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**Coral reefs as sites for experiential environmental education: Learning with
Australian students – a foundational study.**

Thesis submitted by

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For the Degree of Doctor of Philosophy

In the School of Tropical Environment Studies and Geography

and School of Education

James Cook University

FRONTISPIECE

maggie and milly and molly and may

*maggie and milly and molly and may
went down to the beach (to play one day)*

*and maggie discovered a shell that sang
so sweetly she couldn't remember her troubles, and*

*milly befriended a stranded star
whose ray's five languid fingers were;*

*and molly was chased by a horrible thing
which raced sideways while blowing bubbles: and*

*may came home with a smooth round stone
as small as the world and as large as alone.*

*For whatever we lose (like a you or a me)
it's always ourselves we find in the sea.*

ee cummings

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Not only were the teachers a very helpful and professional group, but the participating students were also a pleasure to work with. They were enthusiastic and responsive. By and large, all took part in the role-playing in the classroom, the coral reef

monitoring exercise and cheerfully answered multiple surveys and interview questions. The research would not have been possible without their participation, and inspiring involvement. I am very appreciative of the adolescents who contributed their time, energy and responses to this educational research. The relationships established during this very short and highly energised project were very meaningful and inspiring to me personally, and I wish them well in their endeavours after high school.

It is also important to note the significant time and energy donated by research assistants from James Cook University and the Cairns community. The names of additional people who assisted me, and helped make the completion of this research project viable are too long to list in this acknowledgement (see Appendix A). Everyone's contribution is sincerely appreciated.

ABSTRACT

Marine education is a subset of environmental education. It aims to educate a citizenry capable of making astute decisions about the impact of human activities on marine and reef environments, as well as encouraging ecologically sensitive practices. Coral reefs are critical for biodiversity, food habitats and as tourist destinations, but they are in serious decline around the world. This research explores high school students' educational reef experiences with respect to specific learning outcomes. Students were selected from five Queensland State and non-state schools, and 57% were enrolled in senior secondary marine studies programs. These students were surveyed and interviewed while groups were trained in coral reef ecology and monitoring in both the classroom and at various sites in the Great Barrier Reef. Both quantitative and qualitative methods were employed. The quantitative quasi-experimental design included various treatments, a contrast group as well as before and after treatment surveys. Qualitative investigation augmented these analyses with structured student interviews and accounts.

In this study, I analyse changes in Queensland Years 11 and 12 high school students' environmental knowledge (awareness), attitudes and ecological actions toward coral reefs when experiential education is added to classroom curriculum. The Three A's of Coastal and Marine Studies, according to the Marine Education Society of Australasia, are awareness, attitudes and action. This presupposes a learning situation where a gain in knowledge (awareness) will lead to a change in attitude, and thereby improve positive personal actions toward marine environments. This research analyses whether the link between the knowledge-attitude-action variables are linear in relation to the effect of direct reef experience.

The student participants were divided into four groups, with each group receiving different educational interventions. These included a classroom presentation on coral reef ecology and monitoring, and then participation in reef monitoring at a Great Barrier Reef site. Some students received both interventions, while others received only one treatment and a contrast group received neither. Pre- and post-test survey questionnaires and interviews collected student responses, and then the results were compared.

This research contributes a Model of Ecological Intention to Act relating to marine education theory and practice. A unique model was developed and tested as part of the research process. Results show reef experiential education to have a positive

effect on students' environmental knowledge (awareness), attitudes towards reef environments and stated intention to act. The reef experience alone caused the greatest change in environmental attitudes and ecological intention to act. This alludes to the fact that knowledge itself could be slowing down the improvement of attitudes and intention to act. However in my study, not only were students' initial environmental scores found to be low, the relationship was not linear across the variables since a change in knowledge (awareness) was not significantly correlated to changes in attitudes or intention to act. Comparisons of classroom interventions and experiences of immersion at a coral reef were revealed in both quantitative and qualitative analyses. Data can be read as both statistically and educationally significant. An interdisciplinary methodology for addressing pedagogical questions in marine education was developed that provides baseline information for future research.

