EVALUATION OF PEST MANAGEMENT CURRICULUM IN HAWAII PUBLIC SCHOOLS: IMPACT AND SUSTAINABILITY

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By
Makena Mason

Thesis Committee:
J. Kenneth Grace, Chairperson
Julian R. Yates, III
Jari Sugano

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ABSTRACT

Educate to Eradicate is a K-12 curriculum project using termite biology and control as the basis for science education that has been implemented in over 350 Hawaii public school classrooms with more than 12,530 students from 2001 to present. This study was initiated to (1) evaluate the efficacy of *Educate to Eradicate* curricula, and (2) identify factors that influence the adoption and continuation of pest management curricula in public school classrooms.

A mixed methods approach, using surveys, focus groups, and work samples, was used to measure changes in teacher knowledge/ practice, student knowledge, behavior, and engagement. Additionally, effects of teacher and curricular characteristics on project adoption and continuation were assessed.

Teachers demonstrated mastery of project content by accurately discussing content, describing their application of curriculum in detail, and sharing curricular modifications and investments. Teachers created original inquiry activities, procured non-fiction resource materials, and constructed lesson props. Early-adopting elementary teachers described additional focus on science to motivate students both before and after *Educate to Eradicate* adoption. Late-adopting elementary teachers reported at least doubling classroom time devoted to science during the *Educate to Eradicate* unit. Middle and high school partner teachers reported *Educate to Eradicate* as their only project-based unit. Teachers were impressed with students' unit-specific content retention. Teachers reported increased student motivation and interest in science. Additionally, teachers described how students applied unit knowledge and skills inside and outside of the classroom during structured and independent activities.

Teachers identified the following keys to curricula adoption and continuation: (1) curricula should be tightly and explicitly linked to state standards, incorporate a range of current best-practice pedagogies (including inquiry), include interdisciplinary lessons, and be written/formatted for easy teacher use/adaptation. (2) Professional development should deepen teachers' content knowledge while minimizing additional time demands.

Teachers suggested the creation of *Educate to Eradicate* videos that include science content and lesson modeling. (3) Project supports should excite entire grade levels/departments about curricula, provide technical support, and create user-friendly lessons that minimize teacher time inputs. Teachers need live termites and habitats to continue *Educate to Eradicate* curricula independently. The goal of this program is a self-sustaining curricula which requires limited institutional inputs, increases science literacy in Hawaii schools, and helps to protect current and future homeowners from incurring structural termite damage.

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Introduction and Literature Review

Area-wide Termite Control

Successful area-wide pest management has been implemented in agricultural contexts (Elliott et al. 2008). However, urban area-wide initiatives struggle to create and maintain stakeholder cohesion (Merritt et al. 1983, Fear et al. 1983). *Operation Full Stop* was a federally-funded research initiative, directed by the United States Department of Agriculture, Agricultural Research Service (USDA-ARS), with the mission of area-wide Formosan subterranean termite suppression in urban areas. The program included public education and termite control (largely by the use of termite baiting systems) in the French Quarter of New Orleans, Louisiana, and in other selected municipalities such as Golden Beach, Florida. Public cooperators received termite control education, property inspection, suggestions for control (Golden Beach), or actual control measures (the French Quarter). The Golden Beach project achieved termite elimination, as measured by monitoring stations and alate capture (Su et al. 2004). The French Quarter achieved significant reduction in alate capture. However, all locations also experienced subsequent encroachment of neighboring termite colonies into the peripheries of treated zones (Su et al. 2004, Guillot et al. 2005). While these projects successfully suppressed or eliminated subterranean termites, the sustainability of these gains is unknown. Golden Beach residents were left to their own devices once the area-wide bait application ended since the town council did not wish to continue the program with municipal funding (Su et al. 2004). Cooperators fear many homeowners may cease treatment or fail to use best control practices. The New Orleans component of Project Full Stop currently has no exit strategy when inspection and baiting funds are exhausted. Property owners have received free termite control, in some cases since 1998 and homeowners may struggle with the transition to paid treatment. One option to sustain area-wide termite control is through community education.

Educate to Eradicate Background and Significance

The Formosan subterranean termite (*Coptotermes formosanus* Shiraki) is the most economically important insect pest in Hawaii, costing over $100 million annually in control and repair (Tamashiro et al. 1990). The *University of Hawaii Termite Project: Educate to Eradicate* is a statewide program intended to suppress termites through research and education (Grace et al. 2007). The *Educate to Eradicate* K-12 curricula project has been implemented in over 350 Hawaii public school classrooms with over 12,530 students from 2001 to present. It is designed to teach children and adolescents principles of science and biology using curricula emphasizing termite biology, prevention, and control. Hawaii science process and life/environmental content standards are addressed, facilitating standards-based instruction while teaching novel termite content (Appendix A, HCPS III 2007).

Educate to Eradicate curricula utilize live termites for observations and investigations. Students establish termite habitats that are observed over several weeks (Figure 1.1). These habitats serve as the springboard for lessons on the scientific method including data collection, predictions, and inquiry. Habitats spark class discussion of adaption, communication, and interdependence. Subsequent lessons and investigations use a range of grade-appropriate pedagogies to further explore these concepts, in addition to termite lifecycles, prevention, and control (Grace et al. 2008).

Curricula incorporate both inspection of the students' own residences for termite hazards with parent/guardian participation, and a culminating service-learning project that requires application of unit knowledge to community outreach activities. These aspects of the curricula result in knowledge transfer from participating students to homeowners within the community (Lemus et al. 2010, Schmidt et al. 2007). The goal of this project is a self-sustaining curricula that requires limited institutional inputs, increases science literacy in Hawaii schools and to helps protect current and future homeowners from incurring structural termite damage.

Educate to Eradicate curricula materials including lesson plans, PowerPoint presentations, guided notes, reinforcement worksheets, insect fact sheets, and laboratory handouts are available for teachers on compact disk and online (http://manoa.hawaii.edu /ctahr/termite/). Partner teachers receive materials, laboratory supplies, and equipment to complete lessons including: books, puppets, craft kits, preserved insects, live termites, habitats, laptops, digital microscopes, and projectors. Curricula are differentiated for grades Kindergarten, 1, 2, 3, 4/5, middle, and high school levels.

The standard K-3 lessons are:

<u>The Insect Jar:</u> Students create and observe a termite habitat.

<u>What is an Insect?</u> : Students learn about the classification, diversity, and importance of insects.

<u>Build an Insect</u>: Students create and describe models of insects, including adaptations.

<u>Termite Ohana</u>: Students differentiate the structures/functions of termite caste members.

<u>Prevention</u>: Students learn the signs of termite infestation along with simple steps to reduce termite-conducive conditions around the home. Students survey their home with a parent/guardian, for signs of termites and conducive conditions.

<u>Sharing Knowledge Project</u>: students inform Hawaii homeowners about termite biology, prevention, and control.

Fourth/fifth grade curriculum delves deeper into the concepts covered in K-3 curricula. Additional lessons include:

<u>Termite Lifecycle:</u> Students diagram the lifecycle of a termite colony.

<u>Termite Communication:</u> Students investigate termite trail-following behaviors and model the use of pheromones in communication.

<u>Types of Termites</u>: Students compare and contrast drywood and subterranean termites.

<u>Inquiry Project:</u> Students plan and conduct student-driven experiments using termites.

Middle/High school curricula cover the above topics in greater depth, at a faster pace. Additional lessons include:

> Termite Feeding and the Protozoa: Students diagram food webs, symbiotic relationships, and anatomy. The accompanying laboratory includes the dissection and examination of termite hindgut protists.
>
> Management and Control: Students learn to reduce termite-conducive conditions around their home. They also compare termite prevention and control measures currently available.

Figure 1.1. Students examine a termite habitat in the classroom.

K-12 Integrated Pest Management Curriculum Projects

While integrated pest management (IPM) curricula have been created and implemented within K-12 classrooms, measurements of curriculum reach, impact, and efficacy are currently limited. IPM content knowledge is currently part of the Pennsylvania academic standards for environment and ecology (PDOE 2011). Webster and Rajotte (2006) assessed the impact of the Pennsylvania Pest Patrol curriculum on middle school participants. IPM knowledge, attitudes, and behaviors were measured with survey responses from project participants and a reference group of students. The largest difference between groups was in IPM behavior. Participants were 27% more likely to "…talk to friends and practice good IPM behavior outside of school and at home," than non-participants. While not as large, participants had better IPM knowledge (2%) and more positive IPM attitudes (4.5%) compared to non-participants. Additionally, Webster and Rajotte (2006) noted improved scores on state assessment IPM questions.

The Iowa State University School IPM curriculum program disseminated K-12 lesson plans via their website and partner school IPM coordinators. School IPM coordinators were asked to submit curricula to associated district curriculum coordinators for review, approval, and dissemination. Curriculum adoption is currently unknown. The program's specialist, Iowa State Extension entomologist M. H. Shour (personal communication, March 17, 2010), views IPM lessons within schools as a key to increasing the adoption of sustainable pest management practices.

The Texas AgriLife Extension Service KIDzANTS curriculum has used word of mouth and state teacher science fairs to recruit teachers. Measures of adoption were not closely tracked and P. Nester (personal communication, March 10, 2010) reports lackluster sales through the Extension Bookstore. Curriculum was later made available at eXtension.org, however, access is not monitored. P. Nester stresses the importance of project staff "championing the program," with adequate time, resources, and commitment. He cites additional keys to project sustainability include partner teachers with an "entomological orientation" and outside grants.

The Manduca Project developed inquiry lessons for public schools through the partnership of the University of Arizona, Tucson Unified School District, and partner teachers. These lessons utilized *Manduca sexta* larvae and reached "thousands of students" (Manduca Project 2001). University-sponsored teacher workshops and teacher-to-teacher training/mentoring expanded the project. Curriculum resources are available online (http://www.manducaproject.com).

Measurement of University/K-12 Partnership Curriculum Efficacy

Curriculum efficacy has been evaluated for numerous university-based K-12 citizen science and student-scientist partnership initiatives. Student surveys, focus groups, and work sample analyses have been used to measure curricula effects.

Citizen Science

Tomasek (2006) utilized mixed-methods to assess the effects of the citizen science curricula *eBird/Classroom BirdWatch* developed by the Cornell Lab Ornithology. She triangulated student self-assessments, teacher observations, and work samples. Using a Likert scale, students self-assessed their autonomy, competence, relatedness to scientists, and intrinsic motivation associated with curriculum participation. Many students reported feeling like scientists (67.5%); however, students were not likely to report a sense of competence (35.7%). Using the same scale, teachers consistently rated students more positively than student self reports. Qualitative data from documents, focus group transcriptions, and interview transcriptions underwent frequency analysis using the content analysis software NUD*IST (qualitative data analysis software, QSR International Pty Ltd., Version 6). Main themes of simple and independent inquiry were described by three participating teachers and summarized. Teachers indicated that students participated initially in simple inquiry and moved to independent inquiry later in the *Birdwatch* unit. Independent inquiry was characterized by student-generated research questions, methodology, observations, data transformations, and indirect reasoning. Tomasek (2006) asserted that the *Birdwatch* unit encouraged inquiry more than science textbooks.

Student-Scientist Partnerships

Baumgartner and colleagues (2006) measured the impact of three NSF-funded Graduate Science, Technology, Engineering, and Mathematics (STEM) Fellows in K–12 Education student-scientist educational partnerships on student learning. Methods of assessment included student self-assessments, work sample reviews, and surveys. To assess the impact of the Hammerhead Shark Tagging Unit, students ranked their knowledge of shark biology and ecology. Students completed Likert-like scales before and after the unit. Pair-wise comparison revealed statistically significant increases in 9 of 10 parameters. These findings were further supported with partner teacher assessments of student learning. The Mangrove Blenny Habitat Choice Study used student-generated lab reports to assess learning. The presence of critical thinking skills, as described by Hawaii State Content Standards, was tallied. Use of qualitative data (75%), appropriate identification of error (60%) and drawing conclusions (48%) were most frequently present within participants' lab reports. The Sand Diver Sex Change Study required one day of student participation and was not coupled with classroom instruction. Student surveys revealed minimal impact on student learning. Students reported greater gains from long-term classroom projects.

Service Learning

Lemus and colleges (2010) conducted a formative evaluation of the service learning based QuikSCience science curriculum. Effects on student learning and perceptions were measured with mixed-methods, comparing both student and teacher surveys and interviews (Creswell 2005). Qualitative analysis was aided by AT-LAS.Ti 5.0 software. Through open-ended questions, students reported knowledge/learning (48%) and community service (35%) as the greatest benefits of project participation. Teacher surveys indicated 92.3% of teachers agreed or strongly agreed that student participation in QuikSCience increased knowledge of science and enhanced involvement in the community. These responses were supported by systematic quantification of responses to open ended survey questions. Teacher surveys were used to measure teacher motivation and benefits from partnership. Main themes identified included linking students to their community and meeting California state science content and process standards. Teacher surveys captured continuation data, noting 31% had partnered with the project in the past. Fifty percent of teachers expressed commitment for the subsequent year. Teacher interviews added weight to survey results, citing community outreach and increases in knowledge as primary student benefits.

Professional Development Assessment Model

Halsem (2010) outlined the Teacher Professional Development Logic Model for evaluating the effectiveness of professional development. The model facilitates tight alignment of professional learning activities with outcomes/indicators. Effective teacher training results in new knowledge/skills and changes in practice. If professional development is successful, these changes in teachers will result in changes in student learning, behavior, and engagement (Figure 1.2). This model was chosen, at the recommendation of Dr. Donald Young, because it allowed for the integration of existing *Educate to Eradicate* professional learning activities (professional development) and documented outcomes/ indicators, as well as new measures of curricula efficacy.

Haslem's model was utilized to evaluate the *Educate to Eradicate* project. Interim indicators were collected throughout the project implementation period (Fall 2003-Spring 2012). Changes in student learning were measured using pre/post tests (Chapter 2). Teachers' perceptions of curriculum design and implementation were recorded through surveys (Chapter 3). Changes in teachers' practice were assessed through focus groups (Chapter 4) and teachers' perceptions of changes in student learning were triangulated with pre/post test scores (Chapters 4 and 5).

This mixed methods evaluation of the *University of Hawaii Termite Project: Educate to Eradicate* curricula project was used to inform project direction. The goals of this project are (1) a self-sustaining curricula that only requires the provision of live termites and habitats to partner teachers, (2) to increase science literacy in Hawaii schools, and (3) help to protect current and future homeowners from incurring termite structural damages.

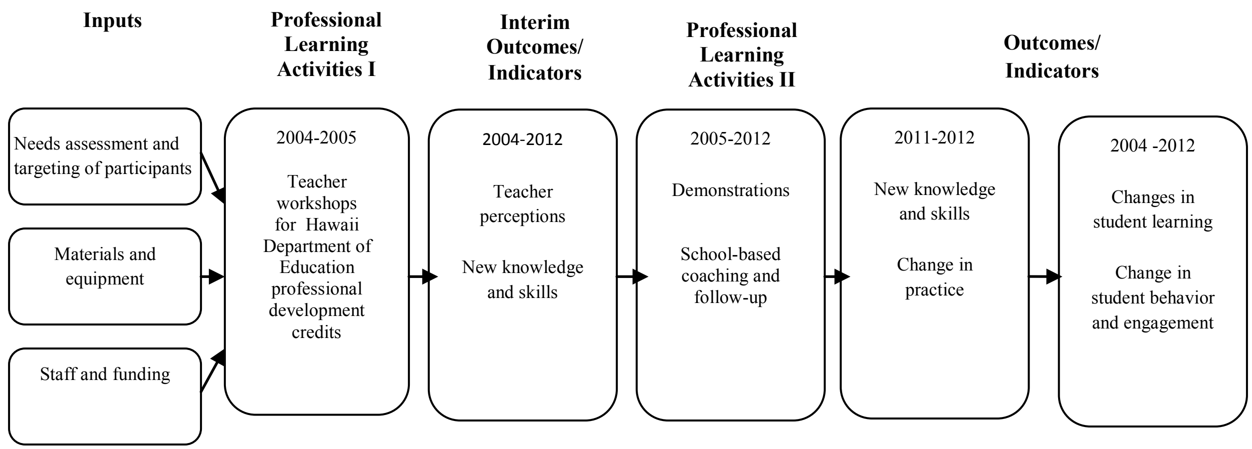

Figure 1.2. Teacher Professional Development Logic Model adapted from Haslem (2010). Modifications include the *Educate to Eradicate* evaluation time frame.

