Effectiveness of programmes for curriculum-based learning experiences outside the classroom: A summary

A summary of research by Judy Moreland, Clive McGee, Alister Jones, Louise Milne, Ariana Donaghy, and Thelma Miller, University of Waikato

Summary by Janet Rivers

Accessed from TKI / LEOTC http://www.tki.org.nz/r/eotc/leotc/index_e.php

Overview

Since 1994, the Ministry of Education has purchased services that provide curriculum-based learning experiences outside the classroom (LEOTC)[1] for New Zealand schools and students. These services are currently provided by a range of organisations, and include museums, historic parks, zoos, art galleries and science centres. The LEOTC programmes complement students' in-school learning and provide experiences that could not be made available in the immediate school environment, and involve teachers and LEOTC providers working together to support student learning.

This report is a summary of research on the effectiveness of programmes offering contextualised learning beyond the classroom, funded by the Ministry of Education. It was conducted by a team from the University of Waikato's Centre for Science and Technology Education Research and the Wilf Malcolm Institute of Educational Research, comprising Judy Moreland, Clive McGee, Alister Jones, Louise Milne, Ariana Donaghy and Thelma Miller.[2]

The research consisted of two parts: a review of the national and international literature on contextualised learning experiences beyond the classroom and six New Zealand case studies of class visits to LEOTC sites.

The research investigated whether contextualised learning experiences outside the classroom improve student learning and, if so, which characteristics and conditions contributed to that learning. The researchers also considered impacts on long-term achievement, identified gaps in the research and discussed the implications for effective LEOTC practices in New Zealand.

The research was carried out between June 2004 and April 2005.

---

[1] The term LEOTC is used in this summary to refer specifically to Ministry of Education-funded programmes and 'contextualised learning experiences beyond the classroom' or 'contextualised learning experiences' are used for discussing the research literature generally in this field.

[2] Judy Moreland, Clive McGee, Alister Jones, Louise Milne, Ariana Donaghy and Thelma Miller, *Research into Effectiveness of Programmes for Curriculum-based Learning Experiences Outside the Classroom,* University of Waikato, Hamilton, 2005. Also available at www.tki.org.nz/r/eotc/leotc

Key messages

Literature review

The review of literature found only a few New Zealand studies of contextualised learning experiences beyond the classroom. The research evidence from these indicates students' learning is improved when the teacher and education officers work together on pre-visit, visit and post-visit learning experiences that include both formal and informal learning. The international literature reinforces this finding and also shows there are many complexities regarding contextualised learning experiences beyond the classroom, such as types of sites, how students learn and react, student–student interaction, the quality of site exhibits and different kinds of learning activities involved in such events.

Case studies

Key findings from the case studies were:

- Students were able to combine fun and excitement during a site visit with curriculum-related content. When assisted by teachers and education officers, students were able to link learning experiences between pre-visits, visits and post-visits. Students were able to share their comments and perceptions about LEOTC and enjoyed opportunities to talk about them.
- Collaboration between teachers, education officers, parents and students resulted in improved learning.
- Teachers played a central role particularly with regard to planning for the visit and developing follow-up activities.
- Education officers were highly regarded and had access to knowledge not otherwise available.
- The quality of site exhibits was related to student learning, with 'hands on' and real life experiences important.
- Students developed positive attitudes about their learning experiences outside the classroom.

Implications for LEOTC

The researchers identified the following implications for LEOTC practice, based on the evidence from the case studies and the literature review:

- Teachers and education officers need to work closely together and share the same goals.
- Teachers, education officers and students need to be clear about the goals of the LEOTC programme, and pre-site visit learning activities need to be linked to visit and post-visit activities.
- Education officers need to build friendly, education-based relationships with teachers, students and parents.
- Learning in out-of-school sites is more effective when the sites are viewed as places for learning as well as for entertainment.
- Learning is more effective when students interact with different tools, objects and exhibits; and when students link site and schoolwork experiences.

Research gaps

The researchers found that more research is needed on the way students learn in different sites, their processes of learning, and their short and longer-term retention of learning. In particular, there is a need for more research that attempts to quantify students' gains through standardised tests. More research is also needed across the range of curriculum areas and on how experiences differ for different groups of students.

How the research was done

Scope of the research

The following research questions informed both the literature review and the case studies:

1. What evidence is there that programmes offering contextualised learning experiences beyond the classroom improve student learning?
2. What do students say about their learning experiences beyond the classroom? What do students feel was most valuable about the learning experience?
3. What do teachers say about their students' learning beyond the classroom? What do teachers feel was most valuable about the learning experience?
4. How do experiences differ for different groups of students?
5. What are the characteristics of such programmes that make positive gains in student learning outcomes most likely? Under what conditions, and for which students are benefits optimised?
6. What evidence is there that such programmes influence long-term achievement and retention of learning?
7. In what areas are there gaps in the evidence base that would merit further New Zealand based research or monitoring of programmes?

