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New Zealand ShakeOut exercise: lessons learned by schools

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Abstract

Purpose – The purpose of this paper is to identify lessons learned by schools from their involvement in the 2012 New Zealand ShakeOut nationwide earthquake drill.

Design/methodology/approach – The results from a survey conducted with 514 schools were collated to identify the emergency preparedness lessons learned by schools through their participation in the ShakeOut exercise.

Findings – Key findings indicated that: schools were likely to do more than the minimum when presented with a range of specific emergency preparedness activities; drills for emergency events require specific achievement objectives to be identified in order to be most effective in preparing schools; and large-scale initiatives, such as the ShakeOut exercise, encourage schools and students to engage in emergency preparedness activities.

Practical implications – Based on the findings, six recommendations are made to assist schools to develop effective emergency response procedures.

Originality/value – The present study contributes to the ongoing efforts of emergency management practitioners and academics to enhance the efficacy of school-based preparedness activities and to, ultimately, increase overall community resilience.

Keywords Lessons learned, New Zealand, Schools, Emergency preparedness, Earthquake drill, ShakeOut

Paper type Research paper

Many emergency preparedness activities undertaken daily around the world have their beginnings in schools. Evacuation drills originated as a response to the unnecessary deaths of children in fires and other school-based emergencies in the USA dating back to the mid-nineteenth century (Heath *et al.*, 2007). Although emergency drills are common in schools globally, there is little research examining the benefits of participation. Existing research suggests that drills are often simple like practising a safety behaviour, evacuating the building, and taking attendance in an assembly area (Ramirez *et al.*, 2009). This may be, in part, due to a long held assumption that by participating in school drills children will automatically absorb the required knowledge about how to respond in emergencies. This assumption has little support in the literature, and has recently prompted researchers to ask the question: "Are drills effective exercises or rote-based routines?" The findings of Johnson *et al.* (2014) suggested that there is little value to individuals in participating in emergency response drills without also receiving supporting education and training. In particular,

Permission was given by the developers of the original ShakeOut questionnaire for it to be modified for use in evaluating school's experiences of the NZ ShakeOut exercise. GNS Science provided the researchers with free access to their SurveyMonkey account for the development of the survey questionnaire.

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the implementation of school emergency response plans requires that staff and students also have the knowledge, resources, and skills to respond appropriately to the range of emergencies they may face (American Academy of Pediatrics, Council on School Health, 2008; Ronan and Johnston, 2005).

In New Zealand (NZ), the complex hazardscape means that both natural (e.g. earthquakes) and technological (e.g. infrastructure) hazards pose a daily risk to individuals and communities. Though large-scale emergencies are relatively rare when they do occur there is the potential for the whole country to be impacted. In 2010 and 2011 a series of large damaging earthquakes occurred in the Canterbury region of NZ. On 4 September 2010, a moment magnitude (M_w) 7.1 earthquake occurred during the night near Darfield, a small South Island town, that caused widespread damage and disruption to infrastructure across the region but resulted in no major injuries or deaths (Potter *et al.*, 2015). Unfortunately, this was not the case for the devastating M_w 6.3 aftershock under the city of Christchurch on 22 February 2011. The aftershock occurred during lunchtime when many people were in the CBD, and as a consequence 185 people lost their lives and several thousand more required treatment for a range of injuries (Potter *et al.*, 2015). The damage to buildings and infrastructure was extensive.

The February 2011 earthquake required all schools and early childhood education services in Canterbury to close immediately and family reunification processes to begin. In the weeks following the earthquake, the Ministry of Education (2011) provided support to more than 180 schools and 250 early childhood education providers across the Canterbury region. The Ministry supported schools by: assessing the safety of school sites and arranging repairs where possible; arranging re-locatable classrooms; providing water, sewerage, and toilet facilities; and helping staff and students cope with the psychological impacts of the ongoing aftershocks. The earthquake response required by schools, and the scale of the assistance provided by the Ministry of Education, reinforces the importance of all schools having access to the expertise and resources necessary to respond appropriately in emergency events, thereby ensuring the safety of students. The 2010-2011 Canterbury earthquakes brought a new reality to many New Zealanders regarding the threat large-scale emergencies pose and the need to be prepared for future events.