Chapter 2
Changes in Student Knowledge and Behavior

Introduction

In 2003, the University of Hawaii Termite Project initiated the K-12 curricula project *Educate to Eradicate*. The goal of this project was to create self-sustaining curricula that increased science literacy in Hawaii schools while helping protect current and future homeowners from termite damages (Grace et al. 2007). Standards-based inquiry science lessons were created and provided to interested public school teachers (Grace et al. 2008). In 2011, a formative evaluation of *Educate to Eradicate* was initiated to assess the project's effects on student knowledge, skills, and behaviors. Student surveys were chosen to evaluate curricula efficacy because surveys can be administered anonymously, gather large amounts of data quickly, and are easily built into classroom instruction (Creswell 2005). Student pre/post-surveys are commonly used to evaluate extension curriculum efficacy (Kelsey et al. 2005, Jensen et al. 2009, Diem 2001, Jones et al. 2006).

The present study evaluated the impact of participation in *Educate to Eradicate* curricula on student knowledge, skills, and behaviors. Findings were used to strengthen the development of self-sustaining curricula.

Materials and Methods

All participating students attended Hawaii Public Schools (Oahu: 28, Maui: 2, Hawaii: 1). Changes in student knowledge, skills, and behaviors were measured with student surveys. These survey tools were created by a panel of experts from (1) the University of Hawaii Termite Project, Department of Plant and Environmental Protection Sciences, (2) the Curriculum Research & Development Group, University of Hawaii at Manoa College of Education, and (3) Graduate Science, Technology, Engineering, and Mathematics (STEM) Fellows in K-12 Education Program, University of Hawaii at Manoa. Pre- and post-concept surveys were designed to measure student skills and unit-specific content knowledge. Initial surveys were trialed during the 2003-2004 school year and refined based on teacher and project staff feedback. Resulting surveys have been administered to groups from 2004 to present. Surveys range from 6 to 28 questions depending on curricula grade-level objectives (Appendix B). *Subterranean Termite Prevention Home Surveys* were created to document student extension efforts and behaviors (Appendix C).

As part of classroom instruction, partner teachers read concept surveys out loud as students recorded their responses. Pre-concept surveys were completed within one week prior to curriculum implementation and post-concept surveys within two weeks of project completion. A total of 5,192 paired-surveys were received from students in grades 1-12 (48% return rate) (Table 2.1). Percentages of item responses were compared before and after participation in *Educate to Eradicate* curricula. Classroom mean pre-/post-concept survey scores were compared with paired *t*-tests (Tables 2.2-2.6).

Student survey data from 92 teachers across 31 schools were combined as split plots to assess curricula performance across a range of conditions. All grade levels were surveyed on insect parts, characteristics of social insects, jobs performed by different termite castes, and termite prevention. Effects of school, teacher, curricula, and years of teacher participation (covariate) on student learning were evaluated with ANOVA (SAS software, Version 9.2, PROC GLM linear model) (Tables 2.7-2.10).

As a culminating activity, students survey their homes with parents/guardians, searching for termite signs and/or termite-conducive conditions. Students use a S*ubterranean Termite Prevention Home Survey* for the inspection, which includes an area for parent/guardian feedback and signature. Return and signature rates were tallied during the 2010-2011 school year.

Not all surveys were returned by teachers. These omissions sometimes included missing documentation from entire classrooms. Other reasons for omission included student movement between schools and absenteeism. This analysis assumes unreturned surveys were random.

The study design, procedures, and instruments were approved by the University of Hawaii institutional review board, the Committee on Human Subjects (CHS#18356).

Results

Students reported significant gains in content knowledge across all but one assessed parameter (Tables 2.2-2.6). Middle and high school students reported the largest gain in their ability to name and describe termite caste members' jobs (63% increase) and indicated significant gains in all concept survey prompts (16%-63% increases). In addition to a concept survey, middle and high school students rated their command of unit-specific vocabulary. Students showed significant increases in vocabulary scores for all terms. The largest mean survey score increase (48%) was found for "*frass*" (drywood termite fecal pellets). Middle school English language learner and special education classrooms reported significant gains (30%- 43%) across all prompts other than "*I can make scientific observations using words and pictures.*" First- through fifth-grade students' mean survey scores increased significantly across all prompts (7%-40%). The largest gains across all grade levels were in the ability to name termite caste members and describe caste jobs (40%). The smallest change was reported for "*I can make scientific observations using words and pictures*."

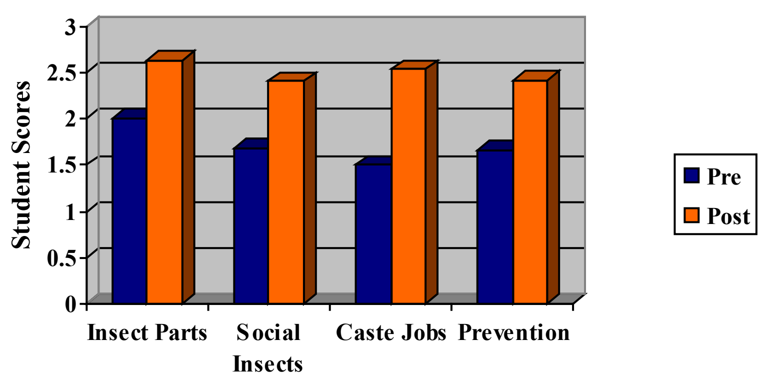

Figure 2.1. Student knowledge before and after *Educate to Eradicate* curricula. All grade levels combined across four prompts.

Participation in *Educate to Eradicate* curriculum had a significant effect on student scores. Average pre-survey responses to the prompt "*I can list the six prevention* *steps scientists suggest my parents take to keep worker termites from damaging our home"* fell between "*Not Really"* and "*I Think So,"* at 1.7. After curriculum participation, the average response was between "*I Think So"* and "*Yes,"* at 2.4.

Curriculum had a significant positive effect on student scores across all four prompts. Teachers and curriculum/school interactions were found to have significant, but inconsistent, relationships on individual survey questions. School had significant impacts on responses to insect parts and social insects, but not on termite caste jobs or prevention. Educator experience with curriculum was not associated with learner outcomes across all four prompts.

The S*ubterranean Termite Prevention Home Survey* was returned by 86% of 2010-2011 students. Of those returned, 74% were signed by a parent/guardian.

Discussion

Students showed significant knowledge gains across most content prompts. The one prompt that did not have significant mean increases still reflected increases in student confidence. The percentage of English language learners and special education middle school students who responded "*Yes*" to "*I can make scientific observations using words and pictures*" increased from 36.1% to 56.6%. Scientific observation is an ongoing performance standard taught at all grade levels (HCPS III 2007). Additionally, students within this group participated in *Educate to Eradicate* curriculum during the second semester of school. Prior to the *Educate to Eradicate* unit, students had completed lessons and laboratories that incorporated scientific observation. While increases in student confidence were identified, relatively high prior ability to record scientific observations were reflected in the survey data.

Middle and high school students reported the largest gains in the terms "frass," "decomposer," and "subterranean." "Frass" is a unique entomological term that describes the termite droppings Hawaii students encounter. Linking vocabulary to a familiar sight may account for large gains in vocabulary acquisition. All groups reported the largest gains in their ability to name and describe the jobs of termite caste members. Students had the lowest prior knowledge of this prompt and the largest subsequent gains. These gains could be attributed to the lessons' connection to the Hawaii "structure and function in organisms" standard, extensive curricula reinforcement activities, and innate student interest. Observed increases from pre- to post-concept surveys were within the range reported in similar assessments of extension curricula (Boleman and Burrell 2003, Hoover et al. 2009, Van Offelen et al. 2011).

In addition to significant increases in unit-specific knowledge, students demonstrated changes in behaviors. Similar to Webster (2006), students demonstrated changes in behaviors by conducting service learning activities, including the creation of pest prevention presentations, posters, websites, pamphlets, and songs. Students then documented their sharing of pest prevention media with adult community members. Additionally, all participating students were assigned the S*ubterranean Termite Prevention Home Surveys* as an extension of classroom instruction. During the 2010-2011 school year, 86% of participating students performed home inspections with guardians and returned completed surveys, with 74% signed by a parent/guardian.

Student survey data indicated significant impacts on student learning based on pre- and post-concept surveys. These gains were most significant within termite-specific content knowledge. Students demonstrated a change in behavior by inspecting their homes for signs of termites and termite-conducive conditions. Effects on student knowledge, behavior, and attitudes are further explored with teacher focus groups in Chapter 4.

Table 2.1. Grade level breakdown of survey respondents

Grade(s)	Number of Schools	Number of Teachers	Number of Students
1	4	8	280
2	8	17	472
2/3	2	6	195
3	2	8	244
3/4	2	2	32
4	8	27	1021
5	5	13	420
6	2	2	85
7	4	7	795
8	1	1	5
9	1	1	59
10	6	7	571
11-12	1	1	214

Table 2.2. Student responses to key terms on concept inventory before and after curriculum implementation from grades 7-12

Survey Prompt	Student Responses	Pre Curriculum (n=1235)	Post Curriculum (n=1222)	Pre-Survey Mean Scores	Post-Survey Mean Scores	Paired *t*-test Results (by class)	Mean Score Increase
Social insect	I don't know or I don't understand.	41.3%	4.4%	1.8	3.2	$t(18)=5.0$, $p=0.0001$	1.4
	I understand a little.	28.4%	16.2%				
	I understand but I cannot teach someone else.	21.9%	37.2%				
	I understand completely AND I can teach someone.	8.5%	42.3%				
Caste system	I don't know or I don't understand.	61.8%	7.3%	2.0	3.2	$t(18)=6.9$, $p=0.0001$	1.2
	I understand a little.	22.1%	15.9%				
	I understand but I cannot teach someone else.	10.5%	32.8%				
	I understand completely AND I can teach someone.	5.7%	44.0%				
Pest management	I don't know or I don't understand.	30.6%	8.3%	1.6	3.1	$t(18)=19.3$, $p=0.0001$	1.5
	I understand a little.	32.8%	16.5%				
	I understand but I cannot teach someone else.	26.4%	34.4%				
	I understand completely AND I can teach someone.	10.2%	40.8%				
Insect	I don't know or I don't understand.	5.5%	1.0%	2.1	3.5	$t(18)=17.3$, $p=0.0001$	1.4
	I understand a little.	14.7%	5.4%				
	I understand but I cannot teach someone else.	35.5%	30.7%				
	I understand completely AND I can teach someone.	44.3%	62.9%				

Table 2.2. Student responses to key terms on concept inventory before and after curriculum implementation from grades 7-12 -*continued*

Survey Prompt	Student Responses	Pre Curriculum (n=1235)	Post Curriculum (n=1222)	Pre-Survey Mean Scores	Post-Survey Mean Scores	Paired t-test Results (by class)	Mean Score Increase
Classification	I don't know or I don't understand.	19.3%	4.4%	2.4	3.0	$t(18)=12.6$, $p=0.0001$	0.6
	I understand a little.	34.2%	20.2%				
	I understand but I cannot teach someone else.	30.0%	43.3%				
	I understand completely AND I can teach someone.	16.5%	32.0%				
Carton	I don't know or I don't understand.	60.1%	7.6%	2.4	3.2	$t(18)=6.7$, $p= 0.0001$	0.7
	I understand a little.	20.4%	15.1%				
	I understand but I cannot teach someone else.	9.7%	31.5%				
	I understand completely AND I can teach someone.	9.8%	45.8%				
Pheromones	I don't know or I don't understand.	58.0%	16.4%	1.6	2.7	$t(18)=6.5$, $p= 0.0001$	1.1
	I understand a little.	16.1%	23.1%				
	I understand but I cannot teach someone else.	13.9%	29.1%				
	I understand completely AND I can teach someone.	12.0%	31.5%				
Alate	I don't know or I don't understand.	81.5%	7.6%	1.8	3.3	$t(18)=6.6$, $p= 0.0001$	1.5
	I understand a little.	12.3%	11.3%				
	I understand but I cannot teach someone else.	4.3%	26.3%				
	I understand completely AND I can teach someone.	1.9%	54.7%				

Table 2.2. Student responses to key terms on concept inventory before and after curriculum implementation from grades 7-12 -*continued*

Survey Prompt	Student Responses	Pre Curriculum (*n*=1235)	Post Curriculum (*n*=1222)	Pre-Survey Mean Scores	Post-Survey Mean Scores	Paired *t*-test Results (by class)	Mean Score Increase
Decomposer	I don't know or I don't understand.	28.3%	5.9%	1.3	3.1	*t*(18)=19.5, *p*= 0.0001	1.8
	I understand a little.	24.6%	18.0%				
	I understand but I cannot teach someone else.	27.2%	35.4%				
	I understand completely AND I can teach someone.	20.0%	40.7%				
Colony	I don't know or I don't understand.	14.4%	1.8%	2.3	3.5	*t*(18)=16.1, *p*= 0.0001	1.2
	I understand a little.	20.6%	7.0%				
	I understand but I cannot teach someone else.	33.5%	26.2%				
	I understand completely AND I can teach someone.	31.5%	65.0%				
Symbiosis	I don't know or I don't understand.	60.1%	15.6%	1.7	2.7	*t*(18)=11.0, *p*= 0.0001	1.0
	I understand a little.	18.9%	26.8%				
	I understand but I cannot teach someone else.	11.6%	28.0%				
	I understand completely AND I can teach someone.	9.4%	29.6%				
Protozoa	I don't know or I don't understand.	64.4%	9.5%	1.6	2.9	*t*(18)=10.9, *p*= 0.0001	1.4
	I understand a little.	22.9%	19.0%				
	I understand but I cannot teach someone else.	9.3%	32.2%				
	I understand completely AND I can teach someone.	3.5%	39.3%				

Table 2.2. Student responses to key terms on concept inventory before and after curriculum implementation from grades 7-12 -*continued*

Survey Prompt	Student Responses	Pre Curriculum (*n*=1235)	Post Curriculum (*n*=1222)	Pre-Survey Mean Scores	Post-Survey Mean Scores	Paired *t*-test Results (by class)	Mean Score Increase
Frass	I don't know or I don't understand.	81.8%	10.7%	1.3	3.2	$t(18)=17.6$, $p= 0.0001$	1.9
	I understand a little.	12.8%	15.3%				
	I understand but I cannot teach someone else.	2.8%	29.6%				
	I understand completely AND I can teach someone.	2.6%	44.8%				
Subterranean	I don't know or I don't understand.	63.0%	6.7%	1.6	3.3	$t(18)=21.7$, $p= 0.0001$	1.7
	I understand a little.	20.3%	12.2%				
	I understand but I cannot teach someone else.	10.9%	28.3%				
	I understand completely AND I can teach someone.	5.9%	52.8%				
Cellulose	I don't know or I don't understand.	57.3%	11.6%	1.7	2.8	$t(18)=9.9$, $p= 0.0001$	1.1
	I understand a little.	20.0%	23.8%				
	I understand but I cannot teach someone else.	14.6%	33.8%				
	I understand completely AND I can teach someone.	8.2%	30.8%				

