Introducing a fifth pedagogy: experience-based strategies for facilitating learning in natural environments

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Educators have identified four categories of 'productive pedagogies' that are considered to lead to authentic student engagement and learning in the classroom. This study was designed to explore and extend these pedagogies in the context of learning in natural environments, in particular, through the programmes of Queensland environmental education centres. In-depth interview and observation data were collected from students, classroom teachers and centre teachers who had participated in 12 environmental education programmes across Queensland, in order to identify the strategies that are most effective in facilitating learning in the natural environment. A fifth productive pedagogy category, 'experience-based learning', is proposed. Experience-based learning is particularly important in addressing students' environmental attitudes and actions. The implications for the delivery of environmental education programmes both within and outside the classroom are discussed.

Keywords: pedagogy; school students; experiential learning; learning in natural environments

Introduction

Environmental education research strongly suggests that learning experiences *in the natural environment* are extremely important in developing students' environmental knowledge, attitudes and responsible actions (Ballantyne and Uzzell 1994; Ballantyne, Connell, and Fein 1998; Ballantyne, Fein, and Packer 2001a, 2001b; Ballantyne and Packer 2002; Bogner 1998; Lai 1999; Rickinson 2001; Tanner 2001). For example, Palmer's (1999) research with 1259 students in nine countries including Australia found that direct experiences with nature had far more impact on subsequent involvement in pro-environmental activities than did formal education. Similarly, Finger (1994) found nature experiences to be a better predictor of environmental behaviour than environmental awareness, information, or value orientations. Dettmann-Easler and Pease's (1999) review of research suggests that environmental education that is solely school-based is only moderately successful, and that the best approach for teaching environmental concepts and awareness is to incorporate outdoor activities. Learning experiences in natural environments have been associated with increased levels of student motivation and achievement (Battersby 1999), as well as a greater likelihood that learning will be transferred to situations that students encounter outside of the school environment (Ballantyne, Fein, and Packer 2001b).

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In Queensland, the State education authority (Education Queensland) has embraced the philosophy of 'real world' environmental instruction by establishing 25 Outdoor and Environmental Education Centres (O&EECs) throughout the State. These centres complement school programmes and provide students with the opportunity to study particular aspects of the sustainability of the environment in which centres are located. Because the centres are located in a range of different environments (including forest, beach, outback, estuarine and freshwater), they enhance students' understanding of various environmental systems and address a broad range of environmental issues, including the use of land, water, mineral and energy resources. They thus offer a diverse range of environmental education programmes, incorporating many different pedagogical approaches. These include day and residential programmes, programmes targeting different content areas and age groups, and programmes employing drama, environmental investigations, didactic presentations, nature experiences and emotional appeals. While each centre has its own local focus, programme content and pedagogies, all programmes are designed to incorporate the themes of biodiversity and education for a sustainable future.

O&EECs have a crucial role to play within the environmental education field because they provide the personal nature-based experiences that have been identified as critical for the formation of pro-environmental attitudes, and are in a prime position to build positive and productive relationships between school students, the local community and the natural environment. Despite the wealth of evidence on the importance of learning in natural environments, little research has been undertaken to identify the specific teaching strategies or pedagogies that are most effective in this context. This paper addresses this need, building on previous research conducted in classroom contexts that has identified 20 'productive pedagogies' or classroom strategies that teachers can use to focus instruction and improve student outcomes (Education Queensland 2002).

Productive pedagogies

The productive pedagogy approach was developed by the Queensland School Reform Longitudinal Study (QSRLS) research team, building upon previous research on authentic instruction (Newmann and Wehlage 1993). Newmann and Wehlage's model was designed to articulate 'standards of instruction that represented the quality of intellectual work but that were not tied to any specific learning activity (e.g., lecture or small-group discussion)' (1993, 8). Their five standards (higher order thinking; depth of knowledge; connectedness to the world beyond the classroom; substantive conversation; and social support for student achievement) provided a tool that teachers could use to reflect on their own performance.

These five standards were incorporated into the productive pedagogy framework, which consists of a total of 20 items in four categories (see Table 1). The framework is based on the premise that effective pedagogical practice promotes the well-being of students, teachers and the school community; improves students' and teachers' confidence; contributes to their sense of purpose for being at school; and builds community confidence in the quality of learning and teaching in the school (Queensland Department of Education, Training and the Arts 2002). The productive pedagogies have been used in pre-service and in-service teacher education, to assist teachers to reflect on classroom practices, inform the design of learning experiences, improve the quality of the curriculum, and identify and respond to individual

Table 1. Productive pedagogy dimensions, items and key questions (Education Queensland, 2002).