How the research was carried out

This research consisted of two parts:

- a review of national and international literature on contextualised learning experiences beyond the classroom, particularly literature relevant to impacts upon student achievement and the factors that affect achievement
- case studies of six New Zealand school classes and their experiences of a visit to an out-of-school education site, and particularly the impact of the experiences on students' achievement.

The literature review

The strategies used to identify material for the literature review of contextualised learning experiences beyond the classroom included:

- locating Ministry of Education websites for information on LEOTC policies and Ministry-funded providers
- contacting researchers and specialists working in the field of contextualised learning experiences beyond the classroom in New Zealand and other countries
- locating recent national and international research literature through library, electronic database and web-based searching
- thesis searches for unpublished Australasian and British research literature.

Criteria used in the final selection were:

- relevance (e.g. the paper had to relate to the research questions)
- methods (either reporting a research study or synthesising the findings from other studies)
- assessment of learning (particularly literature that documented attempts to assess and measure student achievement as a result of contextualised learning experience beyond the classroom.

The literature review focused on 109 major review articles, meta-analyses, articles by key researchers, and reports of research findings (refer to Appendix 1). From this list, the research team identified 13 articles which included material connected to the research questions (that is, with information on the research methods used, such as qualitative and quantitative methods, sample sizes and types, and measures used to assess the impacts of learning experiences). These are listed in Appendix 2.

Much of the literature related to science and informal learning in museums, with only a limited body of research in other curriculum areas.

Most of the research was carried out in the United Kingdom, Australia and the United States, with little from New Zealand apart from a small number of theses and related papers.

Apart from the key studies (Appendix 2), many studies were of limited value because they were dated or the details about methods of data collection and sampling were too brief to

draw findings from. The paucity of quantifiable data in most of the reported studies meant it was difficult to assess the effectiveness and impact of contextualised learning experiences.

Case studies

The case studies involved six classes which visited six different New Zealand LEOTC sites, with each site visit making up an individual case study (refer Table 1).

Two LEOTC sites were from the social sciences curriculum group; two from the science, technology and mathematics group; and two from the arts, language and languages, health and physical education group.

The case studies explored the interplay between the perspectives and experiences of teachers, education officers and students, with between four and six students involved in each case study. The students were selected on teacher recommendations as those confident and articulate enough to share their perceptions with the researchers.

Data collection was through interviews, observation and reading documents. The researchers observed classroom lessons, LEOTC lessons and visits, and took field notes and photographs of students undertaking their work at school and at the LEOTC sites. Documents included samples of teacher planning and assessment, summaries of teacher–class discussions, samples of student work and samples of LEOTC publicity material.

Interviews with teachers, students and education officers were semi-structured to gain further information about students' thinking and learning before, during and after the observed lessons and visits.

The research team conducted both within-case and cross-case analyses.

The sample of students was small, as was the number of teachers and education officers. Therefore, findings – particularly of student achievement – are indicative only.

Table 1 provides a summary of the six case studies. For more detailed information, go to www.tki.org.nz/r/eotc/leotc.

Table 1: Six case studies

LEOTC curriculum group	School	Class level	Case study title	Case study description
A. Science, technology & mathematics	City, Intermediate, State, Co-ed, Roll: 815, Decile: 2	Year 8	*Hands on, feet wet, mind salty*	A wildlife harbour cruise, followed by a visit to a marine research and education site, and a trip to a marine reserve where they viewed albatross, sea-lion and penguin colonies
B. Science, technology & mathematics	City, Contributing, State, Co-ed, Roll: 627, Decile: 3	Years 4 and 5	*Seeing it for real up-close*	A visit to a glow-worm cave site and its associated museum and education centre
C. The arts, language & languages, health & PE	Town, Contributing, Integrated, Co-ed, Roll: 160, Decile: 6	New Entrant and Year 1	*We go to galleries*	A visit to an art gallery, in the context of the school's long-term relationship with the local gallery
D. The arts, language & languages, health & PE	City, Full Primary, State, Integrated, Co-ed, Roll: 231, Decile: 9	Years 2 and 3	*Sowing a seed for the future*	A visit to an exhibition of work by a New Zealand artist. The multi-media exhibition included models, sculptures, photographs, videos an audio-taped displays
E. Social sciences	Rural, Full primary, State, Co-ed, Roll: 78, Decile: 5	Years 5 to 8	*You know more after going on a visit*	A visit to a museum as part of a three-day camp in a town several hundred kilometres from the school
F. Social sciences	Rural, Full primary, State, Co-ed, Roll: 82, Decile 9	Years 3 and 4	*You're the experts*	A visit to an art and history museum which included a particular focus on volcanoes and volcanic eruptions. It included museum classroom discussions and exploring exhibits that included photos and artefacts from some eruptions

Accessed from TKI / LEOTC http://www.tki.org.nz/r/eotc/leotc/index_e.php

Results

The following section summarises the main findings from the literature review and the case studies.

