

Case Study A: Hands on, feet wet, mind salty

Science, technology and mathematics

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Introduction

I think the important thing is that they [the teacher] make it [the visit] part of their unit, and they do follow up and pre-trip preparation. (Tony, education officer)

This case study follows the work of a Year 8 class as it prepared for and visited an isolated part of the South Island. The day began with a wildlife harbour cruise, followed by a visit to a marine research and education site, and a trip out to a marine reserve where the class viewed albatross, sea lion and penguin colonies. The case study focuses on the students' work at the marine centre and the workshop they participated in called 'Supper in the Sea'. The workshop looked at marine food webs and 'who eats who' in the ocean. Students found out how sea creatures caught their food, avoided their predators and stayed alive. Students worked in both the laboratory and the aquarium. The visit was part of a planned science unit entitled 'Introduced Animals from the Living World', a strand in the science curriculum. The journey to the South Island was also an opportunity for students to travel to a different part of New Zealand, and to experience learning in an exciting educational setting which they would normally never have access to.

The children in the participating class attended a large state intermediate school, which had a roll of 815 students. The school had a decile rating of 2, and was situated in a satellite city adjoining a major New Zealand city. The ethnic composition was 26 percent New Zealand Pakeha, 23 percent Māori, 15 percent Samoan, 11 percent Indian, seven percent Chinese and 18 percent other ethnic groups. The gender split was 53 percent girls and 47 percent boys. The

teacher, referred to as Megan, or Miss Keeley, in this case study, described the class as having a very wide range of abilities.

Megan was in her second year of teaching and had taught for both years in a Year 8 class at an intermediate school. She had a Bachelor of Education degree, and this was the first time she had organised a trip away from school.

The programme director at the marine centre, referred to in this study as Deborah, had a Master of Science degree and specialised in marine science. Her job was to oversee the education programmes, to work alongside the education officer when planning and evaluating programmes and to liaise with the University of Otago research scientists and students. The education officer, Tony, also had a Master of Science degree and he was responsible for the delivery of programmes to visiting groups of students. Both of these educators had previous experience working at other Department of Conservation sites and overseas, in Canada and the United Kingdom respectively.

Before the visit

Teacher views and planning

Goals and rationale

As Megan had not taken students on a visit outside school before, this was a huge undertaking. She investigated various sites that would complement the work the class was going to carry out during the science unit she was planning. Megan completed her teaching degree in the South Island and was familiar with the marine centre. She had seen programmes being delivered at the aquarium, and knew that it was very hands-on and led by people who were knowledgeable and had experience in both teaching and marine research:

I have been there myself before and have been able to go into the touch tanks and I knew there was nothing like that here – also it was part of the university and it had people who are informative and have in-depth knowledge about what they are teaching. I've been told that some places you go to people don't know as much as they should or could – when kids ask questions they go “oh – ah....,” but at the marine centre they are all extremely knowledgeable – they all have the qualifications and are also studying.

She thought that if the funding could be found to transport her 12- and 13-year-olds down there, then this would be the best site for her class to experience. With the support and encouragement

of her teaching team and administration staff the funding was found through local sponsorship, and planning began.

The initial contact with the marine centre was friendly, and their help with planning the visit was invaluable. Megan's first contact involved gathering information about the site and getting a general idea about what was on offer for her students. She followed this up by sending some information describing what she planned to do in the classroom beforehand, and at this stage the education officer, Tony, was able to identify which of their programmes would best suit her – the original selection of the 'Fish and Fins' programme was changed to the 'Supper in the Sea' programme. Tony thought this would link better with the work she and the students had already completed on 'Introduced Animals'.

Teacher preparation

Megan had identified six specific learning outcomes around which the unit was developed.

These were to develop an understanding of how to:

- define terms specific to introduced animals
- describe the special characteristics of an introduced animal and how we can help them survive to the next generation
- categorise animals as introduced or native
- define a herbivore and a carnivore
- research a chosen animal, describing its habitat and its place in the food chain
- explain the effects of human intervention in positive and negative situations, and the reasons for this intervention.