1. 2012 NZ ShakeOut earthquake drill

In part as a response to the Canterbury earthquakes and as a means to enhance the earthquake preparedness and response capabilities of NZ communities, the Ministry of Civil Defence and Emergency Management (MCDEM) administered the first nationwide earthquake response drill in NZ. The exercise was based on the successful 2008 Great Southern California ShakeOut earthquake drill which is now an annual event across the USA, with millions participating (ShakeOut.org, n.d.).

Following a small pilot study of the ShakeOut concept in 2009 (Orchiston *et al.*, 2013), MCDEM partnered with GNS Science, emergency response organisations, and government agencies to promote and support the 2012 NZ ShakeOut event. A national multi-media campaign combining mainstream media, social media, advertising, and government communication networks publicised the ShakeOut drill and the supporting website. The website recommended actions that participants could take in the lead up to the drill and included a variety of resources such as the correct "drop, cover, hold" procedures and resources that could be used to increase earthquake preparedness at work and home (NZ ShakeOut, n.d.a).

The ShakeOut organisers recognised the benefits of encouraging schools to be involved due to their relatively large numbers and links into homes. The Ministry of Education promoted the ShakeOut exercise prompting schools to register their participation on the NZ ShakeOut website. In addition to the earthquake response practice, schools were encouraged to review their existing emergency procedures and promote the ShakeOut drill within their community. In the lead up to the exercise, 80 per cent of schools registered as participants on the ShakeOut website and received the information necessary to take part in the drill including regular ShakeOut news updates and preparedness tips (NZ ShakeOut, n.d.b). In total, more than 2,000 schools, representing 650,960 staff and students, participated in the ShakeOut exercise (Ministry of Civil Defence and Emergency Management (MCDEM), 2013).

Research examining emergency preparedness and response experiences in NZ schools has been limited. The study of a Wellington primary school conducting an earthquake response and family reunification exercise (Johnston *et al.*, 2011) provides one of the few examples of earthquake drill best practice protocols for schools. Where the experiences of schools have been investigated (e.g. Stuart *et al.*, 2013; Tarrant, 2011), recommendations have encouraged the sharing of lessons learned to assist all schools in improving their preparedness efforts and response capabilities.

On 26 September 2012 more than 1.3 million people (of a total NZ population of 4.43 million; Statistics New Zealand, 2012) in homes, schools, and businesses throughout NZ took part in the ShakeOut exercise (NZ ShakeOut, n.d.b). The present study leveraged off this event by contributing to the MCDEM evaluation programme aimed at determining the effectiveness of ShakeOut in increasing the earthquake preparedness of NZ communities (MCDEM, 2013). The aim of the present study was to identify the lessons learned by schools during their participating in the 2012 ShakeOut earthquake drill.

2. Method

2.1 Participants

With the approval of the University Ethics Committee invitations to participate were sent to 1,878 schools registered on the NZ ShakeOut website that had also indicated a willingness to be contacted by a researcher. In total, 514 agreed to participate representing 20 per cent of all NZ schools and more than 170,000 students and staff. The participating schools were representative of schools nationwide, with the study sample corresponding to national statistics for school type, decile (a socio-economic measure), and regional distribution according to figures available from the Ministry of Education (Education Counts, 2012).

2.2 Questionnaire

The study used a self-administered, electronic questionnaire based on questionnaires developed for use in the 2008 Great Southern California ShakeOut (RiskRED, 2009) and the 2011 Great Central United States ShakeOut (Petal *et al.*, 2011). Minor modifications were made to reflect a NZ context such as: the addition of extra NZ-specific response options for some questions; and the removal of questions specific to American schools. The survey was then piloted with emergency management practitioners and researchers from Massey University, the Ministry of Education, and MCDEM, who provided feedback. The questions covered the following ShakeOut-related themes: people involved; drill types; performance of drill elements; evaluation methods; and lessons learned.

