

WESTERN SYDNEY UNIVERSITY



Teaching Resource on Flooding
in the Hawkesbury-Nepean Valley:

Assessing the impact on student learning

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- Australian Institute for Disaster Resilience
- Bureau of Meteorology
- New South Wales, Geography Teachers' Association
- Western Sydney Social Science Teachers' Association
- New South Wales Department of Education
- Catholic Schools, New South Wales
- The Association of Independent Schools of NSW.

Aim

The project will develop a useful, effective, high quality online resource that aligns to the Australian Curriculum and the NSW Geography Syllabus to teach the topic in Stage 4, *Water in the World*, in collaboration with key stakeholders, schools and teachers within the Hawkesbury-Nepean Valley Flood zone. This resource will develop student and community awareness and knowledge about flood planning within this local context, preparedness, flood mitigation and community resilience.

Executive Summary

This report details the findings of research conducted for Infrastructure NSW assessing the impact of teaching curriculum resource about Hawkesbury-Nepean Valley on students' understanding of natural hazards, community preparedness and responses to flooding. This research project was conducted in 2019 with teachers and schools by Western Sydney University, in partnership with Infrastructure NSW.

The Project: Flooding in the Hawkesbury-Nepean Valley School Geography Resource

An online resource about *Water in the World* for the Stage 4 Geography Australian and NSW Curriculum was co-created by teachers, industry experts and academics from Western Sydney University for the NSW State Emergency Service in partnership with Infrastructure NSW. This resource has been designed to develop student knowledge of flooding within the unique context of the Hawkesbury-Nepean Valley, by;

- considering the history of flooding;
- presenting research on flood patterns;
- using data reported as part of the 'Hawkesbury-Nepean Valley Flood Risk Management Strategy' (2017);
- using scenarios to work through real-world problems relating to flood risk;
- using cross-curriculum content particularly Science, English, Maths and History to explore flooding in the Hawkesbury-Nepean Valley;
- delivering a model for high-quality fieldwork experiences;
- developing geographical skills;
- using an inquiry based approach; and
- using a problem based approach to dealing with the complex issues around flood risk, risk management, preparation and resilience within flood prone communities.

Research Overview

Research to assess the impact of the resource *Water in the World* on students' understanding of natural hazards and disasters in their local context was undertaken. This comprised pre and post surveys of students' understanding and awareness of natural hazards and emergency services and planning before and after the resource was delivered. This quantitative survey data has been analysed in the findings. A focus group to identify teacher's perspectives and experiences of using the resource was conducted. Qualitative evidence from the focus group interviews is presented.

Survey participants included a sample of 332 students from a range of schools including government, catholic and independent schools. The participants were stage 4 students (aged between 12 and 14 years) studying geography at school in NSW Stage 4 classrooms from diverse backgrounds.

Focus group participants were teachers from schools who had implemented the resource within their classrooms throughout 2019. The focus group participants came from government, catholic and independent schools and had a range of experience in teaching geography.



Yarramundi Bridge (Western Sydney University)

Findings

The resource, *Water in the World*, did improve student understanding of natural hazards and preparation for these events. Students showed improved awareness of their geographical context within the Hawkesbury-Nepean Valley and the need for flood planning and responses to emergency information and agencies. Geographical concepts related to the curriculum were better understood by the students as a result of learning about *Water in the World* via this resource.

The results also provide evidence of how teachers can use localised curriculum to develop inquiry learning and fieldwork opportunities. The resource provided teachers with a relevant context for students' learning that was highly engaging and innovative.

For students not located within the Hawkesbury-Nepean catchment who participated in the study, an increased awareness of the water cycle, of geographical concepts and inquiry/investigation, as well as the importance of the Hawkesbury-Nepean Valley for water security in the Sydney Metropolitan region was evident. Understanding of natural hazards, the risks, preparation and recovery of communities/individuals was an overall benefit from using the resource.

Recommendations

The following recommendations are provided to assist in the development of future community education programs about natural hazards.

- Use local case studies, context and authentic situations connected to the curriculum that makes the learning relevant and valued by students.
- Engage students with rich inquiry learning that includes fieldwork, immersive and virtual experiences to develop stronger understanding of geographical concepts.
- Connect learners with their local community to build community resilience for natural hazards and disaster education.
- Challenge and include all diverse learners with opportunities to problem-solve to develop preparedness and responsiveness to natural hazard scenarios.
- Collaborate with teachers, the community and school leaders to develop high quality and innovative curriculum resources.



View from Castlereagh Road (Western Sydney University)

1 Purpose of the Research Report

This research report presents evidence of the student learning and engagement with the stage 4 Australian and NSW Geography curriculum resource for *Water in the World – Hawkesbury-Nepean Valley*. This report uses data collected from stage 4 students across NSW Government, Catholic and Independent Schools and provides perspectives from secondary Geography teachers involved in implementing the resource with their classes.

This resource for *Water in the World* is hosted on the New South Wales State Emergency Service public website and has been designed using expert input from Infrastructure NSW (INSW), NSW State Emergency Service (NSW SES), the Bureau of

Meteorology, Western Sydney University, NSW Geography Teachers' Association (NSW GTA), Western Sydney Social Science Teachers' Association (WESSSTA) and the School Advisory Committee from The Association of Independent Schools of NSW (AISNSW), the NSW Department of Education (NSW DoE) and Catholic Schools NSW.

The report shows how the resource, *Water in the World*, has impacted upon students' awareness of the relative risk of natural hazards and preparedness and identifies the benefits of this school based curriculum approach in developing community resilience for natural disasters.



View from Yarramundi Reserve (Western Sydney University)

2

Background

The project has developed a useful, effective, high quality online resource that aligns to the Australian Curriculum and the NSW Geography Syllabus to teach the topic in Stage 4 *Water in the World* in collaboration with key stakeholders, schools and teachers within the Hawkesbury-Nepean Valley Flood zone. This resource has been designed to develop student knowledge about floods within this local context, community preparedness, flood mitigation and community resilience.

This project is in response to the following evidence about current flood planning and risk mitigation within NSW. Specifically, this project addresses the NSW government's initiative 'Hawkesbury-Nepean Valley Flood Risk Management Strategy' (2017).

The key objectives of the project were:

1. Delivery of a high quality Geography online resource for the Stage 4 topic *Water in the World* that strategically addresses issues related to community resilience, preparedness and flood planning and mitigation in the Hawkesbury-Nepean Flood Valley.
2. The development of a curriculum resource that is engaging, accessible, useful and relevant for teachers, schools and students across all educational sectors.
3. Building an appropriate and scalable research method to evaluate the impact and efficacy of the curriculum resource across multiple stakeholders.
4. Collaboration with the peak professional associations in Western Sydney and across Australia, relevant emergency services, schools, teachers and education providers and representatives to create, implement and evaluate the curriculum resource.

3 Context for the Research

Within the Hawkesbury-Nepean River Valley a 1 in 100 chance per year flood event, or 1% ARI event may result in 64,000 people requiring evacuation (INSW, 2019) with over 25,000 residential properties being prone to flood risk (INSW, 2017). A 1 in 500 chance per year event would result in 12,000 residential properties being impacted, 90,000 people needing to be evacuated and estimated economic damages to be \$5 billion (INSW, 2019). The risk to the community in this instance is concerning. Factors such as decision-making, timing, the preparedness of the community, flood warning protocols, and the routes and roads for evacuation make this complex with the potential for adverse outcomes high. Studies into natural disasters show that human behaviour and preparedness are critical factors in influencing evacuation success. Premature or misleading evacuation orders, the loss of collective memory about past flood events and non-compliance with emergency service orders can delay community response.

