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Cynthia Pierfax

Travella Free

Tiffany Franklin

Manola Erby

Lynn Schmitt-McQuitty

See next page for additional authors

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CYNTHIA PIERFAX[1], TRAVELLA FREE[1], TIFFANY FRANKLIN[1], MANOLA ERBY[1], LYNN SCHMITT-McQUITTY[1], C. L. MEEHAN[1], AND MARTIN H. SMITH[1]

AUTHORS: [1]University of California, Davis.

Abstract. There is a defined need to provide accessible and effective professional development for 4-H educators. Lesson study is a Community of Practice-based approach to educator professional development. Prior research has shown lesson study to be effective with 4-H staff, adult volunteers, and teen volunteers. This inquiry, a multi-site case study, was designed to investigate the application of lesson study in authentic contexts with 4-H county agents from 1890 land-grant universities. Quantitative and qualitative measures revealed improved preparedness, participation, and camaraderie among participating educators. Other benefits to participants included improved lesson planning and implementation.

INTRODUCTION

The Morrill Act of 1862 established the national system of land-grant colleges and universities (Nevins, 1962). Prior to this bill, the availability of post-secondary education to the working-class population in the United States was limited. To that end, the Morrill Act of 1862 expanded opportunities for higher education to a broader segment of the U.S. population (Nevins, 1962). This was accomplished by providing federal land, or rights to federal land, to individual states for the purpose of establishing land-grant colleges and universities. Furthermore, the Morrill Act of 1862 proposed focused areas of study, principally agriculture and mechanical arts (Nevins, 1962).

The benefits of the newly established land-grant system were not inclusive, however; segregation of African Americans in southern states prevented them from attending Whites-only 1862 land-grant institutions (Croft, 2019, 2021; Lee & Keys, 2013). To provide higher education to Blacks, Congress passed the second Morrill Act of 1890 (Croft, 2019, 2021). This bill sought to extend access to Blacks by providing additional funds for 1862 universities that were conditional based on non-restrictive race-based admissions. Thus, to accept these additional funds, 1862 universities could either admit Black students to their schools or create new institutions for Blacks only. The 1862 universities in the South chose the latter of these two options, forming separate institutions for Black students (Croft, 2019, 2021; Lee & Keys,

2013). Today, there are 19 1890 land-grant colleges and universities in 18 states (Croft, 2021).

COOPERATIVE EXTENSION

The National Cooperative Extension System is the outreach arm of land-grant universities; it was established in 1914 by the signing of the Smith-Lever Act (Gould et al., 2014). Supported by federal, state, and local funding, Extension has networks of university and county-based academics and staff in every state that focus on addressing authentic needs within a community, county, region, or state. Originally, Extension focused on advancing agricultural production in rural areas, but expanded quickly to address additional needs and segments of society, including public health and nutrition, emergency relief, youth clubs, community gardens, arts and recreation programs, and pests and diseases (Gould et al., 2014).

COOPERATIVE EXTENSION AND THE 4-H YOUTH DEVELOPMENT PROGRAM

Although boys' and girls' agricultural clubs (e.g., Corn Clubs, Tomato Clubs, Canning Clubs, Hog Clubs) began around the turn of the 20th century, boys' and girls' club work was included as part of Cooperative Extension when it was established by Congress in 1914 (Enfield, 2001). The boys' and

girls' club work expanded quickly and evolved into the 4-H Youth Development Program. Today, the 4-H Program is the nation's largest nonformal youth education program and is part of the U.S. land-grant university (LGU) system in every state (Borden et al., 2014). The 4-H program reaches over six million youths annually through diverse educational programming in a variety of learning settings.

The 4-H program uses a positive youth development (PYD) framework focused on high-quality educational experiences that help youth thrive, leading to positive behaviors and key developmental outcomes (Arnold & Gagnon, 2020). Many 4-H projects and activities_ranging from STEM and healthy living to college and career readiness and civic engagement—are implemented with youth audiences by staff, adult volunteers, and teen volunteers using a variety of delivery modes, including after-school and camping programs, community clubs, and school enrichment programs (Borden et al., 2014).

4-H EDUCATORS AND PROFESSIONAL DEVELOPMENT

4-H educators—staff, adult volunteers, teen volunteers—vary widely with respect to their prior teaching experience or formal training in education, yet they are on the frontlines of engagement with youth enrolled in 4-H programs (Bechtel et al., 2013; Smith & Schmitt-McQuitty, 2013). To help ensure high quality 4-H programming and the achievement of intended learning outcomes, 4-H educators need opportunities to participate in accessible and effective professional development (Culp & Bullock, 2017; Smith et al., 2017).