The science concepts that she planned to address focused on introduced animals, native animals, habitat, carnivores, herbivores, the food chain and human intervention. 'Supper in the Sea' was the marine centre programme that was going to best link with these goals. It was going to look at the way animals locate, catch, eat and digest food, as well as investigating marine food chains and food webs, and the importance of plankton. The preservation and conservation of marine life were specific goals for the education officer to weave through his work, and these were able to blend easily with Megan's teaching and learning outcomes.

Megan made the following comment about her preparation with the students before embarking on their journey:

I guess them having an understanding of what we were going down there for was helpful and them having learnt about the introduced animals and herbivores, and the food chains – it definitely was going to make it easier for them to do the links and get the information quicker, instead of having learn what all those things were down there.

Megan was also aware she was taking her students into a research environment so managing the students, ensuring that no damage was done to exhibits and that they were able to get the very best out of the experience were all going to be important. The students had previous experiences in visiting museums and similar sites but the novelty of the exhibits being live animals may have created other temptations, even for these older students:

I had to talk about their behaviour. I explained that it was an actual work site and so there would be things there saying ‘Touch me, touch me’ but we’re not allowed to touch.

Student views

Views of the marine centre

Five students were selected to participate in this case study. The first interview was a survey, and the students provided written answers. This gave the bare bones of the children’s thinking rather than in-depth responses, which might have been achieved with face-to-face interviews.

None of the children involved this research had been to the marine centre before although they had been to other LEOTC sites with other school parties; for example, Kelly Tarlton’s, the local museum and the zoo. They were all able to outline what they had learnt in preparation for their visit, and Kristina summarised this with her statement:

Miss Keeley had taught us about food chains and life cycles. We’ve also learnt about food webs and introduced animals.

The students all anticipated learning about and seeing plenty of sea and shore creatures:

I think we will see different fish, their habits, their way of life and how they survive. I think we will feel the fish in the touch tanks and watch the fish.

When asked about how they thought going on a trip like this would help them learn, they had some insightful thoughts to share:

This visit will help me learn by making the trip fun, so I should learn more than I do inside the class.

We will be able to have pictures in our minds and relate them to the information we are given. We will also remember the experience.

You will be able to get a better understanding than staying in the class.

These students were also beginning to develop some ideas about metacognition and thought they would be able to recognise their learning because they would know things, or be able to answer people's questions which they could not answer before. Andrea made this comment:

I will know when people ask me questions about fish and their food chains. I will be able to answer them with ease.

She also made this comment in response to a question asking how she would know if the trip was worthwhile:

The visit *will* be worthwhile because even if we don't learn anything (which we will), we will still have had the experience of going to the South Island.

Help with learning

The students were all clear that the teaching responsibility was going to be handed over to the education officer at the marine centre and that Miss Keeley would probably sometimes help him. They referred to 'the host' and 'the workers' or 'people who work at the aquarium'. The students were clear that this was a site where they would learn about new things, and some of them suggested that the learning would be better, more fun, than in the classroom. There was no indication that in their minds the site was anything other than a place of learning.

Education officers' views

Value of LEOTC

Deborah and Tony were interviewed together because, although they had different responsibilities within the marine centre, their work overlapped in terms of planning and evaluating the teaching programmes. They believed that the greatest value of LEOTC sites such as the marine centre was the opportunity for students to have realistic experiences which could not be reproduced in the classroom, alongside experts in the field. At this site, the experts were actively involved with research programmes, and this gave the education officers an added enthusiasm for the work, and kept them 'connected with the environment – hands on, feet wet, mind salty'. There were also many stories to be told about discoveries along the coastline, gory shark stories and all those tales which would capture the imagination of the students. Tony's hope was that a class visit would create in the minds of the students a sense of appreciation and wonderment at the slice of marine life they had observed and, as a result, they would be

interested enough to follow it up at another time and perhaps another place. He also thought that the experience might provide insights to a future career for some of the students. In terms of the less formal family visits, Deborah and Tony saw the site as providing a very rich recreational pastime which would be an unforgettable experience for any visitor or any age group. Deborah made the following comments:

I would say that we want to make this a memorable experience for any age and in terms of the outcomes of increased sensitivity and conservation management, they are more informed, they are better able to make a choice and - they care!