Past research reveals more about environmental knowledge and attitudes than about students' educational experience and preferences. An attempt to advance the understanding of learning in marine experiential education was made by addressing the idea of moving away from linear learning models, and developing an analytic methodology. This study identifies future issues and challenges, and supplies a focus on adolescent student learning, learners, and their experiences.

This work took an elemental step in addressing the question of proximal relations between humans and coral reefs, and analysis brought together literature and techniques from varying disciplines to generate statistical findings, while student accounts confirmed the learning value of structured activities underwater as part of reef trips. It is time for us to begin the long journey of bringing natural environments closer in/to curricular practice as we rethink issues of sustainability and education in the 21st century.

TABLE OF CONTENTS

	<u>Page</u>
Frontispiece	ii
Statement of Access	iii
Statement of Sources	iv
Acknowledgements	v
Abstract	vii
Table of Contents	ix
List of Tables	xiv
List of Figures	xvii
List of Acronyms	xx
SECTION ONE: THESIS FOUNDATIONAL INFORMATION	
Chapter 1 How This Marine Education Study Came About	
1.1 Introduction	23
1.2 Motivation for Study	24
1.3 The Study is Timely	26
1.4 Knowledge (awareness), Attitude, Action	26
1.5 Call for Marine Experiential Education	27
1.6 The Study and Approaches	28
1.7 Contribution of Research in Practice	29
1.8 Synopsis	29
Chapter 2 Literature Review: Historical Perspective on Marine Education	
2.1 Introduction	31
2.2 Environmental Education:	32
2.2.1 Environmental Education Definition	32
2.2.2 Creation of the Awareness-Attitude-Action Objectives	33
2.2.3 The Lucas Model	36
2.2.4 Developments in Environmental Education	36
2.2.5 Behaviouralism Challenged	38
2.3 Experiential Education	39
2.3.1 Changing Educational Frameworks	39

2.3.2 Levels of Environmental Knowledge in High Schools	45
2.4 Marine Education	47
2.4.1 Interdisciplinary Issues in Queensland Marine Education	49
2.4.2 Background Information for Marine Education in Queensland	50
2.5 The Knowledge (Awareness)-Attitude-Action Relationship	52
2.5.1 Australian Research	52
2.5.2 International Research	56
2.5.3 Attitudinal Studies in Marine Education	64
2.6 Chapter Summary	66
Chapter 3 Theoretical Framework: Methodological, epistemological and ontological approaches	
3.1 Introduction	67
3.2 Research Problem and Related Theories	68
3.2.1 Research Problem	68
3.2.2 Knowledge-Attitude-Action Relationship Model (K-A-A)	69
3.2.3 The Model of Responsible Environmental Behaviour (REB)	70
3.2.4 The New Environmental Paradigm Model (NEP)	71
3.2.5 The Theory of Planned Behaviour (TpB)	73
3.2.5.1 the subjective norm.	75
3.2.5.2 perceived behavioural control.	75
3.2.5.3 environmental attitude.	76
3.2.5.4 ecological intention to act.	77
3.2.5.5 compatibility.	78
3.3 Model of Ecological Intention to Act (MEIA)	79
3.4 Multi-Method Project Design	82
3.5 Qualitative Theoretical Framework	83
3.5.1 Summary-aided Approach to Analysis	84
3.5.2 Qualitative Data Analysis	85
3.6 Chapter Summary	85

Chapter 4 Procedures and Field Trips: The Students, Schools and Educational Interventions	
4.1 Introduction	87
4.2 Preparations	87
4.2.1 Ethics and Safety Considerations	87
4.2.2 Pilot Study	90
4.2.3 Participating Queensland High Schools	91
4.3 Student Study Population Characteristics	92
4.4 Learning Interventions	93
4.4.1 Introduction	93
4.4.2 Classroom Presentation	93
4.4.3 Reef Experience	95
4.4.4 The Conduct of One-day Reef Trips	96
4.5 Southern Cross Catholic College Week-long Excursion to Northwest Island	97
4.6 Chapter Summary	98
Chapter 5 The Research Approach	
5.1 Introduction	105
5.2 The Study Population	106
5.3 Pilot Study	109
5.4 Quantitative Methodology	110
5.4.1 Experimental Design	110
5.4.2 Design of Survey Questionnaire	110
5.4.3 Research Orientation	112
5.4.4 Schedule of School Research	116
5.4.5 Educational Effects and Hypotheses	117
5.5 Quantitative Data Analysis	119
5.6 Qualitative Research Methodology and Analysis	121
5.6.1. Qualitative Approach	121
5.6.2 Interviews	123