2.3 Procedure

The SurveyMonkey® website was used to facilitate data collection. A list of participating schools was provided by the NZ ShakeOut organisers. An e-mail invitation containing a weblink to the survey was sent to the school point of contact identified when the school registered on the NZ ShakeOut website. The e-mail invitation included a cover letter describing the study, requirements of participants, data security and anonymity, ethics information, and contact details for the researchers. The survey was accessible to participants from 27 September to 26 October 2012.

2.4 Analysis

Thematic analysis was used in the present study due to the flexibly and thematic freedoms it provides as pointed out by Braun and Clarke (2006). Themes were identified at a semantic level to gather meaning and were used to describe the lessons schools had learned from their experiences of the ShakeOut exercise.

3. Results and discussion

Participation in the 2012 NZ ShakeOut earthquake drill provided an opportunity for schools to plan, conduct, and evaluate an earthquake response drill. The drop, cover, hold (DCH) practice enabled students and staff to learn and rehearse the correct safety actions to take when an earthquake occurs. Participating schools were encouraged to combine their DCH practice with a building evacuation drill. All participating schools completed a DCH practice, but less than half (44 per cent) also conducted a building evacuation drill. Respondents reported a range of lessons learned from their participation, the lessons falling into seven broad categories: DCH practice; building evacuation; participants in school drills; linking drills to education and preparedness; ShakeOut resources; evaluating the ShakeOut exercise; and the influence of emergency experience and preparedness research. The seven categories are discussed below, and in some cases several lessons are reported within each category.

3.1 "Drop, cover, hold" practice

3.1.1 Lesson: consider the effectiveness, and alternatives types, of alert systems. Most survey respondents reported the use of some form of alert (e.g. bell, siren, or alarm) to begin the earthquake drill. For the most part, alert systems worked well; however, some schools did identify problems. Most common amongst these were the inability to hear the alert in all areas of the school and the need to be able to differentiate between the alert signals used for different emergency types (i.e. fire, earthquake, lockdown). A few respondents also considered what they would need to do if alerts did not operate in an actual emergency, with one school choosing to try an alternative method that did not require electricity, to announce the beginning of their drill. A US study of emergency drills in schools found that faulty or inadequate emergency alert systems were a commonly reported challenge when conducting drills (Ramirez *et al.*, 2009). Such findings reinforce the need to consider the effectiveness of alert systems and alternatives.

3.1.2 Lesson: identify alternatives to DCH if cover is unavailable or not suitable. Once the alert had sounded participants were expected to adopt the DCH safety behaviour. A small number of respondents identified concerns with staff and students not being able to DCH, often due to the size or mobility of the person, or the cover available.

In a few cases, respondents reported children became anxious if they could not get to cover, or others spending too long looking for cover rather than just adopting an alternative position. Some schools had considered this possibility prior to the drill and had encouraged children to identify other options such as using the turtle safe technique, as recommended on the ShakeOut website (NZ ShakeOut, n.d.a). The "turtle" is a safety behaviour in which the individual crouches down on the ground and covers his or her head and neck with their arms, like a turtle. The "turtle" is recognised as the appropriate earthquake safety behaviour in NZ pre-schools where cover may be limited, but can be used by anyone who cannot DCH. Ensuring that children have knowledge about safety actions they can take in an emergency, including alternatives, can help reduce their vulnerability (Finnis *et al.*, 2004).

3.1.3 Lesson: dispel myths around inappropriate safety behaviours. In a few schools respondents reported participants questioned the use of DCH. The NZ ShakeOut website (NZ ShakeOut, n.d.b) provided advice on the efficacy of DCH, or suitable alternative actions, as well as dispelling myths such as the "triangle of life", where individuals place themselves beside a table (or bed) during an earthquake so falling objects hit the table at an angle resulting in a triangle shaped space in which they are kept safe. The triangle of life myth persists despite being discredited (Lopes, 2004). Ensuring individuals have access to consistent and credible information about how to respond in an emergency can reduce their reliance on unsubstantiated myths and rumours.