Literature review

The literature on contextualised learning outside the classroom emphasised that learning is complex, and is affected by the personal, sociocultural and physical contexts in which it occurs and the interplay between all these factors. Learning is also cumulative, influenced by prior knowledge and experience, and occurs over time. Therefore, while there is agreement that contextualised learning experiences support learning, it is difficult to assess the impact of different sites. (Examples of the literature covering this aspect include Dierking et al., 2003; Falk and Dierking, 1997; 2000; Rennie, in press; Rennie and Johnson, 2004.)

However, some key points emerged from the literature on the characteristics of experiences and programmes that contributed successfully to student learning

Several studies identified the importance of pre-visit preparation by the teacher and pre- and post-visit activities for students in order to maximise learning during school visits: if educational activities provided at the site are not part of pre- and post-visit classroom lessons it would appear they are of little value. Linking the school curriculum and the content of the site visit helps to connect activities more effectively and enhances student learning: teachers should be familiar with the site and have a clear purpose and reasons for the visit. (Examples of the literature touching on this aspect include Anderson et al., 2000; Anderson, Lucas and Ginns, 2003; Bracey, 1995; Falk and Dierking, 2000; Falk, Moussouri and Coulson, 1998; Jarvis and Pell, 2002; 2005; Pershey and Arias, 2000; Tofield et al., 2003

The quality of the school–site partnership seems to contribute to the effectiveness of the site visit, and collaboration between site education officers and teachers before, during and after the visit supports student learning – the importance of linking school and site resources and expertise is a common imperative in the literature. (An example of the literature touching on this aspect is Brodie and Wiebe, 1999).

The literature identified a number of factors relating to sites that enhance learning experiences. The site has to capture students' attention (Tully and Lucas, 1991). For example, interactive, hands-on exhibits in museums and zoos aid student interest and engagement (e.g.

Mackintosh, 1998), as does students being able to relate the site visit experience to their own experiences. Sound, movement and layout are other key characteristics of effective exhibits (e.g. Anderson et al., 2000; Floyd, 2002; Griffin and Symington, 1997; Sandifier 2003). There is evidence of a link between focused science museum experiences and the replacement of students' existing ideas with more scientific knowledge (Borun, Massey and Lutter, 1993).

Some studies emphasised the need for sites to keep up to date (Rennie and Johnston, 2004). Because learning is personal, sites must provide relevance. To achieve this, Kelly (2002) argued for sites to base their exhibits upon a learner's prior knowledge and experience. This is, of course, a difficult goal to achieve. Exhibits themselves have received some attention in international literature, especially regarding their quality and usefulness in capturing visitors' attention. Alt and Shaw (cited in Miles and Tout, 1991) have outlined criteria for assessing the "ideal" exhibit for both 'naïve' and experienced visitors. Positive features include an exhibit that makes the subject come to life, makes its points quickly, has something for all ages and is memorable. Factors that detract from an exhibit are that it is badly placed and not easily noticed; it does not give enough information, it is confusing and that one's attention is distracted from it by other displays.

Students should be given time during visit to familiarise themselves with the environment, explore the site and experience the exhibits first hand. They should also have access to informed staff – the quality of the staff and the way they interact with students influences the way students react and what they learn. For example, guided tours of exhibits made expertise available that a school could not other wise provide but the quality of interaction with students was crucial to the way the students responded and what they learned (e.g. Falk & Dierking, 2000; Cox-Peterson et al. 2003; Anderson, Lucas and Ginns, 2003).

Students should also be encouraged to take responsibility for their own learning. Several studies referred to the value of working in small groups with other students and with adults. Adult helpers should be encouraged to participate, and well-prepared parents can help student learning (e.g. Anderson, Lucas and Ellenbogen, 2003; Gilbert and Priest, 1997; Jarvis and Pell, 2005; Price and Hein, 1991; Rennie and McClafferly, 1995).

Some authors identified the need for sites to gear their exhibits to the age level and interests of visitors (e.g. Brown, cited in Wineman, Piper and Maple, 1996). However, there were no

studies of ethnicity or on students of different abilities, and little on gender (see Jarvis & Pell, 2005, who cite two examples).

Having fun and learning are legitimate goals, and there evidence students are able to do both when they visit sites (e.g. Rennie, in press). One study (Tofield et al 2003) found learning occurred even when the visit was relatively informal and the major aim was to have fun. Another indicated that over-reliance on worksheets may constrain students' experiences during the visit, and that students preferred family visits to a museum over school visits because they had more choice and control (Falk and Dierking, 2000). However, a New Zealand study (Bolstad 2000) of a science centre found evidence that the centre was seen primarily as a place for fun and hands-on experience with no systematic way of matching science and technology learning to students' abilities. To Bolstad, it seemed that teachers and the science centre staff needed to do more joint planning in pre-visit and post-visit phases to achieve a better match.

The literature shows it is difficult to assess the amount and quality of actual learning site visits. Most of the studies that assessed learning used qualitative research, and hence much of the evidence of impact is inferential, such as observed on-site behaviours and self-report data – there was little that used quantifiable achievement measures such as test scores before and after site visits.