5.7 Limitations	127
5.7.1 Limitations of the Research Methodology	127
5.7.2 Limitations of the Research Data Collection	128
5.7.3 Limitations of the Research Analysis	129
5.8 Chapter Summary	130

SECTION TWO: QUANTITATIVE AND QUALITATIVE RESULTS – ANALYSIS OF EDUCATIONAL OUTCOMES

Chapter 6 Quantitative Results - Unpacking Knowledge-Attitude-Action

Relationship

6.1 Introduction	132
6.2 Data for Analysis and Interpretation	134
6.2.1 Independent and Dependent Variables	134
6.2.2 Study Population Description	135
6.2.3 Interventions and the Survey Instrument	137
6.2.4 Exploratory Statistical Analysis	138
6.2.4.1 environmental knowledge.	138
6.2.4.2 environmental attitudes.	140
6.2.4.3 ecological intention to act.	143
6.2.4.4 demographic relationships.	148
o previous reef experience	151
o swimming	155
o snorkelling	156
o camping	157
o watching nature channels on tv	159
6.2.5 Gender	159
6.2.5.1 environmental knowledge.	159
6.2.5.2 environmental attitudes.	161
6.2.5.3 ecological intention to act.	163
6.2.5.4 gender and previous reef experience.	165
6.2.5.5 gender and previous snorkelling experience.	165
6.2.5.6 gender and previous camping experience.	165
6.2.5.7 gender and previous experience watching nature channels on TV.	165

	Coral reef ... education	13
6.3	Discussion Quantitative Results	166
6.4	Chapter Summary	171
Chapter 7 Qualitative Findings: Student Accounts		
7.1	Introduction	173
7.2	Data Collection	173
7.3	Interviews	176
7.4	Student Accounts in Relation to Research Questions	177
7.5	Marine Studies Curriculum and Student Accounts	188
7.6	Chapter Summary	190
SECTION THREE: DISCUSSION AND CONCLUSIONS		
Chapter 8 Discussion and Conclusion		
8.1	Introduction	195
8.2	Review of Significant Findings in Light of Existing Research	195
8.3	The Model of Ecological Intention to Act (MEIA)	198
8.4	Limitations of the Research	199
8.5	Contribution of Qualitative Research	200
8.6	Implications for Educational Practice	202
8.7	Possibilities for Further Research	204
8.8	Contributions to Marine Education	205
8.9	Conclusion	206
	References	207
	Appendices	228

LIST OF TABLES

<u>Table #</u>	<u>Table Caption</u>	<u>Page</u>
1	Project Implementation Timeline	92
2	Schools and Reefs Visited 2003	95
3	Study Group Make-up by School and Course of Study	107
4	Study Group Make-up by Participation of Students from each High School and Group	108
5	Independent - Dependent Variable Relationship to Educational Interventions	113
6	The Three Components of the Dependent Variables	113
7	Component Relationships to Independent and Dependent Variables	114
8	Attitude (A) and Intention to Act (Ac) Question Numbers per Component on the Survey Questionnaire	115
9	Schedule of High School Research by School in 2003	117
10	Independent Variables (IV) and Demographic Variables Shown in Relationship with Dependent Variables (DV) of Environmental Knowledge (Awareness), Attitude and Ecological Intention to Act	134
11	Independent Variables and Dependent Variables Shown in Relation to the Different Components that are Compared to Same Component Across Variables	135
12	Survey Questions per Variables and Components	135
13	Total Student Population Make-up by School and Course of Study	136
14	Student Population Make-up by Participation of Students	137
15	Significant Correlations Between Environmental Knowledge (K) and Environmental Attitudes (EA)	142
16	Significant Correlations of Environmental Knowledge (K_{pre} and ΔK) to Ecological Intention to Act (Ac) and Changes in Ecological Intention to Act (Δac)	146
17	Correlations in Pre-test Environmental Knowledge (K_{pre}), Attitude (EA) and Ecological Intention to Act (Ac)	146

