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Teacher Self-Efficacy During the Implementation of a Problem-Based Science Curriculum

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Abstract

This study was conducted to investigate eighth-grade science teachers' self-efficacy during the implementation of a new, problem-based science curriculum. The curriculum included applications of LEGO® robotics, a new technology for these teachers. Teachers' responded to structured journaling activities designed to collect information about their self-efficacy for teaching with the curriculum and, later, to a survey designed to probe their self-efficacy for enacting specific elements of the curriculum. Participants reported high confidence levels throughout the study but expressed some concerns related to their local contexts.

Many researchers have investigated teachers' self-efficacy, defined by Bandura (1986) as "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (p. 391.) (For example, see Tobin, Tippins, Gallard, & Gabel 1994.) Bandura (1997) recommended examining science teachers' self-efficacy, specifically, stating that "teacher efficacy in science education is of particular concern, given the increasing importance of scientific literacy and competency in the technological transformations occurring in society" (p. 242).

Indeed, previous research provides evidence for a relationship between teacher self-efficacy and successful science teaching (Tobin et al., 1994; Roberts, Henson, Tharp, & Moreno, 2001). For example, Czerniak and Shriver (1994) reported that preservice science teachers with high self-efficacy used a variety of instructional strategies, in contrast to teachers with low-self efficacy, who relied primarily on the textbook. Similarly, Riggs, Enochs, and Posnanski (1991) analyzed teaching videos and found that teachers with high self-efficacy taught science content and skills more thoroughly, asked more open-ended questions, checked more frequently for student understanding, and connected content to students' lives more often than did teachers with low-self efficacy.

Science teachers' self-efficacy beliefs do not exist in a vacuum but, rather, exist in relation to teachers' other belief structures and the real-world teaching contexts.) Bandura (1986) acknowledged that "self-efficacy, a belief sub-construct, is too broad, vague and context free to be useful" and that "self-beliefs must be context specific and relevant to the behavior under investigation to be useful to researchers and appropriate for empirical study" (as quoted in Pajares, 1992, p. 315).

Several studies have illustrated a relationship between contextual factors and science teachers' self-efficacy. For example, Ramey-Gassert, Shroyer, and Staver (1996) found that teachers' science teaching self-efficacy was related not only to antecedent factors (previous science experience, teacher preparation, or science teaching experiences) and internal factors (attitudes toward and interest in science), but also to external factors, including the school workplace environment, student variables, and community variables.

Given the degree to which science teachers' self-efficacy may be context specific, teacher self-efficacy should be examined in the context of specific efforts to improve science teaching and learning. The use of technology in the teaching and learning of science represents an important element of this context. Some recent studies have focused on teacher self-efficacy when technology is included in science classrooms (e.g., Graham et al., 2009; Minshew & Anderson, 2015), and the present study adds to the knowledgebase in this area.

In recent years, robotics has emerged as a potentially powerful tool for fostering student engagement and learning in STEM (science, technology, engineering, and mathematics) disciplines (Park, 2015; Taylor, 2016). Through a rapidly growing network of FIRST LEGO® League (FLL) competitions, students participate in team challenges that use robotics and engineering design to solve real-world problems (Rosen, Stillwell, & Usselman, 2012).

Although much of the published research on educational robotics focuses on informal, out-of-school time settings, researchers and practitioners have begun to explore the possibilities of using LEGO Robotics in formal K-12 STEM education settings (Mills, Chandra, & Park, 2013; Park, 2015; Taylor, 2016). For example, Tufts University's LEGO Engineering program provides materials and guidance to educators interested in utilizing LEGO robotics in the classroom (Tufts Center for Engineering Education & Outreach, 2016). Park (2015) examined the effects of robotics-enhanced, inquiry-based learning in South Korean science classrooms and found significant improvement in motivation and academic achievement among students who participated in a robotics-enhanced science curriculum. Robotics also is beginning to be used with preservice teachers (Kim et al., 2015).