There is also little in the literature on the kind of learning students retain from site visits or how long they retain it for. That learning takes time makes it difficult to measure, particularly as memories of a visit linger and can contribute to later learning (e.g. Anderson, 2003; Falk and Dierking, 1997; Dierking et al., 2002; Stocklmayer and Gilbert, 2002, cited in Rennie, in press). Anderson (2003) describes two studies (Falk and Dierking, 1997 and Stevenson, 1991) which both found evidence of long-term learning but neither study linked the learning to quantifiable student achievement. There was no New Zealand literature looking at long term achievement, and some of the studies suggest longitudinal studies are needed to document learning over time (Anderson, Lucas and Ginns, 2003; Rennie, in press).

Case studies

The case studies showed that teachers, education officers and students all believed that access to expertise, spaces, exhibits, artefacts and hands-on experiences not available at school provided stimulating, realistic learning experiences for students.

Participating in an excursion outside school provided a novel component which was interesting and motivating for students. They were learning by being involved in concrete, tangible experiences which added realism to the ideas and skills they were trying to grasp. Their interactions with exhibits helped them bring their other senses into use which provided a rich learning experience, and they readily remembered experiences which had evoked strong emotional or physical responses.

The case studies provided clear indications of student achievement, with evidence from researcher observations, discussions with students, studies of work samples, and teacher and education officer comments.

Students' behaviour at the various sites indicated they were engaged in learning, often taking responsibility for, and initiating, their own learning, and they showed high levels of engagement, curiosity and interest. Appropriate worksheets helped some students search for relevant information.

Students were able to describe details of their learning, and the sophistication of their accounts indicated they had acquired new vocabulary and an understanding of new concepts and ideas. They judged the worth of a visit by whether they could talk more about it, knew more, were not bored and that it was fun.

Most students thought that pre-visit activities with their teachers were important, because then they knew the purposes for which they were going, and they had ideas upon which to build.

Students understood that, in the course of their LEOTC site visit, various people helped them with their learning, including the education officers, parents, teachers, friends and peers. Students said that the education officers knew a lot and were enthusiastic, and this helped them learn.

Students especially liked being in small groups, and they increased their learning when working in groups with peers and with adult helpers.

Post-visit interviews reflected students' positive attitudes towards undertaking LEOTC and their comments demonstrated that their learning had been stimulated by the visits. The students saw that work in class after the visit helped to consolidate their learning from the pre-visit activities and during the visit itself. All those interviewed believed that they had learned because of the experiences they had undertaken, and the visits had contributed to their learning in ways that could not be replicated at school.

Teachers were a key factor in facilitating and enhancing students' learning experiences outside the classroom and provided the bridge between classroom learning and visit learning.

All teachers stated that the visits their students undertook as part of their classroom programmes enhanced student learning because the visit programmes provided unique and stimulating learning opportunities.

The activities and discussions they held in their classrooms before and after the visits helped to enrich the visit experience. Teachers believed that it was important to provide background knowledge for the visits, and also follow-up activities. In particular, they thought that it was important to ensure that a school visit was not a one-off activity for the students but part of a more extensive unit.

Student data show that when relevant and related concepts were highlighted in both the school and the LEOTC site, students were more likely to make positive learning gains.

When teachers shared the learning goals with their students, the students were more likely to make positive learning gains because the goals provided a focus and they could work towards them. Helping students to understand the learning goals meant that they were also less likely to treat the visit as just a fun experience–student seemed to make more positive learning gains when they students realised the visit was for learning as well as for enjoyment. Learning connections were also found to be more effective when teachers had identified the curricula focus as well as the learning goals.

Teachers also treated the visit as a learning experience for themselves, which then influenced their teaching after the visit, thus helping to make their teaching more efficient.

Teachers valued the liaison with education officers before visits as it enabled them to become acquainted with what was on offer, to select the most appropriate programmes and to ensure

that students were adequately prepared for the experience. Teachers also liked the resources provided by education officers for use in the classroom before and after the visit.

Some teachers thought that previewing the site or exhibition was a critical aspect of their preparation. However, not all teachers were able to do this, as sometimes the site was too distant from the school; in these instances, the teachers thought the pre-visit liaison with education officers was essential to reduce discontinuity between school and site.

Education officers established positive relationships with teachers and used the pre-visit liaison to find out the teachers' goals and expectations. This meant the education officers could see where their programme would fit within the classroom teaching programme, and it helped to signal the level at which they should pitch their discussions and activities. The teacher–education officer interaction enhanced the flow of ideas between school and visit which created a smoother transition between the two, building a cohesive match between visit activities and school learning.

Education officers were key people for facilitating and enhancing student learning on site. They helped students gain the most from the experiences—when education officers established positive, friendly relationships with students, students reciprocated in kind, which helped students make positive learning gains.

Teachers said that education officers, as experts in their field, provided unique insights, had extensive knowledge and used effective pedagogical approaches. They felt the role the education officers took during the visits was important for stimulating and extending student learning.