Trying to raise a spark in the classroom can be quite hard but here it is so easy – there is not one child that you can't interest with a gory shark story eating something or a beautiful little anemone.

Deborah and Tony went on to describe the strengths of the site. These were many and varied, and included most of the features which attracted Megan and her class – the live animals, the natural environment, the unmodified rocky shore line, the rich inter-tidal area, its association with a research lab, its equipment, research project and lots of new exhibits being made available on an almost daily basis. Tony talked about the other attraction, which he summarises here.

Another important aspect here which possibly gets overlooked is that schools going out on trips want to squeeze in as much as possible because of the expense, because the peninsula here – they might go on to see the penguin colony or to see the albatrosses. We are not stuck out on some far flung corner of the coast where to do a dedicated trip to us is all they can do that day – they can incorporate it into a much wider programme.

The students in this case study, as mentioned previously, were able to do a harbour cruise in the morning, then come to the marine centre, and in the afternoon go on to see the penguin colony and the albatrosses. If the weather was bad, Tony was also able to offer an indoor field trip, and give the students a lab programme instead of a shore walk.

Liaising with teachers

The education officers considered it essential to liaise with teachers prior to their visit if the learning experiences at the site are to be truly worthwhile. Speaking on the phone to Megan, for example, allowed Deborah to explain more about their programmes and to help Megan select the programme which would best suit her needs. By sending them a copy of her science unit, Deborah and Tony could see where their programme was going to fit, and the work that was to be carried out in the classroom beforehand. This signalled to Tony the prior knowledge that the students should come to his workshops with and the approximate level at which he should pitch

his discussions to in order to move the students on. Deborah added to this by making the following point.

In terms of us evaluating our delivery, if we don't know what their objectives are beforehand, and they say, oh well, you didn't meet our objectives, and we don't know what they are prior – well...it's really important for us to know what they are - in order for us to evaluate our programme.

Programme delivery and evaluation

Deborah and Tony had clear ideas about the delivery of their programme, particularly the importance of variety and of trying to engage all students in their workshops. They were aware that talking to the students all the time was not good practice but, by giving them the opportunity to ask questions, to investigate on their own, to carry out directed tasks and to look for specific things, they could stimulate and motivate the students into greater involvement. The nature of the centre and its exhibits was a constant challenge to manage. Tony comments:

It is sometimes hard here because there is so much to say – so much to experience, and it is all so interesting.

To keep the sessions focused and manageable, Tony gave the students three key questions that he asked them to explore while they were at the centre, and they could view these as widely or narrowly as they were able. These questions vary according to the programme being offered, and give structure to the framework of each workshop. Student responses to these questions during the concluding phase of their visit also helped Tony evaluate how effective the session had been. But he adds to this idea with this comment:

I think one of the best forms of evaluation is the letters we get from students, and what they highlight is what they remember and what they like. I can read them and think - oh! – It's often not what you predicted they would get out of it.

Tony had also noticed that the students liked being singled out to do something, or being part of a joke and causing some laughter amongst their peers – 'anything that relates to them personally they remember'. This could be a distraction, if the strategy was overused. Tony made this comment:

If you precede information with somebody's name they tend to remember it. It's that personal connection.

Teacher roles

Getting acquainted with the exhibition, and if possible carrying out a preview of the site prior to their students' visit, was the most important feature of teacher support – knowing what they were bringing their students to, understanding the desired outcomes of the visit, all allowed for enhanced preparation and conversations to occur when teachers were interacting with their classes. Staff at the marine centre had also committed a great deal of time to the development of resource booklets. These were comprehensive and included an overview of the selected programme, a curriculum guide, teacher and adult supervisor notes, how to help children during the programmes and a wonderful range of post-visit activities for teachers to use when they returned to the classroom. This booklet effectively filled the gap for those teachers who were unable to carry out a site visit because of its isolation, or distance to travel.