Studies conducted into community attitudes and flood awareness indicate that people are conscious of flood risk but do not perceive this as a significant risk to their life or property (Hawkesbury-Nepean Floodplain Management Strategy, HNFMSC 2004). The HNFMSC study (2004) revealed that up to 70% of residents were unaware they resided on a floodplain. Research cited in the Hawkesbury-Nepean Valley Flood Risk Management Strategy' (2017) reported that more people would stay in a flood situation even if warned to evacuate (16% in 2006 to 28% in 2008). Reliance on SMS messaging in flood events was the preferred communication strategy of the public surveyed in 2008.

For resilience to flood events, communities need support for social learning. This requires building on what the community already knows, identifying a diverse set of flood management options, and facilitating effective collaborations between community members and emergency managers.

Local initiatives and communication are the most effective in managing flooding events. This means public participation can play an important role in improving resilience, and participation empowers vulnerable groups to make informed decisions about their flood risk. Community participation can also help build trust and understanding between the community and those involved in government agencies to manage flood risks. Three key aspects that influence resilience of community for flooding are:

- the interplay of institutions;
- flood risk communication; and
- and flood prediction tools.

However, the key to achieving the resilience is the participation of different stakeholders at the grassroots level. This increases the ownership of the problem and creates opportunities for sharing responsibility between the authorities and the local people.



Flood planning workshop with schools in the Hawkesbury-Nepean Valley (Infrastructure NSW)

Education programs to prepare the community to deal with disasters are effective in creating awareness and building preparedness. However, engaging with a diverse community about these issues presents significant challenges. Educating school children via appropriate and relevant curricula can enhance generational understanding of disaster and prepare the community to cope with these events. Children are effective agents to indirectly enhance family and adult behaviours in subtle ways and influence the wider community as they grow to adulthood. Thus educating children can be very effective in creating behavioural change for the next generation; however, it is a long-term process.

The main challenge with community flood education programs is these are often designed and delivered with a 'top-down' approach, and for this reason they tend to be less effective. To overcome the shortcomings of current education programs, Dufty (2008) outlined an approach to flood education that not only helps in increasing awareness and preparedness levels but also focusses on building flood resilient communities.

This approach has four main features (Dufty, 2008):

1. focusses on building community resilience to flooding;
2. encourages learning from preparedness conversion, mitigation behaviours and adaptive capability, and post-flood events;
3. allows participation of community in the design, implementation and evaluation of flood education; and
4. encourages ongoing community education through local flood education strategies.

This approach uses community participation to design and implement flood education and supports ongoing sustained flood education strategies. This approach develops social resilience and is noted to be more effective in delivering adaptive behaviours when faced with flood events.

Social resilience is dependent upon the dynamic interaction of information, leadership from emergency services, participation by the community in the activities, and trust and strategic coordination and improvisation when problems and crises arise. These activities occur before, during and after a flood event and certain factors such as trust and exchange of information must be present throughout these activities. Different agencies and individuals must collaborate and shoulder these activities for social resilience to emerge.



Flood preparedness workshop with early childhood services in the Hawkesbury-Nepean Valley (Infrastructure NSW)

Garde-Hansen et al. (2017) proposes the concept of sustainable flood memory as an important form of social and cultural learning to live with floods and build resilience. The memory of flooding events by community can play a valuable role in an individual's sense of future preparedness for flooding. This requires effective flood communication with communities that encourages a shared participatory role for local communities, policy makers and other stakeholders in preparing for floods.

Psychological research by Towers & Paton (2007) and Ronan & Johnston (2005) indicate that children and youth can recognise causation and human agency in disaster responses and develop an understanding of mitigation strategies. Specifically, Ronan & Johnston (2005) identify the critical significance of schools and communities in preparing for disaster responses. Internationally, projects such as the World Disaster Reduction Campaign (2006-2007) used schools as their launching ground for developing concepts such as community preparedness. Emergent evidence about school based disaster education identifies that children are more likely to develop understanding of natural hazards and responses to emergencies when it is part of a sustained and mapped curriculum delivery (Dufty, 2009).

Within Australia comprehensive mapping projects of natural hazards and opportunities for disaster education within the Australian Curriculum has been undertaken by Dufty & Molino (2014). This mapping shows extensive opportunities for curricular engagement in students' study of Geography, from ages 10-15 years, across different states and territories. Specifically, in year 5 with the impact of bushfires and floods; in year 7 with responses to hydrological and atmospheric hazards; in year 8 with studies of geomorphological hazards and in year 9 with challenges about hydrological hazards and climate change.

The National Strategy for Disaster Resilience (2011) identifies important factors in developing disaster resilient communities. These include communities that can cope while under significant stress, adapt, use self-reliance, and create collective social capacity (Council of Australian Governments, 2011). The strategy recognises that curriculum based education that is relevant, authentically and locally situated is an effective approach to develop disaster resilient communities.

This research about Hawkesbury-Nepean Valley Flooding School Geography Resource is informed by the National Strategy for Disaster Resilience (2011) and evaluates how curriculum content influences a student's understanding of the relative risk of a natural disaster in their local context and their adaptive capability.

4

Research Aims

The aim of the research is to conduct a rigorous evaluation of the Stage 4 unit of work and resources for *Water in the World*, focusing on:

- a) Assessing the impact of the unit on student understanding about the relative risk of natural disasters in their local area and *Water in the World* curriculum content, and
- b) Teachers' perspectives and experiences in using the unit and resources.

The data will be used to evaluate the impact of the unit of work and to identify ways in which the unit and resources can be improved in future iterations.



View from Terrence Rd over Richmond Lowlands showing land use (Western Sydney University)

5

Methods

This study has used appropriate quantitative and qualitative methodologies, such as focus groups, case studies and surveys. These methods have been employed to determine the usefulness, relevance, currency, educational impact, value of resources, and its adaptability to a variety of classroom environments and student capabilities. Survey data and focus group findings have been collected and analysed from a range of stakeholders, including; teachers, students, community groups, geography experts and science experts who have all engaged with the resource, *Water in the World*.

Data gathering methods for this study comprise the following:

Survey

Pre teaching surveys and post teaching surveys were conducted with students. Surveys were designed to assess changes in their knowledge of natural disasters and their understanding of preparedness for natural disasters such as flooding as a result of learning about *Water in the World* through the resource.

Focus Groups/Interviews

Focus group interviews were held with teachers to explore their opinions of the effectiveness of the project resources as a teaching/learning tool in the geography classroom.

5.1 Ethics

Approval for the Project: Flooding in the Hawkesbury-Nepean Valley School Geography Resource has been granted by the Human Research Ethics Committee at Western Sydney University (Approval number H 13221), by the NSW Department of Education (SERAP, 2019309), by the Catholic Diocese of Parramatta (CEDP) and by each school, principal and parents and care-givers of student participants. Details of the school, stage 4 students and teachers have been de-identified.

5.2 Participants

A purposive sample of stage 4 students and secondary Geography teachers from schools who engaged with the resource, *Water in the World*, from NSW Department of Education, Diocese of Parramatta and Independent schools was undertaken. This comprised of students ($n = 332$) and teachers ($n = 5$) from five schools who participated in the research.

Students were aged between 12 and 14, with most being 13 years old ($n = 159$, 48.3%). There were more females ($n = 200$, 60.6%) than males ($n = 114$, 34.5%) in the sample, with the rest of the students ($n = 16$, 4.8%) indicating either another gender or a preference not to disclose their gender. A total of 36 (10.9%) students identified as being of Aboriginal and/or Torres Strait Islander background, while 47 (14.3%) identified as being from a non-English speaking background. Among those students who chose to disclose which language they spoke at home, the most commonly identified languages were those belonging to the Polynesian language group (e.g. Samoan, Tongan), with the remainder identifying various Asian (e.g. Chinese, Korean) and European (e.g. Russian, French) languages.