Expert-led workshops represent the most common approach to professional development in 4-H (Smith et al., 2017). This method is considered ineffective in improving educators' practice (Bissonnette & Caprino, 2014; Darling-Hammond et al., 2017) because it is not typically informed by data specific to the audience of learners, does not normally involve active learning, and is decontextualized (Smith et al., 2017). In contrast, professional development models that are iterative, occur over extended time periods, engage participants in active learning, are informed by both formative and outcome data, and occur in authentic contexts are most effective for supporting educators' growth (Darling-Hammond et al., 2017).

LESSON STUDY

Communities of Practice (CoPs) represent an effective strategy to engage educators in collective inquiry and discourse around teaching and learning (Lieberman & Pointer Mace, 2010; Wenger et al., 2002). By definition, a CoP comprises individuals who share a common passion or concern relative to something they do (e.g., teaching), and through regular interactions as a group (their community), they improve their craft (their practice) (Wenger-Trayner & Wenger-Trayner, 2015). The learning that occurs for educators who participate in a CoP arises through the social interactions among the CoP members as it relates to their shared concerns about their practice (Buysse et al., 2003). Because CoPs are situated in authentic contexts, new knowledge is cultivated, developed, and shared most effectively through this social engagement.

Lesson study is a CoP-based approach to educator professional development that is grounded in constructivism, situated learning, and reflective practice. During the lesson study process, educators work in small groups over extended periods of time to formulate goals, improve lessons within discrete contexts, and explore deeper issues around teaching and learning (Lewis & Hurd, 2011). The process involves the systematic collection and analysis of, and dialogue around, formative data collected during lesson implementation. Using what they learn from formative data, educators plan, test, and revise lessons prior to subsequent implementations (Lewis & Hurd, 2011). Furthermore, the lesson study process is iterative; steps in the progression are repeated in a recurring cycle over time (Lewis & Hurd, 2011). Integral to lesson study " . . . is the belief that discussing others' points of view enhances the learning process and the final product" (Loucks-Horsley et al., 2003, p. 186).

Most research on lesson study in the United States has focused on formal education (Smith, 2013). The first investigation on the use of lesson study in nonformal education was published by Smith (2013). Findings from that inquiry revealed that lesson study can be effective as an approach to professional development for adult 4-H volunteers. Since that time, studies by Schmitt-McQuitty et al. (2019) and Smith et al. (2021) have provided additional evidence of lesson study being used successfully with other 4-H educators, including professional staff and teen volunteers. Furthermore, Smith et al. (2023) provided a theoretical argument for the use of lesson study to enhance 4-H educators' *pedagogical design capacity*—the ability to make effective curriculum adaptations—and improve curriculum implementation with youth. To date, no research on the use of lesson study with 4-H educators from 1890 LGUs has been published.

The purpose of the study presented in this paper was to investigate the application of the lesson study model of professional development in authentic contexts with 4-H educators from 1890 LGUs. Specifically, we describe a multi-state case study (Hatch, 2002) designed to address the following central question: What are the affordances and constraints of lesson study as a professional development model for county-based Extension 4-H agents in 1890 land-grant institutions as they pertain to curriculum implementation in their 4-H programs?

METHODS

CASE STUDY PARAMETERS

The case studies were bounded by the following parameters: 1890 LGUs; the use of lesson study as a professional development model for 4-H educators; county-based 4-H agents as lesson study group participants; and the use of a common curriculum for implementation with 4-H youth audiences. Lesson study at each university was coordinated by state-level Extension employees that were trained in the lesson study process by national experts (Smith et al., 2019). Each lesson study group implemented the essential elements of 4-H Youth Development programs (Martz et al., 2016) with 4-H youth in their respective states.

SUBJECTS

Lesson study group participants in the case studies were county-based agents associated with 4-H Youth Development programs at three 1890 LGUs: Kentucky State University, Prairie View A&M University, and Tennessee State University. One lesson study group from each university was included in this study.