Intellectual quality	
Higher-order thinking	Are students using higher order thinking operations within a critical framework?
Deep knowledge	Does the lesson cover operational fields in any depth, detail or level of specificity?
Deep understanding	Do the work and responses of the students demonstrate a deep understanding of concepts or ideas?
Substantive conversation	Does classroom talk lead to sustained conversational dialogue between students, and between teacher and students, to create or negotiate understanding of subject matter?
Knowledge as problematic	Are students critically examining texts, ideas and knowledge?
Metalanguage	Are aspects of language, grammar, and technical vocabulary being given prominence?
Supportive classroom environment	
Student direction	Do students determine specific activities or outcomes of the lesson?
Social support	Is the classroom characterized by an atmosphere of mutual respect and support between teacher and students, and among students?
Academic engagement	Are students engaged and on-task during the lesson?
Explicit performance criteria	Are the criteria for judging the range of student performance made explicit?
Self-regulation	Is the direction of student behaviour implicit and self-regulatory?
Recognition of difference	
Cultural knowledge	Are non-dominant cultures valued?
Inclusivity	Are deliberate attempts made to ensure that students from diverse backgrounds are actively engaged in learning?
Narrative	Is the style of teaching principally narrative or is it expository?
Group identity	Does the teaching build a sense of community and identity?
Active citizenship	Are attempts made to encourage active citizenship within the classroom?
Connectedness	
Knowledge integration	Does the lesson integrate a range of subject areas?
Background knowledge	Are links with students' background knowledge made explicit?
Connectedness to the world	Is the lesson, activity or task connected to competencies or concerns beyond the classroom?
Problem-based curriculum	Is there a focus on identifying and solving intellectual and/or real-world problems?

student needs. The research reported in this paper was designed to extend this work by identifying the specific teaching strategies or pedagogies that are most effective in bringing about desired learning outcomes in the context of learning in natural environments.

Method

Research sites

Eight O&EECs in Queensland, Australia agreed to participate in the research. These included centres from Brisbane (three), southeast Queensland (three) and northern coastal (two) locations (see Figure 1). The aim of these centres is to 'promote, develop, provide and deliver highly effective outdoor and environmental education programmes for schools and the community, and provide professional development for teachers' (Queensland Department of Education, Training and the Arts 2003).

Twelve programmes were selected for inclusion in the research, in collaboration with the eight O&EEC principals. These included seven programmes for primary students and five for secondary students; four residential programmes and eight day programmes. The selected programmes covered a range of environmental topics and employed a variety of teaching strategies, but all focussed on learning in the natural environment.

Overview of research methods

Three different methods were used to collect evidence regarding the strategies or pedagogies that are most effective in bringing about desired learning outcomes in the context of learning in natural environments:

(1) *Students were observed* as they participated in each of the 12 programmes in order to (a) determine the extent to which each of the 20 existing classroom

Figure 1.   Locations of the 8 Centres (3 in Brisbane itself).

productive pedagogy items (from Table 1) were being practiced in these programmes in natural environments; and (b) identify those programme activities that were most engaging for students.

(2) *Students were interviewed* immediately after participating in each programme, and again at their schools, three months after the programme. The interviews sought to establish not only what students had learned as a result of the programme, but more importantly, what parts of the programme had been instrumental in bringing about new knowledge, attitudes and behaviours.

(3) *Classroom and O&EEC teachers were interviewed* immediately after participating in the programme. These interviews sought to establish the parts of the programme that teachers considered the most effective in bringing about desired student learning outcomes. Classroom teachers were interviewed again at their schools three months after the programme, in order to allow them to further reflect on those aspects of the programme that had been most effective.

Participants

Sixteen classes (10 primary classes, aged 10–12; 4 lower secondary classes, aged 13–15; and 2 upper secondary classes, aged 16–17) were observed as they participated in the target programmes. Immediately after each programme, a total of 199 students (102 males; 97 females), 23 classroom teachers (14 primary; 9 secondary; between 1 and 4 for each programme) and 16 O&EEC teachers (between 1 and 3 for each programme) were interviewed. Three months after participating in the programme, 173 of the students (86 males; 87 females) and 18 of the classroom teachers (10 primary; 8 secondary; between 1 and 3 for each programme) were interviewed again. The number of classes and students able to be included in the project was limited by (a) the number of class groups participating in the target programmes during the data collection period; and (b) the number of students whose parents had signed and returned participant consent forms.

Procedure

(1) Student observations

Participating students were observed in order to (a) determine the extent to which each of the 20 existing classroom productive pedagogy items were being practiced; and (b) identify those programme activities that were most engaging for students. Two pilot programmes were observed by three researchers and their ratings compared and discussed in order to clarify definitions and establish reliability. Subsequent observations and ratings were made by one researcher across all 12 programmes.

(a) *Existing productive pedagogy items*. During each programme, the researcher (a qualified teacher) used a five-point scale to rate the extent to which each of the 20 productive pedagogy items were characteristic of the programme as a whole.