Hawkesbury-Nepean Valley Geography students (Infrastructure NSW)

5.3 Student Surveys

Surveys were administered to students in online or paper format, depending on each school's preference. Students completed one survey before they started the unit (pre-survey) and one unit after the unit was taught (post-survey). The pre- and post-surveys were identical aside from a brief unit evaluation section that was added to the post-survey. The following measures were included in the surveys:

Firstly, students were asked to report their age, gender, whether they identified as an Aboriginal or Torres Strait Islander, and whether they spoke a language other than English at home.

A multifaceted approach was taken to evaluate the extent to which students were prepared for a natural disaster. Students were asked to rate how frequently they spoke to their (a) families and (b) teachers about preparing for a natural disaster. If students identified that they frequently or very frequently discussed natural disasters with their parents or teachers, they were also asked who initiated these conversations. Second, for each of the disaster types below, students were asked to nominate who they had spoken to about the disaster type (family, teachers, friends, or no one) and to identify how likely the disaster was to happen in their local area:

- House fire
- Earthquake
- Dangerous storm
- Volcanic eruption

- Flood
- Bush fire
- Tornado
- Tsunami.

Students were asked whether their parents or carers had made any changes at home to prepare for a natural disaster, and if so, whether they had practised as a family what to do in an emergency, discussed a plan for evacuating their house, or discussed a place to meet if they were away from home and there is an emergency. If the student reported that their family had not made any preparations for a natural disaster, they were also asked to identify why this was the case. Finally, for each of the following groups, students were asked to identify (a) whether they had heard of the group, (b) what types of disasters the group could help with, and (c) how the group could be contacted:

- NSW Rural Fire Service (NSW RFS)
- Fire and Rescue NSW (FRNSW)
- NSW State Emergency Service (NSW SES)
- NSW Police Force
- NSW Ambulance Service.

Students were also asked two open-ended questions about ideas for assisting;

- a) their community, and,
- b) their family, to prepare for a natural disaster.



Yarramundi Reserve (Western Sydney University)

5.4 Teacher Focus Group

A focus group was conducted with teachers who had implemented the resource, *Water in the World*. The purpose of the focus group was to gather information about the teachers' experiences when teaching the unit, their views on the impact of the unit of work on student learning, and any benefits or challenges that they experienced. The focus group was conducted in two parts. The first part consisted of a general discussion focusing on the teachers' views on teaching the unit. In this part, question prompts included:

- Based on your experiences teaching *Water in the World* in the past, how would you rate the new unit based on a local issue such as flooding in the Hawkesbury-Nepean Valley?
- What were the benefits of a localised approach to the curriculum for your students?

The second part used student work samples (provided by the teachers) to stimulate reflection and discussion about the teachers' perceptions of student engagement and learning in the unit. Question prompts in this part included:

- What does this work sample demonstrate in terms of the effectiveness of the new unit of work?
- What did your students understand/do well? What did your students struggle to understand/do?
- Do you think teaching the unit has had wider impacts on the family, friends and community with which your students interact?
- What worked well about the unit? What could be improved? Why?

The duration of the focus group was approximately one hour, and was audio recorded and transcribed verbatim.



INSW Briefing Day (Western Sydney University)



INSW Briefing Day (Western Sydney University)

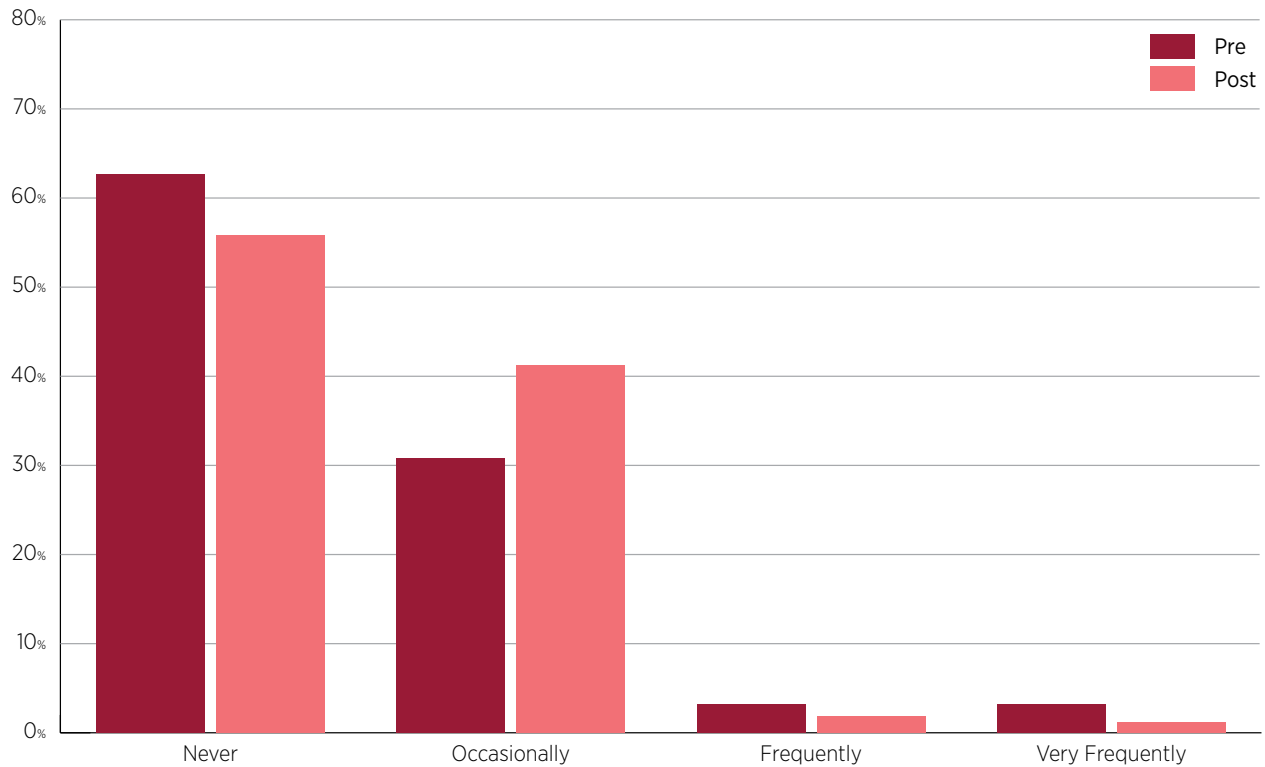
6 Findings

In this section, we first report findings from the student surveys and then from the teacher focus group.

6.1 Student surveys

After engaging with the resource, *Water in the World*, there was a reduction in the proportion of students who reported never talking with their family about preparing for a natural disaster (Figure 1).

Figure 1 - In the last year, how often have you talked with your family about preparing for a natural disaster?

