"This is my thing!": Middle years students' engagement and learning using digital resources

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It is widely acknowledged that multimodal digital texts support student engagement with ideas, knowledge and new forms of literate practice. With this in mind, an interdisciplinary team at The University of Melbourne collaborated to create a digital resource – *The Venom Patrol* website – to teach scientific concepts about Australia's venomous animals to middle years students (Years 5-9). The website's development was a response to students' increasing use of digital texts and technologies, and the need to develop students' skills around being 'multiliterate'. An inquiry-based pedagogy sought to encourage interactive learning and to enhance student development of scientific literacy. This article reports the findings of a pilot study that investigated student and teacher responses to the functionality and appropriateness of the digital resource for teaching scientific literacy, and for engaging students with the science-based content. The study revealed different teacher approaches to using the digital resource in the classroom, with varying levels of success. It also found the students to be critical and insightful users of digital texts who welcomed both the choices offered by the non-linear structure of the resource and the opportunity this research afforded for their voices to be heard around texts and contexts for learning.

Introduction

Australian students perform strongly in terms of scientific literacy, with the latest data collected through the *Programme for International Student Assessment* (PISA) highlighting that Australian 15 year olds score significantly above the OECD average (Organisation for Economic Co-operation and Development, 2010). However, these strong results are not uniform across Australia, with lower levels of achievement evident amongst students living in remote settings, Indigenous students, those from homes speaking a language other than English, and students of lower socioeconomic backgrounds (Thomson, De Bortoli, Nicholas, Hillman & Buckley, 2010). Within Australia, as well as internationally, there are additional concerns about the relevance and resonance of classroom learning for adolescents, the texts selected for student use, and teachers' enacted pedagogies when using these texts (Alvermann, 2007; Guthrie, 2008; Unsworth, 2008). It has been noted that the highly digital literacy practices and reading preferences of students outside the classroom frequently do not match with their classroom experiences (Kalantzis & Cope, 2008; Snyder & Beavis, 2004). With this in mind, an interactive website, *The Venom Patrol* (Australian Venom Research Unit and Melbourne Graduate School of Education, 2011), was developed by an interdisciplinary team at The University of Melbourne.

This article details the development and subsequent research around *The Venom Patrol*, an interactive, science-based website that teaches students about Australia's venomous

animals and the treatment of bites and stings. It was designed with the intent of supporting the teaching of science Australia-wide in the middle years of schooling (Years 5-9). Prior to the website being freely available on the world wide web, a pilot study was undertaken in three schools to investigate teacher and student responses to the functionality of the website, the degree to which it engaged students with the website content, and its effectiveness in supporting students' learning around scientific literacy. While the need for greater classroom take-up of new technologies is widely advocated (for example, Gee & Hayes, 2011; Kalantzis & Cope, 2008), research around the use and impact of these technologies is under-reported. This article responds to this need in reporting the survey, interview and observational data collected at three diverse school sites where the website was trialled.

Digital technologies in the middle years of school

The Venom Patrol website was developed as a response to the well documented challenges of facilitating engaged and empowered student learning in the middle years of schooling. A number of large scale inquiries and research projects in Australia have identified issues around student disengagement and under achievement, and have made recommendations in response, both in terms of curriculum and pedagogy. For example, middle years related research has focussed on areas of literacy and numeracy (Culican, Emmitt & Oakley, 2001; Culican, Milburn & Oakley, 2006; Luke et al., 2003), and around issues of gender and learning (Alloway, Freebody, Gilbert & Muspratt, 2002; Cuttance et al., 2007; Lingard, Martino & Mills, 2009). Although some studies are close to a decade old, and there is a need to move beyond artificial separations of middle years from earlier foundational stages and later post compulsory schooling pathways (Luke et al., 2003), the issues they raise remain relevant and salient today.

In identifying adolescence as a time where significant levels of disenchantment and alienation beset many learners, Culican, Milburn and Oakley (2006) recommended rich, authentic, world-connected teaching and learning. In acknowledging students' interests and abilities, and honouring their out-of-school literacies (with particular emphasis on digital literacy practices), student engagement and learning can be greatly enhanced. Engagement in learning requires adolescent students to be motivated. They will take up the learning opportunities schools provide if they see sufficiently compelling reasons for doing so (Kamil, 2003, p. 8). It has been suggested that multimodal texts (with their multiple semiotic systems) often support even the least motivated learner to engage with more challenging content and ideas (Alvermann, 2007).

The need for students in the middle years to develop proficiency in the specific language registers and subject-specific discourses of schooling continues to challenge schools and teachers, especially amongst linguistically and culturally diverse student populations (Cummins, 2000; Gee, 2004; Schelppegrell, 2004). Supporting students' engagement with these more challenging texts could be achieved if greater attention was given to the factors that motivate students outside of school: the text or topic should be something they feel is important to communicate about, or be something they feel strongly about, or are interested in (Irvin, Meltzer & Dukes, 2007). These research-driven imperatives underpinned the development of *The Venom Patrol* website.

Multimodal texts, a multiliteracies pedagogy

The use of learning technologies, alongside informed scaffolded instruction, has been posited as a means of addressing issues of student engagement and motivation, as well as assisting students to develop powerful forms of literate practice relevant to their in-school and out-of-school lives (e.g. Beavis, 2004, 2007; Culican et al., 2001; Gee, 2007, 2010). The incorporation of popular culture texts and digital texts and technologies in the classroom to enhance learning and improve literacy has been strongly advocated (see Cope & Kalantzis, 2009; Luke et al., 2003) and has been documented in classroom-based research (Carr & Bossomaier, 2011; Veletsianos & Doering, 2010).