(b) *Student engagement in programme activities*. In order to rate students' engagement in different programme activities, each of the 12 programmes was divided into components. A new component was defined every time there was a change

in the type of learning activity being used. The number of components per programme varied from two to 13, with an average of 7.3 components per programme. Overall student behaviour during each component of each programme was rated using an observation record sheet designed by Ballantyne, Packer, and Everett (2005). This instrument is designed to give a measure of programme effectiveness that is separate from student self-report data, for the purposes of triangulation. It is not an individual measure, but can be categorized by programme component and by teaching/learning approach. Eight behaviours indicative of learning were each rated on a four-point scale according to the observed frequency of engagement of the student group as a whole. These behaviours (drawing from Griffin 1999) included sharing learning with peers and experts; making links and transferring ideas and skills; initiating and show-ing responsibility for learning; purposefully manipulating objects and ideas; showing confidence in personal learning abilities; being actively involved in learning; responding to new information or evidence; and disengagement. An average engagement score was calculated for each programme component using the ratings for each of the eight indicators with disengagement reverse scored. Average engagement scores were then calculated for each different type of learning activity, across all of the 12 programmes.

(2)   *Student interviews*

Participating students were interviewed using the Environmental Learning Outcomes Survey (Ballantyne, Packer, and Everett 2005) immediately following each programme, and again three months after participating in the programme. This instru-ment is a structured interview schedule designed to measure students' conceptual learning, emotional responses, attitudinal change and behavioural intentions as a result of participating in an O&EEC programme. Using three open-ended questions, students were asked to report the things they had learned about caring for the environ-ment, changes in the way they felt about the environment, and changes in what they would do for the environment, as a result of participating in the programme. Each separate item mentioned by the student was considered a 'learning event', and the number of learning events in each of the three categories (Knowledge, Attitudes and Behaviour) was calculated for each student.[1] For each learning event, students were also asked to report the emotions they felt as they were learning (using a prompt card with 12 emotions, e.g., happy, surprised, sad, bored); and the parts of the programme to which they attributed their learning (coded according to the programme compo-nents identified during the programme observations).

(3)   *Classroom and O&EEC teacher interviews*

Teachers involved in the delivery of each of the 12 selected O&EEC programmes (both the classroom teachers accompanying the students and the specialist centre staff deliv-ering the programmes) were interviewed immediately following each programme. They were asked what aspects of the programme, teaching strategies or pedagogies they felt had the most impact on students' environmental learning and why. Classroom teachers were interviewed again three months after the visit, and were asked to further reflect on the impact of the programme. Interviews were analysed qualitatively using an iterative process of categorization, sorting, grouping and refining codes in order to

extract the main recurring themes. Frequency counts were performed to determine the relative importance of each of the emerging themes.

Results and discussion

Programme observations

(a) Existing productive pedagogy items

Observational ratings of the extent to which the 20 productive pedagogy classroom items were being applied in the natural environment are reported in Table 2. Those items that were observed in over 75% of programmes and/or received an average rating over 4.0 on the five-point scale are highlighted (a total of six items from three of the four categories). The researcher's observations are supplemented in the following discussion by teachers' comments regarding the strategies and approaches that they considered were effective in facilitating learning in natural environments. Although all four of the existing productive pedagogy categories were found to be relevant to some extent in natural environments, they varied in the extent of this relevance.

As illustrated in Table 2, the 'Connectedness' category was particularly highly rated, with all four items being observed in over 50% of programmes. The items 'Connectedness to the world' and 'Problem-based curriculum' were observed in all 12 programmes. This is not surprising, as environmental issues are by definition real world problems, and environmental education programmes explicitly aim to help students 'connect' with these problems, and explore possible solutions. In natural environments, 'Knowledge integration' occurs not only across subject areas, but also ideally across contexts, i.e., the integration of learning in the natural environment with classroom learning. Teachers felt that being able to connect aspects of the programme with classroom activities impacted on student learning. In particular, they referred to the importance of post-visit activities in reinforcing and deconstructing what students had seen and experienced in the field. 'Background knowledge' may include links not only with students' prior knowledge, but also their prior experiences, and their relationship with their environment. Teachers commented that it was important to help students make connections between their own experience and the messages being conveyed. In natural environments, this can be done using story and drama to help students make personal connections with a place or an issue, as well as group discussion designed to draw out personal experiences.

Under a 'Supportive learning environment' (the natural environment extension of a supportive classroom environment), the most relevant items were 'Social support' and 'Academic engagement'. Learning in the natural environment is often characterized by cooperative, engaging and intrinsically motivating learning experiences, and tasks allow for the development of rapport between teachers and students, as they share new experiences outside the classroom.

Learning in the natural environment can often facilitate 'Recognition of difference'. 'Inclusivity' is cultivated because learning activities appeal to students with a range of backgrounds and abilities. 'Group identity' is built as students work together towards a common goal, and 'Active citizenship' is encouraged through a focus on environmental issues.

'Intellectual quality' was observed least of all the categories, however, items such as 'Substantive conversation' and 'Higher-order thinking' were important in terms of

Table 2. Extent to which each of the 20 productive pedagogies were observed to be characteristic of the 12 programmes.