3.2 Building evacuation

3.2.1 Lesson: establish criteria that would determine if and when building evacuations will occur. Once the DCH practice was completed, almost half of schools conducted a building evacuation, prompting many to consider various aspects of their evacuation processes. In particular, schools identified the need to formalise procedures about if and when they would evacuate buildings, with several asking if an evacuation is always necessary after an earthquake. Some schools indicated that they would automatically evacuate once the shaking has stopped, while others were more circumspect suggesting that decisions would need to be made at the time, dependent on severity of the earthquake and potential damage to the building. A few schools also recognised the need to have a method to trigger a building evacuation, especially if they were unable to use existing alert systems due to power failure or damage. Establishing guidelines prior to an emergency, about if and when to evacuate buildings, can reduce uncertainty and increase the effectiveness of the response.

3.2.2 Lesson: identify potential hazards and risks along evacuation routes and in the assembly area. On the way to their designated assembly areas several schools identified potential hazards along their evacuation route, with a few recognising the importance of having alternative routes to the assembly area. Potential issues with evacuation routes and the suitability of assembly areas have been considered in previous studies (e.g. Johnston *et al.*, 2011; Ramirez *et al.*, 2009), with recommendations that building evacuation drills be used as opportunities to identify such problems prior to an emergency. Many respondents also considered the need to have staff and students familiar with particular procedures to follow if they are not in their own classroom (e.g. in the bathroom, hall, or outside) when an emergency occurred.

Schools require a safe place for students and staff to assemble when a building evacuation is necessary. The area must be free from further threats, with enough space for everyone, and in a location that allows the emergency response, or drill, to be managed effectively (e.g. accessible to emergency response agencies and for family reunification). Several respondents identified potential risks in their assembly areas, such as power lines or the possibility of liquefaction, and indicated they would be addressing these risks in future planning activities. The drill also provided an opportunity for participants to test alternative assembly areas, such as "higher ground" assembly points for schools located in tsunami inundation zones. Feedback from respondents suggested that testing alternate locations for assembling after an emergency was a useful component of the ShakeOut exercise. When planning and preparing for emergencies, time must be given to the identification, and were possible removal, of any hazards and risks on evacuation routes and in assembly areas.

3.2.3 Lesson: establish procedures to ensure all students, staff, and visitors are accounted for in the assembly area. The importance of accounting for everyone on site during an emergency, or a drill, was acknowledged by most schools that completed a building evacuation. The benefit of having readily accessible copies of all class rolls and student contact details was acknowledged by many, especially as schools may currently only have this information in electronic form. Most schools were confident they had appropriate procedures to account for teachers and students, with some reinforcing the importance of considering all the school staff including non-teaching personnel (e.g. librarians, administrators, caretakers) and visitors (e.g. parents, contractors, guest speakers) that may be present during an emergency. The inclusion of any on-site visitors in the drill was seen as a useful lesson for schools, with many having not considered them in their prior planning or having not zinvolved them in previous emergency drills. In addition, some schools considered the need to have backup replacements for any staff that may be absent during an emergency, especially those that had specific response roles (e.g. wardens, first-aiders, media, or emergency services contact). To avoid unnecessary confusion in an emergency, procedures need to be developed to ensure everyone on site is able to be accounted for in the assembly area.

3.2.4 Lesson: establish procedures for the supervision and care of students and staff in the assembly area. The ongoing safety and management of students and staff in the assembly area was considered by many participants, with several indicating they had discussed the type of physical and psychological support that may be necessary for those requiring attention following an emergency. The need to support potentially distressed students prompted some respondents to comment on processes they had put in place to help when communicating with and accounting for students. For example, having children sit in class and/or year groups for easier information sharing and supervision. The Wellington primary school earthquake drill (Johnston *et al.*, 2011) recommended encouraging older children to be involved in providing support to younger students during an emergency. In particular, the study suggests reuniting siblings from other classes, thus providing comfort for these children and also making reunification easier. When planning for emergencies, consideration needs to be given to communication, supervision, and the emotional support of students and staff in the assembly area.