County agents were recruited by state-level Extension employees and introduced to lesson study. Lesson study groups ranged in size from three to nine members. In two of the three groups, both in-person and virtual meetings (video/teleconference) were held, while in the third group only virtual meetings were held. The frequency and duration of lesson study groups varied slightly from one university to another. However, groups met once every three to four weeks for 60–90 minutes over a period of seven to 10 months. Additionally, each lesson study group had a rotating leadership structure that included a chairperson, a note keeper, and a timekeeper. Furthermore, meetings included agents sharing their reflections on curriculum implementation; interpreting formative data focused on achievements and challenges of planned activity implementations; discussing formative data; and making data-driven decisions to plan subsequent curriculum implementations.

DATA SOURCES

The sources of data for this case study included online surveys and focus group interviews. Data from both sources were collected post project.

DATA STORAGE

Data were anonymized and stored on the hard drive of a password-protected computer.

Surveys

The survey tool was administered online and included open and fixed-response questions. One survey was requested from each participating lesson study group. We were interested in gathering longitudinal information to help us understand participants' changes in perspective from the start of the project period until the end. To accomplish this, we asked two questions that used a retrospective approach (Raidl et al., 2004) to help compare key components of the lesson study process from the first to the last group meeting.

The first survey question asked respondents to rate (on a scale of 1–5) aspects of their lesson study experience from their first meeting. The second question asked respondents to rate (again, on a scale of 1–5) the same aspects of their lesson study experience from their final meeting. In addition, survey respondents reported on the types of formative feedback collected by lesson study group members during curriculum/project implementation and the ways in which that information was used in the lesson study process. Respondents were asked to report on what types of formative data they used during the lesson study process, and how those data were incorporated into their reflective practice.

Descriptive analyses of survey results were conducted, and because the data did not meet requirements for parametric analyses, the non-parametric Wilcoxon signed-rank test was conducted to compare the two related data sets (first meeting vs. final meeting).

Focus Group Interviews

Each lesson study group participated in a separate focus group. All focus group interviews were held using teleconferencing. The focus group facilitator asked a series of open-ended questions and recordings of the conversation were transcribed for analysis. Focus group interview data were analyzed using typologies, predetermined themes into which the overall data set was divided (Hatch, 2002; Patton, 2015). The three *a priori* themes that were used included: 1) benefits of lesson study to 4-H educators; 2) strengths of the lesson study process; and 3) lesson study process, opportunities for improvement. These themes were drawn from a previous study on the use of lesson study in 4-H (Schmitt-McQuitty et al., 2019); each theme had associated subthemes that were also used for the initial coding of the interviews from this investigation.

RESULTS

SURVEY OUTCOMES

Survey respondents rated their first and last lesson study meeting with respect to the following qualities: Group camaraderie; equal participation of all members; member preparedness; collaborative approach to problem-solving; time management; and use of documented youth feedback. The change in score for each group on each quality is presented in Figure 2.

Theme 1: Benefits of Lesson Study to 4-H Educators
- o Subtheme: Data-driven decision-making.
- o Subtheme: Content knowledge.
- o Subtheme: Lesson planning and implementation.
- o Subtheme: Social connections.

Theme 2: Strengthens of the Lesson Study Process
- o Subtheme: Leadership and Roles.
- o Subtheme: Lesson study group meeting format.
- o Subtheme: Role of content experts.
- o Subtheme: Formative data tools.
- o Subtheme: Reflection on Action.

Theme 3: Lesson Study Process—Opportunities for Improvement
- o Subtheme: Timing and frequency of meetings.
- o Subtheme: Lesson implementation schedules.
- o Subtheme: Formative data tools.