	Average rating, 1–5 scale (over 12 programmes)	Number and % of programmes rated 4 (quite characteristic) or 5 (very characteristic of the programme)
Intellectual quality		
Higher order thinking skills	3.6	6 (50%)
Deep knowledge	3.4	2 (17%)
Deep understanding	3.3	4 (33%)
Substantive conversation	3.7	7 (58%)
Knowledge as problematic	3.5	6 (50%)
Metalanguage	2.7	1 (8%)
Supportive learning environment		
Student direction	2.7	2 (17%)
Social support	4.5	11 (92%)
Academic engagement	4.3	10 (83%)
Explicit performance criteria	2.5	3 (25%)
Self-regulation	3.3	6 (50%)
Recognition of difference		
Cultural knowledge	3.1	5 (42%)
Inclusivity	3.8	8 (67%)
Narrative	2.9	3 (25%)
Group identity	4.1	8 (67%)
Active citizenship	4.5	10 (83%)
Connectedness		
Knowledge integration	3.7	7 (58%)
Background knowledge	3.8	7 (58%)
Connectedness to the world	4.8	12 (100%)
Problem-based curriculum	4.7	12 (100%)

the critical examination and discussion of ideas and alternative perspectives on environmental issues. Teachers also commented that programmes were most effective when they encouraged students to ask questions, compare different perspectives, create meaning, draw conclusions, and develop opinions and values.

This analysis suggests that the existing productive pedagogies that have been developed in the context of classroom environments have some relevance to learning in natural environments, and that learning in natural environments is particularly conducive to establishing 'Connectedness'. However, some of the 20 items were found to have marginal relevance in this context. For example, the items 'Metalanguage' and 'Explicit performance criteria' are more appropriate to classroom teaching than teaching in the natural environment. There is a need, therefore, to extend the conceptualisation of productive pedagogies to include those items that are uniquely the province of learning in the natural environment.

(b)   Student engagement in programme activities

Eight different types of learning activity were identified: 'Field investigation'; 'Group discussion'; 'Teacher presentation'; 'Interpreted walk' (including discussion, explanation or investigation); 'Story or drama'; 'Reflective response'; 'Worksheets'; and 'Games or play'. The extent to which these different learning activities occurred in the 12 programmes is reported in Table 3. The frequencies reported in Table 3 reflect the number of changes from one activity to another (and often back again), rather than the amount of time spent in each activity. It is noteworthy that programmes for primary classes tended to use a broader range of learning activities than those for secondary classes. In particular, primary programmes were more likely to include 'Story or drama', 'Games or play', and creative or 'Reflective response'.[2]

Average engagement scores were calculated for each of the eight types of learning activity, based on the researcher's observations of student behaviour, and these are reported in Table 4. On the basis of these scores, the types of learning activity can be divided into 'High engagement' (average rating at least three – 'most of the time' – on the four-point scale), 'Moderate engagement' (average rating between two,

Table 3.   Number of components in each programme, categorized according to type of learning activity.

	Primary								Lower sec		Upper sec		Total components
Field investigation	1	3	0	2	2	3	0	1	4	1	4	0	21
Group discussion	3	0	4	0	1	1	0	2	0	1	1	2	15
Teacher presentation	1	0	0	0	0	1	0	1	0	0	1	9	13
Interpreted walk	1	1	1	1	1	1	1	1	4	0	1	0	13
Story or drama	1	1	5	2	1	0	1	0	0	0	0	0	11
Reflective response	0	0	1	7	0	0	0	0	0	0	0	0	8
Worksheets	0	0	0	0	0	0	0	0	4	0	0	0	4
Games or play	2	0	0	1	0	0	0	0	0	0	0	0	3
Total components	9	5	11	13	5	6	2	5	12	2	7	11	88

Table 4.   Average (observed) engagement for each type of learning activity (1–4 scale).

Type of learning activity	Average engagement
High engagement	
Field investigation	3.0
Story or drama	3.0
Moderate engagement	
Interpreted walk	2.7
Reflective response	2.7
Games or play	2.6
Group discussion	2.5
Low engagement	
Teacher presentation	1.6
Worksheets	1.6
Total	2.6

'sometimes', and three, 'most of the time') and 'Low engagement' (average rating less than two – 'sometimes'), as indicated in the table. The most highly engaging activities were 'Field investigation' and 'Story or drama'. Field investigation was also one of the most frequently observed activities (Table 3), and was present in programmes for both primary and secondary students. As such, it may be considered one of the principal learning activities offered in natural environments. 'Story or drama' was only observed in programmes for primary students. Given its highly engaging nature, ways of incorporating this activity into secondary programmes should perhaps be explored. The least engaging activities were 'Teacher presentation' and 'Worksheets'. The use of 'Worksheets' was also one of the least frequently observed activities. These findings are consistent with previous research that has questioned the value of worksheets as a teaching tool in nature-based excursions (Ballantyne and Packer 2002).