The purpose of this study was to explore teacher self-efficacy beliefs during the implementation of the Science Learning Integrating Design, Engineering, and Robotics (SLIDER) project. SLIDER was a multi-year, National Science Foundation funded project, in which university researchers and middle school science teachers collaborated to develop a new, problem-based curriculum.

Savery (2006) defined problem-based learning as "an instructional (and curricular) learner-centered approach that empowers learners to conduct research, integrate theory and practice, and apply knowledge and skills to develop a viable solution to a defined problem." In the SLIDER project, the Mindstorm robotics materials and technology were integrated into the project's problem-based curriculum.

Just as the use of robotics is a relatively new development in formal K-12 settings, LEGO robotics represented a new technology for the teachers in this study and placed new demands on their science teaching. Specifically, facilitating the problem-based inquiry activities included in the curriculum required that teachers become proficient at building and programming robotic vehicles created using the LEGO Mindstorm kits (Usselman & Ryan, 2015). The curriculum materials are available for review online at http://slider.gatech.edu.

Teachers' beliefs regarding science reform ideas are important elements of educational change, as there is a relationship between what teachers believe and what they do in the classroom (Haney, Lumpe, Czerniak, & Egan, 2002). Thus, the careful consideration of teacher self-efficacy may be particularly important for programs or interventions intended to enhance or change science teaching practices. Specifically, in the context of a project with the goal of developing and implementing a new inquiry-based science curriculum, understanding teacher self-efficacy may help explain variations in how teachers interact with and implement the curriculum.

The notion of *fidelity of implementation* refers to "the extent to which a delivery of an intervention adheres to the protocol or program model originally developed" (Mowbray, Holter, Teague, & Bybee, 2003, p. 315; see also Fogleman, McNeill, & Krajcik, 2011). Previous research has suggested a relationship between teachers' self-efficacy and fidelity of implementation (Keys & Bryan, 2000). Guskey (1988) determined that teacher self-efficacy is a good indicator of teacher attitudes toward implementing a new instructional practice or reform. In his study, Guskey found that teachers who are "confident about their teaching abilities" (p. 67) are also the "most receptive to the implementation of new instructional practices" (p. 67).

Similarly, Fogleman et al. (2011) suggested that whether or not a teacher implements curriculum reform with fidelity is determined, in part, by their beliefs about teaching and learning. They also noted that teacher self-efficacy is an important predictor of the successful implementation of new curriculum; "teachers who believe they are able to achieve specific teaching goals are more willing to try new innovations in their classrooms" (p. 151).

On the other hand, Smith (1996) posited that educational reform efforts may negatively affect teacher self-efficacy, since teachers would not be able to gauge how they are affecting student learning due to lack of traditional assessment measures. Thus, examining teacher self-efficacy specific to the implementation of new curricula may yield important insights into how teachers approach the implementation of new science curricula and help explain variations in curriculum implementation. With that in mind, the following research questions were investigated:

1. How does teacher self-efficacy for implementing the new curriculum change during the initial 8-week implementation of the curriculum?

2. How does teacher self-efficacy vary across the elements of the curriculum?

The Curriculum

The curriculum utilized by the teachers in this study is an inquiry and problem-based learning curriculum for middle school physical science classes, which was designed to align with the *Next Generation Science Standards* (NGSS Lead States, 2013). Specifically, the curriculum challenges students to learn disciplinary core ideas in physical science related to force, motion, and energy through a series of investigations and engineering challenges. In addition to deepening students' conceptual understanding of disciplinary core ideas in physical science, the curriculum intends to engage students in the engineering practices of defining engineering problems, designing solutions to solve engineering problems, and optimizing design solutions.

The curriculum was developed iteratively using a design-based implementation research (DBIR) approach (Penuel & Fishman, 2012) involving a team of university researchers, subject matter experts, and classroom teachers. The DBIR approach was utilized in order to use analyses of curriculum implementation, including adaptations made by teachers working in diverse contexts, to refine the curriculum iteratively.