Figure 1. A Priori themes and subthemes for focus group analyses.
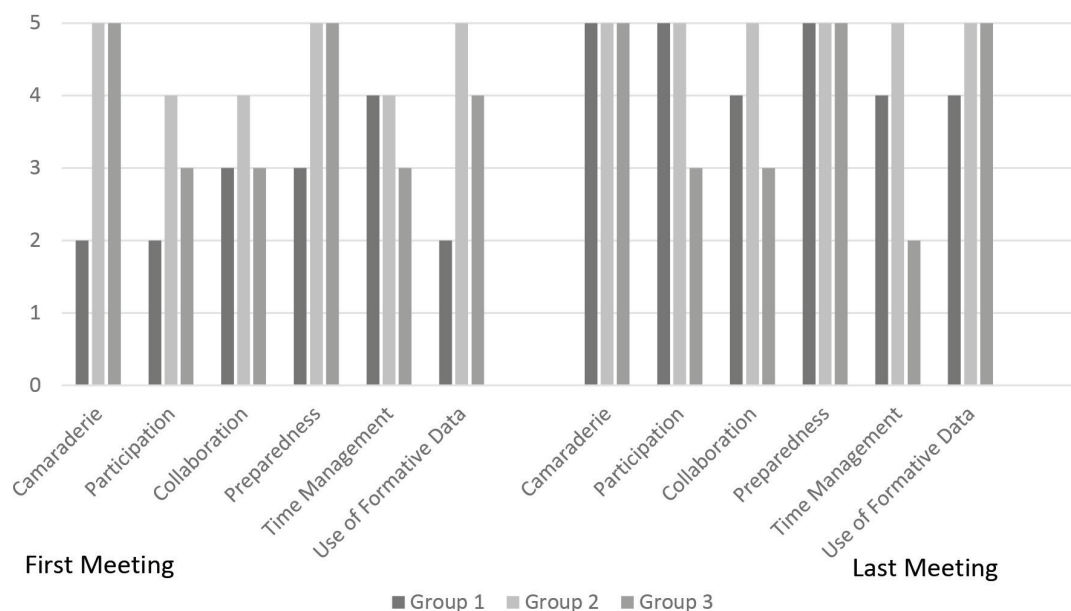

Figure 2. Ratings on lesson study group qualities during the first and last meetings.

Table 1. Frequency of Formative Data Tool Use by Type, Purpose, and Level of Confidence

Types of Formative Data Used	Number of Groups	Uses of Formative Data	Number of Groups	Degree of Confidence in Using Formative Data	Number of Groups
Clover Reflection Sheet	3	Understand youth perspectives	3	Very Confident	2
Share Sheets	2	Verify that learning objectives had been met	2	Somewhat Confident	1
Graffiti Wall	2	Address implementation challenges	3	Somewhat Unconfident	0
Photos	2	Plan for next lesson	3	Very Unconfident	0

A Wilcoxon signed-rank test was performed on all data comparing scores from the first meeting with those from the last. Results demonstrated an overall increase in scores across groups from the first meeting to the last (W-value = 3; p < .05).

All lesson study groups reported using multiple mechanisms for the collection of youth feedback, including Clover Reflection Sheets, Graffiti Walls, Share Sheets and Photos. All groups reported using youth feedback to help them understand the youths' experiences with each lesson. Groups also reported feeling very or somewhat confident in the use of formative data. The frequency of formative data tool use by type and purpose are presented in Table 1.

FOCUS GROUP OUTCOMES

Focus group transcripts were analyzed by researchers according to the thematic framework described previously (Figure 1). Educators shared their perceptions on the lesson study process pertaining to their own development, and a subset of the subthemes were represented in their responses. We focused on achieving credibility of our findings through the establishment of trustworthiness (Patton, 2015). Specifically, credibility was established through peer debriefing; dependability was ensured through a logical analysis process that was systematically documented; and objectivity was maintained by linking interpretations directly to the data. Results of the thematic analysis, including selected quotes, are presented in Table 2.

DISCUSSION

DATA INTERPRETATIONS

Participants experienced improvements in key qualities of a lesson study group across the period of the study. These included preparedness, participation, and camaraderie. Focus group data also highlighted the importance of inter-personal factors as positive outcomes of the lesson study experience and improved social connections were cited by all groups. This theme also presented as an item of significant importance in our previous case study (Smith et al., 2019), which demonstrates that lesson study addresses a common need among 4-H educators for positive and productive collaboration among colleagues. Additionally, as was the case in the 2018 study, all groups indicated that lesson study helped them inform their lesson planning and implementation. In this sense, the lesson study process was a useful strategy in helping educators improve program quality through time dedicated for reflecting on previous lesson implementations, troubleshooting implementation challenges, and subsequent lesson preparation.

All lesson study groups expressed confidence in the use of formative data and reported experiencing the benefits of using these data. Given the emphasis lesson study places on formative data, it is critical that practitioners have access to effective formative data collection tools, and the ability to appropriately interpret and apply the data collected. We are encouraged by the results of the current case study as they indicate that the professional development opportunities provided throughout their project were effective in supporting these educators in their use of a variety of formative data tools.

