Importantly, this study highlighted that while many education initiatives can increase the awareness and knowledge of children and their communities, it is also important to examine how such programs can target policy and practice to address the root causes and drivers of risk and vulnerability.

These findings also show that major stakeholders in CC-DRR, including children and youth, parents and teachers, endorse the value of these programs (e.g. Amri *et al.* 2016, Kelly & Ronan 2016, Johnson & Ronan 2014, Johnson *et al.* 2014). Findings indicate that parents and teachers have a preference for programs based on an interactive problem-solving approach versus a key safety message only or didactic approach (Kelly & Ronan 2016). Thus, programs developed with input from theory and research (Ronan & Towers 2014), and with input from those who participate in and deliver these programs, appear worthwhile.

With this combination of a bottom-up and top-down approach to program development, a large majority of children indicated they are motivated to learn about disasters. Additionally, they and their parents and teachers want them to be involved in DRR efforts at home and school (e.g. Amri *et al.* 2016, Webb & Ronan 2014, Johnson *et al.* 2014a). On the top-down side, international policy developments have moved the focus from DRE-based programs to a more comprehensive school safety (CSS) focus. The CSS Framework is a United Nations-driven development of an alliance of school safety advocates and practitioners led by UNICEF and UNESCO and includes UNISDR and some NGOs,

Education Sector Policies and Plans

Aligned to national, subnational and local disaster management plans



Figure 3: Comprehensive School Safety Framework: the Three Pillars.

including Save the Children. Figure 3 shows the CSS approach of three inter-connected pillars:

- safe learning facilities (Pillar 1)
- school disaster management (Pillar 2)
- DRR and resilience education (Pillar 3).

The idea is that these inter-connected pillars will lead to the protection of children and staff in school facilities, improve education continuity in times of emergency and crisis, safeguard education-sector investments, and build a long-term culture of participatory risk reduction, resilience and safety.

The potential benefits of this comprehensive approach for children and youth would be increased child participation in whole-of-school and whole-of-risk approaches. These start with understanding and assessing risk through to participating in the development of school emergency plans, linking DRE program knowledge with enactment and skills-based learning (linking schools with household planning, safe reunification procedures, flexible, versus routine-only, drilling skills and procedures³). Research is underway to test such possibilities.

³ Note that all of these link Pillar 2 with Pillar 3.

Teacher training also raises some issues. Research indicates that teachers express interest in delivering these programs (Amri *et al.* 2016, Johnson *et al.* 2014b). However, they express concerns about not being trained and potentially exacerbating problems for children and youth (Amri *et al.* 2016, Johnson & Ronan 2014, Johnson *et al.* 2014b). This appears to be one of the deterrents to uptake and implementation of such programs in classroom and school settings.

Implementation

Reviews have shown that most CC-DRR initiatives, including disaster resilience education, tend to have a short 'shelf-life.' That is, scaled, sustainable implementation is a major problem both internationally and in Australia. Research has begun to identify ways to support scaling up effective programs (Johnson *et al.* 2014a, Domschrader *et al.* 2009).

Johnson and colleagues (2014b) summarise previous research linked to a New Zealand DRE initiative, 'What's the Plan, Stan?' (WTPS). This includes findings from national focus group research with teachers (Johnson 2011, Johnson & Ronan 2014) and national survey