The visit

Megan and her students travelled from their school in the northern part of the North Island to the marine centre in the South Island. They began the day with a wildlife cruise of the harbour and then returned to the marine centre to begin the 'Supper in the Sea' programme. The students, parents and classroom teacher all assembled in the centre's spacious reception come-teaching area, where introductions were made and Tony outlined the programme for the rest of the morning. The students were then taken down to the aquarium to view the live fish tanks, and then on to the laboratory where the main focus of their work began. The session was interactive and interspersed with vast quantities of humour and a great deal of interesting information. Tony had donned his famous 'fish hat' – a very colourful version of some unidentified species – and he guided the children through the session: looking, thinking, investigating, asking questions and considering answers. The laboratory was set up with microscopes, live creatures in touch tanks, labels, information, and tasks for them to carry out.

As Tony worked with the students, it became obvious that he had a talent for explaining biological concepts at a level which the students were able to comprehend. For example, when talking about phytoplankton, he referred to them as 'sun munchers'. He had a great repertoire of animal stories which he used to contextualise some of the topics he was covering, and he used a great variety of teaching aids to capture the children's interest – a tape recording of a chiton feeding, containers of krill and shark eggs, trays of seaweed and the other resources described

earlier. The session lasted approximately 45 minutes, and the room buzzed with the students' delight in their investigations and discoveries.

The students made their way back to the classroom where Tony summarised and reflected on what they had seen. They role-played the dynamics of a food chain and how the pollution of sea water can result in absorption of contaminants such as oil by plankton. Tony concluded the session with a discussion on how the children and their families could contribute to the preservation and conservation of marine life. Students, parents and teacher then set off to the beach, for lunch, and after the 'Seashore Scramble' programme, they left for the albatross and penguin colonies.

After the visit

In the classroom

The work carried out at the marine centre addressed several of the achievement objectives that Megan had planned for. It fitted into the middle section of the unit and her task upon returning to the classroom was to help the students make the links between what they had learnt previously and what they had discovered at the marine centre – particularly relating to 'Introduced Animals'. This work was all going to lead into the next major focus, which was about pollution and the environment. Megan anticipated they would reflect on what happens if you take out one part of the food pyramid and what causes marine and other species to be wiped out. The seashore life activity booklet supplied by the marine centre was going to be a useful resource to complement the work the students were going to do and would also provide a range of extension and homework activities to help them clarify some of their new understandings.

Student reflections

At the time, only four students were interviewed about their experiences at the marine centre as one student was absent. They all emphatically stated that the trip was worthwhile, and mentioned the fish and sea creatures they had seen and handled, along with the problem of pollution and how this could affect the food chain.

All students were able to describe details of what they had seen and learnt, and their enthusiasm for the trip, although almost a week later, was still bubbling. Here is some of the new information they felt they had learnt at the centre:

Fish feed on smaller fish, and then bigger fish eat these fish – like if the phytoplankton eats the oil and its dies, and then the plankton eats that and the small fish eat that and the big fish eat that and the sharks feed on that – they all die – and if you took one away (from the food chain) then they will all die.

If you overfish you will be taking away heaps – there wouldn't be enough for like – if you take away the baby guys they won't grow up and there won't be any more.

We went into the touch tanks and we looked at the kinas and starfish with magnifying glasses. The starfish mouth is small - and one of the animals can drill a perfect circle - and one can chuck out its stomach and suck in all the stuff [food] and mix it all up like a milkshake and then drink it!

We did the food chain – Tony gave out these cards and we had to sit in a line. Now we remember... like if one thing is taken out, the whole food chain suffers – like if someone pollutes the water with oil or something and the phytoplankton eats it and the zoo plankton eat the phytoplankton and all the way up the food chain... sometimes they die but usually they just get really sick.