The education officers' ability to interact easily with the students, transform complex ideas to those that students could understand, encourage students to participate, and provide interesting and varied presentations helped students to gain the most from their experience.

They were enthusiastic about their exhibits and used a variety of approaches to captivate students. They enlivened exhibits by using their specialist knowledge and skills and tailored interactions to specific needs of students attending the sites. The repertoire of stories that they told helped to make some of the most effective links in student learning. As a result, students responded positively, became enthusiastic and entered the learning experiences with confidence. The researchers assumed positive learning gains would be linked to such positive responses, but there was no quantifiable evidence, such as test scores, to support this.

All education officers discussed the expected site etiquette with students and parent visitors. This was important to help with on-site management, and for appropriate behaviour around exhibits, conditions necessary for optimising student learning.

Different kinds of involvement by adult helpers meant that they were an integral part of visits, and not just child minders and their interactions with students added to the richness of the students' learning experiences.

It seemed that the tasks given to the adult helpers by the teachers and education officers influenced how they worked with students. It was important for teachers and education officers to give adult helpers clear and manageable instructions on how to support students to behave appropriately, to focus on the exhibits and to promote discussion. It was clear that a shared learning focus, understood by all parties (adult helpers, education officers, teachers and students) was important in optimising on-task activity.

Because of the small samples, the case studies provide few data on the ways in which experiences different for different groups. There were students of different ages across the six case studies, and it seems that factors which contributed to learning were similar for younger and older students. Young students tended to be concerned about visit behaviour and 'being good'. Although older students were aware that they needed to behave appropriately, they were more interested in what they would see and do.

Little can be reported in terms of recorded school achievement connected with ethnicity, social background or students of different attainment levels. However, the researchers did not perceive any obvious differences in student reactions during site visits on the basis of factors such as ethnicity.

There was little evidence from the case studies about how such programmes might influence long-term achievement and retention of learning; there was evidence from one case study that indicates the students retained learning five weeks on from their LEOTC but no data were collected from other case studies.

However, the quality LEOTC experiences may have a long-term impact. Though some of the images, exhibits and tools seen in the exhibitions may have been complex for some students, the notion of 'sowing a seed' of interest was important. Students viewed the examination and use of real things as part of a 'good' experience, and good experiences may contribute to students becoming regular museum or art gallery visitors in later life.

For more details on individual case studies, go to www.tki.org.nz/r/eotc/leotc.

Guidelines for New Zealand LEOTC programmes

This section presents some guidelines for effective LEOTC programmes in New Zealand based on the key findings from the literature review and the case studies.

Building educative relationships

Teachers and education officers need to build an educative relationship

When teachers and education officers form an educative relationship, the learning experiences for students are likely to be more worthwhile. When teachers and education officers communicate with each other before the visit, they can talk about the outcomes each expects from the visits and how the LEOTC visit will link with the curriculum. At the site they can work together to enhance students' learning experiences, complementing each other's contributions and skills. A partnership relationship can continue to create constructive links in school after the visit.

Establishing compatible goals

Teachers and education officers need to establish compatible goals

To enhance learning in LEOTC programmes, teachers and education officers need to know about each other's learning intentions in order to establish compatible goals for the students. Goals should focus on learning, and should be curricula-related, social and cultural. Compatible goals help to create a seamless learning whole for the students, and they build connections between school and site.

Understanding the goals

Teachers, education officers and students all need to know the goals

With everyone knowing the learning goals, it is more likely that students may achieve them. A shared understanding of the purposes and targets enriches students' experiences, as all educationalists can help the students reach their goals. With students also knowing the goals, they can work towards these with some independence. Goals need to be clearly outlined, repeated and reinforced throughout LEOTC programmes.

Linking activities

Pre-activities, the visit and post-activities need to be linked

Learning in LEOTC programmes is complex, interrelated and has an evolving nature. Teachers, education officers, students and parents therefore need to work together to maximise the learning that students may achieve. Teachers need to define the topic learning goals for the whole experience, not just for their classroom, as this helps to smooth out any discontinuity between places, people, experiences and ideas. During the visit, the education officer needs to take note of student responses and adjust the programme to build on the understandings, skills being demonstrated and attitudes being exhibited. After the visit, teachers need to help students to recall their visit experiences and learning; they also need to create further experiences and activities that build on those of the visit.

Effective education officers

Education officers need to build friendly, educative relationships

Education officers need to be friendly towards teachers, students and parents throughout the visit. They must provide a variety of stimulating and unique experiences, and be knowledgeable about the topic and how different levels of students learn. It is important that education officers can think 'on the go', as this helps them respond to different students and circumstances.

Valuing LEOTC sites

When places other than school are valued as learning spaces, learning happens within them

When people involved in LEOTC, especially students, understand that education happens in many places, learning is enhanced. Students, teachers and parents can all benefit from being involved with LEOTC sites. Learning happens at these sites when the teacher incorporates links to the classroom programme. When this occurs, learning opportunities are expected and planned for, and learning goals are more likely to be achieved.