Student interviews – initial learning events

Immediately after participating in the programme, students were interviewed using the Environmental Learning Outcomes Survey. They were asked to describe:

- What they learned about caring for the environment (Knowledge);
- How they had changed the way they felt about the environment (Attitudes); and
- How what they learned would change what they do for the environment (Behaviour[3]);

For each of these learning events, they were also asked to indicate where they were when it occurred, what it was that helped them learn or change, and how they felt when they were learning.

Number and types of learning events

The 199 students who were interviewed immediately after the programme each reported an average of six different learning events. Of these, 54% (or an average of 3.3 events) related to new knowledge (including knowledge of what they could do to help the environment); 10% (or an average of 0.6 events) related to changes in the way they felt; and 35% (or an average of 2.1 events) related to changes in what they would do, or would like to do, for the environment. All students reported at least one learning event, the highest number reported was 16, and 60% of students reported six or more events. Thus the programmes in general can be considered successful in their impact on students' capacity and willingness to act responsibly toward the natural environment.

There were no significant differences between primary and secondary students in either the number of learning events reported, or in the proportions of Knowledge, Attitude and Behaviour changes. Female students reported significantly more learning events (average of 6.4) than males (average of 5.7), t (197) = 2.28, $p < .05$, and were more likely to report changes in attitudes than males (χ^2 (2) = 7.73, $p < .05$). This may be due to female students being more willing to discuss their feelings than male students. Students in residential programmes reported significantly more learning events (average of 7.0) than those in day programmes (average of 5.8), t (197) = 3.49,

$p < .001$, although the proportions of Knowledge, Attitude and Behaviour changes were roughly equal. Thus the extra time spent in residential programmes could be considered worthwhile in terms of the overall learning outcomes produced.

Learning events by type of learning activity

Although students were asked to indicate in which parts of the programme they had learned the particular items they reported, it was difficult to make connections between specific learning activities and learning outcomes because there was so much variation in the way different learning activities were applied across the programmes. For each programme, the number of learning events that students attributed to each type of activity was calculated as a function of the total number of students participating in that programme. The number of learning events per student was then calculated for each type of activity by taking an unweighted average across all the programmes that included that activity. Table 5 reports both the overall averages for each type of activity, listed in decreasing order of effectiveness, and the range of scores obtained among those programmes that offered the activity.

One activity that stands out as producing higher than average learning outcomes was 'Reflective response' (averaging 2.6 learning events per participating student). Unfortunately, however, this was only offered in two programmes. 'Field investigation' was the second most successful learning activity, averaging 1.9 learning events per participating student. There was some variation in the impact of different learning activities on Knowledge, Attitudes and Behaviour. 'Reflective response' was the only type of activity to have a real impact on attitude change. 'Reflective response', 'Field investigation' and 'Interpreted walk' were important for both Knowledge and Behaviour change. 'Worksheets', 'Story or drama', and 'Teacher presentation' were important only in conveying Knowledge. Thus it might be concluded that 'Reflective response', being the most effective activity overall, and the only one impacting on Attitude change, should be incorporated more frequently as a component of learning in natural environments. Theories of experiential learning (e.g., Kolb 1984) support the important place of reflection in the experiential learning cycle. As natural environments are considered

Table 5.   Average learning events per student for each type of activity (taken as an average across those programmes where the activity was offered).

Type of activity	Range across programmes	Average LE/student
High effectiveness		
Reflective response	2.1–3.1	2.6
Moderate effectiveness		
Field investigation	0.1–3.4	1.9
Interpreted walk	0.2–2.1	1.0
Low effectiveness		
Group discussion	0.0–2.2	0.6
Worksheets	0.6–0.6	0.6
Story or drama	0.1–2.2	0.6
Teacher presentation	0.0–3.4	0.5
Games or play	0.0–3.1	0.4

conducive to reflective, restorative experiences (Kaplan 1995), it seems appropriate to ensure that, wherever possible, reflective experiences are included while students are in the natural environment.

What helped students learn?

For each learning event, students were asked to indicate what it was that helped them to learn or change. Their responses were coded as either 'teacher-directed learning' (responses that focussed on what the teacher or other adults had presented, including stories and printed information) or 'experience-based learning' (responses that focussed on what the students had seen, done, felt or experienced, including listening to nature, creative and reflective responses). Students identified that 49% of all learning events were learned through experience; 31% through teachers; and 20% through a combination of both (Table 6).

Because students were asked both where (in which learning activity) they had experienced each learning event and what it was that helped them learn or change, associations between the different types of learning activity and the things students reported had helped them to learn were able to be tested statistically. The different learning activities varied significantly according to whether they elicited teacher-directed or experience-based learning (χ^2 (14) = 139.55, p < .001). 'Teacher presentation', 'Group discussion' and 'Worksheets' elicited mostly teacher-directed learning; 'Reflective response', 'Story or drama', 'Interpreted walk' and 'Field investigation' elicited mostly experienced-based learning. Referral back to Table 4 indicates that the teaching activities associated with teacher-directed learning were observed to be the least engaging.