Table 2.3. Student responses to concept survey questions from grades 6-12

Survey Question	Student Responses	Pre Curriculum (n=1310)	Post Curriculum (n=1294)	Pre-Survey Mean Scores	Post-Survey Mean Scores	Paired t-test Results (by class)	Mean Score Increase
Q1. I know the three body parts that define an insect.	No	21.9%	1.2%	2.1	2.9	$t(21)= 7.7$, $p= 0.0001$	0.8
	Maybe	37.8%	9.5%				
	Yes	40.3%	89.3%				
Q2. I can name t least two different levels of scientific classification.	No	33.2%	7.3%	1.9	2.4	$t(21)=6.52$, $p= 0.0001$	0.5
	Maybe	37.2%	39.0%				
	Yes	29.6%	53.7%				
Q3. I can list the three special qualities of a social insect.	No	51.3%	7.2%	1.6	2.5	$t(21)= 10.2$, $p= 0.0001$	0.9
	Maybe	33.5%	31.0%				
	Yes	15.3%	61.8%				
Q4. I can name all the caste members of the termite colony and describe their jobs.	No	73.6%	7.1%	1.3	2.6	$t(21)= 17.8$, $p= 0.0001$	1.3
	Maybe	21.8%	28.4%				
	Yes	4.6%	64.5%				
Q5. I can diagram and label the termite lifecycle.	No	69.4%	12.5%	1.3	2.3	$t(21)= 9.6$, $p= 0.0001$	1.0
	Maybe	24.7%	40.7%				
	Yes	5.9%	46.8%				
Q6. Alates are the only caste member to fly from a termite colony.	No	37.3%	9.9%	1.7	2.5	$t(21)= 7.6$, $p= 0.0001$	0.8
	Maybe	55.7%	19.5%				
	Yes	7.0%	70.6%				
Q7. Frass is made by drywood termites.	No	25.3%	9.4%	1.8	2.5	$t(20)= 12.4$, $p= 0.0001$	0.7
	Maybe	63.2%	22.4%				
	Yes	11.6%	68.2%				

Table 2.3. Student responses to concept survey questions from <u>grades 6-12</u> *-continued*

Survey Question	**Student Responses**	**Pre Curriculum** (n=1310)	**Post Curriculum** (n=1294)	**Pre-Survey Mean Scores**	**Post-Survey Mean Scores**	**Paired *t*-test Results (by class)**	**Mean Score Increase**
Q8.Termites and Protozoa live in a symbiotic relationship.	No	29.3%	4.4%	1.8	2.6	$t(20)$= 13.1, p= 0.0001	0.8
	Maybe	59.3%	23.3%				
	Yes	11.5%	72.3%				
Q9. I can explain how termites communicate information within their colony.	No	58.4%	5.4%	1.5	2.7	$t(20)$= 16.0, p= 0.0001	1.2
	Maybe	27.8%	21.3%				
	Yes	13.8%	73.3%				
Q10. I can tell the difference between a subterranean termite and a drywood termite.	No	62.4%	6.7%	1.5	2.6	$t(20)$= 16.9, p= 0.0001	1.1
	Maybe	26.9%	21.7%				
	Yes	10.7%	71.6%				
Q11. Carton is made up of saliva, dirt and waste material.	No	24.7%	4.9%	1.9	2.6	$t(20)$= 9.7, p= 0.0001	0.7
	Maybe	60.1%	25.9%				
	Yes	15.2%	69.3%				
Q12. In the forest environment the termite is a beneficial insect.	No	26.3%	11.3%	2.0	2.5	$t(20)$= 7.0, p= 0.0001	0.5
	Maybe	42.6%	31.3%				
	Yes	31.1%	57.4%				
Q13. I can list the six prevention steps scientists suggest my parents take to keep worker termites from damaging homes.	No	58.2%	8.5%	1.5	2.5	$t(20)$= 18.0, p= 0.0001	1.0
	Maybe	32.4%	33.2%				
	Yes	9.4%	58.4%				

Table 2.4. Student responses to concept survey questions from grades 6-8 (includes English language learner and special education science classes)

Survey Question	**Student Responses**	**Pre Curriculum** (n=335)	**Post Curriculum** (n=349)	**Pre-Survey Mean Scores**	**Post-Survey Mean Scores**	**Paired *t*-test Results (by class)**	**Mean Score Increase**
Q1. I know the four defining characteristics an insect.	Not really	48.9%	4.9%	1.7	2.6	$t(8)=8.6$, $p=0.0001$	0.9
	I think so	48.9%	35.8%				
	Yes	12.2%	59.3%				
Q2. I can make scientific observations using words and pictures.	Not really	13.4%	5.7%	2.3	2.5	$t(8)=2.16$, $p=0.07$	0.3
	I think so	50.5%	34.7%				
	Yes	36.1%	56.6%				
Q3. I can describe the main difference between social insects and non-social insects.	Not really	59.0%	10.6%	1.5	2.4	$t(8)=6.4$, $p=0.0001$	0.9
	I think so	32.9%	41.3%				
	Yes	8.1%	48.1%				
Q4. I can name all the members of the termite family and describe the colony jobs for each member.	Not really	72.9%	6.3%	1.3	2.7	$t(8)=10.7$, $p=0.0001$	1.3
	I think so	20.2%	24.4%				
	Yes	6.9%	69.3%				
Q5. I can draw and label the termite lifecycle.	Not really	58.4%	10.6%	1.5	2.5	$t(8)=7.9$, $p=0.0001$	0.9
	I think so	33.4%	33.8%				
	Yes	8.1%	55.6%				
Q6. I can explain how termites communicate information within their colony.	Not really	55.4%	7.2%	1.6	2.6	$t(8)=6.6$, $p=0.0001$	1.0
	I think so	32.5%	25.0%				
	Yes	12.1%	67.8%				
Q7. I can list the five prevention steps scientists suggest my parents take to keep worker termites from damaging our home.	Not really	57.3%	6.0%	1.5	2.6	$t(8)=12.6$, $p=0.0001$	1.1
	I think so	34.2%	30.2%				
	Yes	8.5%	63.8%				

Table 2.5. Student responses to concept survey questions from grades 4-5

Survey Question	Student Responses	Pre Curriculum (n=1331)	Post Curriculum (n=1256)	Pre-Survey Mean Scores	Post-Survey Mean Scores	Paired t-test Results (by class)	Mean Score Increase
Q1. I know the four defining characteristics an insect.	Not really	29.3%	4.7%	2.0	2.6	$t(24)=11.1$, $p= 0.0001$	0.6
	I think so	43.8%	27.2%				
	Yes	26.9%	68.2%				
Q2. I can make scientific observations using words and pictures.	Not really	12.9%	5.5%	2.4	2.6	$t(24)=4.9$, $p= 0.0001$	0.2
	I think so	39.1%	28.8%				
	Yes	48.0%	65.7%				
Q3. I can describe the main difference between social insects and non-social insects.	Not really	51.2%	7.3%	1.6	2.5	$t(24)=10.3$, $p= 0.0001$	0.9
	I think so	34.2%	36.3%				
	Yes	11.6%	56.5%				
Q4. I can name all the members of the termite family and describe the colony jobs for each member.	Not really	59.4%	6.6%	1.5	2.6	$t(24)=17.2$, $p= 0.0001$	1.2
	I think so	29.0%	23.5%				
	Yes	11.6%	70.0%				
Q5. I can draw and label the termite lifecycle.	Not really	48.6%	7.6%	1.6	2.5	$t(24)=19.1$, $p= 0.0001$	0.9
	I think so	37.3%	33.7%				
	Yes	14.1%	58.7%				
Q6. I can explain how termites communicate information within their colony.	Not really	58.3%	10.4%	1.5	2.5	$t(22)=12.0$, $p= 0.0001$	1.0
	I think so	31.6%	31.7%				
	Yes	10.1%	57.9%				
Q7. I can list the five prevention steps scientists suggest my parents take to keep worker termites from damaging our home.	Not really	50.3%	11.2%	1.7	2.4	$t(24)=8.5$, $p= 0.0001$	0.7
	I think so	32.1%	35.5%				
	Yes	17.6%	53.4%				

Table 2.6. Student responses to concept survey questions from grades 1-3

Survey Question	Student Responses	Pre Curriculum (n=1858)	Post Curriculum (n=1771)	Pre-Survey Mean Scores	Post-Survey Mean Scores	Paired t-test Results (by class)	Mean Score Increase
Q1. I can name all the body parts of an insect.	Not really	29.7%	2.7%	1.9	2.8	$t(88)= 19.1$, $p=0.0001$	0.8
	I think so	48.7%	18.9%				
	Yes	21.6%	78.5%				
Q2. I can make observations using words and pictures.	Not really	24.4%	7.8%	2.2	2.5	$t(88)= 7.5$, $p= 0.0001$	0.3
	I think so	35.3%	31.6%				
	Yes	40.2%	60.7%				
Q3. I can describe three things special to social insects.	Not really	49.6%	15.1%	1.7	2.4	$t(88)= 13.1$, $p= 0.0001$	0.7
	I think so	30.6%	30.3%				
	Yes	19.8%	54.7%				
Q4. I know the names of six different termite family members.	Not really	65.3%	7.9%	1.5	2.7	$t(88)= 21.0$, $p= 0.0001$	1.2
	I think so	22.9%	19.9%				
	Yes	11.8%	72.2%				
Q5. I know the jobs of each of the six termite family members.	Not really	53.0%	6.1%	1.6	2.7	$t(82)=19.1.$ $p=0.0001$	1.1
	I think so	30.7%	18.1%				
	Yes	16.3%	75.8%				
Q6. I know the six Do's and Do Not's of ground termite prevention that help my family make our house less termite friendly.	Not really	53.6%	10.8%	1.6	2.5	$t(88)= 16.9$, $p=0.0001$	0.9
	I think so	28.6%	25.6%				
	Yes	17.8%	63.6%				

Table 2.7. ANOVA Table for Insect Parts Prompt				
Source	df	Mean Square	F	*p*
School	30	14.2	7.5	<0.0001
Teacher (School)	63	1.9	5.4	<0.0001
Curriculum	1	296.8	18.6	0.0002
Curriculum X School	30	16.0	45.1	<0.0001
Years of Teacher Participation	1	0.008	0.02	0.09

Table 2.8. ANOVA Table for Social Insects Prompt				
Source	df	Mean Square	F	*p*
School	30	6.0	2.2	0.004
Teacher (School)	63	2.7	6.2	<0.0001
Curriculum	1	335.0	19.5	0.0001
Curriculum X School	30	17.2	39.3	<0.0001
Years of Teacher Participation	1	0.3	0.7	0.4

Table 2.9. ANOVA Table for Termite Caste Jobs Prompt				
Source	df	Mean Square	F	*p*
School	30	3.3	1.6	0.06
Teacher (School)	63	2.1	5.6	<0.0001
Curriculum	1	650.7	26.7	<0.0001
Curriculum X School	30	24.4	64.8	<0.0001
Years of Teacher Participation	1	0.9	2.3	0.1

Table 2.10. ANOVA Table for Prevention Prompt				
Source	df	Mean Square	F	*p*
School	30	2.5	1.1	0.3
Teacher (School)	63	2.2	4.8	<0.0001
Curriculum	1	385.6	18.5	0.0002
Curriculum X School	30	20.9	45.9	<0.0001
Years of Teacher Participation	1	1.4	3.0	0.08

CHAPTER 3

Teacher Characteristics and Perceptions of Curricula: Clues to Adoption and Continuation

Introduction

Educate to Eradicate is a K-12 curriculum project using termite biology and management as the basis for science education that has been implemented in over 350 Hawaii public school classrooms with 12,530 students and is coupled with community outreach efforts (Grace et al. 2007). This study aimed to (1) identify factors that influenced the adoption and continuation of pest management curricula in public school classrooms, and (2) evaluate the efficacy of community education efforts. This was accomplished in part by a survey of partner teachers to identify characteristics correlated with either sustained use or discontinuation of the curriculum, such as perceptions of project content/pedagogy, science background, teacher training, and teacher/school demographics. Secondly, we evaluated gains in teacher knowledge and skills and changes in instructional practice and student learning. Lastly, efficacy of the program in promoting termite suppression was measured through student engagement in extension (outreach) activities and changes in knowledge of termite prevention methods. The goal of this program is a self-sustaining curriculum that will require limited institutional inputs, increase science literacy in Hawaii schools, and help to protect current and future homeowners from termite damages.

Past science curriculum studies have linked teacher age, gender, experience and tenure (Rudd and Hillison 1995) to novel science curriculum adoption rates. Teachers' content knowledge and attitude were positively correlated with the implementation of state-sponsored curriculum (Rudd and Hillison 1995). Perceived advantage, simplicity, and trial-ability of curricula have been predictive of intended continuation. Additional factors associated with teacher adoption and continuation of curriculum include perceived resource availability, quality of professional development, faculty support, standard alignment, student abilities, planning time, and technical support (Diker et al. 2011, Ni 2009, Lee 2000, Fishman et al. 2007, McNeely and Wells 1997, Roehrig et al. 2007).

Face-to-face teacher training and explicit curriculum with prescribed activities have also been associated with increased teacher adoption rates (Perry et al. 1990).

The University of Hawaii Termite Project has recruited teachers by offering Hawaii Department of Education professional development credits, curriculum/materials, and in-class curriculum modeling. The project was advertised by flyer-drops and word of mouth. Teachers self-selected into the curriculum and underwent weekend, weeknight, and/or on-site professional development. Over six years of the project (2004-2010), approximately two-thirds of teachers did not repeat the curriculum after the first year of implementation. We examined teacher survey responses for clues to both project efficacy and continuation.

Materials and Methods

All *Educate to Eradicate* partner teachers were targeted for project evaluation throughout curricula implementation. Partner teacher demographics and perceptions of *Educate to Eradicate* curricula were recorded with surveys. These survey tools were created by a panel of experts from (1) the University of Hawaii Termite Project, Department of Plant and Environmental Protection Sciences, (2) the Curriculum Research & Development Group, University of Hawaii at Manoa College of Education, and (3) Graduate Science, Technology, Engineering, and Mathematics (STEM) Fellows in K-12 Education Program, University of Hawaii at Manoa. Surveys were designed to capture teachers' motivations, subject specialties, teaching experience, and education through multiple-choice and open-ended questions. Surveys also measured perceptions of curricula, resources, and impacts on teacher/student learning with Likert-type scales (Appendix D).

After unit completion, all teachers were asked to return surveys (from 2004 to present). When teachers continued use of the curriculum and submitted several surveys over successive years, the first submission was used for analysis, as representative of their initial impressions. Omitted responses to survey questions were treated as missing values and not included in response means. Response frequencies and means were calculated.

Linear regression (stepwise method, $P< 0.1$ enter rate) was used to correlate teacher continuation (participated: 0- one year, 1-two years, 2- three or more years) on the basis of grade level, science background, teaching experience, perceptions of project content/pedagogy, motivations, subject specialties, and school socioeconomic status (SES) (SAS software, Version 9.2, linear regression). Teacher continuation data were square root transformed [$\sqrt{(X + 0.5)}$] because data points are small whole-number counts of rare events. School SES data were arcsine transformed because they were reported as a percent of the student population. Survey data were collected with two surveys. Regression analysis was applied to demographic and teacher motivator questions for all responders. Perceptions of curriculum were analyzed separately for survey versions A (Table 3.4) and B (Table 3.6), due to different constructs, wordings, and scales. A total of three stepwise regressions were preformed (combined A and B: Table 3.3, survey A: Table 3.5, survey B: Table 3.7).