3.2.5 Lesson: plan for family reunification. There was no requirement for schools to conduct a family reunification drill as part of the ShakeOut exercise. However, many respondents acknowledged the importance of having prior plans in place to reunite families after an emergency. Several schools identified a need to review existing plans

to ensure they could quickly and safely return children to their families. A key component of any reunification plan is ensuring all contact and emergency-related information is kept up-to-date. One school indicated they should also include: "[…] processes to follow if other members of the family pick up children - aunties and nanny's mark off on [the] roll". Encouraging schools and families to plan for reunification should be prioritised as it can provide reassurance to children and assist in bringing families together more promptly after an emergency (Johnston *et al.*, 2011; Ronan and Johnston, 2005).

3.2.6 Lesson: establish formal endings to drills. Very few schools in the present study mentioned the need to have a recognisable ending to the drill. Just as emergency drills require a clear beginning, they also need a distinct end. Providing a formal conclusion to the drill affords an opportunity to recognise the role participants have played (Johnston *et al.*, 2011), and reinforce the importance, seriousness and benefit of practising emergency response actions (Ramirez *et al.*, 2009).

3.2.7 Lesson: participation in large-scale drills can help engage schools and students in preparedness activities. Overall, schools found participating in the NZ ShakeOut earthquake drill beneficial for emergency preparedness. Many schools identified areas on which to focus their future planning and preparation activities. Several respondents identified the advantage of participating in a nationwide event: "Students had a greater feeling of ownership of this exercise when they knew that thousands of others were doing the same things throughout the country, unity of purpose" and "Good to have [an] opportunity to be part of NZ-wide experience. Students & parents [were] aware that it was happening because of [the] extensive advertising campaign". As in the present study, previous ShakeOut-related surveys of schools found that large-scale drills, with pre-identified objectives have been well supported and successful in enhancing school-based emergency management activities (Petal *et al.*, 2011; RiskRED, 2009). Large-scale community, national and international preparedness initiatives provide opportunities to engage schools, students, and families in preparing for future emergency events.

3.3 Participants in school drills

3.3.1 Lesson: involve everyone on site in school drills. In addition to 170,000 students and staff, one quarter of participating schools had parents present during the ShakeOut drill. In most cases respondents indicated that everyone at the school at the time of the drill was expected to participate. Visitors may have included temporary staff, students visiting from other schools, contractors, and emergency or civil defence personnel present expressly as part of the ShakeOut exercise. By encouraging everyone to be involved, many schools used the opportunity to identify the different people they should consider when planning for emergencies. Encouraging everyone to participate in emergency drills provides opportunities to discover gaps in existing processes and to share the school's response plans with visitors.

3.3.2 Lesson: plan for those with disabilities and special needs. In more than half of schools (57 per cent), staff and students with disabilities participated in the earthquake drill, prompting many schools to consider, and potentially reassess, the requirements of those with special needs. In particular, the types of difficulties that were identified for children with disabilities that are reliant on wheelchairs, as was the need to have alternative response plans in place to support those students. A few schools also

recognised that students with other special needs or health-related conditions may require additional support and assistance, including, for example, specialist support due to behavioural problems. Graham *et al.* (2006) found almost a quarter of schools had no provision for children with special needs in their emergency response plans. In the last decade consideration of people with disabilities or special needs has become a focus for school-based emergency management efforts (e.g. Boon *et al.*, 2014). When planning for emergencies schools must consider the specific response requirements of those with special needs, in particular, the accessibility of evacuation routes and any additional support necessary in the assembly area.

3.4 Linking drills to education and preparedness

3.4.1 Lesson: link drills to learning opportunities for students. Many schools linked the ShakeOut drill to their classroom-based learning and found this had a positive influence on student's knowledge and understanding of earthquakes and other hazards. Before, during, and after the drill, students: learnt about different types of hazards and the appropriate safety behaviours and response actions to take; had discussions about different emergency scenarios; identified commonalities and differences in school plans for different emergency events; and learnt about how civil defence can help in emergencies. Classroom discussions with students provided opportunities to answer questions, such as: "what [if] school leaders [are] off site?", or "in the event of a real earthquake I would […]". In addition to teacher-led discussions, some schools reported students taking an active role in their peers' learning.

