

# Exploring the Impact of Integrated Fieldwork, Reflective and Metacognitive Experiences on Student Environmental Learning Outcomes

**Roy Ballantyne**<sup>†</sup>

*University of Queensland*

**David Anderson**

*University of British Columbia*

**Jan Packer**

*University of Queensland*

## Abstract

Although the important role of providing fieldwork experiences for students in the natural environment is now well-established within environmental education literature, there is still little research evidence to guide teachers in their choice of effective teaching strategies. This paper presents findings from an interpretive case study designed to investigate the value of combining experience-based fieldwork in a mangrove and coastal environment with reflective and metacognitive activities. Analysis of video recordings, researcher observation notes and interviews of a class of Year 11 biology students who participated in the activities resulted in the emergence of five themes. These themes together provided evidence of enhanced student environmental learning, and included student appreciation for various learning contexts, self-awareness of group learning processes, and awareness of the integration of cross-curriculum knowledge. The study supports and illustrates the contention that the most effective environmental learning experiences are likely to be those that integrate learning *in* the natural environment *with* classroom learning strategies.

---

## Introduction

Research indicates that the provision of learning experiences *in* the natural environment is an effective strategy for promoting student environmental learning, which includes the development of environmental knowledge, attitudes and the adoption of responsible action (Ballantyne & Packer, 2002; 2009; Ballantyne, Fien, & Packer 2001; Dettmann-Easler & Pease 1999; Rickinson 2001; Rickinson, Lundholm & Hopwood 2009). School fieldwork visits to places such as environmental education centres provide important opportunities, outside the classroom, for students to manage and direct their own learning (Griffin & Symington, 1997; Hisasaka, Anderson, Nashon, & Yagi, 2005). A growing literature base on learning in non-school contexts clearly demonstrates the

---

<sup>†</sup>Address for correspondence: Professor Roy Ballantyne, School of Tourism, University of Queensland, Brisbane, Queensland 4072, Australia. Email: r.ballantyne@uq.edu.au

value of these settings in developing cross-contextual, holistic learning (Anderson & Nashon, 2007; Anderson, Lucas, Ginns, & Dierking, 2000; Ramey-Gassert, Walberg & Walberg, 1994; Rennie & McClafferty, 1996).

Similarly, advocates of place-based education (Gruenewald, 2003; Smith, 2007) urge educators to incorporate a focus on local environments in their teaching, in order to ensure its relevance and contribution to community life. This is particularly important in the case of environmental education. Smith (2007) argues the need for environmental and social stewardship to be based on the foundation of students' care for and affiliation with their own local environment. By focussing students' attention on local concerns, and empowering students to work towards improving the wellbeing of their own communities, place-based education aims to break down the barriers between school and community.

Although the important role of providing fieldwork experiences for students *in* the natural environment is now well-established within environmental education literature and teacher practice, there is still little research evidence to guide teachers in their choice of effective teaching strategies. Recently, Ballantyne, and Packer (2009) attempted to identify the strategies that are most effective in facilitating learning in the natural environment. They proposed that "the most engaging, effective, and enduring learning experiences in the context of learning in natural environments, occur through experience-based rather than teacher-directed strategies" (p. 259). Among the strategies found to be most effective were those that capitalise on the unique learning opportunities that are available in natural environments, such as hands-on exploration; using all five senses to experience and appreciate the natural environment; undertaking authentic tasks; and investigating real-life issues in local contexts. They concluded, however, that the best results in relation to enhancing student environmental learning "will be obtained when teachers are able to integrate learning in the natural environment *with* classroom learning strategies" (p. 260).

The need to follow-up or integrate experience-based environmental learning activities with the opportunity to make a reflective response has been noted in both formal and informal learning contexts. Ballantyne and Packer (2009) found that "reflective response" was the activity that produced the highest learning outcomes for school students participating in outdoor and environmental education programs, and was the only type of activity to have a real impact on student environmental attitude change. They reported similar findings with adults participating in wildlife tourism experiences (Ballantyne, Packer, & Falk, 2010; Ballantyne, Packer, & Sutherland, 2010). They suggest that the reflective response provides the missing link between experience and action (Ballantyne et al., 2010) and draw on Kolb's (1984) experiential learning cycle to argue the important place of reflection in facilitating learning from experience in the natural environment. Accordingly, this paper explores, evaluates and discusses the nature of student learning outcomes emerging from an environmental education activity that integrates experience-based fieldwork in a coastal mangrove environment in Southeast Queensland with reflective and metacognitive exercises.

### **Theoretic Frame – Reflection and Metacognition**

Boud, Keogh, and Walker (1985) define reflection as "those intellectual and affective activities in which individuals engage to explore their experiences in order to lead to a new understanding and appreciation" (p. 19). According to Moon (1999), it is reflective activity that enables integration of new learning into the learner's cognitive structure. Different levels of reflection on experience, from surface descriptions to deeper levels of analysis and synthesis, are possible. The deeper levels, which are associated with transformative learning outcomes, are more difficult to reach and less frequently

demonstrated (Mann, Gordon, & MacLeod, 2009). Desautel (2009) suggests that self-reflection tasks can enrich students' self-awareness as learners and make formerly unconscious processes or events more explicit. Self-reflection can thus contribute to developing metacognitive skills, as well as the critical thinking skills that are central to establishing meaning in learning endeavours (Desautel, 2009).