Students experiencing the curriculum use LEGO Mindstorm robotics kits in activities designed to foster understanding of disciplinary core ideas in physical science related to force, motion, and energy. The curriculum is designed as two 3- or 4-week units. Since the materials were designed with a project-based learning foundation, students work collaboratively to solve a problem by identifying learning goals, plan how they will solve the problem, conduct research, interpret the results of the research, and explain their solutions to the problem.

Within the curriculum these activities are designated and labeled as specific curriculum elements, such as "Explore," "Add to Your Understanding," "Reflect and Connect," and "Share." The processes the students use are often cyclical, where they move back and forth between the phases of the problem-solving process until a reasonable solution is obtained. A thorough description of the curriculum can by found in Usselman and Ryan (2015).

Methods

Design

As this research sought to discover *how* questions regarding eighth-grade science teachers' self-efficacy during the implementation of a new, problem-based science curriculum, it was conducted as a case study consistent with Creswell's (1998) definition. Creswell asserted that a case study is appropriate when the researcher is "developing an in-depth analysis of a single case or multiple cases" (p. 65), with multiple data sources, for the purposes of description and theme identification. The use of a case study design is further supported by Yin (2003) who posited, "In general, case studies are the preferred strategy when 'how' or 'why' questions are being posed, when the investigator has little control over events, and when the focus is on a contemporary phenomenon within some real-life context" (p. 1).

Participants

The participants in this study were six eighth-grade science teachers (two male, four female) from a state in the southeastern United States. Two teachers were from a rural school, and four teachers were from suburban schools near a large metropolitan area. The schools varied significantly with regard to class size, schedules, and the transiency rates and socio-economic background of their student populations. Participating classes in the rural school included a relatively stable (i.e., low transiency) predominantly low-income student population and had medium to large class sizes but slightly longer class periods than in the other participating schools.

One of the suburban schools serves an ethnically and socio-economically diverse student population that has a relatively high transiency rate and a history of challenges regarding student achievement. Teachers from this school reported large class sizes, a lack of physical space, and a scarcity of time to implement science activities. In contrast, the second suburban school is located in a predominantly upper-class neighborhood, and the majority of students who participated in curriculum activities were high-achieving and designated as gifted. The teacher from this school reported having relatively small class sizes and a school environment that is generally conducive to science teaching and learning (e.g., few interruptions, adequate time, space, and materials, administrative support).

The participants had been working on the project with us, the authors and researchers, for 2 years prior to curriculum implementation. During this 2-year period, in which the first version of the curriculum was being developed and pilot tested, teachers were asked to implement science curricula that utilized problem-based learning to teach physical science concepts. Although this preliminary phase of the program meant that all teachers had developed a basic understanding of problem-based learning prior to curriculum implementation, only one of the six teachers had experience working with LEGO Robotics prior to the program.

As described in Table 1, teachers' involvement in the project included annual summer week-long professional development institutes, as well as ongoing professional development, both in person and online, through remote communication with the project team and professional development materials (i.e., videos, email, etc.). The specific topics for summer institutes and ongoing professional development sessions were informed both by the curriculum development process and observed and reported teacher needs.

Professional development sessions were designed to familiarize teachers with newly developed curricula, develop teachers' proficiency working with LEGO Robotics materials, and build teachers' capacity to engage students' meaningfully in the science and engineering practices within the curriculum. All six teachers attended all professional development sessions and implemented both of the curriculum units in their science classrooms.

The nature of the professional development activities could have easily enhanced the participants' self-efficacy through the enactive mastery, vicarious, and social persuasion sources of developing self-efficacy beliefs, as suggested by Bandura (1997). The activities in the professional development sessions provided many opportunities for the teachers to work with the robotics and curriculum (enactive mastery), to see their peers having success (vicarious), and to receive positive feedback about their work and ideas (social persuasion).