The digital electronic texts of the classroom, home and community have been identified as increasingly complex and multimodal, employing a combination of linguistic, visual, audio, spatial, and gestural communicative modes (New London Group, 1996). Cope and Kalantzis (2009) have more recently reconfigured and reworked these semiotic modalities. They note that contemporary texts deploy combinations of written and oral language, and visual, audio, tactile, gestural and spatial representations as they communicate meanings on representational, social, structural, intertextual and ideological levels.

Yet the deployment of digital texts in the classroom is problematic on a number of levels. Effective skills around such texts require coding, semantic, pragmatic and critical competencies — reader resources first iterated by Freebody and Luke (1990), but since reflected in writings around multiliteracies pedagogies (Anstey & Bull, 2006; Bull & Anstey, 2010; Healy, 2008; Healy & Honan, 2004; Unsworth, 2002) as well as in reiterations, in the form of the *Four Resource Model*, by the original authors (Luke & Freebody, 1999; Freebody & Luke, 2003).

It has also been noted (Ladbrook & Probert, 2011) that many teachers' established pedagogical practices and their levels of technological knowledge limit the degree to which critical and creative engagement with digital texts and technologies can be supported in the classroom. This challenge accords with Koehler and Mishra's (2009) position that good teaching in contemporary classrooms requires teacher proficiency with content, pedagogy, and technology, and an understanding of the relationships among and between them. Their technical pedagogical content knowledge (TPACK) framework, which builds on Shulman's (1986, 1987) construct of pedagogical content (PCK), was developed in recognition of the fact that teaching with technology is a difficult thing to do well. In light of this, Wilson and Stacey (2004) have highlighted a need for greater levels of teacher professional development around the use of information and communication technologies in the classroom.

A further challenge relates to anxieties around children's access, particularly in schools, to the Internet, cyberspace and computer games, which have been comprehensively documented by Snyder (2008). In addressing the notion of multimodal texts and computer-based technologies being at odds with more traditional, print-based texts, Mills (2005) argued such binaries are unhelpful. In reality, Mills maintained that supporting students to be 'multiliterate' necessitates that print-based literacy around traditional paper-based texts be maintained and extended to incorporate skills and understandings about the construction and use of screen-based, digital texts. A key aim, as *The Venom Patrol* was developed, was to reconcile paper-based, linguistic modes of communication with students' increasing use of and

preference for electronic, online texts and thereby support their developing skills around being 'multiliterate'.

The Venom Patrol website

The Venom Patrol was developed by staff from the Australian Venom Research Unit and the Graduate School of Education at The University of Melbourne, with funding from the Australian Government's Department of Health and Ageing. The website embraces constructivist learning principles, which include encouraging learner autonomy, nurturing students' natural curiosity, emphasising learner initiated inquiry and exploration, and providing real-world, case-based learning environments (e.g. Duffy & Jonassen, 1992). In accordance with these principles, the website features questions and prompts at its multiple entry points and pathways, which invite students to construct knowledge by making predictions and then checking their responses. Jerome Bruner (1960) has long attested that posing questions for students to answer is an effective method of educational instruction, as it supports the development of autonomous learners. This emphasis also accords with the Australian Science Curriculum's (Australian Curriculum, Assessment and Reporting Authority/ ACARA, 2011) focus on 'Inquiry Skills', which are detailed in the content description at each year level: questioning and predicting; planning and conducting; processing and evaluating data and information; evaluating; and communicating. The intent of the question prompts is to encourage learners to engage in dialogue with other students and the teacher, particularly when used on an interactive whiteboard in a whole class context. As Barron and Darling-Hammond (2010, p. 199) indicated, when students engage with inquiry approaches involving real world contexts and problems, such as Australian venomous animals, they learn more deeply.

The website homepage (Figure 1) introduces three characters and the work they do: Penny from the 'Venom Laboratory'; Ruby from the 'Medical Clinic'; and Ranger Roy from the 'Ranger's Office'. A widely used entry point for students' engagement with the digital resource is the four habitats: arid deserts, suburban parklands, rainforests, and tropical coasts. Here, students are invited to scroll over the selected habitat to reveal the hidden animals and to predict their venom rating, before the correct answer is revealed. Links can then be followed to the animal's identikit, safety tips for avoiding bites and stings, first aid techniques, and emergency procedures. The information is presented in ways that emphasise multimodal communication, employing devices such as film clips, animations, sound effects and timelines. When accessing this information, students are encouraged to predict, investigate, analyse, and synthesise their new knowledge both individually and collaboratively.

For teachers who want a structured approach to using the website with their students, resources can be located through the 'For Teachers' tab on the toolbar. A flexible, inquiry-based planner is provided using an 'understanding by design' focus (Wiggins & McTighe, 2005) that links with the Australian Science Curriculum content and standards (Australian Curriculum, Assessment and Reporting Authority/ACARA, 2011). The planner's suggested cross-disciplinary learning experiences and assessment tasks emphasise reflection and re-iteration of new knowledge, and reinforce a specialised scientific meta-language related to venomous animals and venom research. Scientific terms are accessible through the 'Glossary' tab on the toolbar and a word challenge mask can be activated to encourage students to guess definitions before they are presented.