Metacognition, which is about awareness, control and reflection on one's own learning and learning processes (Anderson & Nashon, 2007; Baird & White, 1996; White, 1993, 1998), is an effective thinking tool that empowers learners to construct knowledge and deep understandings, as well as deeper appreciations of their own learning processes. The use of metacognition thus has the potential to assist learners to construct more meaningful interpretations of the world (Baird & White, 1996; Flavell, 1987; Gunstone, 1994; Mintzes & Wandersee, 1998; White, 1993, 1998) and to become better learners (Baird, 1986; Swan, 1988). From this perspective, it is argued that a metacognitive approach would help environmental educators to create learning experiences that enable students to become more self-aware of their own environmental learning and learning processes, develop the ability to identify such processes and subsequently master or control them in the service of future learning. Herein lies an important bridge between out-of-school contexts, such as environmental education fieldwork experiences, and higher order conceptual learning which is more often the domain of the classroom. The former should ideally use those pedagogies identified by Ballantyne and Packer (2009) as most "productive" in facilitating student learning *in* the environment, viz., being in the environment, local context, learning by doing, real life learning and sensory engagement; the latter should use reflective exercises incorporating student environmental learning developed in the environment to encourage them to cognitively and affectively process their experience and form new meanings and understandings.

Applying a reflective and metacognitive approach to environmental education fieldwork experiences has the potential to increase students' self-awareness, deepen their conceptual understanding of environmental issues, and enable them to develop a personally meaningful response to such issues. Learning activities in fieldwork settings that provide opportunities for students to develop environmental knowledge and concepts in a hands-on manner, as well as engage metacognitively with the meaning and implications of such knowledge and concepts, would appear to have the capacity to be very powerful learning experiences (Burnett, 1995).

The current study was framed to provide students with authentic environmental education experiences *in* the environment as well as the opportunity to reflect deeply about their own learning processes and strategies for environmental learning. The group context for these experiences served to engage participants socially. The resultant interactions between individuals within the group context served to foster conditions that supported metacognition. The study employed an interpretive case study methodology (Gallagher & Tobin, 1991; Merriam, 1998; Stake, 1995) to capture highly descriptive accounts of the richness of metacognition and knowledge construction.

## Method

### *Context and Participants*

This study was conducted at the Jacobs Well Environmental Education Centre which is located on the coast of South East Queensland, Australia, and operated by the State education authority. Dedicated teaching staff facilitated a wide variety of programs that complemented the State-mandated school curriculum in the areas of general science, biology, and the environmental sciences.

The students participating in the study were one class of twenty, Year 11 biology students from a State public school. Only those students whose parents had signed and returned participant consent forms were included in the research, although the whole class undertook the same learning experiences. Students were organised into small collaborative working groups of three and four for the purposes of participation in the fieldwork and classroom reflective exercises. Selection of student working groups was achieved on the basis of two criteria – student metacognitive capacities and advice from the students' classroom teacher. Students' metacognitive capacities were measured using a validated instrument – the SEMLI-S (Thomas, Anderson, & Nashon, 2007). Efforts were made by the research team to constitute groups with mixed metacognitive capacities in a heterogenous fashion given the evidence from previous research that such constitution makes for more effective learning groups (Nielson, Nashon, & Anderson, 2009). The class teacher's opinion about the group composition was also sought in order to ensure that students would work together effectively and that non-harmonious combinations of students might be avoided.

Students visited the environmental education centre over the course of two days and participated in a programmed experience connected with their school curriculum. This experience involved (a) active, hands-on, engagement in an authentic environmental setting designed to promote the development of meaningful learning about mangrove ecology, and (b) a subsequent set of exercises that promoted deep reflection and metacognitive thinking about their learning in the environment. The metacognitive experiences were "tiered" in three levels and integrated with the research study's data collection strategies, that is, students' participation in the metacognitive reflection became part of the data collection process. The following section outlines the nature of the environmental experiences, the reflective learning exercise and the metacognitive activity.

## Procedures

### *Participation and Engagement in Experience-Based Learning*

On the morning of day one, students visited the Environmental Education Centre which covered a range of different physical environments including salt water estuaries, mangrove swamps, sheltered salt water bays, sand dunes, grassland, and forest areas. Of particular importance to the student learning experience were the mangrove ecosystems in which students investigated the abiotic and biotic features of the ecosystem, human impacts, interactions, adaptations, food chains, and issues and actions relating to conservation. Students undertook tasks that involved them in collecting data and investigating the mangrove ecosystem – the tasks focused largely on biodiversity and the adaptation of organisms living in the hostile intertidal environment. Mangroves and crabs were identified using dichotomous keys; quadrat/transect studies were performed examining the abiotic and biotic features of the ecosystem; and the exercise culminated in an analysis of the findings. The fieldwork experience aimed to help students construct rich, detailed knowledge and appreciation of nature and the importance of mangrove environments.

