# Optimizing Pest Management Curricula for Adoption in K-12 Classrooms

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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). This program has been developed and conducted in partnership with USDA-ARS, and is intended as a modification of more traditional agricultural "area-wide" pest management programs, using public schools to reach and influence the behavior of Hawaii residents over a large area, rather than focusing efforts exclusively on a single community or more limited geographic area. The *Educate to Eradicate* K-12 curricula project has been implemented in over 350 Hawaii public school classrooms on the islands of Oahu, Maui, and Hawaii, 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 state science process and life science instructional standards are addressed, facilitating standards-based instruction while teaching novel termite content (HCPS III 2007).

*Educate to Eradicate* curricula utilize live termites for observations and investigations. Students establish termite habitats that are observed over several weeks (Fig. 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).

Fig. 1. Students examine a termite habitat in classroom.

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 curriculum that requires limited institutional inputs, increases science literacy in Hawaii schools, and will help protect current and future homeowners from incurring structural termite damage (Mason et al. 2013a).

*Educate to Eradicate* curricular 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 in Hawaii receive professional development, materials, laboratory supplies, and equipment needed to complete the lessons. Supplies and items supplied on a loan basis include 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.

This study was initiated to flesh out factors that influence adoption and continued use of our pest management curricula in public school classrooms. Initial paper-and-pencil surveys completed by partner teachers revealed trends in continuation (Mason et al. 2013b). Teacher focus groups were organized to more robustly assess *Educate to Eradicate* curriculum design and professional development implementation. Perceptions of key project components and supports were recorded during teacher focus groups. Our findings will inform modifications to curricula, professional development, and project supports. The goal of this assessment was to optimize our limited resources to maximize teacher continuation and student learning.

## 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. Emergent themes were coded throughout

all transcripts, highlighting overall teacher perceptions (Krueger 1998, Morgan 1997).

## Results and Discussion

***Curriculum Design.*** Qualitative content analysis of the five teacher focus groups revealed key motivators for project curriculum adoption and continuation (Fig. 2). 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 by teachers 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**

The focus group results suggest that the incorporation of Hawaii state instructional 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 other extension faculty research on adoption of K-12 curricula. Diker et al. (2011) and McKeely and Wells (1997) cited 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, were 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 instructional standards, incorporate a range of current best-practice pedagogies (including inquiry), include interdisciplinary lessons, and be written/formatted for easy teacher use.

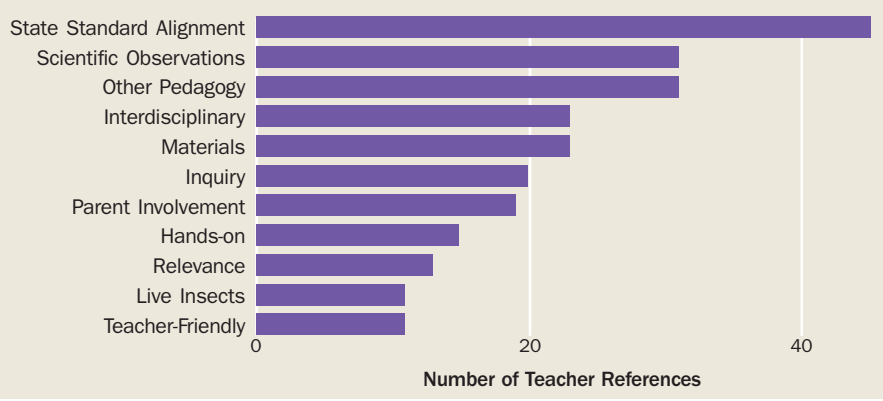


**Fig. 2. Emergent motivators for *Educate to Eradicate* partnership from teacher focus group transcript data analyzed with NVIVO 9.**

***Professional Development.*** Teachers were asked to reflect on their professional development experiences. *Educate to Eradicate* has employed a range of professional development techniques throughout its lifetime (2001-present). Early-adopting elementary teachers felt that the weekend training that they received in the program 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 curricula. Late-adopting elementary teachers in our project valued in-class lesson modeling, which did not require additional hours beyond the workday, rather than weekend workshops. 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 curricula are more likely to continue with collegial 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) argued 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. Some teachers noted that their school 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 that planning time and help with technology positively influenced adoption and continuation. Teachers valued user-friendly components of *Educate to Eradicate*, including prompt communication, material drop-off/pick-up, and 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.

In summary, teachers identified the following keys to curricula adoption and continuation:

*Curriculum design:* Curricula should be tightly and explicitly linked to state/local instructional standards, incorporate a range of current best-practice pedagogies (including inquiry), include interdisciplinary lessons, and be 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. Although some aspects of the program can be reduced or eliminated to minimize university resource commitments, teachers will continue to need live termites and termite habitats to continue to use *Educate to Eradicate* curricula.

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