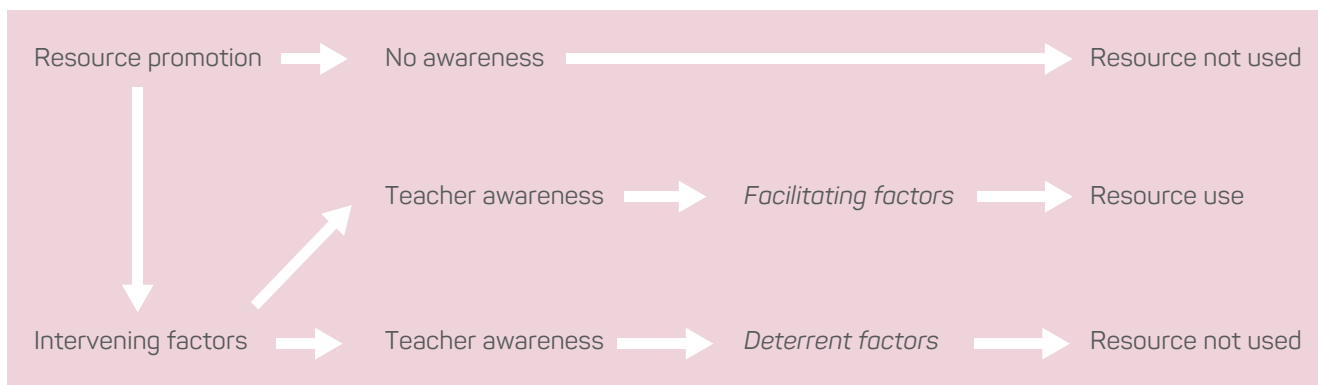


Figure 4: An implementation model for 'What's the Plan, Stan?'

Source: Johnson *et al.* 2014b. Copyright permission from Emerald Group Publishing.

research with primary school leadership, including principals (Renwick 2012). The overall purpose of review was to test a simple implementation theoretical model as illustrated in Figure 4.⁴

A WTPS program was sent to all primary schools in New Zealand in 2006 for use in classrooms. To assess attitudes and uptake, survey and focus group research was carried out. A survey was sent to all primary schools in New Zealand, with 1020 being returned (47 per cent return rate). The survey assessed awareness, use of WTPS and implementation deterrents and facilitators (Renwick 2012). For additional research on WTPS, Johnson and colleagues (2011, Johnson & Ronan 2014, Johnston *et al.* 2014b) employed a mixed methods approach.⁵ The survey was carried out across the country in seven of 16 regions to get a representative mix of locales and schools (small, medium, large). This included a mix of rural and urban areas. In the schools (N = 31) that participated, 49 teachers and principals agreed to participate in focus groups. Twelve of these teachers also filled out a survey. Additional research (interviews and focus groups) was carried out with civil defence staff in the regions.

In testing the model, the Renwick study found relatively low to moderate awareness (24 per cent of principals surveyed indicated an awareness of the resource but had not read it, 24 per cent had no awareness). Across survey and focus group findings, teachers appeared receptive to the program (Johnson 2011, Johnson & Ronan 2014). However, they identified significant obstacles to using the program and factors that facilitated use. These are (Johnson *et al.* 2014b):

Facilitating factors

- school-wide use of the resource*
- teacher training (if available)
- direct engagement with local emergency management staff

- good-quality design
- promotion of the resource by teachers
- student interest in the subject
- personal interest in the subject
- recent disaster

*strongest facilitator

Deterrent factors to classroom/school use

- lack of awareness of the resource*
- perception that teacher training is needed*
- lack of time/competing interests*
- voluntary nature*
- lack of direct engagement with local emergency management staff
- incompatibility with teaching methods
- lack of school-wide use
- lack of relevancy when no disaster has occurred

*strongest deterrents

Research in Indonesia replicated and extended these findings (Amri *et al.* 2016), including identifying similar facilitators and deterrents and generating recommendations for the Indonesian context.

Thus, from this set of studies, promoting programs at school through school-wide or Ministry-level support and providing teacher training appear to be critical factors required for scaled implementation and use of a resource. On the other hand, simply creating a resource and disseminating it for voluntary use at local school level, by teachers not aware or confident to deliver it, is likely to lead to low uptake and use (Johnson *et al.* 2014b, Amri *et al.* 2016, Ronan 2015b). Implementation efforts that are based on education department and ministry policy infusion that are supported through research findings of the sort reported here would have a better chance of success.

A CSS Framework might have added benefits for children, schools, families and communities, and can be used to help policy-makers and practitioners solve some implementation problems. For example, schools

4 Another implementation framework worth mentioning given it is currently being used in some emergency management research settings to guide implementation efforts is the consolidated implementation framework for research (Damschroder *et al.* 2009).