### *Reflective Exercise*

Following lunch on the first day, all students participated in a one-hour hypothetical scenario activity (See Appendix A) concerning the environmental impact of a proposal to build a cruise ship terminal in the mangrove swamp area that the students had visited that morning. The scenario posed a situation where the mangroves would be cleared and the bay dredged to a depth of 12 meters to allow ship access – the building

of the terminal was “motivated” by local community needs to provide jobs, promote tourism and thus progress the economic development of the region. Students were asked to participate in the hypothetical decision-making process by discussing the proposal and producing recommendations as to whether the terminal should be granted approval. In their groups, over the course of an hour, students were required to engage in critical discussion about the scenario drawing upon their fieldwork experience in the mangroves that morning, their previous classroom learning, and personal life experiences. Given the time constraints and context of the activity, it was focussed particularly on the environmental consequences of the proposed cruise ship terminal rather than the processes of government decision-making. The activity was designed to be highly reflective in nature and required students to engage in argumentation (Duschl & Osborne, 2002; Mason & Scirica, 2006). Student interactions and engagement in the reflective activity were video recorded in order to allow them to recall and reflect on their thinking and responses within the group at a later stage.

### *Metacognitive Self and Group Reflection on the Scenario*

On the second day students reformed their working groups and observed the video recording of their one-hour group engagement in the hypothetical scenario activity. Over the course of one and a half hours they were required to reflect and identify three occasions (noting the time index on the video) where group members felt they were learning new things; were prompted to rethink their environmental knowledge, attitudes or beliefs; or were doing or saying things that helped (or didn't help) them to learn about the environment (see Appendix B). This activity provided an opportunity for students to observe and discuss their environmental learning during the course of the activity; think deeply and critically about their self and group awareness; and identify (both individually and as a group) the roles they had self-selected in the group while engaging in the reflective exercise. Providing students with the autonomy to self-select video segments which they deemed to be important to them was a deliberate strategy to both promote metacognition and improve the validity of the data. The view was taken by the research team that self-perception of environmental learning is a highly personal activity and that the students themselves were in a better position than the researchers to ascertain those incidences that were salient for themselves (Anderson, Nashon, & Thomas, 2009).

### *Metacognitive Interview on the Integrated Environmental Learning Experience*

On the third day, when students had returned to school, each student group was interviewed for approximately one hour by the research team about the entire environmental education learning experience (see Appendix C). The interview aimed to first gain an overall understanding of the students' developing knowledge, understandings and appreciations surrounding their experiences within the environmental education centre, and second, gain an understanding of how students' participation in the experience-based learning, the reflective exercise, the self and group reflection on the scenario, and indeed their participation in the interview, influenced their metacognition and environmental learning (Anderson, Nashon, & Thomas, 2009).

The experience-based fieldwork, reflective and metacognitive activities together constituted the student environmental learning experience. Students' environmental learning outcomes are thus seen as emerging from these collective and integrated experiences. It is acknowledged that the researchers and the research process were an integral part of this particular environmental learning experience, and as such, their influence on students' learning outcomes can not be isolated or removed from the study. The findings are not intended to be generalised beyond the original context, however,

they give an indication of the kinds of learning outcomes that might be expected when the essential ingredients (experience-based learning and reflective metacognitive activities) are combined.

## Data Analysis

Video recordings of the interviews with student groups were analysed by the research team who collectively viewed the videos of students':

- interactions in the mangrove environments;
- participation and engagement in the reflective exercise; and
- self-observation and concluding group interview relating to their reflections on the overall environmental learning experience.

The video recordings were augmented and supported by the researchers' field notes and observations. The research team met to discuss and compare their analyses and developed a collective interpretation of the data sets (Stake, 1995; Strauss & Corbin, 1988). Final interpretations of the nature of the students' learning experience (fieldwork experience, reflective and metacognitive exercises) during the field trip resulted in the emergence of five themes, based on consensus among the three researchers. These themes are discussed below and exemplified by verbatim transcripts of the voices of the participants.

## Results and Discussion

### Overview

Group interview transcripts provided evidence of the holistic impact of the integrated environmental learning and reflective experiences. In particular, students were able to articulate personally significant appreciations and awarenesses in relation to the value of the experience-based learning context, the value of the reflective learning activities, their understanding of themselves and others as learners, and their understanding of environmental education concepts. Five major themes emerged from the analysis which together provided evidence of enhanced student environmental learning and self-awareness. These were:

- appreciation for the experience-based environmental learning context;
- appreciation for the group learning and decision-making activity;
- self-awareness of their own and others' roles in facilitating 'peer' learning in the group;
- awareness of fruitful argumentation; and
- awareness of the integration of cross-curriculum knowledge.

In the following analysis, sections of the group interviews that represent the most vivid exemplars of the emergent themes are presented in order to illustrate the potential outcomes of this experience-based, reflective pedagogical approach. Student names have not been used so as to protect their identities.

### 1) Appreciation for the experience-based learning context

Students' interview responses confirmed the importance of the components of experience-based learning identified by Ballantyne and Packer (2009), i.e., active hands-on exploration, using all five senses to experience and appreciate the natural environment, undertaking authentic tasks, and investigating real-life issues in local contexts. In particular, seeing animals (even fish and plankton) in their natural habitats gave students an appreciation for the interconnectivities within the ecosystem and the likely impacts of destructive human actions.