Table 1
SLIDER Professional Development Activities

Professional Development Activity	Description

SLIDER Summer Institutes	
Curriculum Review	Teachers are led through each unit of the SLIDER curriculum to review key science content knowledge and learn about revisions from previous versions.
LEGO Robotics Activities	Teachers complete LEGO activities including building cars and trucks used as manipulatives in investigations and programming using LEGO Mindstorm NXT kits. Teachers share and learn strategies for organization and management of LEGO Mindstorm kits in the science classroom.
Investigations	Teachers complete SLIDER investigations using LEGO Robotics materials.
Group Discussion	Teachers provide feedback on the curriculum, discuss previous experience implementing SLIDER, and describe any anticipated challenges for upcoming SLIDER implementation.
Ongoing Professional Development and Support	
SLIDER Professional Development Days	Day long professional development sessions typically mid-way through the academic year focusing on supplemental robotics activities, any observed or reported challenges, and reviewing any changes to curriculum since Summer Institute.
Regular Classroom Visits and Check-ins	Periodic visits to SLIDER classrooms to observe and provide guidance on curriculum implementation.
Online PD: Videos and Message Boards	Tutorial videos review key science content, provide technical assistance on LEGO robotics activities, and describe best practices for implementation of each section of the SLIDER curriculum. Message boards for teachers to engage in dialogue about their experience implementing SLIDER.
Troubleshooting	One-on-one exchanges (via phone, email, or text messages) between SLIDER teachers and project staff to address challenges that arise as teachers implement SLIDER curriculum.

Data Sources

Multiple data sources were used in this study. Participants completed journal entries during an 8-week implementation of one unit of the curriculum in the fall semester. Later, they responded to a survey during the implementation of a second unit of the curriculum in the spring semester.

Journaling. Guided reflective journaling has been observed as a way for participants to recognize accomplishments and to reflect on the development of important content, skills, and dispositions (Dunlap, 2006b) and has been used to investigate self-efficacy (Dunlap 2005; 2006a). Guided reflective journaling was used in the present study to collect the teachers' self-efficacy beliefs about implementing a new problem-based science curriculum.

Journaling prompts were assigned to the teachers three times during the 8-week implementation. See Appendix A for a listing of the journal prompts. The three journaling activities were designed to determine the participants' self-efficacy levels prior to implementing the unit, while they were implementing it, and when the unit was completed, as recommended by Dunlap (2005). We created the prompts for the journaling activities by following the recommendations of Dunlap (2006b) for guided reflective journaling.

Participants were asked to respond to questions about their confidence for facilitating learning with the new materials, their confidence for implementing the materials the way we designed them to be implemented, and the way they defined success for the new curriculum. The journal questions were presented in various forms in each of the three sets of journaling activities. Data were collected during the implementation period from October to November 2012. We applied the constant comparative method (Glaser & Strauss, 1967) to the journal entries. Merriam (2009) stated that the objective of this method of analysis is to "identify patterns in the data" (p. 30).

Both within-case and cross-case analyses were performed to investigate patterns in the changes of individual's self-efficacy beliefs related to the implementation of the new curriculum and to attempt to build a general explanation of how curriculum reform affected their self-efficacy beliefs. Some participants neglected to answer all of the journal questions. The number of respondents included in each analysis is noted if there was less than complete participation.

Self-Efficacy Survey. We constructed a 14-item survey (Appendix B) to assess the participants' self-efficacy for enacting specific elements of the curriculum and general inquiry learning techniques. Two questions were constructed per curriculum element, and two questions addressing general inquiry learning techniques were included. The specific elements from the curriculum included labeled sections from the student materials: Add to Your Understanding, Explain, Explore, Organize the Challenge, Reflect and Connect, and Share. The two questions on the survey that were not connected to specific curriculum elements addressed important inquiry teaching practices and are labeled in this report as facilitation.

The survey was constructed through negotiation and discussion with the research team, with guidance from Bandura's (2006) *Guide for Constructing Self-Efficacy Scales*. With only six participants in the study, statistical analysis of the survey did not seem appropriate, especially when the questions were not constructed with that type of analysis in mind. However, the survey had a high degree relevance, as it was designed to align with the curriculum and elements of the inquiry-based philosophy on which the curriculum was grounded. The participants completed the survey using a web-based survey tool. The surveys were not completed anonymously so that we could match the survey responses with the journal entries.