5 Mixed methods approaches combine both qualitative data-gathering (focus groups) with quantitative methods (surveys).

have a duty of care for children's safety. Given the research on schools drilling, a re-think on drills may be necessary. At the same time, drills are conducted in virtually all schools in Australia and New Zealand. Linking CSS Pillar 2 activities (school disaster management that includes drilling) with Pillar 3 (disaster risk reduction and resilience education) may help solve this duty of care problem. Thus, creating a brief education program and companion brief teacher training that uses drills (and drill simulations) as the leveraging point might enhance effective implementation potential. Linking school drilling with a broader CSS-driven risk reduction and resilience educational school planning agenda would be thought to produce benefits for children, households and schools. If such an implementation effort is coupled with local emergency management agency partnerships, identified in the research as an implementation facilitator, this would enhance the chances of CC-DRR DRE implementation.

A lack of teacher training is a significant implementation deterrent as reported by teachers. There are examples of national teacher training approaches, including those that use internet technology for large scale and relatively low cost dissemination. Perhaps the best example of widespread dissemination and uptake is in Turkey (Petal & Sanduvac 2012). However, implementation of pre- or in-service teacher training approaches requires accompanying evaluations of effectiveness. To date, with Turkey as an exception, no data are available on DRE teacher training effectiveness. Teacher training is a problem that clearly needs more attention.

Promoting theory-based monitoring and evaluation

Part of a co-development process with the Bushfire and Natural Hazards CRC CC-DRR project end users, is a new research-informed, CC-DRR Practice Framework tool that evaluates the internal workings of DRE programs, including program design, monitoring, evaluation and implementation.

Systematic testing of CC-DRR outcomes and implementation can be carried out through theoretically-driven evaluation models (i.e. to test CC-DRR models systematically and consistently). Based on a comprehensive review of the literature (Johnson *et al.* 2016), models available for testing program outcomes and implementation and the accompanying questions they answer, respectively, are:

1. Program theory matrix: Is the program producing desired immediate, intermediate, and ultimate outcomes and what are the mechanisms responsible for producing those outcomes?
2. Stage step model: Is the program being implemented in the manner planned, what are the barriers and facilitators to effective implementation, and what is the program's reach and ability to produce sustainable, long-term, cost-effective impacts?

Johnson and co-authors (2016) provide more details on each of the models in a CC-DRR context, alongside examples from recent research. Advantages of these models are that they are reasonably pragmatic; a necessary consideration for implementation in settings that develop and carry out CC-DRR DRE programming (Johnson *et al.* 2014b).

Does DRE save money?

Within a theory-driven evaluation model, benefit-cost analysis and cost effectiveness research is important. Cost-relevant analyses link first to program theory matrix-driven evaluations and provide data on larger scale implementation and evaluation. Costing analyses are deemed an important consideration of politicians and policy-makers. Regarding space considerations, the discussion here is limited to summary words. In a review of cost-effective measures for disasters, particularly earthquakes, Kenny (2012) makes the following data-based conclusion:

...regardless of context, emergency communication systems that can be utilised in a range of disaster conditions and require little in the way of complex (re-) construction are likely to be both comparatively cost-effective and institutionally simple to implement. This suggests priorities for...agencies seeking to reduce the risk posed by future disasters, and indicates that measures are not, in reality, always prioritised in a reasonable manner. In countries rich and poor, the simple logic of prioritising cheap, institutionally simple responses does not always prevail.
(Kenny 2012, p. 576)

Theoretically, in costing terms, increasing community awareness, knowledge and skills may be cost-effective (Gibbs *et al.* 2015). According to Kelman (2014), 'the more structural a measure, the less cost-effective it usually is...' (p. 2). Positive benefit-cost ratios for a range of social solutions have been reported (Kelman 2014, see also Rose *et al.* 2007). For example, a major cause of flood-related deaths, both in Australia and overseas, is drowning due to risk-taking, which may well be largely preventable through non-costly means. This would be true whether in relation to driving or in the case of children and youth walking, swimming or playing in flooded waters (Gissing *et al.* 2016, Haynes *et al.* 2016). In bushfires, a major cause of deaths and property losses is a lack of household mitigation and preparedness leading to late evacuation and poorly-prepared properties (Whittaker *et al.* 2013, Haynes *et al.* 2010). Thus, in both floods and bushfires, compared to the costs of response (rescue and recovery operations), both economic and social investment in prevention and mitigation efforts through community-based education programs would save lives and, in some cases, a considerable amount of money (e.g. in Australian bushfires, Gibbs *et al.* 2015). However, in terms of community-level education programs, research has not yet been conducted, and is necessary, to evaluate the cost-savings potential in relation to CC-DRR/DRE programs.