Emergency response drills provide training and experiential learning opportunities for students (Ramirez *et al.*, 2009; Wood and Glik, 2013) and present openings for the inclusion of disaster education across the curriculum (Ronan *et al.*, 2015). Students (and staff) need to understand the "why" so they can extrapolate that out into new or unfamiliar situations (Johnson *et al.*, 2014). Emergency drills are opportunities to engage students in learning about hazards and increasing their knowledge of how they can protect themselves by understanding appropriate response actions.

3.4.2 Lesson: use drills to engage with families and encourage home-based preparedness. An added benefit of the 2012 NZ ShakeOut was the opportunity the exercise provided to link the drill with the promotion of earthquake preparedness at home. Several schools indicated they had actively involved families in the drill by providing students with information about earthquakes and encouraging them to discuss this material at home. The potential benefit of using children to promote home-based preparedness has been supported in previous research investigating school hazard education programmes (e.g. Finnis *et al.*, 2004; Ronan *et al.*, 2008). Engaging with families about the school's emergency plans and encouraging them to develop family plans may reduce hazards-anxiety and assist schools in responding more effectively.

3.5 ShakeOut resources

3.5.1 Lesson: improve school's accessibility to emergency preparedness and response resources. In total, 91 per cent of respondents used resources from the NZ ShakeOut website to assist in their preparation for the earthquake drill, with the consensus being that it was a useful tool. One quarter of schools reported using the civil defence "sting" (the NZ emergency broadcast signal that was available on the ShakeOut website and selected radio stations) to begin their DCH practice. The "sting" was the only ShakeOut

resource that proved to be problematic for participants, in particular the way it was broadcast on some radio stations with one school suggesting that: "If CD alert is to be broadcast on radio it needs to be done thoughtfully. One radio station we had on in a classroom started being silly about alternative earthquake [responses] immediately after drill time and while radio still on in classroom. Kind of undermined the importance and lesson we were trying to teach".

In addition to the ShakeOut website, schools reported using one or more of the resources available from both MCDEM (i.e. 36 per cent used the "What's the Plan Stan?" school teaching resource; n.d.) and the Ministry of Education (i.e. 24 per cent used the emergency plans and guidelines; n.d.). One school described how they had adapted the resources to make them appropriate for their school: "[We] used our own detailed plan for emergency response and traumatic incidents, initially based on Ministry [of Education] templates but much more detailed to fit our circumstances and community".

It would be helpful if there were a central point, similar to the ShakeOut website, where emergency management resources from the various providers (e.g. government, practitioners, and researchers) could be accessed to assist schools when planning for and responding to emergency events.

3.6 Evaluating the ShakeOut exercise

3.6.1 Lesson: use drills as an opportunity to evaluate the effectiveness of plans and procedures. In combination with the promotion of the earthquake drill, the NZ ShakeOut website also encouraged schools to review and evaluate their participation to assist them in gauging the effectiveness of their existing response plans and procedures. In total, 93 per cent of participants reported evaluating their school's experience of the ShakeOut exercise. The most common evaluation methods were discussion in staff meetings (75 per cent) and in classrooms with students (71 per cent), with more than half (54 per cent) using both. One in five schools reported having produced a written report of their evaluation results, with 12 indicating they share their evaluations with the school's Board of Trustees (school governing bodies) and in some cases with the families of students. Further research is needed to establish the extent to which schools use any lessons identified from evaluations to improve their future emergency planning and drill procedures.

Most respondents indicated preparedness discussions with students and staff occurred both before and after the ShakeOut exercise. Discussions were not only about the earthquake drill, but also the effectiveness of the school's existing emergency plans and procedures. Examples of the types of improvements and adjustments identified by respondents included: the need to have plans readily accessible; having clear and effective leadership; regularly reviewing emergency supplies; and having effective internal and external communication plans and processes in place to assist during an emergency.