Results

Participating teachers from 17 public schools responded (Oahu: 12, Maui: 5). Data collected from 2004-2010 were used for this analysis. Survey data from 66 (33%) partner teachers were collected. Eighty-eight percent of the respondents were females and 12 percent male. Forty-seven percent of the respondents continued the curriculum into at least a second year, 39% repeated curriculum three or more years, and 53% did not repeat curriculum. Higher continuation rates were seen within survey respondents, compared to the overall teacher population. The majority of partner teachers fell within the 30-39 (31%) and 50-59 (28%) age groups (Figure 3.1). The majority of *Educate to Eradicate* partner teachers had worked in Hawaii throughout their careers, and had moved between schools (Table 3.1).

Teacher Demographics

Figure 3.1. *Educate to Eradicate* partner teacher age distribution

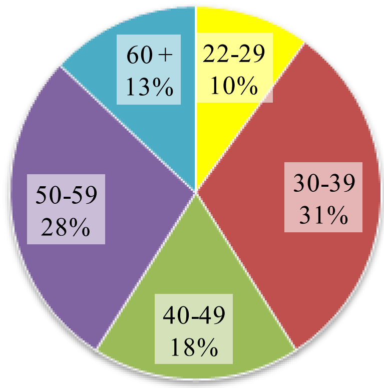

Table 3.1. *Educate to Eradicate* partner teacher professional experience

	≤5 years	**6-10 years**	**11-20 years**	**21+ years**
Years of teaching experience:	32%	16%	31%	21%
Years teaching in Hawaii:	34%	18%	30%	18%
Years at current school:	58%	15%	22%	5%

Table 3.2. *Educate to Eradicate* partner teacher motivations for adopting curriculum

Motivations for partnering with the University of Hawaii Termite Project: *Educate to Eradicate*	**Percent response**
Meet science standards	88%
Science skills	76%
Live insect observations	76%
Excite students about science	71%
Experience scientific inquiry	65%
Curriculum/ material resources	59%
Subject relevance to student's lives	58%
Termite content knowledge	53%
University partnership	45%
In class termite staff support	38%
Community outreach	33%
Personal interest	33%
Language art/ reading skills	26%
Other responses:	9%
● Tie in with community curriculum (6%). ● Contact with real scientists, Proximity to University- can walk to termite lab for field trip (1.5%). ● Part of grade level curriculum (1.5%).	

Table 3.3. Regression of 66 *Educate to Eradicate* partner teachers' curriculum continuation on teacher characteristics (surveys A and B)

Variable	**β**	**t-val**	**t-prob**	**Seq R^2**	**Model R^2**
Motivation: *Excite students about science*	0.31	2.78	0.0074	0.12	0.12
Arcsine (percent free/reduced lunch)	-0.55	-2.05	0.045	0.067	0.18
21+ years at current school	-0.32	-2.12	0.039	0.058	0.24

Teachers cited meeting science standards (88%), teaching science skills (76%), and using live insects (76%) most often as motivators for partnering with the University of Hawaii Termite Project (Table 3.2). Teachers who indicated "*exciting students about science*" as a motivator were significantly more likely to continue curriculum (β= 0.31, P= 0.007). Partner schools' population of students who qualify for free or reduced lunch ranged from 9.4% to 89.2%. This measure of student socioeconomic status (SES) was a significant predictor of teacher continuation. Partner teachers servicing lower SES students are less likely to continue curriculum (β = -0.55, P= 0.045). Additionally, teachers who had worked at their current school over 21 years at the time of curriculum adoption were less likely to continue curriculum (β = -0.32, P= 0.039).

Table 3.4. *Educate to Eradicate* partner teachers' perceptions of curriculum (survey A)

Part 1: Project Curriculum and Resources	**Mean**	**SD**
1. Overall impression of UH Termite Project curriculum, materials and resources	3.7	0.45
2. Arrangement of learning sequence and termite content knowledge topics	3.6	0.49
3. Classroom delivery of subject content and activities	3.5	0.58
4. Grade level appropriateness of content, activities, and worksheets	3.6	0.70
5. Activity and lesson alignment with Hawaii State Science Standards	3.4	0.64
6. Ability of the Termite Project Unit to fit into and enhance already existing classroom science curriculum	3.4	0.64
7. Effectiveness of visual aides and activities in demonstrating and enforcing termite content knowledge	3.6	0.49
4=Excellent, 3= Good, 2= Satisfactory, 1= Unsatisfactory		
Part 2: Impact on Teacher/Student Learning	**Mean**	**SD**
1. Overall student/ teacher learning experience with the UH Termite Project	3.6	0.58
2. Student enthusiasm and enjoyment levels during program participation	3.8	0.43
3. Did students show interest in learning about termites?	Yes	0.00
4. Student understanding and comprehension of major termite knowledge concepts	3.4	0.50
5. Were students excited about sharing their new termite knowledge with others (sharing knowledge project)?	Yes	0.00
6. Impact of program on science learning, skills, and content knowledge for both teacher and students	Significant	0.00
7. Was this a valuable experience for both teachers and students?	Yes	0.00
8. Would you consider partnering with the project again next school year?	Yes	0.00
4=Excellent, 3= Good, 2= Satisfactory, 1= Unsatisfactory [Questions 3, 5-8 are binary response]		

Table 3.5. Regression of 43 *Educate to Eradicate* partner teachers' project continuation on perceptions of curriculum and teacher characteristics (survey A)

Variable	β	t-val	t-prob	Seq R^2	Model R^2
Impact on teacher/ student learning: *Student understanding and comprehension of major termite knowledge concepts*	0.61	6.62	<0.0001	0.44	0.44
Teacher subject specialty: *Other*	-0.48	-4.34	0.0003	0.34	0.77

Teachers reported that curriculum implementation was a valuable experience for teachers and students and had a significant impact on science learning, skills, and content knowledge. The overall student/teacher learning experience was ranked between good to excellent (3.6). Mean teacher responses indicate good to excellent perceptions of project curriculum, resources, and impacts on teacher/student learning. The highest mean scores were for "*student enthusiasm and enjoyment levels during program participation*" (3.8) and "*overall impression of UH Termite Project curriculum, materials, and resources*" (3.7). Teachers' response to impact on the teacher/student learning prompt "*student understanding and comprehension of major termite knowledge concepts"* was the only response positively correlated to teacher continuation (β= 0.61, P<0.0001). Teachers who identified having unlisted subject specialties were less likely to continue the curriculum (β= -0.48, P =0.0003).

Table 3.6. *Educate to Eradicate* partner teacher perceptions of curriculum (survey B)

Impact on Student Learning	Mean	SD
1. My students gained knowledge about termites from this project	4.5	0.79
2. My students gained awareness of termites through this project	4.6	0.72
3. This project helped my students understand the nature of the scientific process	4.0	0.82
4. My students were motivated during the project	4.6	0.72
5. My students gained content knowledge through this project	4.4	0.72
6. This project helped us connect parents with the learning program	3.7	0.81
7. My students could recognize signs of termite infestation at our school	3.8	0.96
8. I would be willing to conduct this project in my classroom again	4.6	0.72
9. My students are more interested in termites after participating in this project	4.6	0.72
10. My students are more interested in science after participating in this project	4.2	0.90
11. This project encouraged community outreach from my students	3.5	0.96
12. I was able to easily incorporate this project into my curriculum	4.3	0.85
13. The lessons and learning sequence was appropriate for my students	4.3	0.71
14. The program was well-aligned to the Hawaii State Science Standards	4.3	0.62
15. The visuals and activities provided were effective in demonstrating and reinforcing termite content knowledge	4.5	0.79
5= Strongly Agree, 4= Agree, 3= Unsure, 2= Disagree, 1= Strongly Disagree		

Table 3.7. Regression of 23 partner teachers' project continuation on perceptions of curriculum and teacher characteristics (survey B)

Variable	β	t-val	t-prob	SeqR ^{2}	Model R^2
Impact on student learning: *My students are more interested in termites after participating in this project*	0.25	2.70	0.014	0.26	0.26

Teachers indicated that students gained knowledge (4.5, 4.4) and the ability to recognize termite infestation (3.8) through project participation. Teachers *agree* or *strongly agree* that the project increased student interest and awareness of termites (4.6). Students were motivated during the project and teachers indicated they would be willing to conduct the project again (4.6). On average, teachers were *unsure* or *agreed* that the project encouraged community outreach from students (18% Strongly Agree, 32% Agree, 36% Unsure, 14% Disagree). Overall, teachers were more confident about the project's ability to help connect parents with the learning program (13% Strongly Agree, 57% Agree, 21.5% Unsure, 8.5% Disagree). Teachers who perceived students as "*more interested in termites after participating in this project*" were more likely to continue curriculum (β= 0.25, P=0.014)

Discussion

Teachers reported positive outcomes as a result of project implementation. The Termite Project's effects on student/teacher learning, student motivation/interest/enthusiasm, and awareness were most positively rated by teachers. Teachers were divided on their perceptions of the project's community impact. However, the majority of teachers viewed the project as a route to increasing parent involvement in learning activities.

Regression analysis indicated the motivation to "*excite students about science*" was correlated with teacher continuation. This is congruent with Ni's (2009) correlation of novel computer science curriculum adoption rates and teacher motivations. Rudd and Hillison (1995) found that as a teacher's tenure at a school increased, the likelihood of adopting the state-sponsored agriscience curriculum decreased (β=-0.25, P<0.01). We found a similar trend in teachers with over 21 years at a school (β=-0.32, P= 0.039). Additionally, teachers at schools with large rates of students eligible for free or reduced lunches were less likely to continue curriculum. This may be associated with higher rates of teacher attrition at schools with lower socioeconomic status (Borman and Dowling 2008), or an increased emphasis on standardized testing (HDOE 2010). Teachers who reported subject specialties not listed on the survey instrument were less likely to continue. Regression analysis highlighted that teachers with positive perceptions of "*impacts on student understanding and comprehension of major termite knowledge concepts";* and "*students interested in termites after participating in this project*" were more likely to continue the curriculum.

In summary, teachers who used the curriculum to excite students about science and perceived an increase in students' interest, knowledge, and comprehension of termite concepts were more likely to continue the project within their classrooms. Teachers who had lengthy tenure at one school, who worked at lower SES schools, or who had unique subject specialties were less likely to continue. Teacher focus groups were conducted to gather more information on the factors that influenced teachers' adoption and continuation of *Educate to Eradicate* curricula (Chapter 4).

CHAPTER 4

Optimizing Pest Management Curricula for Use in K-12 Classrooms

Introduction

Educate to Eradicate is a K-12 curriculum project using termite biology and management as the basis for science education (Grace et al. 2007, 2008) that, as of October, 2012 has been implemented in over 350 Hawaii public school classrooms with over 12,530 students; and is coupled with community outreach efforts. This study was initiated to (1) identify factors that influence the adoption and continuation of pest management curricula in public school classrooms, and (2) evaluate the efficacy of community education efforts. Teacher focus groups were organized to assess *Educate to Eradicate* curriculum design and professional development implementation. Perceptions of key project components and supports were recorded during teacher focus groups. Project supports useful for continued curriculum implementation were summarized and rated. Secondly, we evaluated changes in instructional practice and student learning. Findings will inform modifications to curriculum, professional development, and project supports. Resources will be optimized to maximize teacher continuation and student learning.

In past studies, teachers cited the incorporation of hands-on/experiential activities, integration with core academic subjects, perceived advantages, simplicity (user-friendliness), quality of professional development, and trialability of curriculum as motivators for adoption (Diker et al. 2011, Penuel et al. 2007). Face-to-face teacher training and explicit curriculum with prescribed activities have been associated with increased teacher adoption rates (Perry et al. 1990). Barriers to implementation included perceived deficiencies in resources, faculty support, planning time, student ability, or technical support (Diker et al. 2011, Ni 2009, Lee 2000, Penuel et al. 2007, McNeely and Wells 1997, Roehrig et al. 2007). This current study aimed to identify motivators and barriers specific to *Educate to Eradicate* implementation and adoption.

Changes in teacher knowledge, skills, and practice in relation to professional development have been measured through classroom observations, interviews, surveys, and/or student performance (Desimone 2009, Heslam 2010, Lemus et al. 2010, Pinzon-Perez & Perez 2006, Fishman et al. 2003). *Educate to Eradicate* partner teacher surveys were used to examine trends in teacher continuation. Teachers who used the curriculum to excite students about science and perceived an increase in students' interest, knowledge, and comprehension of termite concepts were more likely to continue the project within their classrooms. Teachers who had lengthy tenure at one school, who worked at lower SES schools, or who had unique subject specialties were less likely to continue.

The limited insights into curriculum adoption gleaned from our original teacher survey data (presented in Chapter 3) necessitated a more robust project evaluation strategy. At the recommendation of Dr. Donald Young, Director of the Curriculum Research & Development Group in the College of Education at the University of Hawaii at Manoa, we chose focus groups to further evaluate teachers' perceptions of the *Educate to Eradicate* curriculum, training, and support. Additionally, we evaluated changes in teacher practice and student outcomes. Qualitative analysis was applied to focus group transcripts as is common practice in assessments of educational partnership projects (Fitzpatrick et al. 2005, Knapp 1995, Pilat 1997) and curriculum adoption research (Diker et al. 2011, Dönmez 2010).

Materials and Methods

Partner teachers during the 2011-2012 school year were asked to participate in focus groups. Twenty-two teachers agreed to participate (41%). Five homogeneous groups were planned based on grade level, years of partnership, and school location (Brandon 2001; Morgan 1997, 1998; Stewart and Shamdasani 1990). All groups were recorded, transcribed, and analyzed using content analysis (NVivo qualitative data analysis software, Version 9; QSR International Pty Ltd.). Focus group interviews were structured with 12 open-ended questions to explore teachers' perceptions of curriculum design, professional development, and project supports (Appendix E). Additional questions were designed to assess teachers' mastery of project content knowledge/skills and to quantify changes in classroom time devoted to science at the elementary level and project-based science at the middle/high levels. Teachers were asked to list and rank curriculum materials necessary for project continuation. Emergent themes were coded throughout all transcripts, highlighting overall teacher perceptions while allowing for comparisons between early/late adopting teachers, and elementary/middle/high teachers (Krueger 1998, Morgan 1997).

Focus group protocol was reviewed by University of Hawaii Termite Project staff; Dr. Donna R. Ching, an expert in group facilitation in the College of Tropical Agriculture and Human Resources, University of Hawaii at Manoa; and Dr. Paul Brandon, a professor of qualitative research in the Department of Educational Psychology, College of Education, University of Hawaii at Manoa. The study design, procedures, and instruments were approved by the University of Hawaii institutional review board, the Committee on Human Subjects (CHS#18356).

Results and Discussion

Curriculum Design

Qualitative content analysis of the five teacher focus groups revealed key motivators for project adoption and continuation (Figure 4.1).