**Excerpt from student group discussion:**

*Interviewer:* What were the experiences that you think had the biggest impact upon your environmental learning, that will influence the way in which you behave towards the environment in the future?

Student A: Oh, I think the mangroves. Because you actually saw them.

Student B: The mangroves, yes.

Student C: The mangroves because you could see how everything is connected.

Student B: Because you were out there and you get to see it first-hand.

Student A: Yeah. When you are in class you just see the book.

*Interviewer:* What was it about the mangrove experience?

Student B: That you were actually there!

*Interviewer:* Was it something that you saw? What was it?

Student A: I think it was the animals we saw there. But it was not so much that we saw so many crabs, but when they tell you that most of the fish in the world started off in mangroves ... when you extend it, it really affects *you* at the end.

Student B: Like if you see an animal, you think 'well if somebody does something and destroys the mangroves, it's actually going to kill that animal'.

Student A: Yeah, yeah.

Student B: Human activities could actually kill them.

Student A: Yeah. Like when we went to the beach and we picked up plankton with the net, that showed us also that even in that water, when you look at it what do you think - 'oh it's water'? But actually there's a lot of little living things.

Student C: All those little things, I didn't know they were there.

Student A: Yeah. That was really interesting to me.

To summarise, the experience-based fieldwork component of the environmental education activity gave students a memorable experience with living creatures which led to a new awareness of the importance of the mangrove ecosystem in sustaining life. These observations provided the foundation upon which later reflective activities could build.

**2) Appreciation for the group learning and decision-making activity**

Students appreciated the opportunity for group discussion and preferred this to other pedagogical approaches, such as teacher-centred or text-based modes. They evaluated the quality of learning mediated by group discussion approaches to be far superior to that of other traditional or solitary methods for learning. It was also considered important that group discussions took place in tandem with the experience-based learning *in* the environment. In the segment below, Student C considered both of these components to be essential for learning... "when you're actually there and you're talking about it you actually learn".

**Excerpt from student group discussion:**

*Interviewer:* What was it about this activity that caused you to learn?

Student A: Because it was all of us, and we all had different views.

Student B: It's the explaining to each other and adding different feelings to what you think.

Student A: Yeah, like if [Student B] experienced something I've never experienced he would tell me about it and that'd change my views, and then I'd have something else to incorporate. So it was everybody just being here and having different opinions and discussing it.

*Interviewer:* Do you think you learned more in that particular instance as a group than you would have done individually?

All: Yeah.

Student C: Definitely, yeah.

Student B: Way more.

Student A: Because normally when you're at school, it's like 'oh, mangroves, let's talk about that'.

Student C: Yes, yes.

Student A: And now we got to discuss it!

Student C: We definitely learned more walking around, working together than in class.

Student B: Yeah. I learned more at the camp than I did the whole term.

Student C: Because in class it's only the teacher talking. I hate it when teachers just sit there and talk. It doesn't come to me.

Student A: Or we only read the textbook.

Student C: I think that as a group we learn better. You learn better. Working as a group and going to camps and seeing things with your eyes, that's when it actually happens. In class you never learn that. And when teachers are just talking about it, you are like 'yeah, yeah, whatever' but you are not taking it in. Whereas when you're actually there and you're talking about it you actually learn. And even though we had fun, we did work. Not probably as much as we do in class, but I learned more in that camp than what I've learned in class all together.

*Interviewer:* So you've learned that you learn most effectively when you are in a group.

All: Yeah.

To summarise, the opportunity to work together on a group task required all students to make a contribution and to participate actively in the learning experience. Students' reflections on the value of this process provided evidence of metacognitive evaluation and higher order thinking skills.



### 3) Self awareness of their own and others' roles in facilitating "peer" learning in the group

The opportunity to engage in reflection on the hypothetical scenario exercise enabled participants to become aware of their own roles and preferences as learners, the roles and contributions of others in their group, and ways they interacted to accomplish the task and enhance their environmental learning. The metacognitive activity encouraged students to look beyond the task itself to the learning processes and strategies that the group had adopted. Their self-evaluation of these strategies in executing the task and supporting (or hindering) group functioning in turn led to new awarenesses and appreciation of themselves as learners and the role that their peers play in supporting their learning.

#### Excerpt from student group discussion:

*Interviewer:* What did you learn about yourselves from the video?

Student A: How we interact with each other.

Student B: For example, some will talk and another person will just be writing down. Yeah, you are just doing... without thinking about it, and with the video we realised how we interact.

*Interviewer:* Was this the first time you had the option to work together as a group?

All: Yeah.

*Interviewer:* What were your roles?

Student A: Writing [laughs].

Student C: I was making questions, I was the critic.

Student B: I was sharing my ideas.

Student D: I was sharing my ideas, and helping [Student A] with the writing. Just backing up the idea and then expanding on it and saying 'you are kind of vague here' or 'yes, that's right'.

Student C: Yeah, you would expand more on the ideas, more than [Student B].

Student D: I just go on with the ideas. I like to pick up the ideas, and talk about them.

*Interviewer* [to Student B]: But you are more an initiator of ideas.

Student B: Yes.

Student C: Mine was to question things.

Student B: Yeah, she would ask 'is this right?'