The literature (e.g. American Academy of Pediatrics, Council on School Health, 2008; Johnson *et al.*, 2014) stresses the importance of schools evaluating their preparedness efforts, including education programmes and emergency drill performance. However, exactly what schools should be evaluating and how, requires further clarification by researchers and practitioners. In order to assess the future effectiveness of school's response capabilities, emergency plans and procedures needed to be tested and evaluated regularly in drills. After real life emergencies, it is critically important that schools evaluate their responses.

3.7 The influence of emergency experience and preparedness research

3.7.1 Lesson: use experience of emergency events as opportunities to promote and improve school preparedness. The 2010-2011 earthquakes in the Canterbury region have increased public awareness about earthquakes and reinforced the need for schools to be prepared for emergency events. Several Christchurch-based schools in the present study indicated how their own direct experiences of the Canterbury earthquakes had influenced their preparedness and response capabilities, in particular how the hundreds of aftershocks they had experienced had provided them with the opportunity to perfect their emergency response plans and procedures. However, a few Christchurch schools also indicated they did not want to add to anxieties children had from the previous earthquakes by making a "big deal" of the NZ ShakeOut drill. Drills require a balancing act between not scaring participants (Johnson *et al.*, 2014) while providing the potentially lifesaving information necessary to respond effectively in an emergency (Ramirez *et al.*, 2009).

The Canterbury earthquakes also had an influence on schools throughout NZ by providing a real world context to use while preparing for and conducting the ShakeOut drill. Several schools outside the region indicated they had sought advice from Christchurch colleagues, which they found very beneficial. In addition, many reported that their school had reviewed their existing emergency plans and procedures after the earthquakes in light of the stories they had heard from their contemporaries in Canterbury schools. Emergency events provide practical opportunities for schools to share their experiences and lessons learned to improve preparedness efforts and response capabilities in all schools.

3.7.2 Lesson: participating in research about emergency management can increase awareness about school-based preparedness activities. Several schools reported that completing the questionnaire made them aware of preparedness activities they had not previously considered, with comments such as: "Now I have seen this [questionnaire] I know what to do to prepare our school and we will get organised". Such responses indicate that schools are not necessarily aware of all aspects of emergency preparedness. Guidelines on the preparedness activities schools should undertake will assist in clarifying their understanding of what is required, to meet their statutory obligations and to keep students and staff safe. It can be suggested that, by participating in the ShakeOut exercise and the present study, some schools may have considered the effectiveness of their emergency preparedness for the first time. Participation in research can be beneficial to participants, as aspects of taking part in the research can raise awareness of specific, potentially relevant or useful ideas and actions.

Some caution is required when interpreting the results of the present study. First, the study participants were self-selecting and had already displayed motivation to improve school-based emergency management efforts by registering to participate in the ShakeOut exercise. Second, the invitation to participate in the study was sent to the point of contact in each school identified in the ShakeOut registration process. Consequently, it is unclear whether the person that completed the survey questionnaire was in fact the person with complete knowledge about the school's emergency management processes. Third, the study had a response rate of 20 per cent of all NZ schools. However, it should be noted that the 514 schools in the study were representative of the range of school types in NZ, as well as school decile ratings, and their regional distribution.

4. Conclusions

The many encouraging comments provided by respondents in the present study demonstrate that participation in large-scale exercises like the NZ ShakeOut earthquake drill can have positive outcomes for schools. For example, through an increased understanding of the risks presented by earthquakes improvements can be made to school emergency plans and more realistic perceptions of emergency response capabilities can be established. The present study has also demonstrated that when schools are encouraged to undertake earthquake preparedness activities, they are likely to do more than the minimum requirement of a "Drop, Cover, Hold" practice, reinforcing the effectiveness of community-based initiatives such as ShakeOut on overall school preparedness and emergency management.