Findings

Research Question 1, which concerned changes in teacher self-efficacy over the course of the 8-week curriculum implementation, was investigated by analyzing the participants' guided journal responses, which were collected in the fall semester during the implementation of the first unit of the curriculum. Research Question 2, which concerned variations in teacher self-efficacy across different elements of the curriculum, was investigated by analyzing the survey responses collected during the implementation of a second unit of the curriculum in the spring semester.

Research Question 1

Overall, teacher journal responses indicated a high level of self-efficacy for implementing the new problem-based science curriculum. In the first set of teacher journal responses, which were taken before implementation began, the confidence ratings from five teachers ranged from 6.5 to 9, with an average of 8.1 on a scale of 0-10, where 0 represented *not confident at all* and 10 represented *completely confident*.

From the first set of journals to the third set of journals, teacher self-efficacy remained high. Teachers self-reported consistent confidence levels, with levels only going up or down by 0.5 points between data collection points. The constantly high teacher self-efficacy ratings are consistent with prior research (Fogleman et al., 2011; Guskey, 1988; Keys & Bryan, 2000) regarding teacher willingness to implement a new curriculum.

As stated in their journal responses, the teachers were confident in their ability to facilitate student learning and also to implement the materials with fidelity. The participants in this study had been involved in the development of the new curriculum materials for approximately 2 1/2 years, which included significant professional development for implementing the materials. This high level of involvement and preparation may have assisted the participants in developing a high degree of confidence for using the materials. In fact, some participants specified training and preparation as reasons why they felt confident with the materials. One participant commented that we had done “a good job of running the procedure beforehand to workout potential problems” in developing the curriculum.

Although participating teachers were confident about implementing the materials, they shared some concerns. Participants expressed concern about integrating the new curriculum materials within their unique school environments, which included growing class sizes and an emphasis on test preparation. Other school expectations, such as changes to the school day for special programs that disrupted the delivery of the new curriculum, were also noted as impacting the participants’ confidence in implementing the curriculum as planned.

When the participants were asked how they would define success for the project, three of the five teachers who responded to this question included aspects of student learning or enjoyment in their definitions. The remaining participants who responded to that question defined success as implementing the new curriculum in the way we, the researchers, intended. The results highlight that half the teachers seemed to value student learning enough to list it prominently in their journals.

Thus, regarding Research Question 1, data from guided reflective journaling revealed persistently high levels of self-efficacy for implementing the curriculum materials among all participating teachers and across the 8-week implementation period. Thus, it appears that teachers began curriculum implementation with relatively high levels of self-efficacy and, despite some challenges within their school contexts, teachers’ beliefs in their capability to implement the curriculum successfully remained relatively unchanged. The three guided journaling activities included questions that allowed the researchers to include triangulation of sources (Patton, 2002, p. 556), so that consistency in the findings could be observed from different periods of data collection, at different points in time. The linking of questions across journaling activities is shown in Table 2.

Table 2
Triangulation of Journaling Data Across Different Points of Time

Journal Prompts Set 1	Journal Prompts Set 2	Journal Prompts Set 3
How do you currently feel about your ability to facilitate student learning with the SLIDER materials?	<Same question asked>	<Same question asked>
On a scale of 1 to 10, how would you rate your confidence regarding facilitating student learning with the SLIDER materials? On the scale, 0 represents “not at all confident” and 10 represents “completely confident”	<Same question asked>	<Same question asked>

Participant’s responses to a prompt common to all journal activities provides examples of how the teachers demonstrated high levels of self-efficacy throughout the implementation when journaling took place. One participant responded as follows in response to the prompt, “How do you currently feel about your ability to facilitate student learning with the SLIDER materials?”:

> *Journal 1:* “I feel okay about most of the materials at this point. I am still apprehensive about some of the robotics, but I feel like we have a good support system in place. It seems that we will be able to have help or answers to just about any problem we have.”
>
> *Journal 2:* “Overall I feel like things are going well.”
>
> *Journal 3:* “I feel that I am capable of facilitating student learning with the SLIDER materials. As we are moving through the materials I feel that there are times when I would like to have more "teaching" time to make some of the connections that it seems the students are missing.”