Although learning of Knowledge, Attitudes and Behaviour were all more likely to be experience-based than teacher-directed, Attitude and Behaviour change were particularly experience-based (χ^2 (4) = 45.03, p < .001). There was no difference between males and females in the extent to which they reported teacher-directed versus experience-based learning. Primary students were more likely to report experience-based learning than secondary students (χ^2 (2) = 21.41, p < .001; see Table 6). This could be a function of the types of activities that were offered to students, as primary programmes tended to include a wider range of experience-based activities than secondary programmes (see Table 3). It may also reflect secondary students' greater capacity for abstract thought.

Feelings associated with learning events

Students were asked to report the feelings that were associated with each learning event. Twelve adjectives were used as prompts, and these were coded according to their

Table 6.   Percentage of learning events attributed to teacher-directed versus experience-based learning.

	Events attributed to experience	Events attributed to teacher	Events attributed to both
Primary students	52%	28%	21%
Secondary students	39%	43%	18%
Total	49%	21%	20%

direction (positive versus negative) and their intensity (high versus low) giving four categories, as indicated in Table 7. Students mostly reported positive rather than negative feelings, and high intensity rather than low intensity feelings. The higher intensity positive emotions, such as excitement, interest and surprise, were most commonly associated with learning events. Females were more likely to report high intensity emotions than males (χ^2 [3] = 13.19, p = .004). In particular, the low intensity negative emotions (e.g., felt nothing, bored) were much more likely to be reported by males than females.

Teacher-directed learning was more likely to be associated with low negative emotions (e.g., felt nothing, bored) than experience-based learning; and experienced-based learning was more likely to be associated with low positive emotions (e.g., feeling happy, calm) than teacher-directed learning. This is consistent with the observation that experience-based activities were more engaging for students.

Previous research (Ballantyne, Fein, and Packer 2001b) has suggested that emotionally engaging students in relation to the effects of environmental degradation on wildlife, has a powerful influence on their learning. The findings of the present study indicate that although emotional engagement is important, the resulting emotions experienced by students do not need to be negative to be effective. In fact, attitudinal and behavioural learning events in particular were more likely to be associated with low positive emotions (happy or calm) rather than high negative emotions (sad or angry). Knowledge-based learning events were more likely to be associated with both high negative emotions such as anger and sorrow, and high positive emotions such as interest and surprise.

Student interviews – follow-up learning events

Approximately three months after participating in the programme, students were interviewed again using the Environmental Learning Outcomes Survey.

Table 7. Emotions associated with reported learning events.

	% of learning events
Low positive	**36**
happy	24
calm	6
relaxed	5
Low negative	**5**
felt nothing	4
bored	1
disinterested	0
High positive	**43**
excited	7
interested	22
surprised	14
High negative	**16**
afraid	3
sad	6
angry	7

Number and types of (long-term) learning events

The 173 students who were interviewed at follow-up each reported an average of 5.3 different learning events, a small but statistically significant reduction from the average of 6.0 events immediately after the programme (paired samples *t*-test, *t* [174] = 3.38, *p* = .001). Of these, 54% (or an average of 2.8 events) related to new knowledge; 11% (or an average of 0.6 events) related to changes in the way they felt; and 35% (or an average of 1.8 events) related to changes in what they would do for the environment. Thus although the total numbers of learning events reported had decreased slightly over time, the proportions of Knowledge, Attitudes and Behaviours remained the same (χ^2 (2) = 1.52, *p* = .47), indicating that no one type was more susceptible to loss over time than another. All students reported at least one learning event, the highest number reported was 13, and 60% of students reported four or more events.

Primary students reported significantly more learning events than secondary students (5.5 versus 4.5), *t* (171) = 2.05, *p* = .04. Female students reported marginally more learning events than males (average of 5.5 versus 5.1) but the difference was not statistically significant, and again were more likely to report changes in Attitudes and less likely to report items of new Knowledge than males (χ^2 (2) = 9.51, *p* = .009). Students in residential programmes reported nearly 50% more learning events (average of 7.2) than those in day programmes (average of 4.8), *t* (167) = 5.07, *p* < .001, although the proportions of Knowledge, Attitude and Behaviour changes were much the same.

Long-term learning events by type of learning activity

Again 'Reflective response' stood out as the activity that produced the highest learning outcomes, across Knowledge, Attitudes and Behaviour, averaging 2.4 learning events per participating student (see Table 8). 'Reflective response' and 'Field investigation' were the most successful techniques for bringing about reported Behaviour change.

Table 8.   Average learning events per participating student at follow-up, for each type of learning activity.

Type of activity	Average LE/student Immediate post-visit	Average LE/student At follow-up
High effectiveness		
Reflective response	2.6	2.4
Moderate effectiveness		
Field investigation	1.9	1.1
Low effectiveness		
Interpreted walk	1.0	0.7
Teacher presentation	0.5	0.7
Story or drama	0.6	0.5
Group discussion	0.6	0.4
Worksheets	0.6	0.3
Games or play	0.4	0.2

What helped students learn?

