

Utilizing Virtual Lesson Study for Agriculture Teacher Professional Development and Social Support Goals

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Abstract

Lesson study is a form of teacher professional development designed to improve instructional techniques by collaborating with teachers to develop and test a lesson plan and examine its effect on learners. Lesson study is designed for in-person meetings and observation. School-based agricultural education (SBAE) teachers often do not have enough same-subject peers in one school to facilitate a lesson study group. This study attempts to determine if lesson study, led in a virtual environment, is an effective professional development technique, leading to increased knowledge related to instructional practices and course content and increased social support for SBAE teachers. Twenty-six SBAE teachers participated in six lesson study groups. A comparison of pretest and posttest surveys, as well as participant interviews, revealed that participants perceived some change in knowledge related to instructional practices and content. Group members added more individual variation to their lesson teaching than is usually found in lesson study. The video-recording process provided a unique opportunity for self-reflection. Social network analysis revealed few additional contacts to support teachers. However, participants specifically mentioned that a benefit of lesson study was engaging with teachers from other areas of the state with whom they might not usually interact, especially those with alternative teaching licenses. Recommendations include further research on how lesson study can provide in-depth professional development experiences and other ways to support relationship building for alternatively licensed teachers.

Introduction

Teacher retention is a well-documented issue impacting both school-based agricultural education (SBAE) and education in general. There are not enough SBAE teachers each year to meet nationwide demand (i.e., Smith et al., 2022). Therefore, efforts to retain current teachers and improve their job satisfaction are of primary concern. One successful avenue for increasing teacher job retention and job satisfaction is participation in professional development opportunities (Allen & Sims, 2017; Brill & McCartney, 2008; Easterly & Myers, 2019; Touchstone, 2015).

Many studies address the professional development needs of SBAE teachers (Figland et al., 2019; Roberts & Dyer, 2004; Smalley et al., 2019; Smalley & Smith, 2017; Sorensen et al., 2014). The professional development needs of teachers are not always the same across different career stages (Roberts et al., 2020; Thornton et al., 2020). In addition, SBAE teachers with professional teaching licenses can have

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different professional development needs compared to teachers with alternative licenses (Coleman et al., 2020).

While professional development opportunities have been linked to teacher retention, relationships with supportive colleagues have also been linked to teacher retention. Among teachers with a high workload, those with more social support connections were more likely to stay in their jobs, compared to teachers with high workloads and fewer social support connections (Pomaki et al., 2010). High workloads that lead to job burnout, specifically among SBAE teachers, have been linked to teachers leaving the profession (Tippens et al., 2013). Moser and McKim (2020) linked teacher retention to feelings of connectivity, specifically to other SBAE teachers. Therefore, interventions that include both professional development and increasing opportunities to connect could impact teacher retention.

Lesson Study

Lesson study is a form of professional development designed to improve instructional techniques by guiding small groups of collaborating teachers to develop a lesson and examine its effect on learners through systematic inquiry (Lewis & Hurd, 2011). Lesson study originated in Japan and has since been introduced to the American educational system and implemented worldwide (Kuno, 2015; Takahashi & McDougal, 2016). Instead of relying on a one-size-fits-all approach to professional development, inviting all teachers to participate in the same training, lesson study draws on the existing expertise of the collaborating lesson study teachers to share their knowledge and learn together (Stepanek et al., 2007). Lesson study allows for relationships to form between participating teachers, often described as professional learning communities (Gutierrez, 2016; Harris et al., 2021; Lieberman, 2009).

School districts invest time and money in providing professional learning experiences through workshops and courses for their teachers (Jacob & McGovern, 2015). Often, the workshops and courses are led by external professionals. Roseler and Dentzau (2013) describe prioritizing external sources as professional development experts as devaluing the expertise found in a district's existing teachers and suggested lesson study as an alternative, allowing teachers to share their expertise with their peers.