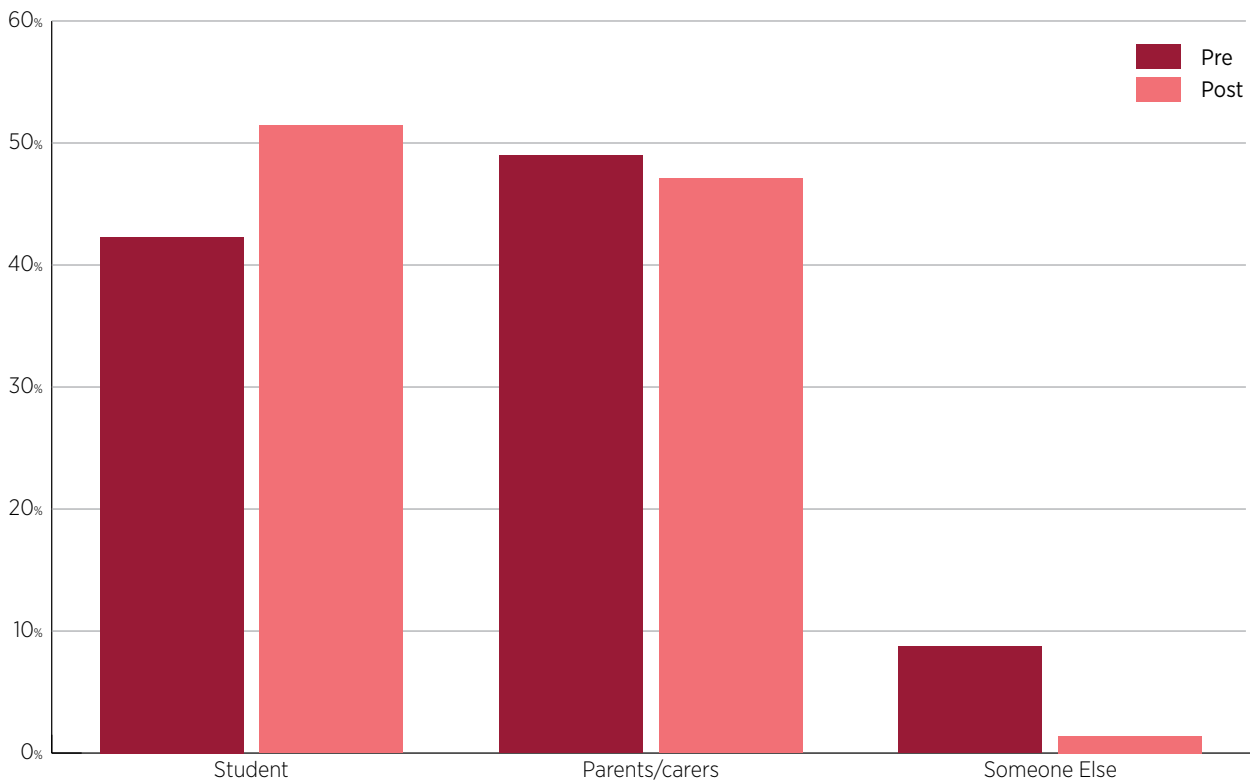




View of floodplain from Castlereagh Road (Western Sydney University)

After completing the activities and tasks from the resource, *Water in the World*, a greater proportion of students said they had raised the issue of preparing for a natural disaster with their family (Figure 2).

Figure 2 – When you talked with your family about preparing for a natural disaster, who brought it up?

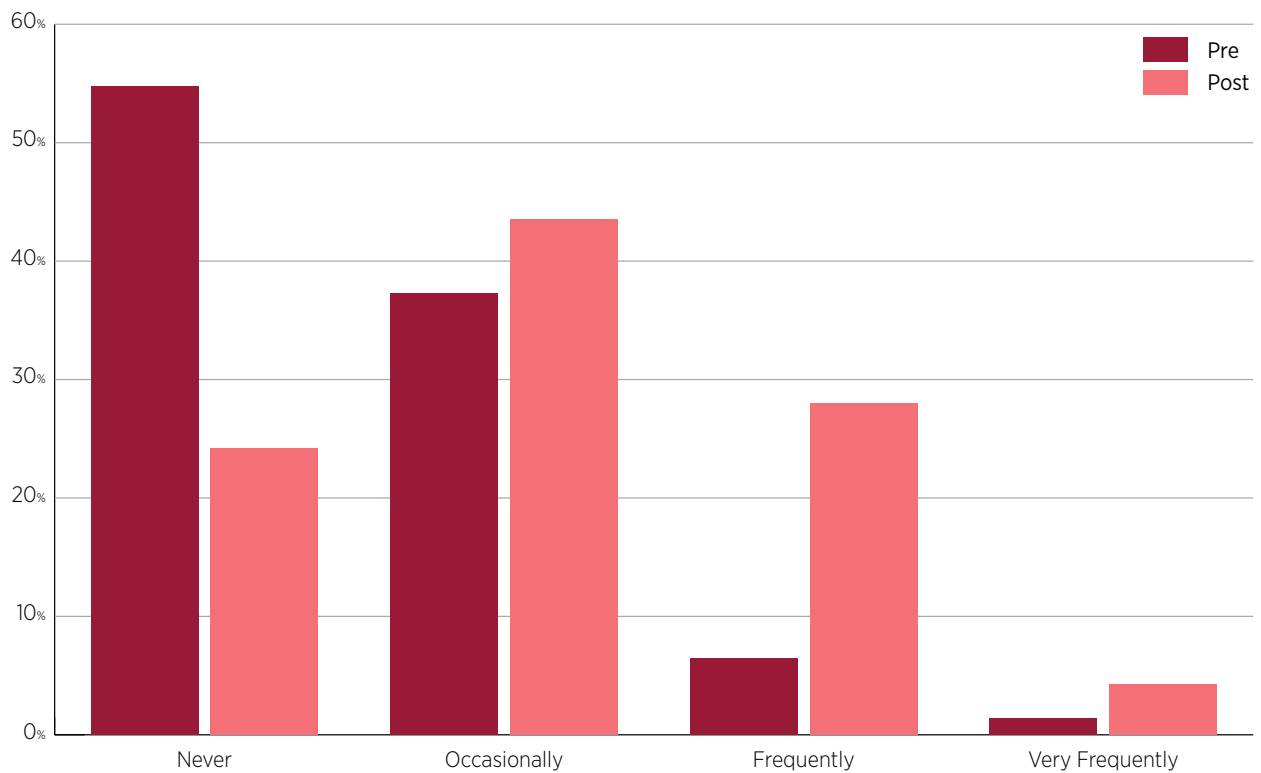




View of Victoria Railway Bridge (Infrastructure NSW)

There were proportionally fewer students who said they had never discussed preparing for a natural disaster with their teachers after engaging with the resource during class (Figure 3).

Figure 3 – In the last year, how often have you talked with your teachers about preparing for a natural disaster?