[All laugh]

Student A: Yeah, if we said 'put this here and this one there', she would say 'oh, but what happens if...'

*Interviewer:* I want you to tell us what you think is the most important thing that you learned about yourself as a learner, as a result of these experiences.

Student A: The most significant thing about me is that I talk maybe too much. I really need to listen more.

- Student D: The fact that I like to think about the ideas a lot, I am always expanding on the things that other people say, and that I don't do that right away; that has to come. I would say, I learnt how we all have different opinions.
- Student B: I realised I am the idea giver, but at the same time I don't like to talk as much when other people talk. Like if [Student A] talks a lot, I won't talk as much as I'm used to. And then I learn more at the same time.
- Student C: To me, I learned that when others talk I like to sit down and listen to what they have to say and from there I question things. I'm a questioner. But I pick the ideas and opinions, and I know I have my own, and so I listen and then I say something to contribute – I saw that on the video. I could see that I talk as well. So I think what happens is that I listen to the opinions and I have my opinions, and then I sort them by importance. I think unconsciously you always think yours are more important than others'.
- Student B: I think that if at the start we didn't have those roles, maybe we wouldn't have worked so well... you know, some people can't work together. That helped us to work together, to have those different roles.

To summarise, the metacognitive self- and group- reflection component of the activity enabled students to become more aware of group processes, and of their own individual contributions and learning preferences. As reported by Anderson, Thomas, and Nashon (2009) there was evidence of shared group metacognitive factors in which students were aware of their own and others' social roles that service the task of individual and group learning, as well as the social maintenance of the group.

#### **4) Awareness of fruitful argumentation**

Students were asked to self-select segments of the videoed group discussion that they felt demonstrated their learning of new things, rethinking their environmental attitudes or beliefs, or doing things that helped (or didn't help) them to learn. The following segment illustrates students' awareness of the value of fruitful argumentation in helping them formulate reasoned positions.

#### **Excerpt from student group discussion:**

- Student A: This video clip is the one that we identified as the most important, because we argued a lot and we all put our opinions in, and we came to a group decision. At first, we had already established that we were not going to approve the cruise terminal...
- Student B: And then all of the sudden [Student C] starts arguing with us and [Student D] agreed we should do it because of the money that it would bring to Australia. And then [Student A] and I explained to [Student C] why it shouldn't go ahead.
- Student A: Our opinions eventually convinced [Student C], and then we decided that we shouldn't go ahead.
- Student C: It just seemed better, to go ahead and get more money into Australia, and also for people, to get more jobs.

- Student B: But then, our talking about the ecosystem and how to protect it changed our mind.
- Interviewer* [to Students A and B]: What do you think caused Student C to change?
- Student B: He was very persistent. And then we started thinking about the impact of large scale tourism. So it was a very deep, in-depth conversation that was going on, and that was when he realised and went 'oh no'.
- Student A: I thought his decision was emotional because it was about how that would affect the ecosystem, that's emotional because it's going to destroy the environment.
- Student B: Because taking all that mangrove area just for one cruise ship terminal, will affect all the animals and things - you lose so much.
- Student A: Yeah, you'd be losing so much that you can't really advocate that. Because once you've destroyed the ecosystem you can never get it back. Before I didn't really care about mangroves and now I want to protect them.
- Student B: Yeah, I didn't know that the mangroves were so important, and now I think we really should keep them and we shouldn't destroy them for a cruise ship terminal.

To summarise, the students reported having engaged in a process of argumentation that involved a difference of opinion. They acknowledged this as a journey in which their personal experiences *in* the environment, mediated by collective discussion and debate, led them to arrive at an agreed conclusion. As part of this process, they returned to the observations they had made in the field regarding the importance of the mangroves and the interconnectivities within the ecosystem.

### 5) Awareness of the integration of cross-curriculum knowledge

The process of experience-based environmental learning, extended through group interaction, discussion and reflection, led to a new awareness and appreciation of the connections between different school curriculum areas. In the following exemplar, students were quite proud of having made the connection between what they observed in the field, and what they had learned not only in Biology but also in other subjects, and in previous years of their formal education. Such insights seemed to provide an overarching purpose to learning for the students.

#### Excerpt from student group discussion:

- Interviewer*: And what is this video clip you have selected about?
- Student A: This is when [Student B] talked about what we had done earlier that day, do you remember?
- Student B: Oh, the types of trees and how they protect the land and that kind of stuff.
- Student A: Yeah, and I remembered stuff from Geography that connected with that. The clip shows that we took information from other places and put it together for this conversation.

Student B: We put it together! Well actually the teachers had taught us little things, so it was like adding that all up. Like quadrats, for example, the teacher had told us in this class, and then a little bit of chemistry, and then everything kind of added up. Every little class, no matter what subject it was, it kind of came together. And I thought 'oh my God, this is what they are trying to teach us, it's one massive thing!' It all came together; all the little bits. When we were there and we got to touch the animals that was Biology, and then the quadrats, that was Biology too, and the little things, like gathered up for me. All the information.

Student C: It all made sense!

Student B: Yeah, like everything!

Student C: What we have learned in previous years, it all connected together when we learned stuff this time.

Student A: Like in Geography, when we learned about the mangroves and how they protect homes in coastal areas ... we were learning about tsunamis and how they affect houses and the soil. So this could have more than one subject, all incorporated into one thing.