The students were drawn to the gruesome, the beautiful and the unusual, but interspersed through their stories and memories are the ideas and vocabulary documented in the learning outcomes of the unit; for example, introduced animals, carnivores, herbivores, the food chain, phytoplankton, zoo plankton and others. They seemed to be fascinated by the fact that so much damage could be caused by something as commonplace as oil, and they are now well-positioned to take these ideas and concerns to the next stage of prevention.

Teacher reflections

Megan was very positive about her class's visit to the marine centre. She was impressed with the way Tony worked with the students, his good sense of humour, the way he held the students' attention and the different types of activity that he included in his programme. She also commented on the way he simplified the science so that students could understand it.

I think he was good because he used their terms and then the scientific terms as well. So when he was talking about the zoo plankton and how they move around, he said they are like tiny little animals, like fleas and things in the air. And he quite often brought it back to what it would be like for humans and he'd say – and wouldn't it be strange if we ate by having all these things flying around in the sky and we had to walk around with big mouths open eating – he brought it back to what it would be like for them. I could see the looks on their faces thinking how would that work?

Megan felt that the visit was managed well, the sequence of activities flowed smoothly and that probably, as a result, the students were well-behaved, careful with the equipment and genuinely interested in what was going on; for example, once they started looking at the animals they could be heard saying, 'Come and have a look at this one – quick'.

She thought one of the biggest challenges for Tony was to keep the balance between providing the right amount of information and yet still holding the students' attention. In terms of how the visit enhanced student learning, Megan was clear that hands-on activities were a major asset. The students were able to use equipment such as the microscopes that they did not have at school. Being able to view the sea creatures through the microscopes, and see the movement of their mouths and how they were eating, enabled students to gain a deeper understanding of the differences between herbivores, carnivores and omnivores. The conversations that Megan had shared with her students since returning to school were testimony to their enhanced understandings and memory of the tasks they had carried out.

The final interview question asked Megan about advice for other teachers who might be attending this site. Megan felt that to use the site as an initial motivation for further work would not be as valuable as the experience her class had. She felt that to get the very best from the visit, it should come part way through a teaching unit so that students and teacher go there well-prepared. It was necessary to look carefully at the programme beforehand so that the students would have a level of familiarity with the topics being covered and could participate confidently. They also needed to have a shared sense of purpose of what they hoped would be achieved. She likened the experience to that of research:

I guess it is a type of research really, but it's just a different method for them. [Rather than] going and finding out what we found out in a book, having it delivered to you in an interesting way makes it more memorable.

Education officer reflections

Deborah and Tony see their job as facilitating the discovery process and, as Tony pointed out, this is quite difficult as it occurs at different rates. Student behavior when using the microscopes for the first time is a good example of this. Many students were initially distracted from the task of looking at marine animal mouth parts when they discovered that the mystery objects they were seeing through their microscopes were their own fingernails and skin. This type of discovery is important and should not be undervalued so the overall timeframe needs to be flexible enough to take these deviations into consideration.

Deborah had been interested for some time in taking on more of a role in classroom follow-up activities but, despite several attempts, she had been unable to get Ministry of Education funding to support this. She says the Ministry believed that this was the teacher's role and at this point the interest had been in providing negotiated learning outcomes and pre-visit support. So the

marine centre staff had put their energies into developing resources, websites and a CD-ROM. They hoped this would provide teachers with knowledge and ideas to help them develop follow-up activities and ensure that their visit was not a one-off activity, but rather part of a more extensive unit.

The advice they would give to teachers bringing students to this site depended on why they were coming and what they hoped to get out of it:

If they are doing a whole unit and they come in at the beginning of the study with no prep, nothing, that's okay. If they come at the end of the unit it works well. So I think the important thing is that they make it part of their unit and they do follow up and pre trip preparation. I don't think it matters where the field trips lie within the unit.

The conversation with the programme director and the education officer concluded with some thoughts about the issue of evaluation. Deborah had this to say:

The whole issue of what the 'value added' is and how you figure out what the children have learned over the course of the visit is difficult. What knowledge they have come in with and what they leave with – it is something that is quite hard to do.