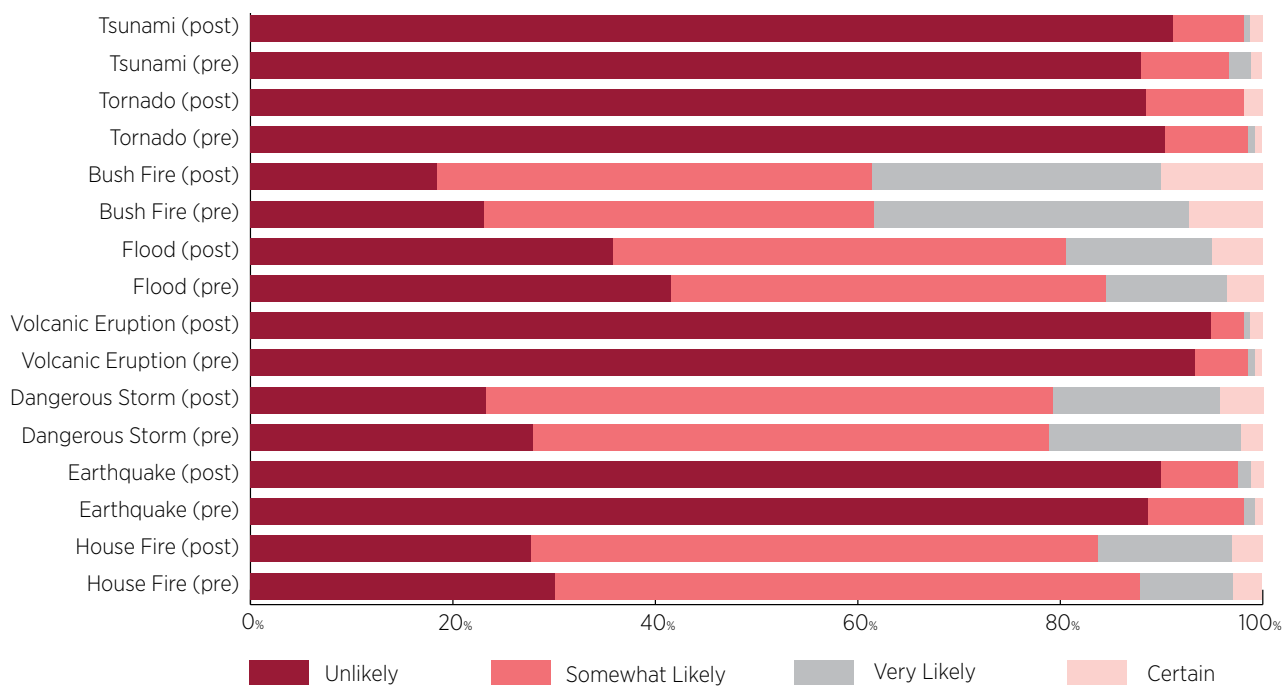




View from Terrence Road over Richmond Lowlands (Western Sydney University)

For the most part, students perceived the likelihood of natural disasters occurring in their local area at the same rates in both pre- and post-surveys. However, there was a greater proportion of students who perceived that a flood was at least somewhat likely after completing activities from the *Water in the World* resource (Figure 4).

Figure 4 – How likely is a natural disaster in the local area?

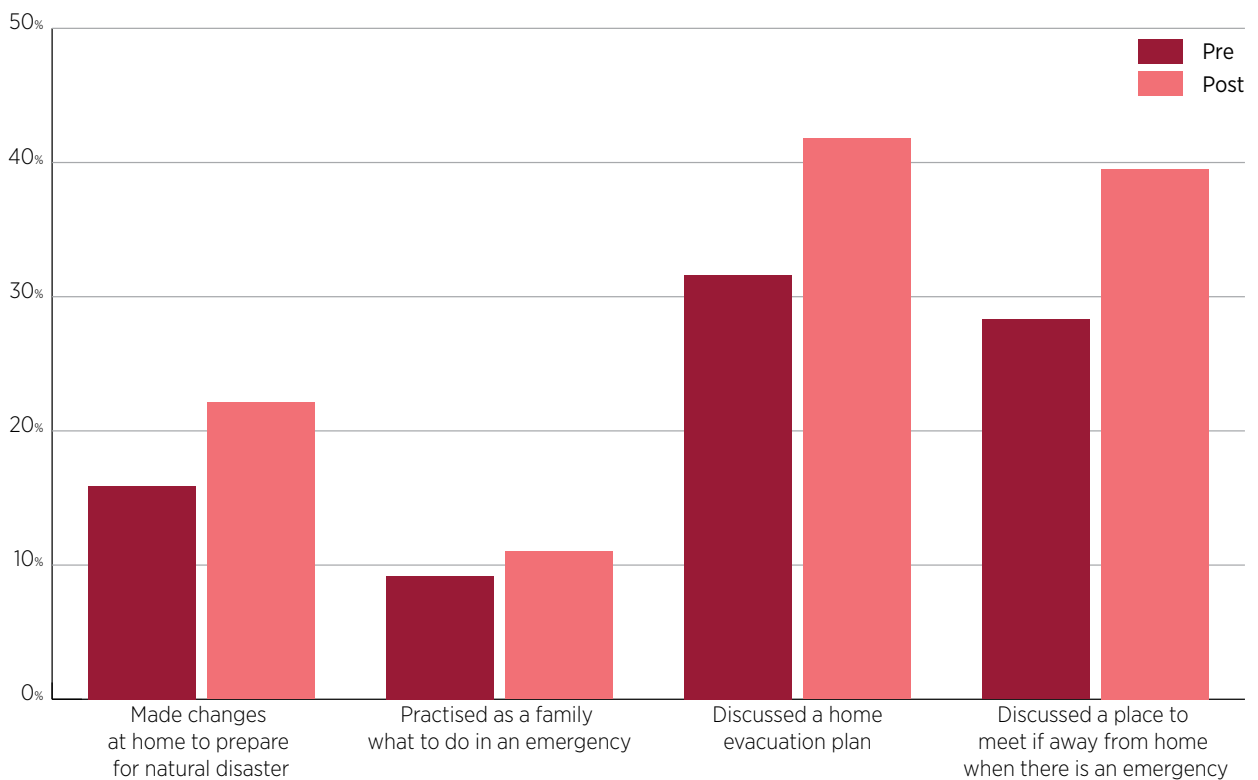




Flood planning workshop with the aged care sector in the Hawkesbury-Nepean Valley (Infrastructure NSW)

After learning about *Water in the World* a larger proportions of students reported having made preparations for a natural disaster (Figure 5).

Figure 5 - Have you made any of the following preparations?

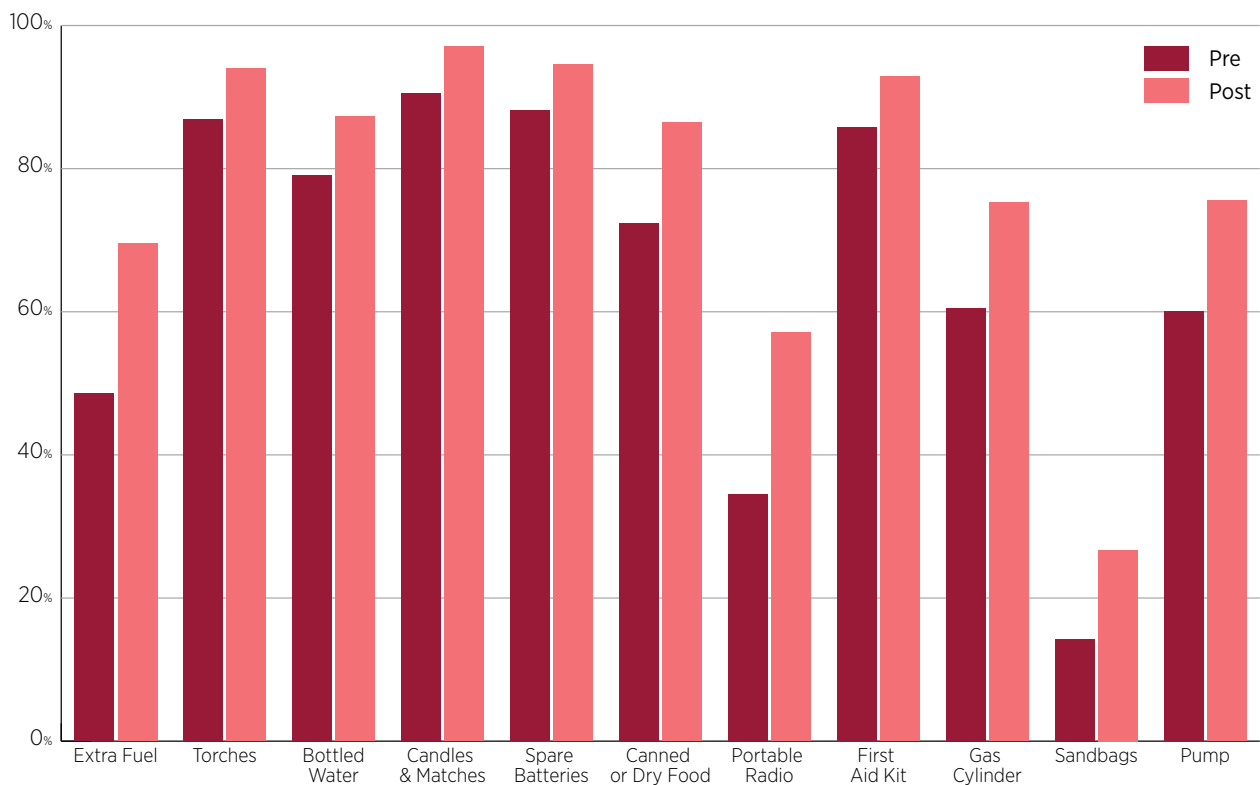




Plaque at Windsor showing height of 1867 flood (Western Sydney University)

After learning about *Water in the World* students reported having more items at home that could be used in an emergency (Figure 6).