BENEFITS TO AND CHALLENGES FACING 1890 LAND-GRANT UNIVERSITIES

The benefits of lesson study to the 4-H Programs as found in this case study have also been shown through previous investigations (e.g., Schmitt-McQuitty et al., 2019; Smith, 2013; Smith et al., 2019). Improving 4-H educators' capacity is critical to serving existing 4-H programs, reaching new youth audiences, and helping to ensure program sustainability over time. Utilizing a model of professional development that is

Table 2. Results of Thematic Analysis from Focus Group Interviews

	Theme 1: Benefits of Lesson Study to 4-H Educators	
Subtheme	*Results*	*Participant Quotes*
Lesson Planning and Implementation	This subtheme was mentioned in all three focus groups and indicated that lesson study group meetings focused on short-term and concrete goals (i.e., preparing for the next lesson).	"Being together helped us prepare for the lessons. It gave us different perspectives. We wanted to all have the same unified outcome but needed to use different techniques." ". . . [lesson study] helped me because I was not familiar with the curriculum. It helped to have other people to talk to when planning for lessons."
Data-Driven Decision-Making	All lesson study groups discussed incorporating data-driven decision-making as part of their lesson study process. The data they utilized were formative in nature.	"[Lesson Study] helped me understand the evaluation process—how I can look at how my programs are running. How am I reaching the kids? It can be hard to evaluate with younger kids, but throughout the process I was able to use a lot of the items in the curriculum that helped me learn to evaluate my programs."
Social Support	Social support was a subtheme mentioned frequently in all three focus group interviews, and for several participants it was clearly the major benefit they experienced through the lesson study process. Respondents mentioned positive social connections and the benefits of a collaborative approach to problem solving and lesson planning.	"[The lesson study process/group] created a comfortable environment to talk about the ideas that you like. We had some freedom to discuss what we thought—no experts. Sometimes, the question of hierarchy pulls back how creative we can be." "Working together as a group was great. I talked to each of the other agents and learned how to use their experiences to help facilitate with my kids."
	Theme 2: Strengths of the Lesson Study Process	
Subtheme	*Results*	*Participant Quotes*
Formative Data Tools	Educators from all three focus groups reported benefits of capturing youths' perceptions and their own reflections, using formative data to inform their lesson planning and data-driven decision-making.	"After we did the graffiti wall we talked about our observations. We used the graffiti wall to help us know what direction we went next. We made changes to the program based on these observations. For example, we decided to reduce the adult to youth ratios based that information."
	All lesson study groups discussed incorporating data-driven decision-making as part of their lesson study process. The data they utilized were formative in nature.	"[Lesson Study] helped me understand the evaluation process—how I can look at how my programs are running. How am I reaching the kids? It can be hard to evaluate with younger kids, but throughout the process I was able to use a lot of the items in the curriculum that helped me learn to evaluate my programs."
"It helped for us to pinpoint what in our lesson needed to be reviewed or clarified. Especially with younger participants."	Social support was a subtheme mentioned frequently in all three focus group interviews, and for several participants it was clearly the major benefit they experienced through the lesson study process. Respondents mentioned positive social connections and the benefits of a collaborative approach to problem solving and lesson planning.	"[The lesson study process/group] created a comfortable environment to talk about the ideas that you like. We had some freedom to discuss what we thought—no experts. Sometimes, the question of hierarchy pulls back how creative we can be." "Working together as a group was great. I talked to each of the other agents and learned how to use their experiences to help facilitate with my kids."
Reflection-on-Action	Educators reported using past experiences to help develop questions and ideas about future activities or practice.	"I always look at the evaluations as soon as I finish a program. When we came together as a group, we broke the information down to see what worked and what didn't work. We found that certain evaluations worked better for certain audiences."

Table 2. (*continued*)

	Theme 3: Opportunities for Improvement	
Subtheme	*Results*	*Participant Quotes*
Timing and Frequency of Meetings	While all groups mentioned scheduling challenges, one group struggled to fit regular lesson study group meetings into their regular schedules and were not successful in bringing the full group together with regularity.	"Being together helped us prepare for the lessons. It gave us different perspectives. We wanted to all have the same unified outcome but needed to use different techniques." " . . . [lesson study] helped me because I was not familiar with the curriculum. It helped to have other people to talk to when planning for lessons."
	"I think it's a great opportunity to connect with other professionals and it was a way of keeping us on track with the lesson that we were doing. Sometimes with crazy schedules you forget that you had meetings."	"[Lesson Study] helped me understand the evaluation process—how I can look at how my programs are running. How am I reaching the kids? It can be hard to evaluate with younger kids, but throughout the process I was able to use a lot of the items in the curriculum that helped me learn to evaluate my programs."
Lesson Implementation Schedules	Lesson study members ended up on very different implementation schedules, which made collaboration more difficult. However, members reported a positive aspect of this scheduling challenge being that those who were further along in the implementation process could advise others as to challenges and "workarounds" in the curriculum activities ahead of time.	"[The lesson study process/group] created a comfortable environment to talk about the ideas that you like. We had some freedom to discuss what we thought—no experts. Sometimes, the question of hierarchy pulls back how creative we can be." "Working together as a group was great. I talked to each of the other agents and learned how to use their experiences to help facilitate with my kids."
	"We couldn't always set meetings for times when we were all at the same lesson. But, if we wanted to do something different, we could use the information that was provided by other agents that had the lesson before us."	