We discussed responses like these comments, applying “analyst triangulation” (Patton, 2002, p. 556) and agreed to the interpretation that the teacher participant was indicating high levels of self-efficacy throughout the implementation period.

Research Question 2

The results of the self-efficacy survey are presented in Tables 3 and 4. The per-teacher averages across all questions ranged from 8 to 10, where 10 corresponded to *Certain can do* and 0 corresponded to *Cannot do at all*.

Table 3
Summary of Self-Efficacy Survey Responses by Participant Number

Survey Item	1	2	3	4	5	6	Item Average
I can help my students formulate science questions and investigations when beginning a new, real-world challenge.	10	10	8	9	10	8	9.16
I can help my students identify and address their science misconceptions through exploration and reflection.	10	10	8	10	9	8	9.16
I can help my students identify patterns or trends in data from investigations and research they conduct.	10	10	9	10	10	9	9.67
I can help my students identify and extract critical information from a given challenge, scenario, or observation of phenomena.	10	10	8	10	9	9	9.33
I can help my students engage with and learn from each other when they share the results of their investigations.	8	10	6	10	9	10	8.83
I can help my students connect what they have learned to real world situations.	10	10	8	10	9	10	9.5
I can help my students connect evidence they gather during an investigation to the claims they make.	8	10	9	9	9	8	8.83
I can let my students struggle with concepts and activities during the learning process, where I refrain from providing immediate answers or solutions.	10	10	8	9	10	9	9.33
I can help my students solve problems, even if they are solving them differently than I would solve them.	10	10	8	10	10	9	9.5
I can help my students conduct group investigations with the goal of revealing science concepts.	8	10	8	10	10	9	9.17
I can help my students use claims, evidence, and reasoning to discuss science concepts.	8	10	8	10	10	9	9.17
I can help students use the scientific content they learn when supporting their claims.	9	10	7	9	10	8	8.83
I can help my students connect science content with their previous investigations, giving scientific meaning to the investigations.	10	10	8	10	10	9	9.5
I can help my students present the results of their investigations to the class with posters or other media.	8	10	9	10	10	10	9.5
Participant average on all items	9.2	10	8	9.7	9.6	8.9	

Table 4
Average Survey Results by Curriculum Element and Survey Item

Curriculum Element	Survey Items	Average Self-Efficacy Score
Add to your understanding	2, 13	9.33
Explain	7, 12	8.83
Explore	3,10	9.42
Facilitation	8,9	9.42
Organize the challenge	1,4	9.25
Share	5,14	9.12

The teacher scoring the lowest, 8, in overall self-efficacy on the survey also consistently rated herself low in the journaling exercises. At the question level, there was a three-way tie for the lowest level of confidence:

1. "I can help my students engage with and learn from each other when they share the results of their investigations." (Share)
2. "I can help my students connect evidence they gather during an investigation to the claims they make." (Explain)
3. "I can help students use the scientific content they learn when supporting their claims." (Explain)

These three questions each had an average of 8.83 out of 10, indicating what we interpreted as high levels of self-efficacy. While indicating high self-efficacy, teachers were least confident as a group in these areas. The magnitude or the significance of the difference may not be as important as simply identifying these potential areas where teachers may have slightly lower or more variable self-efficacy beliefs.

Of particular note is that Questions 2 and 3 addressed one particular element of the curriculum, Explain. The Explain portions of the curriculum required teachers to facilitate activities where students applied their understanding of science and engineering to develop arguments. Specifically, students were asked to engage in scientific reasoning by making and supporting claims based on evidence gathered through their investigations and their newfound knowledge of physical science concepts. With respect to Research Question 2, survey results suggest that the Explain portions of the curriculum may be an area where the teachers struggled to implement the curriculum as intended.