Figure 6 – Do you have any of the following things at home to be used in an emergency?

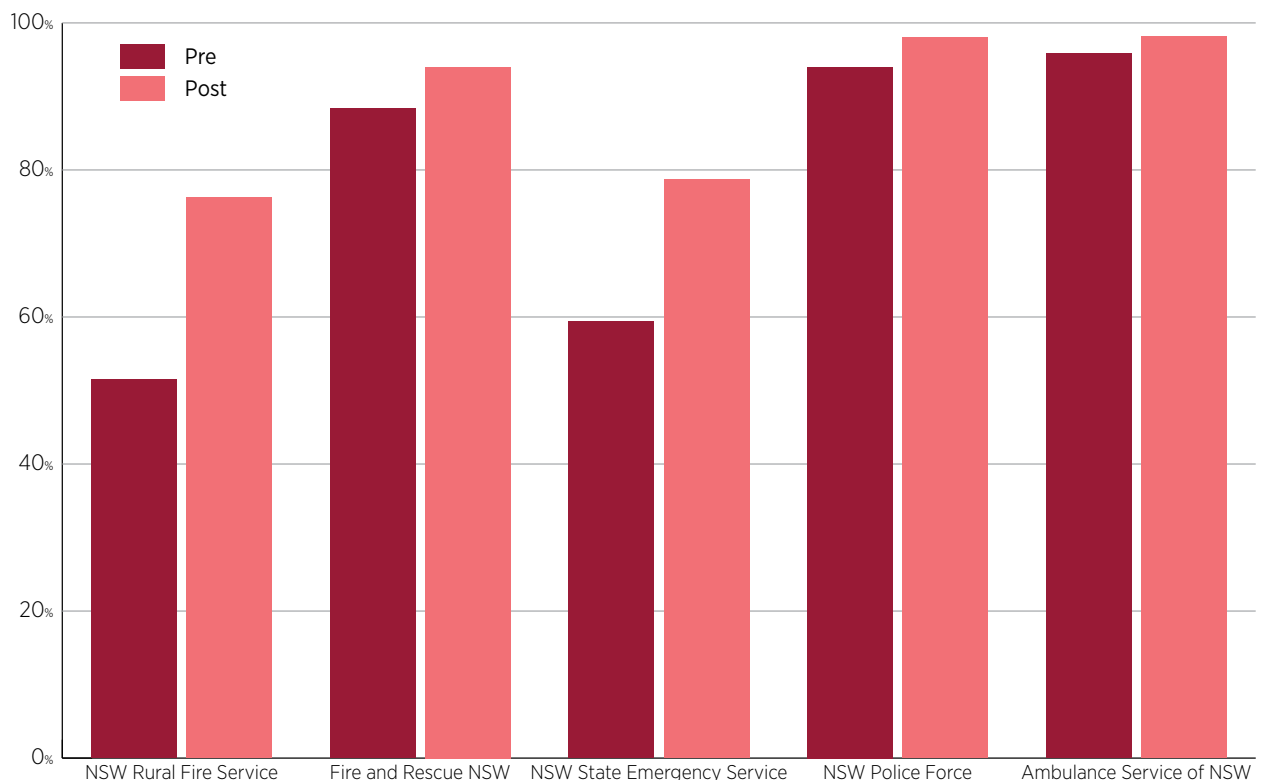




The Nepean River Pedestrian Bridge (Western Sydney University)

After learning about *Water in the World* students more frequently reported knowing about various emergency services, in particular the NSW Rural Fire Service and NSW State Emergency Service (Figure 7). In their open responses students generally had an accurate understanding of the types of events to which the different services respond. However, students often said the NSW SES responded to undefined “emergencies” before completing the unit of work about *Water in the World*. Following the unit, students appeared to better understand the role of the NSW SES in responding to severe floods and storms.

Figure 7 – Have you heard about this emergency service?





Roads in the floodplain showing inundation levels – sign (Western Sydney University)

6.1.2 Open-ended responses

Students provided a number of insightful comments on learning about flooding through the context of the Hawkesbury-Nepean Valley. Students reflected positively on the quality, depth, and age-appropriateness of the content covered by their teachers:

- “ This was a very good unit and I wouldn’t change anything. It had a great amount of information at the perfect level for my age group. ”
- “ I liked learning about how the HNV is so at risk of flooding, especially the ‘bathtub effect’, being able to use a map to know where the water can spread and what we should do during a flood. ”
- “ I thought it was interesting and fun learning about the flooding in the past and how floods occur and what we can do to help prevent flooding in the future. ”

Students also recognised the real-world value of learning about key geographical concepts as they applied to their local area, with many comments highlighting a raised awareness of how they could respond to a flooding event in the catchment.

- “ I also liked learning about what to do in a flood situation because it made me feel more confident if a natural disaster should occur. ”
- “ I liked learning about the different topic areas such as safety equipment, evacuation plans and how floods are formed. ”



Student work samples about natural hazards (Western Sydney University)

6.2 Teacher focus group

The focus group with teachers was recorded and transcribed. The transcript was analysed to identify key themes which emerged from the discussion. These themes comprised;

- Student engagement and development of geographic understanding of space, place and interconnection.
- Localised curriculum and impacts on social resilience and community preparedness.
- Geographic understanding, skills and student agency.

In many instances, these themes were intertwined. Each of the key themes are illustrated with quotes from the teachers.

6.2.1 Student engagement and development of geographic understanding of space, place and interconnection

Engagement plus, plus, plus!

A frequently noted theme throughout the discussion was the high-levels of engagement fostered by the resource, *Water in the World*, and how this enabled students to see connections between space and place. Teachers frequently linked engagement to localising the curriculum, as students were inherently interested in the content when it was linked to their local area.

I found the engagement of students was a lot more with inquiry-based learning, because suddenly we're dealing with something in your backyard.

In addition to engagement with the content, teachers remarked upon the constructive engagement of students with one another. During the Hawkesbury-Nepean Valley case study, students were able to effectively collaborate with each other to investigate geographic issues. Student engagement was high individually and in group learning contexts. Students were able to collaborate together in graphing and interpreting, directions, contour maps and scale. This engagement level was heightened by the geographical challenges students were asked to deal with about their local context.

They were feeding off each other constantly... once again linking back to the whole idea of critical thinking and getting them to really come up with solutions, potential solutions. It stimulated a lot of debate and discussions throughout.