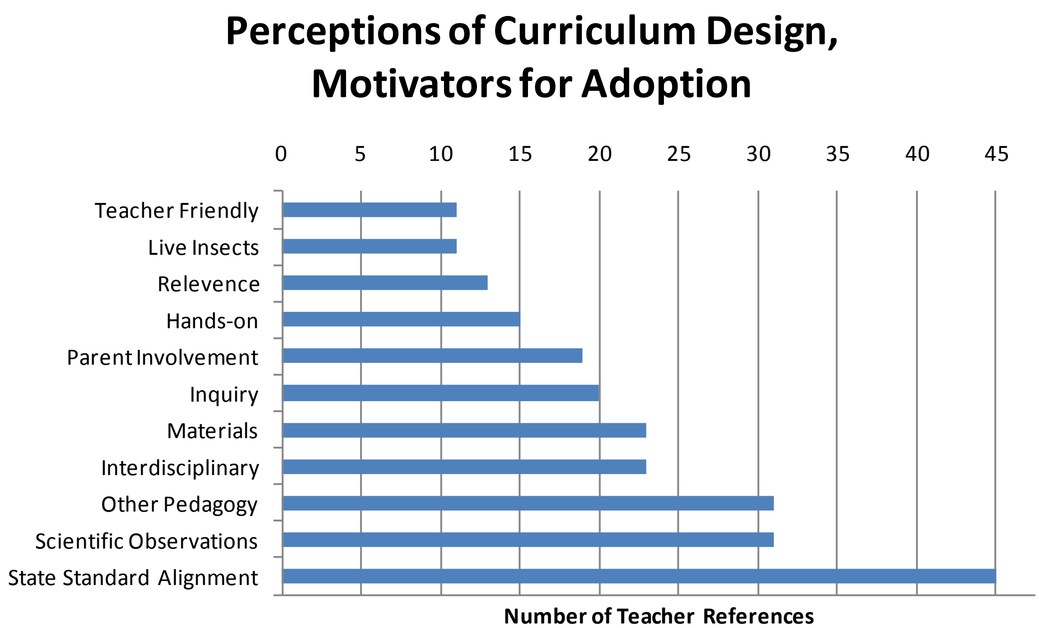

Figure 4.1. Emergent themes from *Educate to Eradicate* partner teacher focus group transcript data analyzed with NVIVO 9.

Overall, the alignment of curricula to Hawaii state instructional standards, incorporation of scientific observation, and use of pedagogy (reinforcement, kinesthetic songs, and crafts) were most often cited as motivators. Select responses that illustrate additional motivators included:

Interdisciplinary

- [The curriculum] was good because you could really kill so many birds with one stone, the art, the science, the math, and connect it with everything else. So we were more than happy to implement such a useful project. It was really manageable.

–Elementary School Late Adopter

Inquiry

- The first time I taught science was our termite unit, so for me it was so helpful because I had never taught science before. The whole inquiry, the observation, the fact that you weren't just having them do a worksheet. I mean they were observing, it was real.

– Elementary School Early Adopter

Parent involvement

We just had parent teacher conferences and I don't know how many parents said, "It's amazing, they come home and they are talking about termites." They're amazed at what their kids know. And what their kids taught them. We had kids writing in their journals, "We found termites in our parents' closet."

–Elementary School Early Adopter

[Students] were empowered. They knew so much that their parents did not know anything about. They felt so smart and so confident. That was really nice.

–Middle School Late Adopter

Hands-on

[A]nything that is hands-on is great. A lot of [my students] do go on to pursue a science degree. Lab technique is important. A lot of them have work-study and they have to work in a lab. Knowing protocols, hand eye coordination. There are a lot of females, especially the ones I've had that go into a science related field.

–High School Early Adopter

Relevance

Termites are germane, squirrels are not.

–Elementary School Early Adopter

Live animals

[Students] show a lot of curiosity. And I do think that fact that [the termites] are alive is a huge part of that.

–High School Early Adopter

Teacher friendly

As far as comparatively, I use this [curriculum] as a whole, and I don't have anything else that I use as a whole. I may pick one thing out and keep that and change it and modify it. This is the only big partnership that had ever lasted for me and I think it is one of the most valuable partnerships I've ever had.

–High School Early Adopter

This study suggests the incorporation of Hawaii state standards, scientific observations, and diverse pedagogy into *Educate to Eradicate* curricula are the main drivers behind teacher adoption and continuation. These findings are supported by research on adoption of K-12 curricula developed by Cooperative Extension Service faculty. Diker et al. (2011) and McKeely and Wells (1997) cite curricula integration with core subject standards as adoption motivators. Incorporation of contemporary teaching methodologies (pedagogies) including inquiry (discovery), hands-on, group learning, and inductive questioning are identified as motivators for adoption in both this and other curriculum studies (Ni 2009, Lee 2000, McKeely and Wells 1997, Diker 2011, Zhang et al. 2010). Perceived ease of use (teacher-friendliness) has been ranked within the top four characteristics of curriculum predictive of teacher adoption across multiple studies (Ni 2009, Lee 2000, McKeely and Wells 1997, Diker 2011), and was mentioned during all *Educate to Eradicate* focus groups, a total of 11 times. Based on this study, we suggest that extension curriculum be tightly linked to state/local standards, incorporate a range of current best-practice pedagogies (including inquiry), include interdisciplinary lessons, and be written/formatted for easy teacher use.

Professional Development

Teachers were asked to reflect on their professional development experiences. These experiences varied greatly within and between schools. Early-adopting elementary partner teachers were trained on the Manoa campus of the University of Hawaii campus in a professional development class accredited by the Hawaii Department of Education, and/or worked within a grade level team which contained at least one formally trained member.

Early-adopting elementary teachers' perceptions of professional development:

- It gave me more information. I knew what termites were and I could identify the poop, but I know more now than I did previously because of the classes. Because the class really went in-depth.
- It was great to go into the lab and to see the kind of experiments you could do with termites. I would love to have a refresher.

- I can see the evening class being a problem if you have a lot of young kids.
- [Training] was a full day and that was one of the complaints.

Early-adopting middle school teachers reported:

- I used the modeling intensively the first year for professional development. [A program staff member] came in and she presented all the lessons for the class the first time.
- I feel like each year I need you less and less physically there. And I am able to do a little bit more each year. I feel I am making strides in technology. I'm learning a lot and I continue to learn a lot.

Early-adopting high school teachers were more autonomous:

- I kind of did it on my own, went through everything, read through everything. When I had questions I asked. But I knew it was there and that they would have people come in if I had needed it. To show me things and whatnot, but I didn't use it.

- So far as professional development goes, I like learning new things. And finding things I can add to my curriculum, or modify to use in my classroom to make it more relevant for [students]. I like to do more hands-on things because the students become more interested. These are really hands-on things that I incorporate into my fourth quarter curriculum, so I like that.

Late-adopting teachers had the option of in-class lesson modeling during the first year of implementation. Professional development on the Manoa campus of the University of Hawaii was not offered after 2005.

Late-adopting elementary teachers valued professional development during the school day:

- It is good when you actually see it, at least for the first year.
- You provide us with everything we needed to do it again, except for the termites. [We] can almost replicate it because you model so well and you provided the [curriculum resource disk].

Late-adopting middle school teachers thought:

- [T]he resource was enough, and I like how we could be flexible with what materials were relevant for us at the time depending on where we were at.
- We feel very comfortable, too, about your support. If we felt we needed more, we would have that ability. It was set up fine.

Educate to Eradicate has employed a range of professional development techniques throughout its lifetime (2001-present). Early-adopting elementary teachers felt their weekend training went beyond what they could utilize in class, but they enjoyed mastering content and conducting inquiry laboratories. Birman et al. (2000) argue that professional development that focuses on science content, while providing opportunities for active learning, positively affects teacher adoption of new science curriculum. Late-adopting elementary teachers valued in-class lesson modeling, which did not require additional hours beyond the workday. At some schools, entire grade levels were trained this way, increasing opportunities for collective participation. Teachers given the opportunity to discuss concepts and problems associated with new curriculum are more likely to continue with collegiate support (Birman et al. 2000, Ni 2007). Early-adopting middle school teachers utilized and valued in-class lesson modeling. Late-adopting middle and early-adopting high school teachers were more autonomous, requiring only limited training (~ 2 hours), curriculum resources, project materials, and access to project staff for question/answer sessions.

While weekend training allowed teachers to explore *Educate to Eradicate* content deeply, at-school lesson modeling allows the project to reach more teachers. White (2005) argues that professional development should deepen teachers' content knowledge, while minimizing additional time demands. Creation of *Educate to Eradicate* videos may efficiently hybridize professional development to include science content and lesson modeling.

Project Supports

Teachers cited help from other teachers in their grade level most often as a key support to project adoption and continuation (15 references). Grade level members helped one another by creating/adapting project materials, preparing copies, setting-up laboratories, issuing grade level reminders, and serving as a project point-of-contact. Assistance from the University of Hawaii Termite Project staff was also valued by teachers (13 references). Teachers cited prompt communication, material drop-off/pick-up, curriculum modeling, field trips, and visits from entomologists as favorable staff services. Teachers noted that administration helped by scheduling grade-level planning time and granting teachers fiscal and curricular autonomy.

The degree of grade/department level buy-in has been cited as a predictor of curriculum adoption in other studies (Birman et al. 2000, Ni 2009, Rogers 2006). Similar to the findings of Penuel et al. (2007), *Educate to Eradicate* teachers indicated planning time and help with technology as positively influencing adoption and continuation. Teachers valued user-friendly components of *Educate to Eradicate* (prompt communication, material drop-off/ pick-up, curriculum modeling). Exciting entire grade levels/departments about curricula, providing technical support, and creating user-friendly lessons that minimize teacher time inputs (White 2005) have the potential to increase curricula continuation.

Barriers to Implementation

All teachers expressed a commitment to continuing the project within their classrooms. All groups cited keeping termites alive as their most difficult challenge during the unit. Within elementary classrooms, teachers requested additional termite habitats to help with classroom pacing. Additionally, teachers requested scientifically accurate termite videos and posters, editable worksheets with clip-art, and models of *good* observations with terminology word banks. Middle school teachers cited material management (keeping track of insect samples) and aligning lessons to state-mandated benchmark maps as their greatest challenges during implementation. High school teachers indicated classroom time limits and access to microscopes as their greatest challenges.

All groups saw keeping termites alive as their greatest challenge to curriculum implementation. Teachers requested a termite care fact sheet for reference. Curriculum implementation was sometimes stymied by large classes coupled with limited materials (Diker et al. 2011, Lee 2000). Some teachers worked around this using live video projection of the habitat for simultaneous classroom observation. Matching unit lessons to existing curriculum outlines was a challenge (Ni 2009). Classroom time limits were also a barrier (Lee 2000). Additionally, teachers found termites underrepresented in grade appropriate reference materials. In response, *Educate to Eradicate* intends to provide editable unit materials and accurate, grade-appropriate supplemental reference materials to partner teachers. The project will also work to align unit lessons with current state benchmark maps, which are a moving target. Additionally, the project is continuing to explore technology applications, including digital microscopes, to improve lesson practicality with limited resources.

Continuation Needs

After brainstorming, each focus group ranked project continuation needs (Table 4.1). Live termites and habitats were essential. Teachers would not continue the project without live termites. Preserved termites and damage samples were also vital project components. All groups were willing and able to store these samples indefinitely. High school and middle school teachers valued laboratory kits. Teachers were willing to house, maintain, and restock kits from year-to-year. One high school teacher had already purchased all materials needed for instruction. He only needed live termites each year to continue. All teachers valued project staff services, materials/kits, and were interested in additional resources. However, these were not considered essential for project continuation.

Table 4.1. Ranked needs and wants of early and late adopting teachers

Ranking	Group A Late Adopting Elementary	Group B Early Adopting Elementary	Group C Early Adopting Elementary	Group D Early Adopting Middle/High	Group E Late Adopting Middle
1.	Live termites and habitats	Live termites and habitats	Live termites and habitats	Live termites and habitats and loose termites for labs	Live termites and habitats and loose termites for labs
2.	Preserved specimens	Preserved specimens	Preserved specimens	Preserved specimens	Preserved specimens
3.	Resource binder	Entomologist Q & A	Editable resource disk	Laboratory kits + Craft kits(SPED)	Laboratory kits
4.	Reference posters	Termite Videos	Build-an-insect kits	Field trips	Materials delivered
5.	How-to videos (of lessons and crafts)	Build-an-insect kits	Digital microscope		How-to videos (habitat set-up, hind gut extraction, trail following)
6.	Materials and kits dropped off	Termite books	Reference posters		Additional information on baiting systems

Teachers valued all current components of the project. Teachers expressed the ability to independently procure all supplies needed for the unit, other than live termites, habitats, and preserved insect specimens. Groups expressed a desire for video demonstrations of lessons, activities, and laboratory techniques. Providing teachers with project material/vendor lists and video tutorials has the potential to increase project reach and teacher autonomy (Barab and Luehmann 2003, White 2005), while decreasing the reliance on project staff and funds. Establishing an efficient termite distribution system, which allows for drop-offs to distant schools, will help insure curriculum continuation.

Teachers' Mastery of Project Content Knowledge and Skills

During focus groups, teachers demonstrated their mastery of project content by accurately discussing content, describing their application of curriculum in detail, and sharing personal curricular applications and investments. Some early adopters described extensive modifications to project source materials, including modification of project handouts to highlight state benchmarks and meet administrative protocols. Teachers created original inquiry activities, procured non-fiction resource materials, and constructed a family of termite caste member puppets. Early-adopting middle school teachers went so far as to "…use termites to do a staff development [activity]." Late-adopting elementary teachers used curriculum as is, while linking termite content across subject areas. Late-adopting middle school teachers used external termite videos, props, and service learning projects to motivate students.

Changes in student knowledge, attitudes, skills, and behaviors can serve as a barometer for teacher unit mastery and project efficacy (Haslem 2010, Shymansky et al. 2004). During focus group interviews, the project's propensity to motivate students across skill levels and gender was frequently cited by teachers (45 references).

> Kids who had pretty much failed at everything did really well at this. Quite a few have done really well, because they are so excited by it, by science.
>
> – Elementary School Early Adopter, Special Education

I think with this particular project they tend to grasp onto it really well and learn a lot, remember a lot, and understand a lot. Because they have all those visuals you can refer back to. Like when we are going to do symbiosis, we have [a topic] to hook onto.
–Middle School Late Adopter, Special Education Science/Math

Teachers noted the project sparked an interest in science across genders and resulted in high rates of content retention. Teachers shared multiple examples of students applying their termite knowledge both inside and outside the classroom.

I think the girls were into it because they're the ones who were looking for the bugs at recess, bringing in the roly-polies. Even the frou-frou girls who you would think it would gross out, they were out there looking for bugs.
–Elementary School Late Adopter

We used it as an interdepartmental unit. In language arts [students] created a presentation. We told them they had to shape it to an audience. We took them to a preschool, a third grade class, and to Moiliili Community Center to talk to old people. They had to create a presentation for that and they had to become masters of the topic. And go in and answer every question. That was profound for most of them. They came away saying, "That was awesome, I knew so much." Especially the guys who went to the old folks, they were shocked at people who were homeowners and who were knowledgeable, they were asking them and intensely wanting to know. I think that happened with the preschools too. [Students] notic[ed] that the parents weren't leaving. They were sitting there and listening. There was a big ring of people around them while they were presenting. They stepped from being a middle school bozo to this master of information.

-Middle School Early Adopter, English Language Learners

Teachers were consistently impressed with student content retention. Teachers observed increased student motivation and interest in science (Shymansky et al. 2004). Additionally, students applied unit knowledge and skills inside and outside of the classroom during structured and independent activities (Webster 2006).