Figure 1: Home page for *The Venom Patrol* website
http://venompatrol.info/

Another feature of the website is its focus on the work that scientists do. In the 'Venom Laboratory', students are introduced to methods of scientific inquiry through interviews with venom experts, clips about the extraction of venom to produce antivenoms, and a timeline of the history of antivenom from ancient civilisations to the present day. These features support the rationale for the Australian Science curriculum (Australian Curriculum, Assessment and Reporting Authority/ACARA, 2011, p.3), which noted that

> Science provides opportunities for students to develop an understanding of important science concepts and processes, the practices used to develop scientific knowledge, of science's contribution to our culture and society, and its applications in our lives.

Framing the research

By mid 2010 *The Venom Patrol* had undergone an intensive period of development and was ready to be trialled in schools. A pilot study was subsequently designed to address the following research questions:

- To what degree do the teachers find the website functional and appropriate for their teaching of scientific literacy?
- In what ways do the students find this to be an engaging digital resource that supports their learning?

Responses to these questions were expected to allow some final refinements to the resource, prior to the website going live and being made accessible to schools Australia-wide in late 2011.

A qualitative case study approach (Merriam, 2009; Stake, 2005; Yin, 2009), with some quantification of data, was employed to elicit a holistic description of teacher and student perceptions of the digital learning resource. Three primary schools were selected purposefully as an *intensity sampling* (Patton, 2002). With some background knowledge of the school's curriculum approaches and the diversity of their settings, it was felt they would provide information-rich cases. The three schools invited to participate in the study were all co-educational and located in Melbourne, Australia: a P-12 independent school (School A); a city fringe government primary school (School B); and an inner suburban government primary school (School C).

Across the three schools, 114 Years 5 and 6 students and five teachers participated in the research. The students represented approximately equal numbers of girls and boys. Table 1 presents a breakdown of the students' backgrounds.

Table 1: Student research participants

	School A		School B		School C	
Number of girls	24	44.4%	9	60%	26	57.8%
Number of boys	30	55.6%	6	40%	19	42.2%
Total students participating	54	100%	15	100%	45	100%

The data collection involved four methods:

- *Classroom observations:* these occurred at two key points of the school's use of the website — the first lesson when students were introduced to the resource, and the end point when students were completing the work they had undertaken.
- *Semi-structured teacher interviews:* these were undertaken with individual teachers following the final class lesson.
- *An online student survey:* this generated quantifiable data about student perceptions of the effectiveness of the resource as a teaching and learning tool.
- *Student focus group interviews:* a group of 6-8 students at each school selected by teachers as representative of the class profile were asked to share their responses to the website.

On task behaviours of students during the observed lessons were closely monitored and recorded. An observation framework was developed by the researchers to allow for a focused and systematic analysis of the classroom interactions around the use of the website. Specifically, the framework for observation involved taking note of ways the following questions were responded to:

- How does the teacher introduce the unit?
- Which section or sections of the website are used?
- Which clips are focused on?
- What questions are asked?
- What predictions are encouraged?
- What pre-assessment is undertaken to determine students' prior knowledge?
- How are the students grouped over the session?
- What tasks do the students undertake?
- How do students respond to the website?
- What do they say/do/ask?
- How is the session concluded?
- Are there follow up tasks flagged?

In addition, and teacher and focus groups interviews were audio recorded and transcribed. The online survey entailed quantitative analysis of data, and the qualitative methods involved the coding of data to identify emergent themes in responses to the research questions (Miles & Huberman, 1994; Richards, 2005; Silverman, 2006).

The study was approved by the Human Research Ethics Committee at the University of Melbourne, and the Victorian Department of Education and Early Childhood Development and Consent to participate in the study was obtained from the school principals, teachers, students and their parents.

The use of the resource in the school settings

As anticipated with the intensity sampling, the diverse learning environments resulted in very different approaches to using the resource. At each school, a preliminary visit by the researchers presented participating teachers with an overview of the website's content and navigation of the site. *The Venom Patrol* was then introduced to students in a manner determined by their teachers. The details of how *The Venom Patrol* was used in each school setting follow.

School A

The secondary science coordinator taught the three Year 6 classes. She planned a sequence of four 60 minute lessons around *The Venom Patrol* website for her fourth term program. However, only two lessons eventuated for each class. The first lesson was conducted in the school science laboratories where students sat in rows and observed the teacher and a selected student navigate the website. This introductory lesson involved exploration of a habitat chosen by the students, the 'Ranger's Office', the 'Medical Clinic' and the 'Venom Laboratory'.

The arrangement of the room did not invite exploratory or collaborative participation. But at the conclusion of the lesson students paired up to write a statement about what they had learnt and to pose a question that arose from their preliminary exploration of the website. A wide range of statements were generated, suggesting strong interest in the website's content. The 'We learnt' statements included:

> The Sydney funnel web is the world's most dangerous spider.
> I didn't know funnel web spiders had such long fangs – 7mm!!!!
> Cone shells are highly poisonous and we also learnt about neurotoxins and antivenoms.
> The cone snail uses a dart to release its venom.

The second and final session was in a computer laboratory with students working in pairs around an exploration of a selected habitat.