Teachers discussed how the resource was accessible to mixed ability stage 4 students. Teachers indicated how they were able to modify and differentiate the resources to suit a range of abilities and used this to promote inquiry learning. Comments about getting girls to undertake interactive activities using geographic tools and Virtual Reality resources were identified as being positive elements that engaged student interest. It was noted that students were interested to continue the lessons and that in some instances more challenging components of working with geographic data such as tables and graphs was able to be completed within a single lesson. The engagement level according to the teachers resulted in improved student learning in this area of Stage 4 Geography and increased completion rates with skills lessons.

And I actually got them all doing it which normally when you have this it can take 45 minutes as you guys are aware, for them to actually do one column. So I actually got them to do it the whole thing which I was quite impressed with.



AISNSW Geography Conference (Western Sydney University)

6.2.2 Localised curriculum and impacts on social resilience and community preparedness

Teachers were particularly positive about how the resources for *Water in the World* localised the curriculum and made students more aware of their community and how to prepare for, adapt to and respond to natural hazards such as flooding.

“ If it’s completely arbitrary to them [the students], if you’re talking about something overseas, they look and then go ‘I don’t really need to know this’ or ‘I don’t really want to learn about this’. But with this one, they actually really got into it and they actually really, really enjoyed looking at flooding... it was dynamic and engaging and fun. ”

In localising the curriculum, teachers thought it was important that the historically marginalised Western Sydney region was recognised as relevant area for study connected to the Australian and NSW curriculum:

“ How often is there something in the syllabus that’s about the area they live in, when we live out here [in Western Sydney]? So for those kids to talk about the places they go to and the things that they could potentially face... as soon as they see any of the suburbs they know on a map, you see them sit up and take a bit more notice. It’s something they’re absolutely used to hearing about everywhere else but here. ”



Water testing equipment (Western Sydney University)

Teachers could see the value of personalising and localising the Geography Curriculum and made connections to the geographic concept of local scale and relevant case studies within the broader content area.

“ In the past, we’ve looked at water in a really global way [...] and probably neglected looking at it at the local scale. I know the syllabus has the local scale emphasised in it [...] so that was refreshing with the unit. ”

The local context also assisted students to consider aspects of transference across stages of learning and connections with community preparedness and social resilience. The students were able to use geographical data to understand contours, elevations, potential flood depths and associate knowledge and understanding of space and place.

“ They’ve really actually got it because they, some of my kids they, they’re river rats too. And so they actually are going out on the river. So it was nice of them to see that stuff and I’m also trying to build in an arc across 8-9-10 so that we do stuff on the river in 8 and then something different Year 9 but then go out and do something in the coastal areas. So you can actually see the whole moving of the river from point to another. So they got the whole arc in one hit by the time they finish Year 10. So I think they’re really engaged as I said at the beginning they were terrified that they were going to be flooded out and it took me a long time to remind them their elevation was actually 100 metres and we would need an awful lot of rain if they were to flood. ”

6.2.3 Geographic understanding, skills and student agency

Teachers commented on the depth of geographic knowledge, skills and advocacy developed by the resource, *Water in the World*. Delivering the content and skills using a localised approach was seen as particularly beneficial, as students could see an important purpose and a real world context for their learning of environmental and geographical issues.

“ I thought it was good in terms of skills, there were some really good practical skills there, because you could actually look at and see what was actually happening [...] closer to where we are. That was really good because then they could actually do work on a graph with reason, it wasn't just some arbitrary thing that you do this stupid – sorry! – climate graph for no apparent reason. ”



Roads in floodplain showing height of potential flooding (Western Sydney University)

These resources considered geographical hazards such as flooding, water security and supply. Students in stage 4 within Australia and around the world are often connected and interested in these environmental issues and challenges but not able to directly relate to their own agency and context. Using this resource and the case study approach teachers identified that students were more practically and authentically aware of these issues in their everyday context. Teachers indicated that students were engaging with aspects of citizenship, self-agency and advocacy in this context.

“ Here's a current environmental issue, everyone knows this, we've gone to Warragamba Dam so we're down there and we're going it's 50% and the education officer is talking about level 1 restrictions and it might go to level 2 early next year. And kids are not aware of that, but it's a real practical learning and you know because that's in a way a response to reduce the impact of a flood, get the whole community to go, right well you can't wash a car. Alright sure you're going to go on, only on the garden no lawns. And then trying to get that across because down in the future they become the adults, the citizens, and you hope well they've learnt something bit like putting your rubbish in the bin and turning the light off and turning the tap off and. So I think it's been a winner in and particularly at stage 4 that level of 13–14 we're pretty distracted with social media... ”

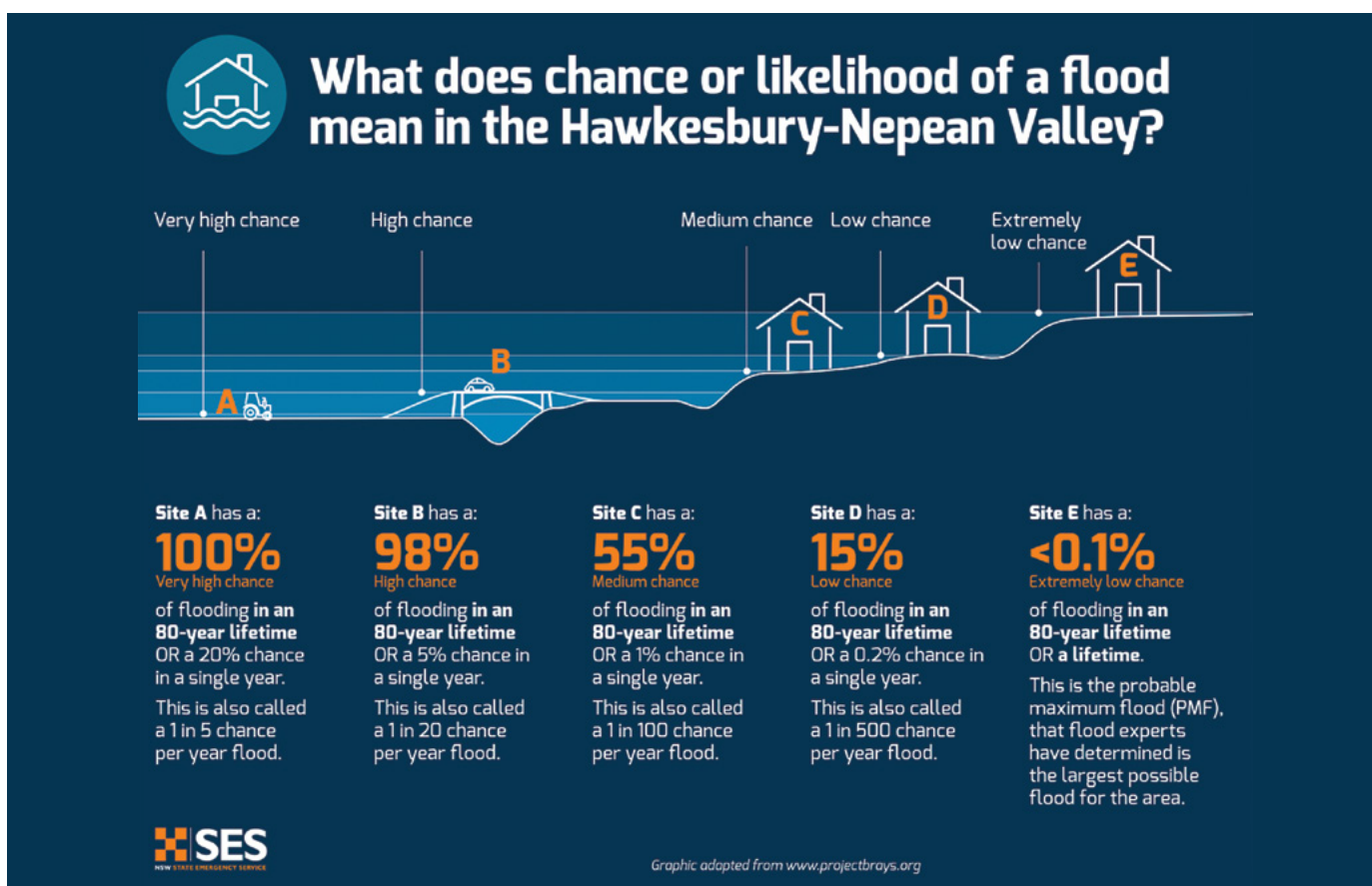
In addition to understanding environmental challenges students were able to apply geographical understanding and use inquiry principles to make deductions about temperature, spatial and topographical features, and physical location.