Change in classroom time allocated to science- elementary level

At the elementary level, teachers were asked to quantify changes in classroom time devoted to science. Early adopters emphasized the importance and extensive use of science instruction throughout their teaching careers. They indicated *Educate to Eradicate* motivated students while honing skills in observation and questioning. One teacher stated, “When we… create[d] our other units, we knew that the termite one was so hands-on that we tried to make the other [science units] hands-on because we wanted to have some of those same things that get the kids so excited.” Late adopters reported increasing science instruction to 1.5 hours per week. This was an increase from 45 minutes per week, twice a quarter, or whenever it fit into instruction.

Change in classroom time allocated to project based science – middle/high school levels

All middle/high groups indicated that *Educate to Eradicate* was currently their only project-based unit. Teachers would like to partner with similar standards-based projects in other areas that provide hands-on activities and project materials. All middle school teachers indicated that partnership with the University of Hawaii Termite Project resulted in increased technology use and note taking.

In summary, implementation of *Educate to Eradicate* affected teachers’ content knowledge and classroom practice. Teachers’ mastery and application of curricula increased student motivation, science skills, and inquiry behaviors. Teachers were most likely to adopt the *Educate to Eradicate* curricula because of alignment with state standards, focus on inquiry, and employment of diverse, grade appropriate pedagogies. Highlighting these components of the curricula may increase new teacher adoption.

Partner teacher feedback will inform the project’s direction. Essential materials will remain available for teachers and online training videos will be offered where possible. Ideally, automated training will increase teacher confidence and autonomy, allowing for continued use of *Educate to Eradicate* curricula with limited inputs of project staff.

CHAPTER 5

Study Lessons and Limitations

This chapter summarizes the major findings and limitations of evaluating changes in student knowledge and behavior (chapters 2 and 4), using teacher characteristics and perceptions to predict project continuation (chapter 3), measuring changes in teacher practice (chapter 4), and optimizing *Educate to Eradicate* curricula for sustained use (chapter 4). Haslem's (2010) Teacher Professional Development Logic Model (Figure 5.1) was used to inform the project's evaluation. Teacher and student surveys, work samples, and focus groups served as measures of the *Educate to Eradicate* curricula outcomes and indicators. Actions to strengthen project sustainability are recommended based on teacher feedback.

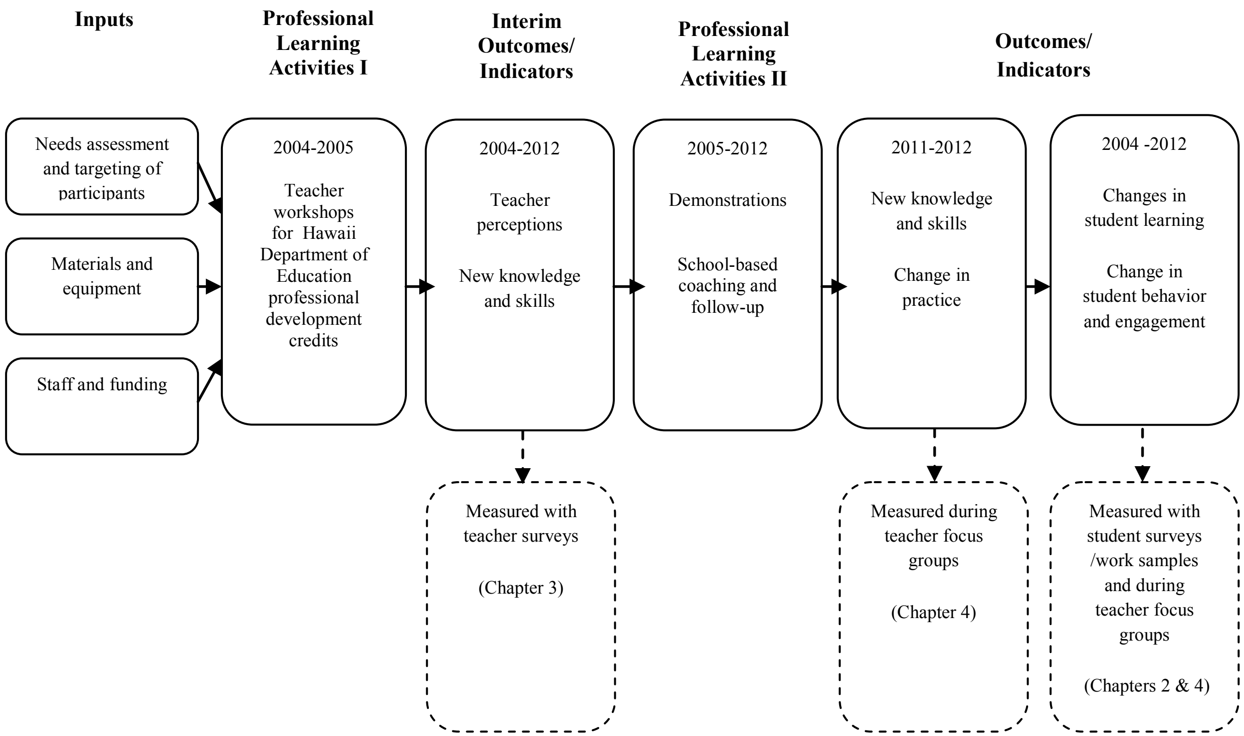

Figure 5.1. Teacher Professional Development Logic Model adapted from Haslem (2010). Modifications include the *Educate to Eradicate* evaluation time frame, measures, and chapter references.

Changes in student knowledge and behavior

Student unit-specific content and prevention knowledge increased after *Educate to Eradicate* curricula participation. The largest gains across grade levels were in the ability of students to name termite caste members and describe their roles within a colony. Significant gains in the ability to "*list the six prevention steps scientists suggest my parents take to keep worker termites from damaging our home"* were also recorded. During the 2010-2011 school year, eighty-six percent of students returned a completed S*ubterranean Termite Prevention Home Survey,* of which 74% were signed by a parent/guardian. Parent/guardian signature indicated that parents helped their child do a visual inspection of their home for termite-conducive conditions and signs of termites. Participation in *Educate to Eradicate* increased student unit-specific content and prevention knowledge and resulted in changes in behaviors at home.

Limitations

Generalizability from this study is limited due to teachers' self-selecting into the project. Another limiting factor was that not all surveys were returned by teachers (48% return). Teachers were encouraged to return surveys both before and after project implementation. Additionally, project staff explained to teachers that project surveys were used to help procure resources from funding agencies. Teacher omissions sometimes included missing documentation from entire classrooms. Other reasons for survey omission included student movement between schools and absenteeism. This analysis assumes unreturned surveys were random.

Teacher characteristics and perceptions of curricula: clues to adoption and continuation

Teacher survey data were used to create predictive models of teacher continuation. A total of 6 survey items were predictive of teacher continuation.

Positive predictors of continuation:

1. Teachers who indicated *exciting students about science* as a motivator were more likely to continue curriculum.

2. Teachers servicing higher socioeconomic status students were more likely to continue curriculum.

3. Teachers who perceived increases in "*student understanding and comprehension of major termite knowledge concepts*" were more likely to continue curriculum.

4. Teachers who perceived their students as "*more interested in termites after participating in this project"* were more likely to continue curriculum.

Negative predictors of continuation:

5. Teachers who had worked at their current school over 21 years at the time of curriculum adoption were less likely to continue curriculum.

6. Teachers who identified having subject specialties not listed on survey were less likely to continue the curriculum.

Limitations

Not all partner teachers returned surveys. Teachers were reminded to return surveys both before and after project implementation. This analysis assumes unreturned surveys were random. When teachers continued use of the curriculum and submitted several surveys over successive years, the first submission was used for analysis, as representative of their initial impressions. Omitted responses to survey questions were treated as missing values and not included in response means.

Optimizing *Educate to Eradicate* for use in K-12 classrooms

Teacher focus groups (1) identified factors that influenced the adoption and continuation of *Educate to Eradicate* curricula in public school classrooms, and (2) evaluated the efficacy of the curricula.

Teachers identified the following keys to curricula adoption and continuation:

Curriculum design: Curricula should be tightly and explicitly linked to state/local standards, incorporate a range of current best-practice pedagogies (including inquiry), include interdisciplinary lessons, and written/formatted for easy teacher use.

Professional development should deepen teachers' content knowledge while minimizing additional time demands. Teachers suggested the creation of *Educate to Eradicate* videos that include science content and lesson modeling.

Project supports should excite entire grade levels/departments about curricula, provide technical support, and create user-friendly lessons that minimize teacher time inputs. Teachers need live termites and habitats to continue *Educate to Eradicate* curricula.

Teachers evaluated the efficacy of *Educate to Eradicate* curricula:

Teachers' mastery of project content knowledge and skills

Teachers demonstrated mastery of project content by accurately discussing content, describing their application of curriculum in detail, and sharing curricular modifications and investments. Teachers created original inquiry activities, procured non-fiction resource materials, and constructed lesson props.

Changes in time allocated to science and project-based instruction

Early-adopting elementary teachers described additional focus on science to motivate students both before and after *Educate to Eradicate* adoption. Late-adopting elementary teachers reported at least doubling classroom time devoted to science during the *Educate to Eradicate* unit. Middle and high school partner teachers reported *Educate to Eradicate* as their only project-based unit. All focus groups were interested in similar University of Hawaii curricula partnerships.

Changes in student learning, behavior and engagement

At all focus groups, teachers were impressed with student content retention. Teachers reported increased student motivation and interest in science. Additionally, teachers described how students applied unit knowledge and skills inside and outside of the classroom during structured and independent activities.

Limitations

Forty-one percent of 2011-2012 *Educate to Eradicate* partner teachers took part in focus groups. Participants were selected to span grade levels and years of partnership. Five focus groups were sufficient for theoretical saturation. Criticism of curricula may have been muted by social desirability biases, responding in ways perceived as favorable. In some focus groups, the presence of a grade level chairperson may have limited feedback. Data does not include feedback from ex-*Educate to Eradicate* teachers. Incentivizing current teachers to participate in a two-hour focus group was challenging because of school schedules and existing time commitments. Motivating teachers who had ended project partnership was impractical.

Conclusions

Implementing *Educate to Eradicate* curricula changed partner teachers' knowledge and practice. These changes in practice resulted in changes in student knowledge and behaviours. Students gained termite content knowledge. Moreover, students demonstrated changes in behaviors by inspecting their homes for termite conducive conditions/signs, and educating community members (including parents/guardians) on the topic. In addition to documenting the efficacy of *Educate to Eradicate* curricula, this study identified strategies for increasing the projects adoption, continuation, and sustainability.

There are a number of opportunities going forward for *Educate to Eradicate* to retain and broaden its teacher base, as well as options for streamlining and enhancing its professional development:

- agree to an efficient method for teachers to procure live insects and habitats. This would potentially include standard drop-off or pick-up dates during school year, help from other entomology labs/groups/clubs with termite colony maintenance, extraction, counting, and distributing.
- explicitly link unit lessons to current state standards on *Educate to Eradicate* website and other promotional materials.
- establish a professional development opportunity through the University of Hawaii College of Education. Goals of this program would be to facilitate partner teachers' communication, share and develop lessons, and link lessons to new standards.
- generate material and vendor lists for consumable project materials
- create professional development videos that include unit content, activities, and laboratory techniques
- develop a commonly asked question and answer section on the *Educate to Eradicate* website
- encourage ongoing communication between K-12 teachers and research/extension staff at the Department of Plant and Environmental Protection Sciences, University of Hawaii at Manoa
- continue to encourage teachers to adapt curricula to meet student needs

This framework will assist the project in generating a sense of shared purpose and direction, which will reduce university inputs, increasing *Educate to Eradicates* sustainability past initial funding.

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APPENDIX A: Outline of *Educate to Eradicate* curricula grades 1-12

Lessons **Biological Science/ Zoology**	Hawaii Content & Performance Standards III-Benchmarks	Summary	Available Resources
Introduction to Insects	SC.BS.4.6: Explain the organization of life on Earth using the modern classification system	• Classification • Importance of Insects • Insect Diversity	Insect collection observation Power Point with guided notes
Termite Biology I	SC.Z.3.5 Trace the life cycles of various groups of animals	• Classification • The Termite Colony/Ohana	Preserved and live specimens Termite observation jars Power Point with guided notes
Termite Biology II	SC.Z.5.4 Explain how the adaptations of the different phyla enhance their survival	• Compare/ contrast drywood and ground termites	Damage samples Hands on Termites: Termite Biology Laboratory PowerPoint with guided notes
Termite Commun-ication	SC.Z.5.4 Explain how the adaptations of the different phyla enhance their survival	• Mechanical/ Chemical Sensory System	Follow the Leader Laboratory Termite Telephone Activity Nest Odor Activity PowerPoint with guided notes
Termite Feeding and the Protozoa	SC.BS.3.3: Explain how matter and energy flow through living systems and the physical environment SC.Z.4.2 Determine how species enhance their rate of survival by using symbiosis	• Symbiotic Relationship • Anatomy • Food chain	Gut Protozoa Laboratory PowerPoint with guided notes
Management and Control	SC.BS.2.1: Explain how scientific advancements and emerging technology have influenced society	• 6 Steps for preventing termites • Remedial control	Termite bait station, BTB, Termimesh House Survey PowerPoint with guided notes

Lessons **Biological Science/ Zoology**	Hawaii Content & Performance Standards III- Benchmarks	Summary	Available Resources
Sharing Knowledge Project	LA.9.4.1, LA.10.4.1: Write in a variety of grade-appropriate formats for a variety of purposes and audiences	Inform Hawaii homeowners about termite biology, prevention and control	Materials will be provided by the *UH Termite Project*, the teacher, and the students
Inquiry Project	SC.BS.1.2: Design and safely implement an experiment, including the appropriate use of tools and techniques to organize, analyze, and validate data SC.BS.1.3: Defend and support conclusions, explanations, and arguments based on logic, scientific knowledge, and evidence from data SC.BS.1.7: Revise, as needed, conclusions and explanations based on new evidence MA.S.11.1: Develop a hypothesis for an investigation or experiment MA.S.11.2: Recognize the variables and controls in an experiment or investigation LA.9.1.2, LA.10.1.2: Use a variety of strategies to gain information from print and online resources, as part of a research plan to support a thesis	The objectives and focus of the inquiry project will vary depending upon the teachers and students	Materials will be provided by the UH Termite Project, the teacher, and the students

Lessons **Grades 6-8**	Hawaii Content & Performance Standards III- Benchmarks	Summary	Available Resources
Introduction to Insects	SC.7.4.4 Classify organisms according to their degree of relatedness	• Classification • Importance of Insects • Insect Diversity	Insect collection observation Power Point with guided notes
Termite Biology I	SC.7.3.2 Explain the interaction and dependence of organisms on one another	• Classification • The Termite Colony/Ohana	Preserved and live specimens Termite observation jars Power Point with guided notes
Termite Biology II	SC.7.5.4 Analyze how organisms' body structures contribute to their ability to survive and reproduce	• Compare/ contrast drywood and ground termites	Damage samples Hands on Termites: Termite Biology Laboratory PowerPoint with guided notes
Termite Commun-ication	SC.6.1.1 Formulate a testable hypothesis that can be answered through a controlled experiment SC.7.1.1Design and safely conduct a scientific investigation to answer a question or test a hypothesis SC.7.3.2 Explain the interaction and dependence of organisms on one another SC.8.1.1Determine the link(s) between evidence and the conclusion(s) of an investigation SC.8.1.2 Communicate the significant components of the experimental design and results of a scientific investigation	• Mechanical/ Chemical Sensory System	Follow the Leader Laboratory Termite Telephone Activity Nest Odor Activity PowerPoint with guided notes