Lewis & Hurd (2011) described lesson study as a specific, replicated process that takes multiple weeks to complete. First, participants select a lesson that can be taught in one class period to focus the work. Participants must also determine the research theme or the desired outcomes when teaching the lesson (i.e., students increasing knowledge of the topic or showing an increased interest in the lesson) and determine how they will measure the outcome (increased test scores, increased questions asked during class). Next, one lesson study participant teaches the lesson while the group observes, watching for the research theme concepts. After the lesson, the group meets and discusses what they observed. From this discussion, they make changes to the lesson and another participant teaches it. This cycle continues until all participants have taught the lesson and the group decides they are satisfied with the edited lesson. A final reflection of the process completes the lesson study process.

Research has found lesson study to benefit teacher knowledge development, teacher attitude toward professional development, and student outcomes (Huang & Shimizu, 2016; Karlsen, 2019; Xu & Pedder, 2015). Lesson study has also been found to increase social support among teachers (Groth et al., 2020; Stokes et al., 2020). Lesson study participating teachers report increasing their knowledge and skills about educational content (Cavey & Berenson, 2005; Parks, 2008) and student-centered instructional practices (McMahon & Hines, 2008). In an international literature review, Xu and Pedder (2015) found studies discussed the positive benefits of lesson study for teacher community building, professional knowledge development, student-centered teaching concepts, and higher-quality teaching and learning. Teele et al. (2015) found evidence that lesson study increases student learning for historically minoritized students.

Collective participation is important for professional development conceptualization and a means to increase social support (Johnson & Johnson, 2017). Allowing teachers to meet new colleagues through a shared project may increase their network of individuals available to provide feedback or support for future projects or issues.

Lesson Study with Agricultural Education

While many studies have documented lesson study in K-12 education settings, often in mathematics, little information exists on lesson study use in agricultural education or any other career and technical education fields specifically. Most reported uses of lesson study revolve around in-person experiences with all participating teachers working in the same building and completing in-person observation during the professional development experience (Huang & Shimizu, 2016; Takahashi & McDougal, 2016). As many SBAE teachers work in schools where they are the only instructors teaching their assigned classes, creating an in-person lesson study experience for one school is unlikely. However, virtual meeting technology can allow teachers in different schools to connect, and video recording can replace in-person observation.

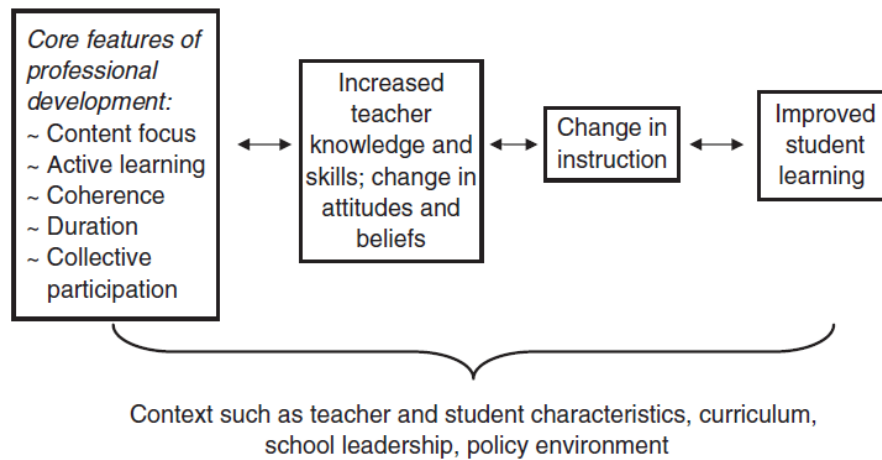
A few studies have utilized lesson studies with teachers too far apart to allow for regular face-to-face meetings (Joubert et al., 2020) or employed video recordings of lesson studies (Lewis & Perry, 2017; Teele et al., 2015). While the Japanese model of lesson study does not substitute video recordings for live observation (Lewis & Hurd, 2011), comprehensive implementation of lesson study for SBAE teachers or other career and technical education teachers who would have to travel to other school districts to find a colleague teaching the same topic would require alternatives to face-to-face meetings, including virtual meetings and video recording lessons.