School B

The digital resource was used with three small groups of students (N = 8) in Years 5 and 6 who were identified as requiring additional literacy support. The students participated in a program sustained over five weeks, working individually or in pairs at a computer. Connections made during this exploratory session were followed up in several activities that reiterated the importance of connecting with text, as demonstrated in Table 2.

Table 2: Students' text-to-self connections

The text said:	This reminds me of …
I saw a scorpion in [the] movie: the tail is venomous and I saw a man take venom out of the scorpion.	In my country (Thailand) when I sleep I got bitten by a scorpion in the night. I need put a leaf in my hand to make me feel better and it took about one day. The tails is venomous.
The wolf spider is dangerous.	The spider bit me when I was asleep. In the morning my hand was so fat.
A small stingray is 67 cm long.	My brother was diving with his dad and one day he saw a stingray and it was pregnant.

The students engaged in a wide range of multimodal literacy activities that included:

- drawing thoughts and feelings about venomous animal as a stimulus for a written response;
- screen-based text reading of the venom rating chart, to identify a dangerous or deadly animal;
- identifying the main idea and then adding details to create a descriptive profile of the animal;
- participating in the quiz 'Amazing Facts about Venomous Animals' that required students to read the venom rating data chart, use the resource's glossary and hyperlink between screen sites to locate information; and
- producing *PowerPoint* presentations about *The Venom Patrol* for others to access. In some instances, students incorporated video recorded interviews and comments about their own experiences with venomous animals.

School C

Teachers of the three Year 6 classes intended to use *The Venom Patrol* Website over a three-week period.

Table 3: Student responses to their first encounter with the website

Confirm	Add	Challenge	Excite
Venom affects the blood, causing very high pressure and the victim may suffer shock, brain damage and become unconscious.	A funnel web spider's venom may cause you shock, brain damage or to become unconscious.	The platypus is dangerous.	Pictures of what happens to all parts of your body when venom affects it.
I knew that venom affects the nervous system.	When venom spreads it goes to your lungs and [it] becomes hard to breathe.	A cone snail can eat a fish bigger than itself.	Graphic images – hard to stop looking.
I knew blue ring octopus' venom was very quick to affect but I didn't think that quick (10-30 minutes).	I didn't know venom is delivered through claws and beaks.	Funnel web spider's venom makes your nervous system become over active - like you were doing sport so it causes you to sweat.	I really liked seeing what happens to people who are bitten or stung.

In the initial session the children explored the website working in pairs at a computer. They were asked to record their responses using the thinking routine*: Confirm, Add,*

Challenge and Excite (Harvard Graduate School of Education, n.d.). Both boys and girls were highly animated in this initial session observed by the researchers, sharing their discoveries with one another and eager to locate all the embedded video clips. Table 3 above presents a selection of student comments in response to the thinking routine.

Despite the School C teaching team's good intentions, there were only two additional classes. One class involved accessing the website and writing questions for a '*Venom Patrol* quiz' and, in the second class, students swapped their quizzes and answered each other's questions.

Teacher responses to the website

Teacher interviews, conducted at the conclusion of their use of *The Venom Patrol*, revealed unanimity about the high level of student engagement with the resource. The teacher in School B emphasised that "They loved how the venom affects your body, how visual that was. And hearing the heart beat, and all – that was really engaging for them." The four habitats were identified by all teachers as the website feature that generated the most interest. They noted the excitement that students experienced as they attempted to locate all the animals in a habitat. The teacher at School B particularly commented on the perseverance of the students, claiming they just would not give up until all the animals were revealed. Teachers in Schools B and C noted that the students' interest in venomous animals stimulated by the website led to them seeking further information and insights about specific animals either through Internet browsing or by reading the *The Venom Patrol* (Lowe & Cooper, 2008) book from which the website was developed. In an aside to the researchers, the deputy principal in School B said there was a very long waiting list of students wanting to borrow the book from the school library. She herself had borrowed the book and students were personally requesting that she return it promptly.

The responses of the teacher in School B resonated with the importance the literature places on engaging and relevant content for middle years students (e.g. Apple & Beane, 2007; Luke et al. 2003). In the interview she shared that "There are a few of them in the group that have borderline behaviour." In referring to these students' use of the digital resource, however, she then said, "When they came in here, they were so focused. They really just loved it and didn't want to waste time." In the observed lessons, no off-task behaviour was evident and neither were the researchers aware of any behavioural issues the students may have had.

The website's use of scientific terms and the inclusion of the 'Master Glossary' for students to gain an explanation of these terms were identified as very positive features of the website by the teacher in School A. As the secondary science coordinator, she welcomed the use of explicit terms such as *toxin, venom,* and *antivenom,* which she believed challenged the students. The coordinator argued the importance of students acquiring a science-based discourse and meta-language, and commended the web designers for making the terms 'entirely accessible' through the inclusion of a glossary. The importance of supporting students to develop specific registers and discourses is well documented in the literature (e.g. Cummins, 2000; Gee, 2004).