The value of artefacts

Learning happens when students interact with different tools

When students interact with different tools they use different senses and as a result, learning is enhanced. Using tools and artefacts shapes student thinking, since actions (or learning by

'doing') may influence the development of knowledge. In addition, students can recall their understandings and experiences more readily when they have used tools and artefacts, because they have real touchstones to act as prompts.

Research gaps and future research

The analysis of the literature review and the case studies also showed several gaps in what is known about LEOTC, and identified areas for further research.

Learning, long-term achievement and retention of learning

One of the most pressing gaps is the effect that LEOTC has on student learning. There is a need for further investigation into what school students learn from the sites; the learning that is added in post-visit activities; and whether longer-term learning accumulates as a result of visits.

There is almost no evidence on the durability of the ideas or impressions that students gain from LEOTC programmes and whether students subsequently become gallery or museum goers as a result of their experiences.

How to measure student achievement following LEOTC is a major issue. Most evidence about learning from LEOTC sites is from qualitative data and there is little research that attempts to quantify learning gains through standardised test measures. Hence, further research is needed to collect quantitative data on student achievement, including test scores and student work samples.

As learning is both a process and a product, research also needs to investigate the processes of learning.

One of the basic aspects of New Zealand LEOTC is the collaboration between teachers and education officers, and there would be value in exploring these collaborations further to uncover factors that relate to student achievement as a result of the partnership.

More research is also needed on whether school and LEOTC settings require different teaching methods.

Research across a wider range of curriculum areas

Much of the research focuses on science sites, and research is needed on a wider range of sites to shed light on whether there are subject differences that need to be taken into account by teachers and education officers.

Quality of programmes

There is little knowledge about what criteria can be used to monitor sites and their impact, and more research is needed on what makes effective site exhibits effective, on the quality of the input from on-site staff and on the impact of New Zealand providers on learning.

Different groups of students

There was little evidence from the literature review that related to how experiences differ for different groups of students based on gender, ethnicity and age. For example, there is a need for research on secondary students when they visit LEOTC sites, and whether their learning needs vary from those of younger students.

Research is also needed into ways in which peer culture and students' social networks have an influence on learning in LEOTC programmes, since this may be connected to how different student groups view LEOTC visits.

Different sites

Research is needed that investigates the effect of LEOTC when students experience different site visits. There is also a need to investigate individual sites to see if the effect on learning is different for different schools and classes. This might indicate if there are differential impacts upon different student groups.

More case studies

There are few detailed descriptions of what actually happens before, during and after the site visits in New Zealand, and more case studies are needed to provide this information. The case studies summarised in this report have helped address this gap by describing several site visits and assessing the impact of these upon students and their learning.

Promoting LEOTC

There is evidence in this research of positive outcomes from LEOTC, suggesting that there is merit in advocating LEOTC to teachers who have so far had little involvement with LEOTC as part of their classroom programmes.

Final word

The literature review and case studies investigated learning experiences outside the classroom and their impacts upon student learning. The findings show that while a lot is known anecdotally about such programmes, little has been written and published, especially in New Zealand. It was clear from the case studies conducted as part of this research that there are many positive and effective factors in LEOTC provision. For example:

- education officers are highly regarded by teachers, students and parents
- students show they can learn while also experiencing fun and excitement
- teachers working with education officers leads to better pre-, during- and after-visit experiences for students
- LEOTC programmes enhance student learning when the programmes are implemented as part of the class curriculum.

Effectiveness factors are now reasonably well-established and these can be used to improve LEOTC programmes further. There is, nevertheless, a continuing issue in the assessment of student learning, and in particular, the development of assessment strategies that can quantify learning in order to supplement qualitative data on involvement, interest and enjoyment.

Appendix 1

The following are the key references consulted for the literature review.

Anderson, D. (2003). Visitors' long-term memories of world expositions. *Curator, 46*(4).

Anderson, D., Lucas, K., & Ginns, I. (2003). Theoretical perspectives on learning in an informal setting. *Journal of Research in Science Teaching, 40*(2), 177–199.

Anderson, D., Lucas, K., Ginns, I., & Dierking, L. (2000). Development of knowledge about electricity and magnetism during a visit to a science museum and related post-visit activities. *Science Education, 84*, 658–679.

Anderson, D., Thomas, G., & Ellenbogen, K. (2003). Learning science from experiences in informal contexts: The next generation of research. *Asia-Pacific Forum on Science learning and Teaching, 4*(1).

Bolstad, R. D. (2000). *Science centres in New Zealand primary education.* Unpublished master's thesis. University of Waikato, Hamilton.

Borun, M., Massey, C., & Lutter, T. (1993). Naive knowledge and the design of Science Museum exhibits. *Curator, 36*(3), 201 - 216.

Bracey, G. W. (1995). Getting the most from field trips. *Phi Delta Kappan, 76*(7), 567.

Brodie, L., & Wiebe, L. (1999). Yellow busloads from hell: A museum trip in three voices. *McGill Journal of Education, 34*(2), 173.