educator-centered, educator-driven, and sustained over time also helps to reduce administrative time and expenses associated with traditional, one-time workshops that are ineffective in improving educators' practices (Smith et al., 2017). This is especially important to 1890 LGUs, where funding issues have been well-documented (Croft, 2019, 2021; Lee & Keys, 2013). Despite recommendations to do so, states have not distributed funds equitably between the 1890 and 1862 institutions (Croft, 2019, 2021; Lee & Keys, 2013). More specifically, many states have been failing to match federal capacity grants to 1890 institutions, which effectively reduces their total funding (Croft, 2021). Not providing 1890 institutions with the same level of one-to-one funding negatively affects their capacity to preserve and extend the land-grant mission (Croft, 2021; Lee & Keys, 2013).

RECOMMENDATIONS AND APPLICATIONS

Overall, we saw many benefits to participating educators that have been reported in previous studies using the lesson study model of professional development in 4-H (Smith, 2013; Schmitt-McQuitty et al., 2019). Based on the data collected from the three lesson study groups in this case study, we believe the following recommendations will assist the 4-H in further use of the lesson study model and help maximize benefits to participating educators and youth learners:

- Understanding of and Commitment to Effective Professional Development at the Level of the Organization: National 4-H and state 4-H programs must understand, prioritize, and make a commitment to effective educator professional development for improved learner outcomes.

- Understanding of and Commitment to Effective Professional Development at the Educator Level: The iterative nature of lesson study requires a systematic approach and intentionality. The 4-H educators who engage in lesson study must commit to the process to advance their practice and improve educational programming. Fidelity of implementation of the lesson study model will maximize benefits: lesson planning, teaching practice, content knowledge, social connections, and, ultimately, learner outcomes.

- Effective Train-the-Trainers Model: Develop a robust, iterative, train-the-trainers approach that models characteristics of reform-based professional development (e.g., extending duration, active learning, authentic context, effective pedagogy), provides strategies for effective formative data collection and interpretation, and emphasizes reflective practice.

- Formative Data Tools: Develop, expand, and make available a "suite" of formative data tools that are developmentally and contextually varied. Develop strategies (e.g., webinars; conference workshops; seminars) to extend knowledge on the use and benefits of formative data through lesson study.

- Understanding Different Contexts: State and county 4-H programs vary relative to the administration and implementation of nonformal education projects. Thus, there is a need to work with state and county programs to understand contextual nuances and help them determine how and where lesson study can be of benefit to their programs. As was evident in the data from this case study, differing contexts presented lesson study groups with unique opportunities and challenges.

LIMITATIONS

The principal limitations of this study were its size and scope. As such, no generalization of the findings can be made to a broader population (Merriam & Associates, 2002).

CONCLUSION

In summary, 1890 LGUs provide an important resource for research and extension for the nation; furthermore, they will continue to be a source of relevant and practical education to improve the lives of the communities they serve (Croft, 2019). These institutions are resilient, provide premier educational opportunities to the agricultural industry's most underrepresented and rural populations, and lead inclusive and innovative research to meet the needs of all communities. However, persistent issues associated with federal and nonfederal funding for 1890 LGUs have raised concerns

associated with their abilities to continue to meet the land-grant mission (Croft, 2021).

Lesson study can help meet the professional development needs of 4-H educators in 1890 LGUs. The lesson study process is designed to provide longer-term, educator-centered, and educator-led professional development opportunities that improve educators' knowledge and skills and improves the likelihood of achieving desired curriculum outcomes with 4-H youth audiences (Schmitt-McQuitty, et al., 2019; Smith, 2013). Additionally, in the face of documented funding concerns, the use of lesson study not only helps to build educators' capacity, but it can assist 1890 LGUs by reducing administrative time and expenses associated with more traditional approaches to educator professional development.

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