Lessons **Grades 6-8**	Hawaii Content & Performance Standards III- Benchmarks	Summary	Available Resources
Termite Feeding and the Protozoa	SC.6.3.1Describe how matter and energy are transferred within and among living systems and their physical environment SC.7.3.1 Explain how energy moves through food webs, including the roles of photosynthesis and cellular respiration SC.7.3.2 Explain the interaction and dependence of organisms on one another	• Symbiotic Relationship • Anatomy • Food chain	Gut Protozoa Laboratory PowerPoint with guided notes
Management and Control	SC.6.2.1 Explain how technology has an impact on society and science SC.6.2.2 Explain how the needs of society have influenced the development and use of technologies SC.8.2.1 Describe significant relationships among society, science, and technology and how one impacts the other	• 6 Steps for preventing termites • Remedial control	Termite bait station, Basaltic Termite Barrier, Termimesh House Survey PowerPoint with guided notes
Sharing Knowledge Project	LA.6.4.1, LA.7.4.1, LA.8.4.1 Write in a variety of grade-appropriate formats for a variety of purposes and audiences	Inform Hawaii homeowners about termite biology, prevention and control	Materials will be provided by the *UH Termite Project*, the teacher, and the students

<table>
<tr><th>Lessons
Grades 6-8</th><th>Hawaii Content &
Performance Standards III-
Benchmarks</th><th>Summary</th><th>Available Resources</th></tr>
<tr><td rowspan="2">Inquiry Project</td><td rowspan="2">SC.6.1.1Formulate a testable hypothesis that can be answered through a controlled experiment
SC.6.1.2Use appropriate tools, equipment, and techniques safely to collect, display, and analyze data
SC.7.1.1 Design and safely conduct a scientific investigation to answer a question or test a hypothesis
SC.7.1.2 Explain the importance of replicable trials
SC.7.1.3 Explain the need to revise conclusions and explanations based on new scientific evidence
SC.8.1.1 Determine the link(s) between evidence and the conclusion(s) of an investigation
SC.8.1.2Communicate the significant components of the experimental design and results of a scientific investigation
MA.6.11.1 Analyze how data collection methods and sample size can affect the results of data sets
MA.7.11.1 Design a study, collect data, and select the appropriate representation to display the data</td><td>The objectives and focus of the inquiry project will vary depending upon the teachers and students</td><td>Materials will be provided by the UH Termite Project, the teacher, and the students</td></tr>
<tr><td colspan="2">Hawaii Content &Performance Standards III-Benchmarks
Continued for Inquiry Project

MA.8.11.1Design a study that compares two samples, collect data, and select the appropriate representation (e.g., double bar graph, back-to-back stem and leaf plot, parallel box and whisker plots, scatter plot) to compare the sets of data
MA.8.11.2Judge the validity of data based on the data collection method
LA.6.1.2 Use grade-appropriate online and print sources to research a topic
LA.7.1.2 Use a variety of grade-appropriate print and online sources to research an inquiry question
LA.8.1.2 Select appropriate information after evaluating the usefulness of print and online resources to investigate a theme, answer a question, or test a hypothesis</td></tr>
</table>

Lessons **Grades 4-5**	Hawaii Content & Performance Standards III- Benchmarks	Summary	Available Resources
The Insect Jars	SC.4.1.2 Differentiate between an observation and an inference SC.4.3.1 Explain how simple food chains and food webs can be traced back to plants	• Create and observe a termite habitat	Termite Jar set-up (with live termites) Observation sheet
What is an Insect?	SC.5.2.1 Use models to represent and investigate features of objects in the real world	• Classification • Importance of Insects • Insect Diversity	Insect collection observation PowerPoint
Termite Family	SC.4.3.2Describe how an organism's behavior is determined by its environment	• Structure and function of termite caste members	Preserved termite specimens PowerPoint
Termite Lifecycle	SC.4.3.2Describe how an organism's behavior is determined by its environment	• Lifecycle of a termite colony	Termite lifecycle puzzle kit PowerPoint
Termite Commun-ication	SC.4.3.2Describe how an organism's behavior is determined by its environment	• Pheromones	Next odor and termite telephone activity PowerPoint
Types of Termites	SC.4.5.3 Describe how different organisms need specific environmental conditions to survive	• Compare/ contrast drywood and ground termites	Termite damage samples Hands on Termites: Termite Biology Laboratory PowerPoint
Prevention	SC.4.2.1 Describe how the use of technology has influenced the economy, demography, and environment of Hawaii	• 6 Steps for preventing termites	Termite bait station, Basaltic Termite Barrier, Termimesh House Survey PowerPoint

Lessons **Grades 4-5**	Hawaii Content & Performance Standards III- Benchmarks	Summary	Available Resources
Sharing Knowledge Project	LA.4.4.1**,** LA.5.4.1 Write in a variety of grade-appropriate formats for a variety of purposes and audiences	Inform Hawaii homeowners about termite biology, prevention and control	Materials will be provided by the UH Termite Project, the teacher, and the students
Inquiry Project	SC.4.1.1 Describe a testable hypothesis and an experimental procedure SC.4.1.2 Differentiate between an observation and an inference MA.4.11.1 Pose questions, collect data using observations and experiments, and organize the data into tables or graphs MA.4.11.2 Label the parts of a graph (e.g., axes, scale, legend, title) SC.5.1.1 Identify the variables in scientific investigations and recognize the importance of controlling variables in scientific experiments SC.5.1.2Formulate and defend conclusions based on evidence MA.5.11.2 Recognize the difference in representing numeric data and categorical data and select appropriate representations to display each type of data LA.5.1.2 Use a variety of grade-appropriate print and online resources to research a topic	The objectives and focus of the inquiry project will vary depending upon the teachers and students	Materials will be provided by the UH Termite Project, the teacher, and the students

Lessons **Grades 1-3**	Hawaii Content & Performance Standards III- Benchmarks	Summary	Available Resources
The Insect Jars	SC.1.1.1 Collect, record, and organize data using simple tools, equipment, and techniques safely SC.1.1.2 Explain the results of an investigation to an audience using simple data organizers SC.1.3.1 Identify the requirements of plants and animals to survive (e.g., food, air, light, water) SC.2.1.1 Develop predictions based on observations Conduct a simple investigation using a SC.2.1.2 systematic process safely to test a prediction SC.2.3.1Describe how animals depend on plants and animals SC.2.5.1 Identify distinct environments and the different kinds of organisms each environment supports SC.3.1.1 Pose a question and develop a hypothesis based on observations SC.3.1.2 Safely collect and analyze data to answer a question	• Create and observe a termite habitat	Termite Jar set-up (with live termites) Observation sheet
What is an Insect?	SC.1.4.1 Describe how living things have structures that help them to survive SC.1.5.2 Describe the physical characteristics of living things that enable them to live in their environment SC.3.4.1 Compare distinct structures of living things that help them to survive SC.3.5.1 Describe the relationship between structure and function in organisms	• Classification • Importance of Insects • Insect Diversity	Insect collection observation Power Point

Lessons **Grades1-3**	Hawaii Content & Performance Standards III- Benchmarks	Summary	Available Resources
Build an Insect	SC.1.4.1 Describe how living things have structures that help them to survive SC.1.5.2 Describe the physical characteristics of living things that enable them to live in their environment SC.2.5.1 Identify distinct environments and the different kinds of organisms each environment supports SC.3.4.1 Compare distinct structures of living things that help them to survive SC.3.5.1 Describe the relationship between structure and function in organisms	• Create insect models • Model and describe adaptations	Build-an-Insect kits
Termite Ohana	SC.1.4.1 Describe how living things have structures that help them to survive SC.1.5.2 Describe the physical characteristics of living things that enable them to live in their environment SC.2.4.1 Explain how plants and animals go through life cycles SC.3.4.1 Compare distinct structures of living things that help them to survive SC.3.5.1 Describe the relationship between structure and function in organisms	• Structure and function of termite caste members	The Termite Ohana storybook Tammy the termite puppet Preserved termite specimens PowerPoint
Termite Ohana Booklet	SC.1.4.1 Describe how living things have structures that help them to survive SC.1.5.2 Describe the physical characteristics of living things that enable them to live in their environment SC.2.4.1 Explain how plants and animals go through life cycles SC.3.4.1 Compare distinct structures of living things that help them to survive SC.3.5.1 Describe the relationship between structure and function in organisms	• Describe structure and function of termite caste members	Termite Ohana booklet kits

Lessons **Grades1-3**	Hawaii Content & Performance Standards III- Benchmarks	Summary	Available Resources
Prevention	SC.1.4.1 Describe how living things have structures that help them to survive SC.3.2.1 Describe ways technologies in fields such as agriculture, information, manufacturing, or communication have influenced society	• 6 Steps for preventing termites	House Survey PowerPoint
Sharing Knowledge Project	LA.1.4.1, LA.2.4.1, LA.3.4.1 Write in a variety of grade-appropriate formats for a variety of purposes and audiences, such as non-fiction formats that explain or give basic information about familiar topics.	Inform Hawaii homeowners about termite biology, prevention and control	Materials will be provided by the UH Termite Project, the teacher, and the students

APPENDIX B: Student Concept Surveys

Student Concept Survey grades 7-12

Concept Survey

School: ____________________ Teacher's Name: ____________________

Class: _____________________ Period: ____________________________

Grade Level: _______________ Date: _____________________________

Circle the answer (YES, MAYBE, OR NO) which best describes your knowledge about the statement. This is NOT a test. There is no right or wrong answers.

1. I know the three body parts that define an insect.

   YES **MAYBE** **NO**

2. I can name at least two different levels of scientific classification.

   YES **MAYBE** **NO**

3. I can list the three special qualities of a social insect.

   YES **MAYBE** **NO**

4. I can name all the caste members of the termite colony and describe their jobs.

   YES ***MAYBE*** ***NO***

5. I can diagram and label the termite lifecycle.

   YES **MAYBE** **NO**

6. Alates are the only caste member to fly from a termite colony.

YES **MAYBE** **NO**

7. Frass is made by drywood termites.

YES **MAYBE** **NO**

8. Termites and Protozoa live in a symbiotic relationship.

YES **MAYBE** **NO**

9. I can explain how termites communicate information within their colony.

YES ***MAYBE*** ***NO***

10. I can tell the difference between a subterranean termite and a drywood termite.

YES ***MAYBE*** ***NO***

11. Carton is made up of saliva, dirt and waste material.

YES **MAYBE** **NO**

12. In a forest environment the termite is a beneficial insect.

YES **MAYBE** **NO**

13. I can list the six prevention steps scientists suggest my parents take to keep worker termites from damaging homes.

YES ***MAYBE*** ***NO***

Termite Concept Inventory grades 7-12

School________________________________ Grade ____________

Class ________________________________ Date ____________

Termite Concept Inventory

For each term circle the number that best describes how well you understand the word. **This is not a test AND there are no right or wrong answers**.

1 = I don't know or I don't understand.
2 = I understand a little.
3 = I understand but I cannot teach someone else.
4 = I understand completely AND I can teach someone.

Social insect	1	2	3	4
Caste system	1	2	3	4
Pest management	1	2	3	4
Insect	1	2	3	4
Classification	1	2	3	4
Carton	1	2	3	4
Pheromones	1	2	3	4
Alate	1	2	3	4
Decomposer	1	2	3	4
Colony	1	2	3	4
Symbiosis	1	2	3	4
Protozoa	1	2	3	4
Frass	1	2	3	4
Subterranean	1	2	3	4
Cellulose	1	2	3	4

*Concept Survey

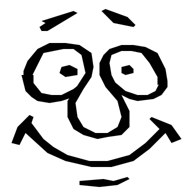
Student Concept Survey grades 4-6

Teachers Name: ______________________________

Circle the face which describes how you feel about the question or statement.

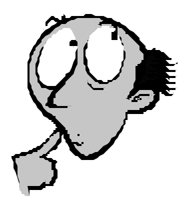
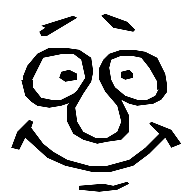
1. I know the four defining characteristics of an insect.





NOT REALLY ***I THINK SO*** ***YES***

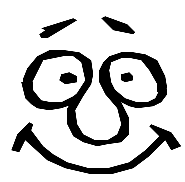
2. I can make scientific observations using words and pictures.

NOT REALLY ***I THINK SO*** ***YES***

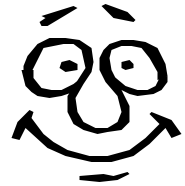
3. I can describe the main difference between social insects and non-social insects.





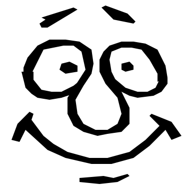
NOT REALLY ***I THINK SO*** ***YES***

4. I can name all the members of the termite family and describe the colony jobs for each member.

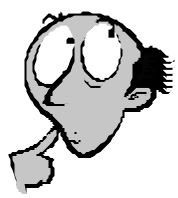
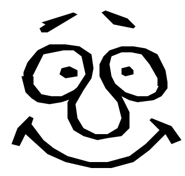
NOT REALLY ***I THINK SO*** ***YES***

5. I can draw and label the termite lifecycle.

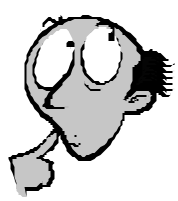
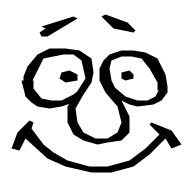
NOT REALLY ***I THINK SO*** ***YES***

6. I can explain how termites communicate information within their colony.

NOT REALLY ***I THINK SO*** ***YES***

7. I can list the five prevention steps scientists suggest my parents take to keep worker termites from damaging our home.

NOT REALLY ***I THINK SO*** ***YES***

---

* PRE   POST   School Name: ______________________________

Concept Survey

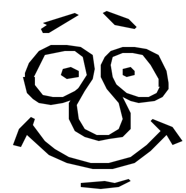
Teachers Name: ______________________________________

Directions:

Circle the picture, which best describes how much you know about the statement.

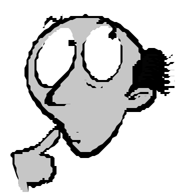
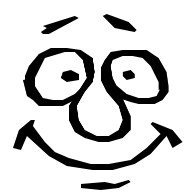
1. I can name all the body parts of an insect.





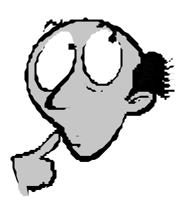
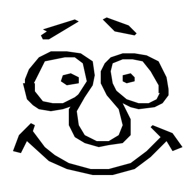
NOT REALLY ***I THINK SO*** ***YES***

2. I can make observations using words and pictures.

NOT REALLY ***I THINK SO*** ***YES***

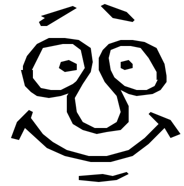
3. I can describe 3 things special to social insects.

NOT REALLY ***I THINK SO*** ***YES***

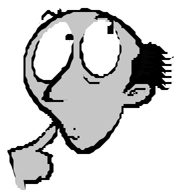
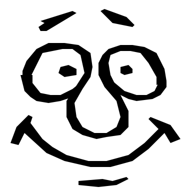
4. I know the names of the 6 different termite family members.





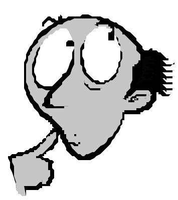
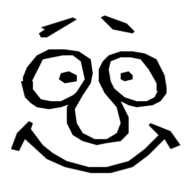
NOT REALLY ***I THINK SO*** ***YES***

5. I know the jobs of each of the 6 termite family members.

NOT REALLY ***I THINK SO*** ***YES***

6. I know the 6 Do's and Do Not's of ground termite prevention that help my family make our house less termite friendly .