Again, students were asked to indicate what it was that helped them to learn or change. Students identified that 57% of all follow-up learning events had been learned through experience; 23% through teachers; and 20% through a combination of both (compared with 49%, 31% and 20% respectively of initial learning events). Thus it would appear that experience-based learning is longer-lasting than teacher-directed learning. The graph in Figure 2 shows the changes over time in the numbers of learning events attributed to 'the teacher' as opposed to personal experience ('what I saw' and 'what I did') – these three being the most frequently reported categories of responses to the question 'What was it that helped you learn', and together accounting for 85% of responses. The pattern in Figure 2 lends credence to the old adage about remembering more of what we do than what we see, and more of what we see than what we hear. Attributions to hands-on experiences ('what I did') actually increased over time, while attributions to visual experiences ('what I saw') remained stable and attributions to instruction from the teacher decreased. The pattern was similar across Knowledge, Attitudes and Behaviour.

There was no difference between primary and secondary students in the proportion of events attributed, at the time of the follow-up interviews, to experience-based as opposed to teacher-directed learning. This was due to a marked reduction in the number of events secondary students attributed to the teacher (from an average of 2.2 events per student immediately after the programme to an average of 1.0 at follow-up), and suggests that much of what the secondary students had learned through what the teacher or other adults had presented was quickly lost.

Feelings associated with learning events

Students were again asked to report the feelings that were associated with each learning event. The proportions of each type of emotion were almost identical to those reported immediately after the programme, suggesting that the direction and intensity of emotion had not impacted on the longevity of learning in any measurable way.
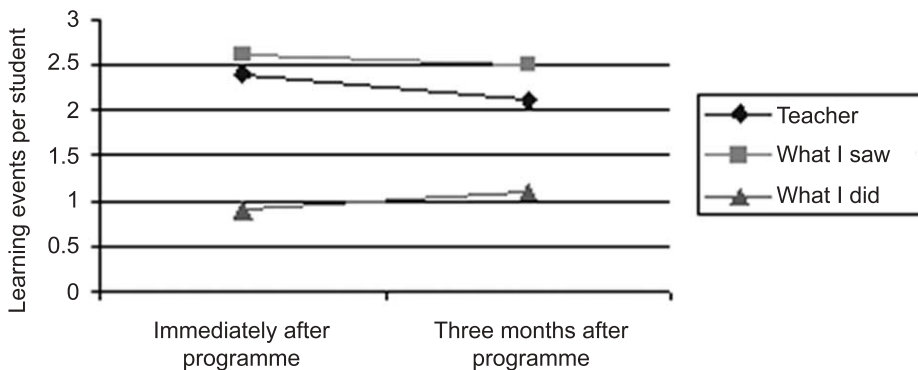

Figure 2.   Learning events per student according to how they reported having learned
Note. 'What I saw' and 'What I did' may be summed to give an indication of events attributed to experience-based learning.

Teacher interviews

After participating in each programme, both classroom teachers and O&EEC teachers were asked to reflect on the teaching strategies, pedagogies, or other aspects of the programme that they felt had the greatest impact on student environmental learning. Two aspects emerged as being the most widely recognized, important characteristics of the participating programmes – 'Learning by doing' and 'Being in the environment'. These were each mentioned by more than half of the 39 teachers.

Learning by doing

Teachers often used the words 'hands on' to describe the aspects of the programme they considered had the greatest impacts on student learning. This included exploring, investigating, collecting data and learning new skills.

- 'Doing it themselves'.
- 'Hands-on activities'.
- 'Here's what they do in the real world – go and do it yourself'.
- 'Water samples – how many yabbies'.

Being in the environment

Actually being in the environment – seeing its beauty, seeing the effects of drought or human activity – had an impact on students, according to their teachers. Seeing the environment helped students to visualize and understand the issues and to grasp the scale and importance of the problems. Just being outdoors and out of the classroom had an impact on student learning according to some teachers.

- 'Seeing it themselves'.
- 'Seeing how drought has affected the number of animals'.
- 'Being here and seeing it is very important'.
- 'They see why we're doing it'.

Another six aspects emerged as being moderately important aspects of the participating programmes, each being mentioned by 20–40% of teachers. Three of these ('Integration with class work', 'Making personal connections' and 'Higher order thinking') are included within the original productive pedagogies framework detailed in Table 1, and were discussed in the section on existing productive pedagogy items above. Three additional items that capitalise on the particular strengths of learning in the natural environment are discussed here: 'Real life learning', 'Local context' and 'Sensory engagement'.

Real life learning

A number of teachers used the words 'real life' to describe aspects of the programme that impacted on student learning. This included being in a 'real' place, responding to 'real life situations', and undertaking 'real life tasks'. According to one centre teacher, 'everything we do is real'.