For the teacher in School C, a notable feature of the website was its facilitation of the participatory nature of student learning. The most positive thing about the website for his students was "the Internet literacy, the web literacy, you know, being able to

interact with the site." He commented on the student interactions at website navigation level with students collaborating to locate interesting sections of the site, supporting each other's navigation of the site's sections, and questioning each other about content:

> ... on a purely website navigation level, I think there was a fair bit of learning there. I mean, you would have heard, and you would have observed, during the sessions, "How do I get to that video?"; "How do I get to here?"; "How do I get to there?"; "How do I get to that?" There was a lot of interaction around the room. A lot of students getting up and showing, you know, which I think is great. (Teacher interview, School C)

Teachers in all three schools commented on the versatility of the website, claiming it could be used in many different ways. But the primary school teachers (Schools B and C) remarked on its usefulness for mainstream literacy classes. In School C, the teacher also noted the website's potential to be used both as an enrichment program for students who required extension work and as a support tool for students, stating "Somewhere in there, there would be extension for everyone. But I think there were access points also for students who need extra support." All teachers commented that they were mindful of the curriculum resources available, but claimed to generally trust their own instincts when planning. Teachers in Schools A and B acknowledged the usefulness of a bank of curriculum and teaching resources, but in School C the teacher asserted, "I tend to trust my own training and my own instincts on those things."

While the teachers' comments were most helpful, the responses of the students — the target audience for the website — were of particular interest to the researchers.

Students' learning and engagement with *The Venom Patrol*

As part of the online survey, a five-point Likert scale asked students to rate their overall response to the website. In addition, the students were asked to consider the structure and functionality of the website, how easily they were able to move around the site, the degree to which the focus on the four habitats was a useful way to learn about venomous animals, and whether the portals of 'Venom Laboratory', 'Ranger's Office' and 'Medical Clinic' were helpful in identifying the different roles people play.

Students' responses were overwhelmingly positive: when asked to rate their overall reactions to the website on a 1-5 scale (1. A dud; 2. Not bad; 3. Good; 4 Very good; 5. Awesome), nearly two-thirds of students rated it 'very good' or 'awesome', with just over one in ten responding in any way negatively, seeing the site as 'a dud' or 'not bad', as indicated in Figure 2.

Importantly, the most enthusiastic student response came from School B whose teacher had supported focused student use of the website over a number of sessions. This approach, targeting students' literacy skills around meaningful, engaging content, correlated most closely with the intended aims of *The Venom Patrol* writing team. At this school, 10 of the 14 students stated they felt the website was "awesome", that it was informative and engaging, one student noting that complex subject matter had been made quite comprehensible to primary-aged learners:

> It must have taken a lot of time to make it, to put hard to understand writing into children's understanding. (Year 5 girl: School B)

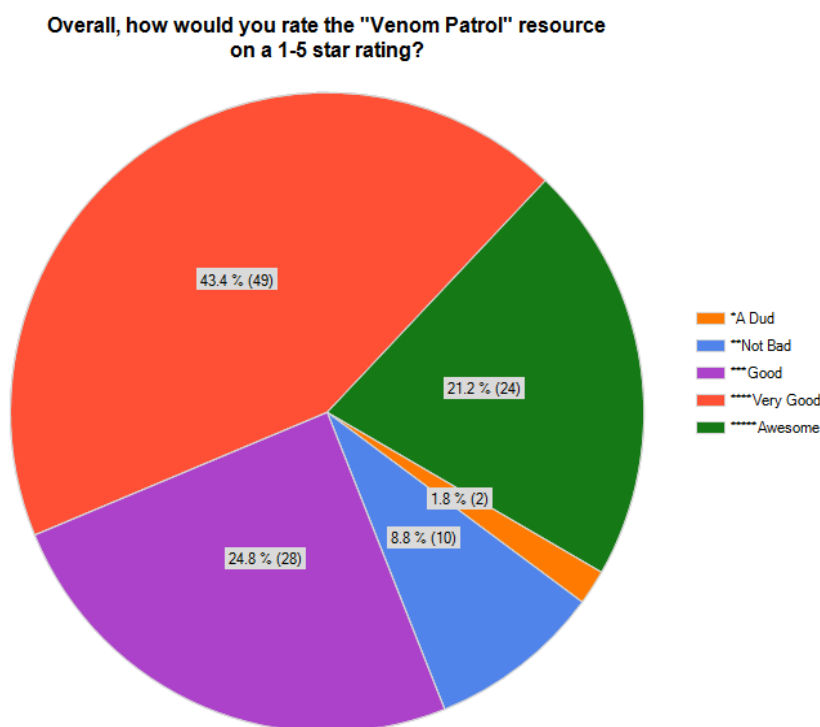**Overall, how would you rate the "Venom Patrol" resource on a 1-5 star rating?**

Figure 2: Students' overall rating of the website

At other school sites, the small minority of students who ranked the website negatively (at a ranking of 1 or 2) commented on the perceived lack of games and interactive features. These students, only 12 of the 113 students who responded to this question, were predominantly boys (9 of the 12): possibly a reflection of boys as more consistent and critical users of technology, particularly interactive game sites. Interestingly, the students – in focus group interviews – discussed at some length the issue of features such as games to attract and maintain website users' attention. While games were seen as attractive elements on some websites, some students commented that, on an educational website, the prevalence of such devices needs to be offset by meaningful content. In the words of one student at School C,

> Well, … you don't want the game too good because then when the kids go on the website, that's all they'll want to do. Say "Oh yeah, go on this game, oh yeah, play this game". And then you can just see that, like, 90 out of 100 percent of them are playing the game and, … because if the game's, like, really detailed, like, mazes and it's like really challenging, then that's all they'll want to do, like, say "Oh, I've got to beat this level". (Year 6 boy, School C, focus group interview comments)

In relation to students' highly positive overall ranking of the website, several reasons were posited for this enthusiastic response. These related to the structure and features of the website, the language and other communicative modes employed, and the content that supported deeper knowledge about venomous animals, prevention and treatment of bites and stings, and are now detailed below.