NOT REALLY ***I THINK SO*** ***YES***

*

* PRE POST SCHOOL NAME: ____________________________

APPENDIX C: *Subterranean Termite Prevention Home Surveys*

Subterranean Termite Prevention Home Survey grades 7-12

Name: ____________________________________

Class/Period: ____________________________________

Date: ____________________________________

How Termite Friendly Is My House?

There are lots of simple steps homeowners can take to help prevent ground termite entry into their home. Below is a checklist that homeowners can take in order to make a visual inspection easier and to eliminate conditions favorable to termite survival. Ask a parent to help you do a visual inspection of your home. Check off those measures that apply to your home (if you live in an apartment building do the whole building). The higher number of check marks the more prepared your family is for termite prevention. After you and your family have finished the inspection, ask your parents to fill out the questionnaire.

____ There is no wood directly touching the soil.

____ There is no water being collecting within a few feet of the house (i.e. a puddle).

____ Vegetation (plants) stands a few feet from the house walls (this allows soil to dry out and observe construction of termite mud tunnels).

____ There are no leaky roof areas or other consistently moist areas on the outside or inside of your home (the kitchen and bathroom are prime areas for water leaks).

____ There are no cracks in cement walkways or driveways (repaired cracks count as no cracks).

____ There are no sprinklers or consistently running water within a few feet of the house.

____ We conduct periodic visual inspection of house exterior and underneath house (if accessible) looking for mud tunnels (a sure sign of an active ground termite colony).

How does your house rate for termite prevention (circle your answer)?

Really prepared
6-7 checkmarks

A little prepared
2-5 checkmarks

Not prepared at all
0-1 checkmarks

Parent Questionnaire

Please fill out this questionnaire after you have done the prevention inspection with your child. We would greatly appreciate some feedback on your experience. Circle the most appropriate answer for each question.

1. Did you find the termite information to be interesting?

   YES NO

2. Did you find this short prevention inspection helpful?

   YES NO

3. Do you want to learn more about termite prevention?

   YES NO

4. Do you have or have you had problems with termites in your home or apartment before?

   YES NO NOT SURE

   If so, which kind of termites have you encountered?

   Drywood Ground Both Not sure

5. Did you learn anything new about termites from doing the inspection?

   YES NO

   If yes, please explain.

Name: ____________________________

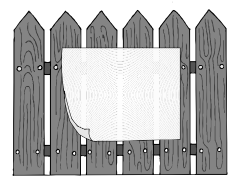
Ground Termite Prevention Home Survey

Your child has been learning about the do's and do not's of ground termite prevention. Please help your child do a visual inspection of their home. Circle yes or no for each prevention measure (if you live in an apartment do the building perimeter at ground level or a relative's home) then rate your home based on the number of no answers. Read the back of this page for more information on termite prevention and please complete the short parent questionnaire. Thanks!

Circle one:

YES NO

Dead wood or large piles of dead plant matter directly touching soil anywhere on property (includes structural elements like fences, lanais and house supports).



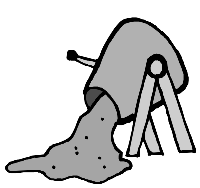
YES NO

Water collecting consistently outside (within a few feet of the house) or inside your home (bathrooms or kitchens).

YES NO

Plants or Planters close to house walls (within a few feet).

YES NO



Jagged cracks in foundation or cement walkways near home.

How does you house rate for ground termite prevention (circle your answer)?

Termite Ready	Needs Work	Help!
3-4 no answers	1-2 no answers	0 no answers

Termite Prevention

Prevention: stop from happening

Do not create termite friendly conditions around your home!

Remove potential food sources

Don't leave lumber, wood, cardboard, paper products or plant debris around structures. Direct wood to soil contact creates easy access to a food source.

Eliminate moisture

Consistent moisture creates ideal soil conditions for termite infestation. It is important to create proper drainage to prevent water from collecting near your home. Storm drains should be designed to empty a few feet from the wall and sprinklers should be placed away from the house.

Do not place plants too close to structures

Plants provide food and moisture for termites. Plants also make it difficult to see signs of damage or termite mud tunnels.

Repair cement cracks and exterior wood damage

Cement cracks, nail holes and wood crevices provide ideal spots to start a colony or gain entrance to your home.

Perform regular termite inspections

Regular termite inspections will help detect termite friendly areas.

To Be Filled out by Parent or other Adult Family Member

If you could provide feedback on your experience with your child we would greatly appreciate it. Circle your answer for each question.

1. Did you find this short prevention inspection helpful?
   YES NO
2. Do you want to learn more about termite prevention?
   YES NO
3. Do you have or have you had problems with termites in your home or apartment before?
   YES NO NOT SURE
   If so, which kind of termites have you encountered?
   DRYWOOD GROUND BOTH NOT SURE

Additional Comments:____

____

____

Parent or other Family member signature: ____________________________________

Teacher Partner Background Survey

APPENDIX D: Partner Teacher Survey/Evaluation **Survey A**

Circle one answer for each question; fill in where necessary.

Gender:

Male Female

Age Group:

22-29 30-39 40-49 50-59 60+

Years Teaching Experience:

< 5 years 5-10 years 11-20 years 21+ years

Number of Years Teaching in Hawaii:

< 5 years 5-10 years 11-20 years 21+ years

Number of Years at Current School:

< 5 years 5-10 years 11-20 years 21+ years

Grade Level:

K 1 2 3 4 5 6

Years at this Level: ____________________

Professional Degrees/Certificates:

Degree: ____

Emphasis: ____

Received from: ____

Degree: ____

Emphasis: ____

Received from: ____

Certificates:

____

____

School Location (circle specific complex area in italics):

Leeward:	Central:	Honolulu:	Windward:	North Shore:
Waianae	*Leilehua*	*Radford*	*Kailua*	*Kahuku*
Nanakuli	*Mililani*	*Moanalua*	*Kalaheo*	*Waialua*
Kapolei	*Waipahu*	*Farrington*	*Castle*	
Campbell	*Pearl City*	*McKinley*		
	'Aiea	*Roosevelt*		
		Kalani		
		Kaiser		

Circle all that apply; fill in where necessary

Subject Specialties:

Mathematics	Science	Speech
Language Arts	History	Reading
Art	Social Studies	Hawaiian Studies
Music	Foreign Language	Other: _____________

Motivation(s) for Partnering with the Program:

Meet Science Standards	Community Outreach
Science Skills	Termite Content Knowledge
Language Art/Reading Skills	University Partnership
Personal Interest	Excite students about science
Live Insect Observations	Experience Scientific Inquiry
Subject Relevance to Student's Lives	In class termite staff support
Curriculum/Material resources	Other: _________________

Termite Project Teacher Evaluation

School Name: ___________________________________

Grade Level: ___________

Part 1: Project Curriculum and Resources

Circle the most appropriate answer for each statement.

1. Overall impression of UH Termite Project curriculum, materials and resources

    a) Excellent   b) Good   c) Satisfactory   d) Unsatisfactory

2. Arrangement of learning sequence and termite content knowledge topics

    a) Excellent   b) Good   c) Satisfactory   d) Unsatisfactory

3. Classroom delivery of subject content and activities

    a) Excellent   b) Good   c) Satisfactory   d) Unsatisfactory

4. Grade level appropriateness of content, activities and worksheets

    a) Excellent   b) Good   c) Satisfactory   d) Unsatisfactory

5. Activity and lesson alignment with Hawaii State Science Standards

    a) Excellent   b) Good   c) Satisfactory   d) Unsatisfactory

6. Ability of the Termite Project Unit to fit into and enhance already existing classroom science curriculum

    a) Excellent   b) Good   c) Satisfactory   d) Unsatisfactory

7. Effectiveness of visual aides and activities in demonstrating and enforcing termite content knowledge

    a) Excellent   b) Good   c) Satisfactory   d) Unsatisfactory

Please answer the following questions in the space provided, feel free to make additional comments not addressed by these questions at the end of this section.

1. What were your learning goals in becoming involved in this project? Were these goals met?

2. What would you like to see added to the unit that was not covered?

3. Do you have any helpful suggestions for improvements on activity supplements such as the visual aides, powerpoints or worksheets?

Additional Comments:

Part 2: Impact on Teacher/Student Learning

Circle the most appropriate answer for each question or statement.

1. Overall student/teacher learning experience with the UH Termite Project

   a) Excellent b) Good c) Satisfactory d) Unsatisfactory

2. Student enthusiasm and enjoyment levels during program participation

   a) Excellent b) Good c) Satisfactory d) Unsatisfactory

3. Did students show interest in learning about termites?

   YES NO

4. Student understanding and comprehension of major termite knowledge concepts

   a) Excellent b) Good c) Satisfactory d) Unsatisfactory

5. Were students excited about sharing their new termite knowledge with others (sharing knowledge project)?

   YES NO

6. Impact of program on science learning, skills and content knowledge for both teacher and students

   Significant Not Significant

7. Was this a valuable experience for both teachers and students?

   YES NO

8. Would you consider partnering with the project again next school year?

   YES NO

Please answer the following questions in the space provided, feel free to make additional comments not addressed by these questions at the end of this section.

1. In what areas (skills, thought, subject content etc.) do you feel your students benefited the most? In what areas were students left behind?

2. What aspects of the experience do you feel were most valuable for your students?

3. What aspects of the experience did you feel were most valuable for you as the partnering teacher?

4. Any stories that you would like to share about specific student impact as a result of project participation (for example if a student showed notable changes in behavior or motivation)?

Survey B

UH Termite Project Teacher Survey

Name ________________________________ Date ___________________________

School ________________________________ District/Complex ___________________

Grade Level(s) ___________________________ Subject(s) _______________________

Is this your first time working with the Termite Project? (circle one) Yes No

If no, how many times have you worked with this project before? _______________________

When? ____

Number of Years Teaching (circle).

Years of teaching experience:	1-3	4-5	6-10	11-20	21+
Years teaching in Hawaii:	1-3	4-5	6-10	11-20	21+
Years at current school:	1-3	4-5	6-10	11-20	21+

Degrees and Certificates (circle all that apply)

Bachelor's Education	Education M.E.	Ed.D or PhD Education
Science B.S. or B.A. subject:_____________	Science M.S. subject:____________	PhD Science subject:_____________

Motivation(s) for Partnering with the Termite Project (circle all that apply)

Meet science standards	University partnership	Subject relevance to student's lives
Community outreach	Personal interest	In class termite staff support
Science skills	Excite students about science	Curriculum/material resources
Termite content knowledge	Live insect observations	Other:__________________
Language art/reading skills	Experience scientific inquiry	________________________

Impact on Student Learning

Please circle the number that best reflects how you feel for each question below.

1 strongly agree	2 agree	3 unsure	4 disagree	5 strongly disagree
My students gained knowledge about termites from this project				
1	2	3	4	5
My students gained awareness of termites through this project				
1	2	3	4	5
This project helped my students understand the nature of the scientific process				
1	2	3	4	5
My students were motivated during the project				
1	2	3	4	5
My students gained content knowledge through this project				
1	2	3	4	5
This project helped us connect parents with the learning program				
1	2	3	4	5
My students could recognize signs of termite infestation at our school				
1	2	3	4	5
I would be willing to conduct this project in my classroom again				
1	2	3	4	5
My students are more interested in termites after participating in this project				
1	2	3	4	5
My students are more interested in science after participating in this project				
1	2	3	4	5
This project encouraged community outreach from my students				
1	2	3	4	5
I was able to easily incorporate this project into my curriculum				
1	2	3	4	5
The lessons and learning sequence was appropriate for my students				
1	2	3	4	5
The program was well-aligned to the Hawaii State Science Standards				
1	2	3	4	5
The visuals and activities provided were effective in demonstrating and enforcing termite content knowledge				
1	2	3	4	5

Please answer the following questions in the space provided. Feel free to make additional comments not addressed by these questions at the end of this section.

1. What were your learning goals in becoming involved in this project? Were these goals met?

2. What (if any) is the primary thing your students gained from the termite project?

3. Do you have any helpful suggestions for improvements on activity supplement such as visual aides, PowerPoint, or worksheets?

Any other suggestions/comments regarding the project: ________________________________

____

____

____

____

____

____

APPENDIX E: Teacher Focus Group Protocol

Focus group question	**Research objective addressed by focus group question**	**Formative / Summative**
1. Why did you choose to be a UH Termite Project partner teacher?	Ice breaker	N/A
2. Tell me a little bit about how you've been involved in the UH Termite Project this year. What kind of activities have you participated in?	Lead-in to evaluation	N/A
3. How would you describe these activities in terms of: Quality? Usefulness? Match for your own professional development needs? Are you open to more partnerships with the College of Tropical Agriculture and Human Resources?	Evaluate teachers' perceptions of Educate to Eradicate curriculum design professional development	Formative
4. Please share with me what you've learned from participating in UH Termite Project professional development. What would you like to learn more about?	Assess teachers' new project-specific knowledge and skills	Summative

Focus group question	Research objective addressed by focus group question	Formative / Summative
5. When we revise the UH Termite Project Curriculum Resource, what information would you include or what information would you change to help teachers integrate the project into their curriculum? How would you improve support for UH Termite Project partner teachers? - What was not on the CD that should have been? -What problems did you run into in your classroom that were not addressed on the CD?	Evaluate teachers' perceptions of Educate to Eradicate curriculum design and project supports	Formative
6. Please share with me any ways that you have changed your classroom practice because of partnering with the UH Termite Project. - Do you incorporate more project-based lessons? Inquiry-based? - More science lessons? Can you share an example?	Quantify changes in classroom time devoted to science (at elementary level) and project-based science (at middle/high level)	Summative

Focus group question	**Research objective addressed by focus group question**	**Formative / Summative**
7. What kind of changes in student learning and achievement have you seen with the changes you've made in your instructional practice? -What is your impression regarding the students' reactions to this project? - Has their attitude toward science changed? -Increase in interest in science fields (careers), increased interest in science of girls, Students interested in College of Tropical Agriculture and Human resources, University of Hawaii.	Does student unit-specific content and prevention knowledge increase as a result of participating in "Educate to Eradicate" curricula (triangulated with student concept survey data)	Summative
8. What has been your greatest success in implementing the UH Termite Project in your classroom? - What has been the most lasting change in your classroom from the UH Termite Project?	Assess teachers' new project-specific knowledge and skills	Summative

Focus group question	**Research objective addressed by focus group question**	**Formative / Summative**
9. What has been your greatest challenge in implementing the UH Termite Project in your classroom? Curriculum design Training- Professional development Project supports	Evaluate teachers' perceptions of Educate to Eradicate curriculum design, professional development, and project supports	Formative
10. What kind of support have you had from the UH Termite Project staff? -What did we do that was helpful?	Evaluate teachers' perceptions of Educate to Eradicate professional development, and project supports	Formative
11. What kind of support have you had from your principal and other teachers in your school? What about your department / grade level chair? -What could they have done to support your implementation of the UH Termite Project?	Identify and rank key factors in project continuation	Summative

Focus group question	Research objective addressed by focus group question	Formative / Summative
12. How would you like UH Termite Project to be different next year in order to better meet your needs? (With limited/ no staff classroom time) - What do you need to continue this on your own? - Teacher blog / Termite Forum? - Video clips of lessons online? - Hard copy of lessons? - Participate in the light-trapping project? What would it take to implement the unit independently (on your own)?	Evaluate teachers' perceptions of necessary Educate to Eradicate project supports	Formative
13. Is there anything else you'd like to tell me about the UH Termite Project? Any concerns you have?	Open ended	