Summary

One of the ways forward in CC-DRR research is for researchers to partner with end users in emergency management agencies, schools (including children and personnel), policy contexts (state, territory and federal departments and emergency management agencies), and others to create and implement effective and cost-effective CC-DRR initiatives, including disaster resilience education programs. One way is to build research-informed capacities in the sector. Another is to co-develop a set of research-driven tools with end users that include:

- developing stakeholder and theory- and research-supported CC-DRR/DRE programs
- building CC-DRR/DRE programs that include routine monitoring and evaluation of outcomes to ensure effectiveness; from student learning outcomes to DRR and resilience outcomes
- promoting scaled, sustainable implementation of cost-effective CC-DRR/DRE programs.

As part of this toolbox, evaluating outcome effectiveness and implementation with theory-driven evaluation models would assist. Importantly, these tools have to take account of agency and school resource issues and ensure that they are pragmatic and actually can, and will, be used. Given the progress in theory development and research to date, these developments can translate into a research-informed toolbox that helps CC-DRR programs be effective and be implemented in consistent, scaled ways that take account of factors that in the past have led to their more sporadic use.

References

- Amri A, Bird DK & Ronan KR, Haynes K & Towers B 2016, *Disaster Risk Reduction Education in Indonesia: Challenges and recommendations for scaling up. Natural Hazards and Earth System Sciences, Discussions*, doi: 10.5194/nhess-2015-344, 2016.
- Amri A, Haynes K, Bird DK & Ronan KR 2016, *A critical review of child-centred disaster risk reduction: Progress, gaps and opportunities. Children's Geographies: in press.*
- Ballantyne KE, Paton D, Johnston D, Kozuch M & Daly M 2000, *Information on volcanic and earthquake hazards: The impact on awareness and preparation. Institute of Geological and Nuclear Sciences Limited science report 2000/2, Institute of Geological and Nuclear Sciences Limited, Lower Hutt.*
- Council of Australian Governments (COAG) 2011, *National Strategy for Disaster Resilience. Attorney-General's Department, Canberra.*
- Damschroder LJ, Aron DC, Keith RE, Kirsh SR, Alexander JA & Lowery JC 2009, *Fostering implementation of health services research findings into practice: a consolidated framework for advancing implementation science. Implement Sci, 4*, p. 50. doi:10.1186/1748-5908-4-50.
- deLeeuw E, McNess A & Stagnitti K 2008, *Theoretical reflections on the nexus between research, policy and practice. Critical Public Health, vol. 18, no. 1*, pp. 5–20.
- Federal Emergency Management Agency (FEMA) 2010, *Student tools for emergency planning (STEP) program: draft evaluation report. Washington DC: FEMA.*
- Gibbs L, Sian K-L, Block K, Baker E, Nelsson C, Gilbert J, Cook A & MacDougall C 2015, *Cost and outcomes associated with participating in the Community Fireguard Program: Experiences from the Black Saturday bushfires in Victoria, Australia. International Journal of Disaster Risk Reduction, 13*, pp. 375–380.
- Gissing A, Haynes K, Coates L & Keys C 2016, *Motorist behaviour during the 2015 Shoalhaven floods, Australian Journal of Emergency Management. At: <https://ajem.infoservices.com.au/items/AJEM-31-02-06#sthash.qk920ILw.dpuf>.*
- Haynes K, Coates L, Dimer de Oliveira F, Gissing A, Bird D, van den Honert R, Radford D, D'Arcy R & Smith C 2016, *An analysis of human fatalities from floods in Australia 1900–2015. Bushfire and Natural Hazard Cooperative Research Centre. At: www.bnhcra.com.au/publications/biblio/bnh-2735.*
