PBL with Savorous Gardens: Cultivating Abilities and Knowledge of Elementary Teachers

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PBL classrooms incorporate free-flowing elements, but it is crucial for teachers to intentionally design the learning environment and support strategies (English & Kitstantas, 2013). Balancing student autonomy with support while moving away from teacher-centered instruction can be challenging for both new and experienced teachers (Pepper, 2009; Strevy, 2014). Striking the right balance between allowing students to have the freedom to discover and withholding excessive assistance can be demanding. Too much or too little student assistance will hinder learning. The need for PBL teacher education is further emphasized as many in-service and pre-service teachers lack experience as PBL learners and may not have had opportunities to observe PBL implementation (Lehman, et al., 2006; Strevy, 2014).

Garden-Based Learning (GBL) is an instructional strategy and a teaching tool that uses gardens to promote educational outcomes. In their synthesis of research, Williams and Dixon (2013) "found a preponderance of positive academic outcomes especially in science, math, and language arts, giving credence to gardens serving as instructional and curricular means for covering academic content" (p.226). A challenge to hands-on science has always been teacher time, training, and materials (Haury & Rillero, 1994) and these are challenges in GBL (Hazzard et al., 2011).

This paper describes a seven-week, 10-hour, professional-development program to enable teachers to implement edible garden-based learning through a problem-based approach. The "Our Plot of Sunshine" grades 3 to 6 curriculum and teacher workshop components are described. The curriculum seeks to solve problems of time and materials that are obstacles to GBL. The workshops seek to overcome training as a barrier.

Four teacher workshops were held with a range of participants from 9 to 20. Analyzed data on the implementation, including posttest and retrospective before-and-after items, are presented and discussed. For the anonymous Likert-items, with 5 being strongly agree and 1 being strongly disagree, the majority of teacher participants strongly agreed that because of their participation in the program, they improved their pedagogical abilities ($\bar{x}$= 4.77, SD=0.43), increased their science content knowledge (4.77, 0.43), gained a better understanding of project-based learning (4.59,

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0.59), increased their understanding of using quantitative data (4.41, SD=0.73), and have a greater appreciation for the importance of qualitative data (4.50, 0.74).

The majority strongly agreed that the curriculum would be engaging for their students (4.95, 0.21), is a good way to learn science (4.95, 0.21), presents opportunities for mathematics integration (4.86, 0.35), and is a good way to implement project-based learning (4.86, 0.35). Retrospective items were also used to reduce response-shift bias. The paired t-tests analysis suggests significant (all < 0.0001) gains in confidence in using garden-based learning, teaching about soil, and teaching others about using food gardens for instruction.

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