*Interviewer:* Did you not realise that before?

All: No.

Student A: This was the first time we saw it.

Student B: This was the first time.

Student B: One teacher teaches us this, and another teacher teaches us that, and we kind of put it all together and it all made up one thing, one big idea.

*Interviewer:* Is that something that you experience often in your lives as learners?

Student C: Not really.

Student D: No.

Student A: That was the first time.

Student B: The first.

*Interviewer:* So that happened as part of this discussion?

All: Yeah.

Student A: The mangroves were just part of it!

Student B: Yeah, learning there and then.

To summarise, the students were excited to discover that many different parts of their previous education suddenly had relevance to the real world. The cross-curricular nature of environmental education affords an ideal context in which such connections can be made. An implicit goal of education is surely to help students develop rich interconnections and meanings such as those exemplified here, rather than the compartmentalised knowledge frameworks which are a common outcome of the way education is traditionally structured. These insights attest to the educational power of an experience-based, reflective and metacognitive learning approach in helping to achieve the broad goals of environmental education.

## Conclusion

This paper presents findings from an interpretive case study designed to demonstrate the value of combining experience-based learning with reflective and metacognitive activities in an environmental education context. After undertaking the environmental learning experience, students demonstrated an awareness and appreciation of the ways in which the field-based and classroom-based approaches were integrated and mutually reinforcing. Students used knowledge they had gained in the field (experience-based learning) about the value of mangroves and the interconnectivities within the ecosystem to inform their discussions of the hypothetical cruise terminal scenario (reflective exercise). This process of group discussion enabled them to formulate reasoned positions using both cognitive and emotive elements of their real-life experience. The metacognitive activity (undertaken by students on day two and reported to the researchers during the interviews on day three) encouraged students to look beyond the task itself to the learning processes and strategies that the group had adopted. It was at this stage that much of the higher order thought and self-evaluation was able to take place. In particular, students were able to identify cross-curricular connections which gave an overarching purpose to the whole environmental education experience.

Building on Ballantyne and Packer's (2009) suggestion that the most effective environmental learning experiences are likely to be those that integrate learning in the natural environment *with* classroom learning strategies, the case study reported here demonstrates the potential of such a multi-faceted approach. The experience of learning *in* the environment provided a sense of immediacy, relevance and emotive engagement that captured the students' attention and imagination. The peer discussion emanating from the reflective learning experience introduced a cognitive element, which enabled students to explore alternative viewpoints and deepen their understanding of the complex nature of environmental issues. The metacognitive exercise empowered students to understand and appreciate the value of the different learning contexts and their individual and collective roles in supporting environmental learning within a group of their peers. It is important to note the positive effect that the use of a metacognitive approach to learning can have in facilitating students' understanding of their own role in promoting environmental change within their communities. The final reporting stage provided an opportunity for students to celebrate their accomplishments, reflect on the ways in which they learn and thus take some control over their future learning strategies. Together, the integration of the environmental learning experiences (fieldwork, reflective and metacognitive exercises) constituted an extremely powerful learning experience that transcends the limits of traditional educational approaches.

## Acknowledgements

This study was part of the Metacognition and Reflective Inquiry: Understanding Learning Across Contexts project, funded by the Social Science and Humanities Research Council (Canada). Contract grant sponsor: Social Science and Humanities Research Council (Canada). Contract grant number: SSHRC File # 410-2004 0117. The authors would like to thank Glenn Leiper and Gina Ygoa from the Jacobs Well Environmental Education Centre, Colleen Palmer and the Year 11 Biology students from the participating high school, and research assistants Michele Leiminer and Belinda McLellan for their contributions to this research.

*Keywords:* metacognition; field work; reflective experiences; secondary students; place-based learning.