- Haynes K, Handmer J, McAneney J, Tibbits A & Coates L 2010, *Australian bushfire fatalities 1900–2008: exploring trends in relation to the 'Prepare, stay and defend or leave early' policy. Environmental Science and Policy vol.13, no. 3*, pp. 185–194.
- Haynes K & Tanner T 2015, *Empowering young people and strengthening resilience: Youth-centred participatory video as a tool for climate change adaptation and disaster risk reduction. Children's Geographies, vol. 13, no. 3*, pp. 357–371.
- International Federation of Red Cross and Red Crescent Societies (IFRC) 2013, *Public awareness and public education for disaster risk reduction: key messages. Geneva.*
- Johnson VA 2011, *Disaster Preparedness Education in Schools: Recommendations for New Zealand and the United States, Fulbright New Zealand, Wellington, At: www.fulbright.org.nz/publications/2011-johnson/ [31 March 2013].*
- Johnson VA, Johnston DM, Ronan KR & Peace R 2014, *Evaluating children's learning of adaptive response capacities from ShakeOut, an earthquake and tsunami drill in two Washington State school districts. Journal of Homeland Security. DOI 10.1515/jhsem-2014-0012.*
- Johnson VA, Peace R, Ronan KR & Johnston DM 2016, *Improving the impact and implementation of disaster education programs for children through theory-based evaluation. Risk Analysis, doi:10.1111/risa.12545.*
- Johnson VA & Ronan KR 2014, *Classroom responses of school teachers following the 2011 Christchurch earthquake. Natural Hazards, 72(2)*, pp. 1075–1092.
- Johnson VA, Ronan KR, Johnston DM & Peace R 2014a, *Evaluations of disaster education programs for children: A methodological review. International Journal of Disaster Risk Reduction, vol. 9*, pp. 107–123.
- Johnson VA, Ronan KR, Johnston DM & Peace R 2014b, *Implementing disaster preparedness education in New Zealand primary schools. Disaster Prevention and Management, vol. 23, no. 4*, pp. 370–380.
- Kelly B & Ronan KR 2016, *The role of children in community disaster resilience: A household survey. Manuscript under review.*
- Kelman I 2014, *Disaster mitigation is cost effective: World development report 2014. CICERO: Norway.*
- Kenny C 2012, *Disaster risk reduction in developing countries: costs, benefits and institutions. Disasters, vol. 36, no. 4*, pp 559–588.
- Mitchell T, Haynes K, Hall N, Choong W & Oven K 2008, *The role of children and youth in communicating disaster risk. Children, Youth and Environment, vol. 18, no. 2.*
- Norris FH, Friedman MJ, Watson PJ, Byrne CM, Diaz E & Kaniasty K 2002, *60,000 disaster victims speak: Part I. An empirical review of the empirical literature, 1981–2001. Psychiatry, 65*, pp. 207–260.

Paci-Green R, Pandey B & Friedman R 2015, *A comparative assessment of school safety after the 2015 Nepal Earthquakes*. Risk RED: London.

Page EC 2008, *The origins of policy*. In Moran M, Rein M & Goodin RE (Eds.), *The Oxford handbook of public policy*. London: Oxford University Press.

Petal M & Sanduvac ZT 2012, *DREAMS for Turkey: A case study of scale and reach of disaster-learning self-study for individual and household preparedness and school disaster management*. Risk RED: London.

Redman S, Turner T, Davis H, et al. 2015, *The SPIRIT Framework: A structured approach to selecting and testing strategies to increase the use of research in policy*. *Social Medicine and Science*, 136-137, pp. 145-155.

Renwick J 2012, *Report of the 2012 'What's the Plan, Stan?' survey of New Zealand primary schools*. Research and Evaluation Services, Strategy and Governance Branch of the Department of Internal Affairs, Wellington. At: www.civildefence.govt.nz/memwebsite.nsf/wpg_url/for-the-cdem-sector-public-education-whats-the-plan-stan?