Website structure and navigation

The students were highly enthusiastic about the four habitats as key portals of *The Venom Patrol* website. Over 90 percent of all students agreed or agreed strongly that these different natural and man-made environments provided a useful way of learning about venomous animals. Table 4 indicates the students' rating of the website in terms of its structure and navigability both in total numbers and overall percentages.

Table 4: Website structure and navigation: Students' online survey responses

Answer options	Strongly disagree	Disagree	Not sure	Agree	Strongly agree	N/A	Rating average
The Venom Patrol website is easy to move around.	1 (0.9%)	12 (10.5)	21 (18.4%)	61 (53.5%)	19 (16.7%)	0	3.75
The four habitats are a useful way to learn about venomous animals.	1 (0.9%)	3 (2.6%)	7 (6.1%)	45 (39.5%)	58 (50.9%)	0	4.37
The Venom Laboratory, the Ranger's Office and the Medical Clinic are helpful in identifying the different roles people play.	3 (2.6%)	1 (0.9%)	19 (16.7%)	56 (49.1%)	34 (29.8%)	1 (0.9%)	4.04

From classroom observations, the habitats were often the areas of the website students interacted with in a sustained manner. When discussing their learning, the habitats were often referred to as the areas through which new understandings were developed. From their investigations of animals within each website, students could connect to further information in various forms: animations, movie clips, timelines and glossaries, for example. The following focus group comment illustrates this:

> I think the habitats were really good because when you scroll over the animal, you can click on it and it gives you the information on the side of the screen and it says 'reveal answers'. And then you can find, like – it can tell you about the animal. It can sometimes come up with a video about the animal and it tells you if it's venomous and how to treat the bite if it is venomous and if it's not venomous how – where you can find them. And if it is venomous, like, how – where to stay away from them and where to find them. (Year 5 girl, School B)

The areas of the 'Venom Laboratory', 'Ranger's Office' and 'Medical Clinic' were also seen as helpful in students' learning about the different roles people play in the world of environment management, treatment of bites and stings, and the development of antivenoms. While enthusiastic, the levels of interest were less emphatic than those around the habitats. This appears due to the fact that the animals themselves were the centrepiece to the habitats, and analysis of the students' survey and interview comments highlights that finding out about the animals: how venomous they are, how they transmit their venom, for example, were deeply interesting to students of the upper primary age groups who participated in this study.

Students were more critical about the navigability of the website, with nearly 30 percent of students expressing some level of criticism in relation to this aspect of the site. Many students offered various positive suggestions for smoother navigation and

speedier location of information. Student suggestions ranged from ideas for improving the pictorial layout, enhancing interactive elements around clicking on the animals, presenting a clearer idea of the site's contents on the home page, adding more quizzes and games, and creating a search bar.

In each of the areas of the survey that focussed on the site's navigability, the usefulness of the habitats and the 'Venom Laboratory', 'Ranger's Office' and 'Medical Clinic', there was little difference in ratings or views between boys or girls or across schools.

Website language and visual features

As the website was in the development stages, close attention was paid to ensuring that the linguistic demands of the site were appropriate for students in the middle years of schooling, a number of whom might be learning English as an additional language. It has been noted by Cummins (2000) and Schleppergrell (2004) that the linguistic challenges of information texts encountered by students in the middle years of schooling can be a barrier to engaged reading and deep learning. Likewise, Gee (2004) has highlighted that – across linguistically and culturally diverse student populations – teachers need to provide equal opportunities to learn conceptually challenging curriculum content. How *The Venom Patrol* responded to such imperatives was a focus of the research, in that students were asked to consider whether the language used in the website was comprehensible, whether new scientific concepts were explained in language they could understand, and whether they believed their scientific vocabulary had increased as a result of their engagement with the website.

Across the three school cohorts, students were in strong agreement that the language used across the website was easy for them to understand, with 101 of the 114 students agreeing or agreeing strongly that this was the case. A somewhat smaller number agreed that the new scientific concepts were explained in easily understandable terms. Here, 17 students (or 15 percent of the total) were unsure or disagreed with this statement. And, just over half the students believed their vocabulary around scientific terms had increased as a result of using the website. The following table displays the students' responses.

Table 5: Website language and visual features: Students' online survey responses

Answer options	Strongly disagree	Disagree	Not sure	Agree	Strongly agree	N/A	Rating average
The language used across the website is easy to understand.	0	5 (4.4%)	8 (7.0%)	52 (45.6%)	49 (43.0%)	0	4.27
Scientific concepts are explained in language I can easily understand.	0	4 (3.5%)	13 (11.4%)	59 (51.8%)	38 (33.3%)	0	4.15
The focus on scientific terms increased my vocabulary.	5 (4.4%)	17 (14.9%)	33 (28.9%)	39 (34.2%)	20 (17.5%)	0	3.46
The movie clips, animations, diagrams and illustrations are positive features of this website.	1 (0.9%)	2 (1.8%)	7 (6.1%)	34 (29.8%)	68 (59.6%)	2 (1.8%)	4.48

This aspect of increased vocabulary differed along gender lines, with nearly 58 percent of girls believing their knowledge of scientific terms had increased, as opposed to only

45 percent of boys. Interestingly, when schools' responses to this focus were analysed, the students at School B who were using *The Venom Patrol* as a tool for supporting literacy were most emphatic that it had augmented their scientific vocabulary. Of these students who, it must be remembered, were Years 5-6 students who were receiving extra literacy assistance, 13 out of 15 believed their scientific word knowledge had increased after using the website. It would appear their teacher's more sustained and explicit use of the website resulted in these impressive feelings of improvement. By contrast, the other teachers' approaches of setting up more open-ended investigations using the site did not result in these two cohorts of students feeling their scientific vocabulary had increased to a similar extent.