Cox-Petersen, A. M., Marsh, D.D., Kisiel, J., & Melber, L.M. (2003). Investigation of guided school tours, student learning, and science reform recommendations at a museum of natural history. *Journal of Research in Science Teaching, 40*(2), 200–218.

Dierking, L., Burtnyk, K., Buchner, K., & Falk, J. (2002). *Visitor learning in zoos and aquariums: A literature review*. Silver Spring, MD: American Zoo and Aquarium Association.

Dierking, L., Falk, J., Rennie, L., Anderson, D., & Ellenbogen, K. (2003). Policy statement of the "Informal Science Education" ad hoc committee. *Journal of Research in Science Teaching, 40*(2), 108–111.

Falk, J., & Dierking, L. (1997). School field trips: Assessing their long-term impact. *Curator, 40*(3), 211-218.

Falk, J., & Dierking, L. (2000). *Learning from museums*. New York: AltaMira Press.

Falk, J., Moussouri, T., & Coulson, D. (1998). The effect of visitors' agendas on museum learning. *Curator, 41*(2), 107–119.

Floyd, M. (2002). More than just a field trip: Making relevant curricular connections through museum experiences. *Art Education, 55*(5), 39–45.

Gilbert, J., & Priest, M. (1997). Models and discourse: A primary school science class visit to a museum. *Science Education, 81*, 749–762.

Griffin, J., & Symington, D. (1997). Moving from task-oriented to learning-oriented strategies on school excursions to museums. *Science Education, 81*, 763–779.

Jarvis, T., & Pell, A. (2002). Effect of the Challenger experience on elementary children's attitudes to science. *Journal of Research in Science Teaching, 39*(10), 979–1000.

Jarvis, T., & Pell, A. (2005). Factors Influencing Elementary School Children's Attitudes toward Science before, during, and after a Visit to the UK National Space Centre. *Journal of Research in Science Teaching, 42*(1), 53-83.

Kelly, L. (2002, 22 November). *What is learning … and why do museums need to do something about it?* Paper presented at the Why Learning? Seminar, Australian Museum/University of Technology. Sydney.

MacKintosh, J. (1998). What can you learn from a boot scraper? The place of "hands on" objects and museums in Social Studies. *New horizons for New Zealand Social Studies.* P. Benson and R. Openshaw. Palmerston North, New Zealand, ERDC Press Massey University**:** 287–310.

Miles, R., & Tout, A. (1991). Impact of research on the approach to the visiting public at the Natural History Museum, London. *International Journal of Science Education, 13*(5), 543–549.

Pershey, M., & Arias, S. (2000). Views of improving the preparation of Social Studies and History teachers: Involving pre-service teachers with history Museums. *Educational Research Quarterly, 24*(1), 67.

Price, S., & Hein, G.E. (1991). More than a field trip: Science programmes for elementary school groups at museums. *International Journal of Science Education, 13*(5), 505–519.

Rennie, L. (in press). Learning science outside of school. In S. K. Abell, and N. G. Lederman (Eds), *Handbook of research on science education.* Mahwah: Lawrence Erlbaum Associates.

Rennie, L., & Johnston, D. (2004). The nature of learning and its implications for research on learning from museums. *Science Education*. 88(Suppl. 1):S4–S16

Rennie, L., & McClafferty, T. (1995). Using visits to interactive science and technology centers, museums, aquaria, and zoos to promote learning in science. *Journal of Science Teacher Education, 6*(4), 175–185.

Sandifer, C. (2003). Technological novelty and open-endedness: Two characteristics of interactive exhibits that contribute to the holding of visitor attention in a science museum. *Journal of Research in Science Teaching, 40*(2), 121–137.

Stevenson, J. (1991). The long-term impact of interactive exhibits. *International Journal of Science Education, 13*(5), 521–531.

Tofield, S., Coll, R. K., Vyle, B., & Bolstad, R. (2003). Zoos as a source of free choice learning. *Research in Science and Technological Education, 21*(1), 74–99.

Tulley, A., & Lucas, A. M. (1991). Interacting with a science museum exhibit: Vicarious and direct experience and subsequent understanding. *International Journal of Science Education, 13*(5), 533–542.

Wineman, J., Piper, C., & Maple, T. (1996). Zoos in transition: Enriching conservation education for a new generation. *Curator 39*(2).