Limitations

The participants in this project consistently reported high levels of self-efficacy for implementing problem-based learning curriculum materials that utilized new technology to facilitate student learning of physical science concepts. The sources of their positive self-efficacy beliefs are unknown, but their prior experience as science teachers and the extensive professional development that was part of the curriculum design process are likely contributing sources. Future research may probe more deeply into specific areas of the curriculum where the relative weaknesses in self-efficacy were observed. Specifically, researchers in this area may consider exploring science teachers' self-efficacy for engaging students in activities related to scientific argumentation. Also, the research reported in this paper addresses only the participants' self-efficacy for implementing the curriculum as it was designed. Future research could compare their self-efficacy beliefs with classroom observations of actual implementation of the curriculum.

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Appendix A
Guided Reflective Journaling Questions

Pre-implementation questions

- How do you currently feel about your ability to facilitate student learning with the SLIDER materials?
- On a scale of 0 to 10, how would you rate your confidence regarding facilitating student learning with the SLIDER materials? On the scale, 0 represents "not confident at all" and 10 represents "completely confident".
- Are you confident that you can implement the materials the way the SLIDER team has planned for them to be implemented? Why or why not?
- How would you define success in terms of implementing the SLIDER materials?

Mid-implementation questions

- What have you learned about your ability to facilitate student learning with the SLIDER materials so far?
- On a scale of 0 to 10, how would you rate your confidence regarding facilitating student learning with the SLIDER materials? On the scale, 0 represents "not confident at all" and 10 represents "completely confident".
- What questions or problems related to using the SLIDER materials with your students have you had lately? How will you answer these questions or resolve these problems?
- How do you currently feel about your ability to facilitate student learning with the SLIDER materials?

Post-implementation questions

- How do you currently feel about your ability to facilitate student learning with the SLIDER materials?
- On a scale of 0 to 10, how would you rate your confidence regarding facilitating student learning with the SLIDER materials? On the scale, 0 represents "not confident at all" and 10 represents "completely confident."
- Were you able to implement the materials the way the SLIDER team had planned for them to be implemented? Why or why not?

Appendix B
Curriculum Teaching Inventory

Instructions: This questionnaire is designed to help us get a better understanding of your confidence for teaching practices related to the <Project Name> curriculum. There are no wrong answers. Please indicate your confidence level for each situation described based on your present capabilities and your current school and classroom environment.

Important: The questions often refer to *helping* your students, which means in this context that you are <u>not</u> providing them with direct instruction on a concept, or telling them an answer; you are letting them discover.

Participants responded to each prompt by choosing an integer between 0 and 10 where 0 corresponded to *cannot do at all* and 10 corresponded to *certain can do*.

1. I can help my students formulate science questions and investigations when beginning a new, real-world challenge. (organize the challenge)
2. I can help my students identify and address their science misconceptions through exploration and reflection. (add to your understanding)
3. I can help my students identify patterns or trends in data from investigations and research they conduct. (explore)
4. I can help my students identify and extract critical information from a given challenge, scenario, or observation of phenomena. (organize the challenge)
5. I can help my students engage with and learn from each other when they share the results of their investigations. (share)
6. I can help my students connect what they have learned to real world situations. (reflect and connect)
7. I can help my students connect evidence they gather during an investigation to the claims they make. (explain)
8. I can let my students struggle with concepts and activities during the learning process, where I refrain from providing immediate answers or solutions. (facilitation)
9. I can help my students solve problems, even if they are solving them differently than I would solve them. (facilitation)
10. I can help my students conduct group investigations with the goal of revealing science concepts. (explore)
11. I can help my students use claims, evidence, and reasoning to discuss science concepts. (reflect and connect)
12. I can help students use the scientific content they learn when supporting their claims. (explain)

13. I can help my students connect science content with their previous investigations, giving scientific meaning to the investigations. (add to your understanding)

14. I can help my students present the results of their investigations to the class with posters or other media. (share)