## References

- Anderson, D., Lucas, K. B., Ginns, I. S., & Dierking, L. D. (2000). Development of knowledge about electricity and magnetism during a visit to a science museum and related post-visit activities. *Science Education*, 84(5), 658–679.
- Anderson, D., & Nashon, S. (2007). Predators of knowledge construction: Interpreting students' metacognition in an amusement park physics program. *Science Education*, 91(2), 298–320.
- Anderson, D., Nashon, S. M., & Thomas, G. P. (2009). Evolution of research methods for probing and understanding metacognition. *Research in Science Education*, 39(2), 181–195.
- Anderson, D., Thomas, G. P., & Nashon, S. M. (2009). Social barriers to engaging in meaningful learning in biology field trip group work. *Science Education*, 93(3), 511–534.
- Baird, J. R. (1986). Improving learning through enhanced metacognition: A classroom study. *European Journal of Science Education*, 8(3), 263–282.
- Baird, J. R., & White, R. T. (1996). Metacognitive strategies in the classroom. In D. F. Treagust, R. Duit, & B. J. Fraser (Eds.), *Improving teaching and learning in science and mathematics* (pp. 190–200). New York: Teachers College Press.
- Ballantyne, R., Fein, J., & Packer, J. (2001). Programme effectiveness in facilitating intergenerational influence in environmental education: Lessons from the field. *Journal of Environmental Education*, 32(4), 8–15.
- Ballantyne, R., & Packer, J. (2002). Nature-based excursions: School students' perceptions of learning in natural environments. *International Research in Geographical and Environmental Education*, 11(3), 218–236.
- Ballantyne, R., & Packer, J. (2009). Introducing a fifth pedagogy: Experience-based strategies for facilitating learning in natural environments. *Environmental Education Research*, 15(2), 243–262.
- Ballantyne, R., Packer, J., & Falk, J. (2010). Visitors' learning for environmental sustainability: Testing short- and long-term impacts of wildlife tourism experiences using structural equation modelling. *Tourism Management*, doi:10.1016/j.tourman.2010.11.003.
- Ballantyne, R., Packer, J., & Sutherland, L. (2010). Visitors' memories of wildlife tourism: Implications for the design of powerful interpretive experiences. *Tourism Management*, doi:10.1016/j.tourman.2010.06.012.
- Boud D., Keogh R., & Walker D. (Eds). (1985). *Reflection: Turning experience into learning*. London: Kogan Page.
- Burnett, J. R. (1995). *Small group interaction among senior science students during field instruction at a marine park*. Unpublished doctoral dissertation, Queensland University of Technology, Brisbane, Australia.
- Desautel, D. (2009). Becoming a thinking thinker: Metacognition, self-reflection, and classroom practice. *Teachers College Record*, 111(8), 1997–2020.
- Dettmann-Easler, D., & Pease, J. L. (1999). Evaluating the effectiveness of residential environmental education programmes in fostering positive attitudes towards wildlife. *Journal of Environmental Education*, 13(1), 33–39.
- Duschl, R. A., & Osborne, J. (2002). Supporting and promoting argumentation discourse in science education, *Studies in Science Education*, 38, 39–72.
- Flavell, J. H. (1987). Speculation about the nature and development of metacognition. In F. E. Weinert & R. H. Kluwe (Eds.), *Metacognition, motivation, and understanding* (pp. 21–29). London: Lawrence Erlbaum Associates.



- Gallagher, J. J., & Tobin, K. G. (1991). Reporting interpretive research. In J. Gallagher (Ed.), *NARST monograph no. 4* (pp. 85–95). Manhattan, KS: National Association of Research in Science Teaching.
- Griffin, J., & Symington, D. (1997). Moving from task-oriented to learning-oriented strategies on school excursions to museums. *Science Education*, 81(6), 763–779.
- Gruenewald, D. A. (2003). The Best of Both Worlds: A Critical Pedagogy of Place. *Educational Researcher*, 32(4), 3–12.
- Gunstone, R. F. (1994). The importance of specific science content in the enhancement of metacognition. In P. J. Fensham, R. F. Gunstone & R.T. White (Eds.), *The content of science: A constructivist approach to teaching and learning* (pp. 131–146). Washington, DC: Falmer
- Hisasaka, T., Anderson, D., Nashon, S., Shigematsu, K., Watanabe, E., Yagi, I., & Hatakeyama, S. (2004). Recognition of amusement park as a studying space. *Physics Education in Tohoku*, 13, 31–34.
- Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development*. Englewood Cliffs, NJ: Prentice Hall.
- Mann, K., Gordon, J., & MacLeod, A. (2009). Reflection and reflective practice in health professions education: A systematic review. *Advances in Health Sciences Education*, 14(4), 595–621.
- Mason, L., & Scirica, F. (2006). Prediction of students' argumentation skills about controversial topics by epistemological understanding. *Learning and Instruction*, 16(5), 492–509.
- Merriam, S. B. (1998). *Qualitative research and case study applications in education*. San Francisco: Jossey-Bass.
- Mintzes, J. J., & Wandersee, J. H. (1998). Reform and innovation in science teaching: A human constructivist view. In J. L. Mintzes, J. H. Wandersee & J. D. Novak (Eds.), *Teaching science for understanding: A human constructivist view* (pp. 29–58). San Diego, CA: Academic.
- Moon J. (1999). *Reflection in Learning and Professional Development: Theory and Practice*. London: Kogan Page.
- Nielsen, W., Nashon, S., & Anderson, D. (2009). Metacognitive engagement during field-trip experiences: A case study of students in an amusement park physics program. *Journal of Research in Science Teaching*, 46(3), 265–288.
- Ramey-Gassert, L., Walberg, H. J. III., & Walberg, H. J. (1994). Reexamining connections: Museums as science learning environments. *Science Education*, 78, 345–363.
- Rennie, L. J. & McClafferty, T. P. (1996). Science centres and science learning. *Studies in Science Education*, 27, 53–98.
- Rickinson, M. (2001). Learners and learning in environmental education: A critical review of the evidence. *Environmental Education Research*, 7(3), 207–320.
- Rickinson, M., Lundholm, C., & Hopwood, N. (2009). *Environmental learning: Insights from research into the student experience*. Dordrecht: Springer.
- Smith, G. A. (2007). Place-based education: Breaking through the constraining regularities of public school. *Environmental Education Research*, 13(2), 189–207.
- Stake, R.E. (1995). *The art of case study research*. Thousand Oaks: Sage Publication.
- Strauss, A., & Corbin, J. (1998). *Basics of qualitative research: Techniques and procedures for developing grounded theory* (2nd ed.). Thousand Oaks, CA: Sage.
- Swan, S. M. (1988). *Helping children to reflect on their learning: An investigation of a teaching strategy designed to encourage young children to reflect on their learning*. Unpublished M.Ed.St. Project, Monash University, Melbourne.