Deborah said they had carried out some research, in an attempt to improve this process, by sending out surveys before and after a visit, but the information they received as a result of this was disappointing. Deborah said that it really did not tell them much. Most sites give out evaluation forms at the end of the visit and ask for them to be returned before they left:

My attitude is quite different in that I know the information we get once they get home on the bus, and they've thought about it and seen how it related – they've seen how students answer questions at the penguin colony and so on, - it takes a while for the benefits – what worked, what didn't work – to sink in. I find that I get quite different feedback if I get (the teachers) to mail it back than if I get them to fill it in at the centre.

And to conclude, the final word from Deborah:

The marine environment is a fantastic topic because it pulls in all areas of the curriculum – it's interdisciplinary.

Key points from Case Study A

Looking back over the case study, several key points emerge:

- There was clarity about the purpose of the visit, which helped students focus on, and participate more effectively in, the tasks provided.

- Time was allocated to discuss the expected site etiquette, which proved to be important both for students and parent visitors, particularly when some areas of the site were active research and/or work environments.
- It was helpful for students to appreciate that they were going into a learning environment, and that there would be opportunities for them to move on in their understandings and knowledge.
- Value from this visit was achieved by students having realistic experiences not available in the classroom, alongside experts in the field.
- The education officers were actively involved in the field of study and had a huge repertoire of stories to tell. These stories seemed to make some of the most effective links in student learning; for example, the gory shark stories or the gruesome explanations of the sea slug digestive system. The appeal of these stories seemed to aid student memories of what they had seen and heard.
- The site offered an outdoor component to the visit and also had the flexibility to provide alternative programmes if the weather was bad.
- Having the opportunity for liaison between the site education officer and the visiting teacher was a critical part of the visit preparation. This enabled the teacher to become acquainted with what was on offer, to select the most appropriate programmes, and to ensure the students were adequately prepared for the experience. It also allowed the education officer to see where the programme was going to fit within the classroom teaching programme and it helped signal the level at which to pitch the discussions.
- In this study there was evidence of the education officer interacting easily with the students, reducing complex ideas down to a level which students could understand, and providing an interesting and varied presentation.
- Using a variety of strategies in order to evaluate the programme being offered at the site was an effective way to get accurate information; for example, taking time to reflect on the programme with the students at the conclusion of the visit, reading and sometimes analysing letters which came in from students, and observing follow-up visits by students with their parents.
- Hands-on activities and experiences with live animals had great appeal for students, and seemed to be what they remembered most.

- Time to explore and investigate on their own was important for students, even though it involved activities which were not strictly to do with the planned programme; for example, students investigating their own hands and fingernails under the microscope before moving on to look at the marine life.
- The education officers believed that providing background knowledge and follow-up activities was important. In particular, it was important to ensure that a school visit was not a one-off activity for the students, but rather part of a more extensive unit. Where the visit comes within the unit was not so important.

Evidence of learning

Evidence of learning from Case Study A is provided in the commentaries in Table 1 and Table 2 below.

Table 1. Students' commentaries on their learning

Before the visit	After the visit
<p>I think we will see different fish, their habits, their way of life and how they survive. I think we will feel the fish in the touch tanks and watch the fish. (Angela. 11)</p>	<p>I liked looking through the microscope and the touch tanks. We put a starfish in and all the little crabs ran away because the starfish eats them. They can sort of smell it. I didn't really know that one bit of oil can make that much of a difference. It was good how we knew a little bit before we went, but at the aquarium it sort of expanded. I never knew these things before, I've never seen them and I found out how they live. If you get involved you have a picture in your mind, like touch the seaweed and touch the different fish you can remember - that's what they feel like, that's where they are, that's what they eat. (Angela. 11)</p>