Appendix 2

Table A1. Major studies located relevant to the research questions reporting research on the impacts of LEOTC

Authors	Date of publication	Type of publication	Type of LEOTC	Where (country)	Sample - size - age	Methods used	Main findings
Anderson	2003	Journal article	Two global exhibitions - World Expo 86 (Canada) - World Expo 88 (Australia)	Australia and Canada	50 visitors (aged between 25-65 years) - 25 visitors who visited Expo 86 (Canada) - 25 visitors who visited Expo 88 (Australia)	In-depth face-to-face interviews	This study found visitors' long term memories were influenced by several key factors - The social context of the visit was dominant aspect of their memory - The majority of visitors were unable to recall exhibitions, displays or pavilions - The long term impact of museum visits based on the visitors recollections was heavily influenced by their socio-cultural identity
Anderson, Lucas, Ginns & Dierking	2000	Journal article	School visit to a science museum	Australia	Twelve students aged 11-12 years	- Case study - Interviews	- Memories of the social context were the most dominant and most vivid of all memories (p.. 407) - Visitors' ability to recall exhibitions, displays, and pavilions was highly deficient - Richness of recall does not correlate with frequency of visitation.
Bolstad	2000	Thesis	School visit to a science centre	New Zealand	Six primary classes	Interviews	Science centre results in more successful science learning outcomes when the science centre visit is supported by school-based pre- and post-visit classroom teaching activities
Borun, Massey & Lutter	1993	Journal article	Science museum learning	USA	Initial sample 122 visitors (aged 9 years and older) reduced to in-depth sample of 88	Videotaped interviews were conducted in 4 exhibit halls: Astronomy, Mechanics, Electricity and Electronics, and Aviation	- 36% understood that gravity is related to mass, and only 15% had no misconceptions - misconceptions are not related to age - misconceptions may either be part of a well developed view of the world or may consist of rather vague ideas
Cox-Peterson, Marsh, Kisiel &	2003	Journal article	School visit to a science museum	USA	30 visiting school groups (Grades 2-8) Teachers (n=30) Students (n=85)	Observation and interviews	Students' responses indicated a high level of satisfaction with tours but low levels of science learning (p. 200).

Accessed from TKI / LEOTC http://www.tki.org.nz/r/eotc/leotc/index_e.php

Melber							
Falk & Dierking	1997	Journal article	Long term recollections of museum visits	USA	128 respondents - 34 fourth graders - 48 eighth graders - 46 adult college students over 20	Survey – set of seven questions	"The early-elementary-school field trip recollections of 9, 13 and 20+ year old individuals were virtually identical in the categories of items and/or experiences recalled. These findings strongly suggest that museum field trips – regardless of type, subject matter, or nature of the lessons presented – result in highly salient and indelible memories." (p. 216)
Gilbert & Priest	1997	Journal article	School visit to a science museum	UK	30 pupils aged 8-9 years	Observation and interviews	Identified key linkages between visiting a science museum and learning: - Linking curriculum currently studied at school with exhibits. - Pupils being able to follow their own itinerary in the museum - Children working in small friendship groups - Each group of children accompanied by a knowledgeable adult (p. 749)
Jarvis & Pell	2005	Journal article	School visit to the Challenger centre	United Kingdom	Ten classes from 4 schools were selected In total 300 children aged 10 or 11 years	Observation and interview	- Children needed adult guidance as they found it difficult to make choices about what to do and were often overwhelmed by the activities - The children's learning benefited from adults taking an active interest in the exhibit. -
Jarvis & Pell	2002	Journal article	School visit to a science centre	United Kingdom	665 elementary boys and girls	Attitude test – students given 38 statements to rate on a 3-point Likert scale Pilot: 33 students 9-10 years	- Immediately after a visit, children showed more interest in space, and a moderate increase in their views about the value of science in society - Nearly 20% of the pupils showed an increased desire to become scientists in the future
Sandifer	2003	Journal article	Museum visit	USA	47 visitors (four age classifications) - youth (8-18) - young adult (19-35) - adult (36-60) - senior (> 61)	47 visitors observed through two adjacent exhibitions – a total of 61 interactive exhibits	Exhibits with sound or movement were key characteristics of effective exhibits, in terms of visitor response (level of interest)
Stevenson	1991	Journal article	Family groups	United	Study to investigate	Observation study	Family groups spent most of their time interacting

			visiting an interactice science and technology center (ISTC) called Launch Pad at the Science Museum in London	Kingdom	long-term outcomes of visits by family groups. 20 visitors were observed 109 family groups were interviewed immediately after visiting Launch Pad and interviewed again six months later.	followed by face-to-face interviews and postal questionnaires	with other family members or other visitors in front of an exhibit. - 99% talked subsequently about their visit with family/friends - Visitors were able to recall details from their visit 6 months later
Tofield, Coll, Vyle & Bolstad	2003	Journal article	Zoo visit	New Zealand	80 respondents -General zoo visitors - Secondary school teachers and students - Primary school teachers and students	Triangulation of methods Structured interviews for general zoo visitors Semi structured interviews for Secondary school teachers and students, and primary school teachers and students Unobtrusive observation of the zoo visit Observation of pre- and post-visit activities	- General zoo visitors and school teachers and school groups do not necessarily associate zoo visits with learning. - Learning was facilitated by pre-planning and appropriate post-visit activities, along with the technology-focused presentation by the zoo education officer.
Wineman, Piper, Maple	1996	Journal article	Zoo visit	USA	100 zoos in 20 countries	Surveys, site visits & workshops	- 71.4% of zoos have some designated children's space (children's zoo and/or discovery centre) - 64.3% of children's exhibits are traditional pens and cages in contrast with other exhibit areas - All but 4% have themes