In terms of the visual elements of the website: the movie clips, animations, diagrams and illustrations, students across the three school settings expressed enthusiasm about the role these features played in their positive reactions to the website. Students at School C responded with higher degrees of enthusiasm about these website features, with over 71 percent of these students stating they strongly agreed that these design elements were positive features of the website. This high level of enthusiasm found corroboration in the researchers' observation of students' use of the website at School C, there was a palpable level of excitement and collaborative exploration of the movie clips, animations and other visual features. By contrast, only 52 percent of those at School A and 53 percent of students at School B rated the visual design features that highly.

In terms of gender, there was a stronger level of appreciation and engagement with the visual features of the website expressed by the girls in the study: nearly 68 percent of the girls strongly agreed that the movie clips, animations, diagrams and illustrations were positive features of the website, while the number of boys agreeing with such fervour was only just over 50 percent. This was somewhat surprising, as it was anticipated – consistent with research by Alloway, Freebody, Gilbert and Muspratt (2002) and Alloway (2007) – that the boys might demonstrate stronger levels of interest in electronic and graphic forms of literate practice. However, while acknowledging that the girls expressed greater enthusiasm for the non-linguistic features of the website, over 83 percent of boys did indeed agree that the visual features of the site were a positive aspect.

Student learning through website use

The students who participated in this study were asked specific questions related to the anticipated learning outcomes of this website. These specifically related to whether the use of 'inquiry questions' (designed to promote student hypothesising and drawing on prior and new knowledge) assisted their learning, and whether the website had increased students' understandings of avoiding and treating bites and stings, as well as the work of scientists involved in venom research.

Across the three school contexts, 80 percent of the 114 students believed the active responses encouraged by the website supported their learning. As revealed in other aspects of the data collection, students felt their learning was most supported through the focus on the animals themselves, as developed through use of the habitats section of the site (89 percent of students agreed this was the case). They felt that the website successfully supported their understandings of the treatment more strongly than the avoidance of bites and stings (42 percent of students strongly agreed that they were more aware of treatment options, as opposed to 34 percent strongly agreeing that they

were more aware of prevention strategies). While two-thirds of the students agreed that they were more aware of the work of scientists as a result of using the website, one-third of the students were not certain or disagreed that this was the case. It would appear that a more long-term, sustained focus on the website would be required to yield these understandings. Table 6 displays these student responses.

Table 6: Scientific learning: Students' online survey responses

Answer options	Strongly disagree	Disagree	Not sure	Agree	Strongly agree	N/A	Rating average
The website activities supported my learning.	0	5 (4.4%)	18 (15.8%)	61 (53.5%)	30 (26.3%)	0	4.02
The use of inquiry questions assisted my learning.	1 (0.9%)	6 (5.3%)	35 (30.7%)	46 (40.4%)	22 (19.3%)	4 (3.5%)	3.75
The four habitats helped me learn more about venomous animals.	2 (1.8%)	3 (2.6%)	8 (7.0%)	43 (37.7%)	58 (50.9%)	0	4.33
The website has made me more familiar with how to avoid bites and stings.	3 (2.6%)	7 (6.1%)	15 (13.2%)	49 (43.0%)	39 (34.2%)	1 (0.9%)	4.01
The website has increased my knowledge about treating bites and stings.	2 (1.8%)	4 (3.5%)	13 (11.4%)	46 (40.4%)	48 (42.1%)	1 (0.9%)	4.19
I know more about the work of scientists after using this website.	3 (2.6%)	8 (7.0%)	28 (24.6%)	59 (51.8%)	16 (14.0%)	0	3.68

There were few gender differences and little differentiation across schools in terms of students' responses to these aspects of their learning. A large number of the students – across the three sites – were uncertain about whether the use of inquiry questions supported their learning, with about 37 percent of students being either unsure or in disagreement about whether this was the case. This number can perhaps be explained by positing that the notion of 'inquiry questions' might be unfamiliar to many students. Even if familiar with the term, their active engagement with the site and focus on content rather than pedagogical features, might have rendered such features invisible to many students. In reality, teachers are more likely to be focused on such website features.