18	Correlations in Environmental Knowledge (K_{pre} and ΔK), Attitude (EA) to Change in Ecological Intention to Act (ΔAc)	147
19	Correlations in Changes in Environmental Knowledge (ΔK), Environmental Attitude (ΔEA) and Ecological Intention to Act (Δac)	148
20	Demographic Survey Questions, Number of Total Answers Used for the Analysis and List of Possible Answers	149
21	Demographic Information and Significant Correlations to Environmental Knowledge (Pre-Test and Change)	149
22	Demographic Information and Significant Correlations to Pre- Test and Changes in Environmental Attitude (EA)	150
23	Demographic Information and Significant Correlations to Pre- Test and Changes in Ecological Intention to Act (Ac)	152
24	Previous Reef Experience (GBR) and Significant Correlations to Pre-Test and Changes in Environmental Knowledge (K) and Attitude (EA)	152
25	Previous Reef Experience (GBR) and Significant Correlations to Pre-Test and Changes in Ecological Intention to Act (Ac)	152
26	Previous Reef Experience and Existing Environmental Knowledge (Awareness), Attitudes and Ecological Intention to Act	155
27	Significant Correlations Between Swimming, Environmental Knowledge (K), Attitude (EA), Ecological Intention to Act (Ac) and Other Background Demographics	155
28	Snorkelling and Correlations with Environmental Attitude and Demographic Variables	156
29	Significant Correlations Between Snorkel Experience and Pre- Test Intention to Act	157
30	Significant Camping Experience and Attitude Relationships	158

- 31 Mean Ranking of Students' Pre-Test Environmental Attitude Responses and Gender. The M_W Category Displays the Mann-Whitney U Level of Significance for all Questions Regarding Pre-Test Environmental Attitude Responses with Respect to Gender 161
- 32 Mean Ranked Change in Student Responses for Environmental Attitudes and Gender. The M_W Category Displays the Mann-Whitney U Level of Significance for all Questions Regarding Change in Environmental Attitude Responses with Respect to Gender 162
- 33 Mean Ranking of Pre-Test Ecological Intention to Act and Gender. The M_W Category Displays the Mann-Whitney U Level of Significance for all Questions Regarding Pre-Test Ecological Intention to Act Responses with Respect to Gender 163
- 34 Mean Ranking of Change in Ecological Intention to Act and Gender 164
- 35 High Schools, Interview Types and Number of Students Interviewed from Each Participating School 174

LIST OF FIGURES

<u>Figure #</u>	<u>Figure Caption</u>	<u>Page</u>
1	“Students study Reef in depth.”	xxii
2	Environmental awareness to ecological action process.	35
3	Traditional learning and behavioural change system.	69
4	Modified behavioural change system.	69
5	The model of Responsible Environmental Behaviour.	70
6	New Environmental Paradigm Model.	72
7	Theory of Planned Behaviour.	74
8	Direct experience, education and Theory of Planned Behaviour.	74
9	Three-component view of attitude.	77
10	Model of Ecological Intention to Act.	81
11	Quantitative – Qualitative research relationship.	82
12	Summary-aided approach to analysis.	84
13	Teacher and researcher meeting at Cairns State High School.	99
14	PowerPoint presentation in classroom by Carl Stepath.	99
15	Woree State High School classroom presentation by Carl Stepath.	100
16	Carl Stepath in classroom presentation at St. Mary’s Catholic College.	100
17	Good Counsel College students and teacher, Tom Jones, on Compass upper deck to Hastings Reef and Breaking Patches.	101
18	Carl Stepath reviewing marine ecology with Woree State High School students before the coral reef monitoring at Michaelmas Cay on board Noah’s Ark, too.	101
19	Good Counsel College student with Humphead Wrasse at Hastings Reef.	102
20	Southern Cross Catholic College students reef monitoring at Northwest Island.	102
21	St. Mary’s Catholic College student coiling up the transect line after monitoring Breaking Patches reef.	103
22	Southern Cross Catholic College students snorkelling at Northwest Island.	103