Before the visit	After the visit
<p>This trip will help me learn by making the trip fun so I should learn more that I do in class. I think we'll see fish and maybe some other sea creatures. (Kris, 11)</p>	<p>We saw crabs and starfish and sea slugs. We saw plankton and we saw different sea creatures and the food that had been packaged from seaweed and stuff. I learnt about the plankton being at the bottom of the food chain. If you over fish you will be taking away heaps – there wouldn't be enough for life – if you take away the baby guys they won't grow up and there won't be any more. I remember how the sea cucumber can dig a hole into the shell and then stick their stomach into it and they make it into a milkshake and then they suck it back up again. The touch tanks were really good. I was a bit scared of touching the little creatures, but once I got my hands in there I was all right. (Kris, 11)</p>
<p>We'll look at the fish and penguins. We have learned about penguins and albatrosses. (Martin, 11)</p>	<p>The visit helped us learn because you learnt about how much fish are being killed by us and whether you think it's good or not. We went into the touch tanks and we looked at the kinas and starfish with magnifying glasses. The starfish mouth is small - and one of the animals can drill a perfect circle - and one can chuck out its stomach and suck in all the stuff [food] and mix it all up like a milkshake and then drink it! Feeling all the fish and all the things helps us with learning rather than just talking about it. I learnt about food chains – how fish feed on smaller fish and then the bigger fish eat these fish. Like if the phytoplankton eats the oil and it dies, and the plankton eats that, and then the small fish eat that, and the big fish eat that and then the shark feed on that, they all die, and if you took one away from the food chain they will all die. (Martin, 11)</p>
<p>I think we'll touch fish, maybe feed them, look at fish and learn about them. (Alistair, 11)</p>	<p>We got to learn about different animals and how they live and how they eat and what they do – like find food in the food chain, and how if one thing gets taken out they won't be able to live. We did the food chain – like if one thing is taken out, the whole food chain suffers – like if someone pollutes the water with oil or something and the phytoplankton eats it and the zoo plankton eat the phytoplankton and all the way up the food chain... sometimes they die but usually they just get really sick.</p> <p>I learned that the starfish mouth is small and one of the animals can draw a perfect circle and they can chuck out their stomach and suck in all the stuff and mix it up like a</p>

Before the visit	After the visit
	milkshake and then drink it. We learnt more when we went down there. (Alistair, 11)

Students' before views indicate that they thought they would see sea creatures of various sorts on the visit. Two of the four thought that they would be able to touch fish; two that they would learn about fish, and one that she would learn more than in class, because the trip would be fun.

Students' after views demonstrate a self-awareness that they had learned. Students were able to specify their own learning gains. They commented on the value and influence of seeing and being involved in real-life contexts – affective aspects impacted on learning; for example, 'feeling all the fish and all the things helps us with learning rather than just talking about it'. There is evidence of substantial content advancement, in vocabulary and in concepts, particularly in understanding food chains; for example, 'I learnt about the plankton being at the bottom of the food chain. If you overfish you will be taking away heaps – there wouldn't be enough for life'.

Table 2. Teacher commentary on student learning

Megan, the teacher, said that the visit was managed well, the sequence of activities flowed smoothly and that probably, as a result, the students were well behaved, careful with the equipment and genuinely interested in what was going on. She said that 'once they started looking at the animals they were hooked. You could hear them saying, "Come and have a look at this one – quick". It was a good sign'. Megan was clear that the hands-on activities were a major asset. For example, she said "the major thing there was that when they looked at the creatures under the microscope, that was something the school would not have the facilities for, to have that sort of equipment; so they actually were seeing how they were eating, and through the mouth movement they could definitely gather a deeper understanding of the whole herbivores, carnivores and omnivores aspect". She also commented that "them [the students] having learnt about introduced animals and herbivores and food chains definitely made it easier for them to make links and get information quicker".

Megan's commentary on student learning is based on her observations of her students when they visited the site. She commented on their engagement in learning, especially on the interest they showed in the happenings at the site and how the examination of real animals focused their attention. She also commented on how they drew other students to their observations, an

indicator of student engagement in learning. She concluded that student learning was facilitated through their use of equipment, in particular the microscopes, as these enabled the students to view sea creatures up close and in detail. She deduced that this close examination helped her students gain deeper understandings. Her final comment related to the preparation they had undertaken in class before the visit, and how this preparation meant her students could link the understandings they built in-class to the information they gleaned during the visit.

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