6 This was a climate chart for Terrey Hills. They were comparing it to the one on the board, which was Richmond. I got them to try and do a comparison and write a paragraph comparing differences between them in temperature and rainfall. They can actually see that comparison and some of them went ‘Oh, there’s more rain, this one must be closer to the coast’. So they were able to do that inquiry concept and come up with it themselves.

6.2.4 Broadening horizons

While there was much discussion about the importance of localising the curriculum, one teacher from a school located outside the Hawkesbury-Nepean Valley still saw potential with his students to broaden their perspective on Greater Sydney. The adaptability of the resource to areas outside the specific context of the Hawkesbury-Nepean Valley for schools and teachers was seen as an opportunity for further learning. By using this resource, teachers can help students to compare and contrast a range of contexts in response to: natural hazards, management of water resources, water security, and community and government mitigation approaches. This aligns with the different scales for geography in the Australian Curriculum and NSW Geography Syllabus.

6 As part of the *Water in the World* unit, we actually linked it really well to metropolitan Sydney and the issues associated with flooding in the outlying areas of Sydney. So rather than just concentrating on their particular area, as a lot of the students do, we want to broaden their scope.



What does chance or likelihood of a flood mean in the Hawkesbury-Nepean Valley? It’s helpful to think about the likelihood of flooding as the chance a particular flood will happen in an 80-year lifetime. This graphic explains this concept of a flood’s likelihood and relates it to other common ways of describing floods. (NSW SES)

7

Discussion and implications

This discussion will consider how the findings support the National Strategy for Disaster Resilience (2011) and evaluate how curriculum content influences a student's understanding of the relative risk of a natural disaster in their local context and their adaptive capability.

The findings from the student surveys and from teacher focus group interviews indicate that the resource, *Water in the World*, did result in increased student awareness of geographical concepts such as space, place, interaction and scale. The resource created opportunities for student agency and understanding of broader environmental and community issues.

Pre-student survey findings prior to learning about the Hawkesbury-Nepean Valley case study indicated that students were less aware of their community's relative flood risk and how to respond to a natural hazard. However, students in this sample after

engaging with the resource showed a stronger understanding of the likelihood of a natural hazard occurring in their context and importantly identified that they had discussed this with family members how to prepare for natural hazards. This shift in understanding and awareness is an important component of improving community resilience in the event of a natural hazard. According to Dufty (2008) flood education needs to encourage conversations and adaptive capability. Flood education that facilitates open discussions amongst family and community members is noted to develop greater responsiveness and agency in a flood event. This exchange of information amongst the community about flood likelihood builds trust, collaborative learning and social support. The intergenerational aspect of this form of learning from child to parent and the broader community is identified as one of the most effective forms of education as it is built on shared understanding and context. The result of this learning builds social resilience to flood events.



Yarramundi Bridge (Western Sydney University)



View of the Nepean Valley and Penrith Lakes (Western Sydney University)

Social resilience is dependent on many factors that include community participation, trust for emergency services and the exchange of reliable and timely information. These factors need to occur prior to, during and after a flood event. The results from the post-survey indicated heightened awareness of the role and responsibility of the New South Wales State Emergency Service (NSW SES). This increased awareness and understanding of the NSW SES promotes opportunities for the exchange of critical information about flood risk, warning and instructions and builds trust within the community to respond to situations in a pro-active manner. The positive co-relation between the student learning in the classroom to outside contexts and community members indicates that the resource, *Water in the World*, was effective in creating these pre-conditions for social resilience to emerge.

The focus group results show several important factors. Firstly, it shows how student engagement in authentic, localised and meaningful tasks and issues increases student geographic learning, sense of agency and understanding. Using the local context for students to understand geographical concepts such as space, place, interconnection, geographical change and scale improves application and transference of skills and understanding. This resource has provided students with context and purpose for learning and enabled opportunities for inquiry and collaboration.

The resource enabled students to engage with planning, mitigation strategies and relevant issues for their community. Students were able to use critical thinking and problem-solving skills informed by geographical data to consider 'potential solutions' (focus group member). The focus group findings showed how students were considering social and economic impacts of natural hazards and how residents within the community could respond to these challenges. Beyond the learning about natural hazards and preparedness students were also able to apply relevant geographic knowledge to issues of water security and management. These opportunities for engagement with current and long-term environmental challenges were identified as an integral feature of the resource for stage learners.

The focus group findings support the research of sustainability curriculum priorities (Barnes, Moore & Almeida, 2018) suggests that when teachers link resources and learning into key Science, Technology, Engineering and Mathematics (STEM) areas students' actions and interest in sustainability and environmental responsibility increases. Teachers in this research adapted and differentiated the resource were able to perceive the benefits to their students for future actions and decision-making.



New Hawkesbury-Nepean flood risk information is available on the NSW SES website (Infrastructure NSW)

The focus group results also show how collective memory about flood events and natural hazards can be activated in a safe, supportive and inclusive way for children. It was noted that students were able to use interactive materials, maps, videos, statistics, graphs and stories to gain an understanding of flood likelihood and impacts despite no physical experience of flooding. Globally, curriculum and education projects related to disaster awareness and planning are recognised to have an important cognitive and affective effect on children and their families (Dufty & Molino, 2014) and this in case served to build collective memory.

Educationally, the effectiveness, accessibility and adaptability of the resource, *Water in the World*, was evident in the survey and focus group findings. Teachers and students showed interest in the materials, commented upon the adaptability and how they used this to build fieldwork and digital experiences. Student engagement throughout the implementation was strong across all sample schools and classes. These findings show that curriculum that is meaningful, locally contextualised and well supported by teachers and well-constructed resources has significant potential to impact positively student learning.

8

Conclusion

This research report has identified how the resource, *Water in the World*, has effectively prepared the sample of young people for flood events within the Hawkesbury-Nepean Valley. Important concepts in community preparedness and resilience in this study have shown how school students in stage 4 can develop agency and influence when faced with a potential flood hazard in their local community.

This report has provided evidence about how authentic, localised and inquiry based curriculum that is aligned to curriculum content, skills and intent can activate disaster preparedness in the community. This research has identified key insights into the relationship between education and flood readiness demonstrates the usefulness of school based curriculum projects.



Nepean River (Western Sydney University)

9

Recommendations

Based on this analysis the following recommendations about curriculum based approaches to natural hazards education in developing community resilience are made.

1

Use local case studies, context and authentic situations connected to the curriculum that makes the learning relevant and valued by students.

2

Engage students with rich inquiry learning that includes fieldwork, immersive and virtual experiences to develop stronger understanding of geographical concepts.

3

Connect learners with their local community to build community resilience for natural hazards and disaster education.

4

Challenge and include all diverse learners with opportunities to problem-solve to develop preparedness and responsiveness to natural hazard scenarios.

5

Collaborate with teachers, the community and school leaders to develop high quality and innovative curriculum resources.

10

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