23	Woree State High School students videoed by a JCU research assistant, Allison Hoskin-Kain.	104
24	Woree State High School students and teachers returning from Michaelmas Cay.	104
25	Study groups and respective educational interventions.	107
26	Project experimental design.	110
27	Predicted outcomes of experiential education.	117
28	Normality of student responses for change in knowledge for all student groups from survey questionnaire.	138
29	Knowledge changes for student responses per group, component one.	139
30	Changes in student attitude responses for the pre- to the post-test per group for component one.	140
31	Changes in student survey response for environmental attitude from the pre- to the post-test by component.	142
32	Changes in student survey responses for ecological intention to act from the pre- to the post-test by component.	143
33	Changes in student ecological intention to act responses from the pre- to the post-test per group for component one.	144
34	Previous reef experience and change in environmental knowledge.	151
35	Previous reef experience and change in environmental attitude.	153
36	Previous reef experience and change in ecological intention to act.	154
37	Previous snorkel experience and change in environmental attitude.	156
38	Previous snorkel experience and change in ecological intention to act.	158
39	Previous camping experience and change in ecological intention to act.	159

40	Change in student environmental knowledge responses per gender and group.	160
41	Change in student environmental attitude responses per gender and group.	163
42	Change in ecological intention to act per gender and group.	164
43	Woree State High School students on the boat ride to port, waiting to be interviewed, April 3, 2003.	192
44	Good Counsel College students underwater, experiencing snorkelling and monitoring Hastings Reef.	192
45	Marine education and learning with Woree State High School students and JCU assistant at Michaelmas Cay.	193
46	Cairns State High School students preparing to go snorkelling and collecting data at Green Island.	193
47	Southern Cross Catholic College student monitoring reef and using underwater slate.	194
48	Cairns State High School students experiencing the reef and monitoring at Green Island.	194

ACRONYMS

A	Attitude
Ac	Ecological Intention to Act
ANOVA	Analysis of Variance
ARE	Aquatic Resource Education
AUSMEPA	Australian Marine Environment Protection Association
CDC	Curriculum Development Centre
CGC&MP	Commonwealth Government Coastal and Marine Program
CSHS	Cairns State High School
CSIRO	Commonwealth Science and Industrial Research Organisation
DSP	Dominant Social Paradigm
DV	Dependent Variable
EE	Environmental Education
ENN	Environmental New Network
EWV	Ecological World View
GBR	Great Barrier Reef
GBRMPA	Great Barrier Reef Marine Park Authority
GCC	Good Counsel College
GCRMN	Global Coral Reef Monitoring Network
IV	Independent Variable
IEEIA	Investigating and Evaluating Environmental Issues and Actions
JCU	James Cook University
K	Knowledge
KAB	Knowledge-Attitude-Behaviour Model
K-A-A	Knowledge-Attitude-Action Relationship
MEIA	Model of Ecological Intention to Act
MESA	Marine Education Society of Australasia
MGOAI	Millward-Ginter Outdoor Attitude Inventory
MS ppt	Microsoft Power Point Presentation
MTAQ	Marine Teachers Association of Queensland
NEP	New Environmental Paradigm
NOAA	National Oceanographic and Atmospheric Administration

NSEE	National Society of Experiential Education
PADI	Professional Association of Dive Instructors
QSA	Queensland Studies Authority
REB	Responsible Environmental Behaviour
RMIT	Royal Melbourne Institute of Technology
SCCC	Southern Cross Catholic College
SMCC	St. Mary's Catholic College
SOSE	Studies of Society and Environment
SPSS11	Statistical Package for the Social Sciences, Version 11
STEP	Secondary Transition Education Project
TAFE	Technical and Further Education
TpB	Theory of Planned Behavior
UNCED	United Nations Conference on Environment and Development
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
WSHS	Woree State High School