5. Recommendations

5.1 Establish clear, specific objectives for emergency drills

Arguably, a core component of the success of the ShakeOut exercise related to the variety of ways in which schools could participate. The NZ ShakeOut website provided specific objectives schools could meet by participating. By undertaking some or all of these activities many schools identified aspects of emergency preparedness they had not previously considered. Research indicates that participants are usually happy to engage in emergency response drills (Ramirez *et al.*, 2009), with the potential for further buy-in possible by establishing specific objectives to be achieved during the drill. Therefore, to ensure emergency drills are effective, consideration must be given to specific elements to be tested, for example: alert systems, safety behaviours, evacuation routes, assembly areas, accounting for everyone, and ending the drill.

5.2 Involve everyone in emergency drills

Participation in the NZ ShakeOut drill encouraged and, in some cases, helped establish relationships between schools and their stakeholders, in particular with the children's families and CDEM agencies. The relationships established and the success of the 2012 NZ ShakeOut drill may act as a catalyst for future stakeholder engagement by schools. Many schools acknowledged the benefit of including everyone on site in the ShakeOut drill. In particular, the requirements of those with special needs were identified, as was considerations for parents, visitors, or guests in the school that may not be familiar with emergency plans and procedures. Initiatives like the NZ ShakeOut drill provide opportunities for communities to be involved in schools' emergency management efforts, while having the potential to increase home-based preparedness and, by extension, overall community resilience (Wood and Glik, 2013).

5.3 Use drills as opportunities to test alternatives and add realism

Many schools recognised the importance of regularly participating in emergency drills. Such activities were seen to aid in preparing staff and students for emergencies by reinforcing emergency training, increasing the likelihood participants would respond appropriately in an actual emergency, and providing an opportunity to test alternative scenarios, roles, and locations (Johnson *et al.*, 2014; Johnston *et al.*, 2011). Drills need realism and variety to maximise their effectiveness (Ramirez *et al.*, 2009; Wood and Glik, 2013). Variety could include, for example, providing opportunities to practice alternative safety actions outside the classroom.

5.4 Link drills to learning

Emergency response drills provide opportunities to engage students in learning about hazards and disasters. By linking drills and hazard education programmes students can learn how to respond appropriately to different emergency situations, whether at school or home. Hazard education can assist in reinforcing correct safety behaviours while also providing opportunities to challenge assumptions and dispel myths. Increasing knowledge and understanding of hazards and disasters can have benefits not only for individuals, but also having the potential to increase family and community resilience (Ronan and Johnston, 2005).

5.5 Evaluate the effectiveness of emergency drills

Evaluation is a component of emergency management that is endorsed throughout the literature as critical to fine tuning plans and procedures (e.g. Johnston *et al.*, 2011; Ramirez *et al.*, 2009), but not always included in response drills. While most schools evaluated the ShakeOut exercise, it is unclear whether lessons learned were shared with stakeholders or implemented into ongoing planning efforts. It is important schools are encouraged to include evaluation as an element of their emergency drill procedures, through both formal reporting processes and informally in feedback from participants and stakeholders. In addition, strengths, weaknesses, and gaps identified through the evaluation process need to be considered when schools are reviewing and revising their emergency plans and procedures.

5.6 Provide opportunities for schools to share their emergency experiences

The schools in the present study were extremely forthcoming in sharing their experiences of the ShakeOut exercise with the researchers. This willingness to share the lessons they learned can be utilised to contribute to our understanding of school-based emergency management best practice and also to provide insights into how schools respond to both drills and real world emergencies. A website, such as that developed for the NZ ShakeOut, has the potential to offer schools a centralised point from which they can access school-based emergency management resources. In addition, the website could act as a forum for schools to seek advice from CDEM professionals and also to share their own emergency experiences (e.g. the Canterbury 2010-2011 earthquakes, temporary school closures, and lockdowns).

6. Future research

The present study has identified the following three key areas that would benefit from further investigation: first, ongoing evaluation of emergency response drills to measure specific learning and benefits to students from participation; second, further examination of how schools use the lessons they identify in evaluations to improve their ongoing emergency preparedness efforts; and finally, exploration of school's real life experiences of emergency events in which they have been involved, to establish strengths, weaknesses and gaps in current preparedness and response efforts.

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