Student choice and student voice

The opportunity to focus on areas of personal interest in a non-linear text like *The Venom Patrol* was seen by students and staff as a positive feature of the website. In the researchers' observations of the teaching sessions, throughout the online survey postings, and as part of the focus group interviews, students at all three schools talked about the areas of the website that interested them most and how they relished the chance to explore these independently and collaboratively. The teachers all realised the potential of the website to motivate and engage students, and at School B, the teacher skilfully managed to balance student choice with teacher guidance and direction. Here, the teacher encouraged the students to explore the website and, building on students' interests and questions, used these areas of interest to support and extend their thinking and literacy skills. This resulted in high levels of sustained engagement and learning. As this teacher stated:

> And their motivation has just – it has definitely been sustained. Some of the – well, all of the children have benefitted but some – it has really just amazed me how much they've got out of it. The two little girls that you were looking at today … are real strugglers with their literacy and they were so motivated. One had gone on the website – on a Google website, to get some more information. And they really just persevered in getting that. The two little boys from Burma, I mean they just, again, persevered. I think that's the thing that I noticed. That rather than giving up on things – another little boy normally would have given up and said – do you remember he said how hard some of the words were? (Teacher, School B, Interview transcript)

Along with the opportunities to choose an area of focus, *The Venom Patrol* and this research that accompanied its rollout, provided participating students with a much-appreciated avenue to express their thoughts about the website, its content and their overall learning. Students' demeanour during both their completion of the online survey and the administration of the focus group interviews attested to how interested they were in providing feedback and how appreciative they were that their voice was being heard in the development of the resource. In the words of one student completing the online survey:

> You have done a really impressive and fascinating website and it's good that you have a username and password on it. It is such a fun way to learn and I am writing this from a student voice position and its good that you have this survey - a teacher isn't telling me what to write. This is my thing. (Year 6 girl: School C)

Conclusion: Implications for classroom use of digital texts

In conclusion, it was evident from this research that, despite the way the website developers envisaged the digital resource might be used, teachers approached this from different perspectives and planned for different outcomes, though working with similar aged upper primary students. The teacher at School A was a science specialist and saw *The Venom Patrol* as a resource to specifically support the students' development of scientific concepts. A longer period of active engagement with the resource on the part of the students at this setting was required for greater benefits to have been apparent. At School B, the teacher's use of this resource was predicated on primarily literacy-related outcomes being achieved, and the content, language and multimodal text features combined to serve this objective successfully. At School C, a team of teachers saw *The Venom Patrol* as a means by which fairly open-ended collaborative inquiry could take place. It certainly actively engaged the students, but a sustained focus on key scientific concepts and content was not a clear outcome of this use of the resource.

At School C, in particular, a strong focus on student choice and inquiry around their own interests resulted in the students reflecting thoughtfully on the design features and content of the website, as well as on their own use of it and other digital texts. If, as Bandura (2001) theorised, human agency embraces acts of intentionality, forethought, self-directness and self-reflection, there is evidence – across the three schools – that digital tools like *The Venom Patrol* capitalise on students' curiosity, facilitate carefully considered navigation and exploration of website content, and encourage critical reflection of the device itself and of the use they make of it. In considering these dimensions of voice and agency, exclamations of "This is my thing" resonate on a number of levels.

In all three schools students benefited from engaging with structured opportunities for inquiries around questions or topics of their own interest. However, the productive outcomes for students in School B affirmed Barron and Darling-Hammond's (2010) assertion that to be effective, inquiry-based pedagogy requires "well-designed, carefully thought out materials and connected classroom practices" (p. 199). In School B, the teacher implemented a carefully planned sequence of lessons around *The Venom Patrol* website which elicited a high level of motivation to learn. She required recording and communicating of information and for students to demonstrate their learning to an audience, which Walsh (2010) identifies with the enactment of multimodal literacy. The teacher at School B highlighted the need for sustaining the implementation of a planned sequence of lessons, as opposed to *The Venom Patrol* being used as simply an add-on to an already overcrowded curriculum. This finding resonates with Carr and Bossomaier's (2011) study that raised issues around the degree to which a digital tool or electronic game can facilitate the required levels of student reflection and understanding without the input of a teacher.

Observations of students using *The Venom Patrol* website showed the potential for highly effective integration of science and literacy teaching. The nature of the website's inquiry-based pedagogy encouraged collaborative participation and, together with the rich science-based content, stimulated the essential literacy practices of talking, listening, reading, viewing and writing. What was closely observed in the School B support literacy classes was 'the holistic nature of multimodal literacy' (Walsh, 2010, p. 29) afforded by a powerful digital media resource. This enabled students to investigate, research, record and create, emphasising the integral relationship between science and literacy. In effect, the website was found to offer rich teaching and learning experiences that acknowledge students' interests, build on their abilities, and address their literacy and learning needs (Culican, Milburn & Oakley, 2006).

While we have reported an increase in student motivation and positive perceptions of their learning based on classroom observations and interviews, the extent to which *The Venom Patrol* impacted on students' scientific literacy was not investigated. It would have been inappropriate to have done so in the short time frame of the pilot study, and was not the intent of this study. However, we recommend that a large scale national study be undertaken over an extended period of time once the website is officially launched. This would allow researchers to investigate the teachers' embedding of the website in their curriculum planning and the impact on students' scientific literacy.

The screen has been identified as the dominant site of texts in the contemporary world, "the site which shapes the imagination of the current generation around communication" (Kress, 2003, p. 166). This reality was borne out in the research reported here. The students participating in this study demonstrated dexterity around keyboards and screens as they entered, navigated and interacted with *The Venom Patrol* website, then reflected, posted and discussed responses to their use of the site. These critical responses to its functionality and capacity to engage them with the science-based content have informed the final iteration of the website. It appears that, as a recent report in the United States highlighted, children's digital media habits expand after the age of 8 (Gutnick, Robb, Takeuchi & Kotler, 2011). As such, digital learning tools like *The Venom Patrol* offer opportunities for students to develop much-needed skills in being creatively and critically multiliterate while developing vital areas of content knowledge.

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