- Thomas, G. P., Anderson, D., & Nashon, S. M. (2008). Development and validity of an instrument designed to investigate elements of science students' metacognition, self-efficacy and learning processes: The SEMLI-S. *International Journal of Science Education*, 30(13), 1701–1724.
- White, R. T. (1993). *Insights on conceptual change derived from extensive attempts to promote metacognition*. Paper presented at the American Educational Research Association (AERA), Atlanta, GA.
- White, R. T. (1998). Decisions and problems in research on metacognition. In B. J. Fraser & K. G. Tobin (Eds.), *International Handbook of Science Education* (pp. 1207–1213). London: Kluwer.

### Author Biographies

Professor Roy Ballantyne (r.ballantyne@uq.edu.au) is a Research Professor at the University of Queensland School of Tourism. His research focuses on environmental education, environmental interpretation, free-choice environmental learning, wildlife tourism and ecotourism research. He is the joint author of *Contemporary Issues in Heritage and Environmental Interpretation* and *Designing Effective Interpretive Signs and Exhibits: Principles in Practice*.

Dr David Anderson (david.anderson@ubc.ca) is associate professor and specialist in museum education in the Department of Curriculum and Pedagogy, University of British Columbia, 2125 Main Mall, Vancouver, Canada. His research interests include visitor memories, children's museum experiences, and the long-term impact of museum experiences. In addition, he is working on the leading edge of the trends in educational reforms in Asia by initiating and strengthening collaborations between museums and schools that make museums key sites for non-formal learning and cultural understanding.

Dr Jan Packer (j.packer@uq.edu.au) is a Senior Research Fellow at the University of Queensland School of Tourism. Her research focuses on applying principles from educational and positive psychology to understand and facilitate visitor experiences at natural and cultural tourism attractions. She is currently the editor of the international journal *Visitor Studies*.

## APPENDIX A: Small Group Discussion Activity

RJM Corporation has proposed building a cruise ship terminal at a small town near the Gold Coast. The proposal involves clearing an area of mangroves, and dredging in the bay to a depth of 12 metres to allow ships access. Dredging could have significant impact on the water quality of the bay. It may also have a negative impact on the surfing conditions at some Gold Coast beaches.

This is a community with a high unemployment rate. If approved, the cruise ship terminal will provide a number of jobs for the local community. It will also generate substantial tourism earnings.

You are a member of a small team of town planners investigating the proposal. The team must come up with a recommendation to Council as to whether the cruise ship terminal should be granted approval. You must be able to justify this decision to the local Council. Your recommendation will be considered by Council in making their decision before it is considered by the State government for their approval.

**Task:** Discuss the following points in your small group, drawing on your experiences today, as well as previous classroom learning and your own personal experiences. Record your responses in writing.

1. As a team of town planners from the local council, list the pros and cons of approving the cruise ship terminal and rank these in order of importance.
2. Decide whether your team will recommend to Council that the cruise ship terminal be granted approval.
3. Record the arguments you will use to justify your team's decision to the local council.
4. Reflect on your group's discussion and decision about the cruise ship terminal.
  - What experiences from the field trip today have influenced the discussion and decision?
  - What other experiences in your lives have influenced the discussion and decision?
  - What attitudes or values do you hold regarding the environment that have influenced your own position on these issues?
  - Have your attitudes or values regarding the environment changed at all in the process of today's activities? Explain.

## APPENDIX B: Identifying 3 Video Segments

On Thursday, you participated in a one-hour activity where you discussed the arguments for and against the construction of a cruise ship terminal in an area currently populated by mangroves. In this activity, as a group you had to think critically about a number of issues, such as the importance of mangroves, the water quality in the bay, local unemployment, tourism revenue, and surf conditions. Additionally, you had to individually and as a group, think deeply about your knowledge, beliefs and attitudes with regard to the environment.

Your task today is to:

1. Play the video of your group's discussion.
2. Identify **three** (3) occasions (noting the time index on the video) where in your discussion you or other group members feel you were learning new things, were prompted to rethink your own attitudes or beliefs, or were doing things that helped (or didn't help) you to learn.
3. From 2 above, identify what the group considers to be the most important incident in the whole discussion.

You will be asked to play-back and talk about these three occasions in a group interview on Monday.

## APPENDIX C: Group Interview Protocol

1. How did you enjoy the camp last week? What key things stick in your mind from your experiences at JWEEC? (2 mins)
2. How did you find the task of listening to yourself and reflecting on what was said? (3 mins)
3. Show us your three video clips and tell us why you selected them. (5+5+5+5=20 mins)
4. In the video activity, how did you each see your role in the group? (5 mins)
5. What did you learn about your own thinking from hearing yourself? (5 mins)
6. What have you learnt about the ways others are thinking in your group? (5 mins)
7. Has anything that happened at the camp – either during the program or discussion activities – that has prompted you to change the way you think or feel about the environment? (5 mins)
8. Can you tell me the most important thing that you've told me today? (5 mins)