Local context

When schools were located relatively close to the O&EEC, teachers felt being in their local area had an impact on student learning. A number used the term 'their own back-yard' to indicate the heightened meaning and relevance that this gave to the students' involvement in the programme, making them a stakeholder in environmental issues. Even when the school was some distance from the O&EEC, the skills and approaches learned at the O&EEC could be applied in the local area as a post-visit activity.

Sensory engagement

Teachers felt that being able to see, hear, touch, smell and 'live the experience' was important for students:

- 'the children saw and smelt'.
- 'touching, seeing, smelling the real world'.
- 'engaging all the senses'.

Other aspects that were mentioned by fewer than 10% of the teachers included the use of relevant themes; engaging curiosity; appealing to different styles of learning; providing a social experience; having a sense of purpose; focussing on environmental action; and allowing students to take some ownership and control. Teachers of the residential programmes noted the impact of having an extended period with students, as it enabled them to develop a deeper rapport and to understand and cater for students' individual needs and interests. Thus the quality, not just the quantity of time spent with students during residential programmes may be an important contributor to the higher learning outcomes identified amongst residential students.

The above strategies are by no means new to environmental education, and in fact their importance has been highlighted in a variety of contexts. For example, the North American Association for Environmental Education's (2004) *Nonformal environmental education programmes: Guidelines for excellence* refers to the need for learning by doing, real life learning, and local context; Packer (2006) discusses sensory engagement as one of the important aspects of the experience of learning in informal learning environments; and Kola-Olusanya (2005) highlights the importance of a first-hand experience of nature as a path to understanding the natural world. What is unique about this conceptualization is its development from empirical research within the productive pedagogies framework.

Conclusions

Triangulated evidence from observations, student interviews and teacher interviews converges on one point: 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. Clearly, these strategies provide the best way to take advantage of the unique opportunities that are available in natural environments, and encourage student learning for sustainability – learning that encompasses changes in knowledge, attitudes and behaviour.

Most of the productive pedagogies that have been developed in the context of classroom environments (Education Queensland 2002) remain relevant in natural settings,

Table 9.   A fifth productive pedagogy, items and key questions.

Experience-based learning	
Learning by doing	Are students actively involved in hands on exploration and investigation?
Being in the environment	Are students encouraged to experience and appreciate the special characteristics of the natural environment?
Real life learning	Are learning activities based on real places, real issues, and authentic tasks?
Sensory engagement	Are opportunities provided to explore the environment using all five senses?
Local context	Are students encouraged to explore and investigate environmental problems and issues in 'their own backyard'?

particularly those that fall into the 'Connectedness' category. Based on the findings of this research, a fifth category, 'Experience-based learning' is proposed, which encapsulates the unique pedagogies that are most effective in facilitating student learning for sustainability in natural environments. The items and key questions that define the fifth pedagogy are set out in Table 9. These include 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. The research reported here indicates that:

- Modes of delivery that rely on experience-based learning actively engage students to a greater extent than teacher-directed methods.
- Students attribute more of what they remember from an environmental field excursion to experience-based learning than teacher-directed methods.
- The outcomes of experience-based learning are more enduring than the outcomes of teacher-directed learning.
- Experience-based learning is particularly important in facilitating attitudinal and behavioural changes.

Given these findings, it is concluded that the greatest benefits for environmental education will be obtained from the use of experience-based learning strategies in natural environments. This is not to negate the importance of classroom learning. Clearly, the best results will be obtained when teachers are able to integrate learning in the natural environment *with* classroom learning strategies, and develop partnerships that ensure the continuity of environmental learning experiences in all aspects of school life (Ballantyne and Packer 2006). Although having access to dedicated centres such as Queensland's Outdoor and Environmental Education Centres will clearly add an important dimension to the learning experience, it is also possible to apply these strategies within the confines of the school grounds. The findings of this research can be used to inform the design of professional development programmes to equip teachers to facilitate learning in natural environments.

By situating the findings of this research within the productive pedagogies framework, it is hoped that the unique characteristics of experience-based learning can be understood as one of the approaches that all teachers need in their toolkit. Although these strategies are particularly suited for teaching the knowledge, skills, attitudes and behaviours associated with the attainment of a sustainable future, there will be other

ways in which they can be creatively applied both in and outside the classroom. Further research is needed to support the development of practical strategies for implementing experience-based learning within the range of contexts that are accessible to classroom teachers, and to support the extension of professional development programmes to incorporate this fifth pedagogy.

Notes

1. All of the 'learning events', including knowledge-based, attitudinal and behavioural events, together constitute the 'learning outcomes'. These are different again from the 'learning activities', which are the structured activities provided as components of the environmental education programme.
2. The mix of learning activities provided in each programme was decided by centre staff, and each programme was designed for a specific range of age levels.
3. It should be noted that changes in actual behaviours were not able to be measured in this study. This is a measure of behavioural intentions, but it is labelled 'Behaviour' to facilitate the presentation of results.

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