Ronan KR 2015a, *Progress made with school curricula, education material and relevant training in disaster risk reduction and recovery concepts and practices. Special section on Australian contributions to the UNISDR World Conference and the next cycle of the Hyogo Framework for Action*. *Australian Journal of Emergency Management*, vol. 30, no. 1, pp. 8-9.

Ronan KR 2015b, *Many advances, continuing challenges towards HFA2 and Post-2015: Policy-practice-research summary and recommendations*. *Hyogo Framework for Action Thematic Review: Priority for Action 3 – Core Indicator (CI) 2: School curricula, education material and relevant training including disaster risk reduction and recovery concepts and practices*. Background Chapter prepared for United Nations Office for Disaster Risk Reduction and the Global Assessment Report on Disaster Risk Reduction, 2015. UNESCO/UNICEF: Paris/Geneva.

Ronan KR, Alisic E, Towers B, Johnson VA & Johnston DM 2015, *Disaster preparedness for children and families: A critical review*. *Current Psychiatry Reports*, 17, pp. 58-66. DOI 10.1007/s11920-015-0589-6.

Ronan KR, Crellin K & Johnston DM 2010, *Correlates of hazards education for youth: A replication study*. *Natural Hazards*, vol. 53, no. 3, pp. 503-526.

Ronan KR, Crellin K & Johnston DM 2012, *Community readiness for a new tsunami warning system: Quasi-experimental and benchmarking evaluation of a school education component*. *Natural Hazards*, vol. 61, no. 3, pp. 1411-1425.

Ronan KR & Johnston DM 2001, *Correlates of hazard education programs for youth*. *Risk Analysis*, 21, pp. 1055-1063.

Ronan KR & Johnston DM 2003, *Hazards education for youth: A quasi-experimental investigation*. *Risk Analysis*, 23, pp. 1009-1020.

Ronan KR, Johnston DM, Daly M & Fairley R 2001, *School children's risk perceptions and preparedness: A hazards education survey*. *Australasian Journal of Disaster and Trauma Studies*, 1. At: <http://massey.ac.nz/~trauma/>.

Ronan KR & Towers B 2014, *Systems education for a sustainable planet: Preparing children for natural disasters*. *Systems*: 2, 1-23; doi:10.3390/systems2010001.

Rose A, Porter K, Dash N, et al. 2007, *Benefit-cost analysis of FEMA hazard mitigation grants*. *Natural Hazards Review*, vol. 8, no. 4, pp. 1-15. At: <http://earthmind.org/files/risk/Nat-Haz-Review-2007-CBA-of-FEMA-Grants.pdf>.

Towers B 2015, *Children's knowledge of bushfire emergency response*. *International Journal of Wildland Fire*, 24, pp. 179-189. At: www.publish.csiro.au/nid/114/paper/WF13153.htm.

United Nations International Strategy for Disaster Risk 2015, *Sendai Framework for Action on Disaster Risk Reduction, 2015-2030*. Geneva: United Nations.

United Nations Educational, Scientific and Cultural Organization/ United Nations Childrens Fund 2012, *Disaster risk reduction in school curricula: Case studies from thirty countries*. Geneva/Paris: UNESCO/UNICEF.

United Nations Educational, Scientific and Cultural Organization/ United Nations Childrens Fund 2013, *Towards a Learning Culture of Safety and Resilience: Technical Guidance for Integrating Disaster Risk Reduction in the School Curriculum (Pilot Version)*. Geneva/ Paris: UNESCO/UNICEF.

Webb M & Ronan KR 2014, *Interactive hazards education program in a low SES community: A quasi-experimental pilot study*. *Risk Analysis*; DOI: 10.1111/risa.12217.

Whittaker J, Haynes K, Handmer J & McLennan J 2013, *Community safety during the 2009 Australia 'Black Saturday' bushfires: an analysis of household preparedness and response*. *International Journal of Wildland Fire*, vol. 22, pp. 841-849.

World Health Organization, UK Health Protection Agency, Save the Children 2011, *Disaster risk management for health: Child health. Disaster Risk Management for Health Fact Sheets: Global Platform, May 2011*. World Health Organization: Geneva. At: www.who.int/hac/techguidance/preparedness/factsheets/en/.

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