Conceptual Framework

Desimone (2009) created a conceptual framework for studying the impact and quality of professional development among teachers. As shown in Figure 1, the framework links the core concepts of the professional development opportunity to increase participants' knowledge, skills, and attitudes, leading to teachers altering their instruction techniques to improve student learning. The framework identifies five core features of professional development, including (1) content focus, (2) active learning, (3) coherence of teacher beliefs with school policies, (4) duration of professional development training, and (5) collective participation (Desimone, 2009). Desimone's conceptual framework creates a pathway for testing how professional development impacts teachers' knowledge, beliefs, and practices, as well as how the change in instruction can alter student outcomes.

Figure 1

Desimone's Conceptual Framework for Studying Professional Development



Lewis and Perry (2017) used Desimone's framework to evaluate lesson study used by mathematics teachers teaching fractions, positing that the core features of professional development are included in the lesson study practice. Lesson study follows this framework of professional development by (1) focusing on the content of one lesson; (2) engaging teachers in actively reviewing, revising, and teaching the lesson while receiving feedback; (3) allowing teachers to create the reviewed and revised lesson in coherence with their previous knowledge and school policies; (4) lasting for an extended period over a semester to meet criteria for the lasting duration of the professional development; and (5) requiring collective participation of teachers sharing the same lesson experience (Lewis & Hurd, 2011; Lewis & Perry, 2017).

Purpose and Objectives

This research aims to determine if lesson study, adapted to a virtual environment, provides positive outcomes for participating SBAE teachers. The following objectives guided this study:

1. Determine to what extent participation in virtual lesson study increases school-based agricultural education (SBAE) teachers' *knowledge and skills* related to both content and instructional practices,
2. Determine to what extent participation in virtual lesson study increases SBAE teachers' *confidence* in both content and instructional practices and
3. Examine SBAE teachers' experiences of *peer social support* during and after participating in virtual lesson study.

Methods

Lesson Study Experience

Lesson study groups were created among teachers in the state of Illinois and facilitated by agriculture education consultants employed by the state to assist SBAE teachers with curriculum, materials, and training support throughout the year. The facilitators were given introductory training on lesson study, materials, and a process outline to guide their groups through the lesson study process. Each lesson study group was tasked with (1) developing their lesson materials and their research theme; (2) determining the outcomes they wanted to measure from their lesson; (3) allowing each teacher to teach and record the lesson; (4) watching the recording and giving feedback to modify the lesson; and (5) repeating the teach and feedback process until they were satisfied with the modified lesson. Meetings and recordings were

conducted through either Zoom or Google Meets. The groups first met in January 2021 and finished by May 2021, meeting at least every two weeks. A grant from the Illinois State Board of Education funded \$150 Amazon gift cards for each teacher who participated and followed through with the process. Participants were also offered continuing professional development credit hours for their time. Table 1 includes the courses and lesson topics explored by each group.

Table 1

<i>Course and Lesson Topic of Lesson Study Group Exploration</i>	
Course	Lesson Topic
Agricultural Business	Supply and Demand
Agricultural Mechanics	Welding Defects
Animal Sciences	Quality Grades of Meat
Introduction to Agriculture	Swine Breeds
Natural Resources & Environmental Sciences	Renewable and Non-renewable Resources
Plant Sciences	Flower Anatomy/Flower Dissection
Veterinarian Sciences	Pharmacology/Dosages

Population and Sample

We recruited SBAE teachers from Illinois to use virtual lesson study in one of six different groups. All 442 high school SBAE teachers in this state were emailed explaining the project and invited to a virtual meeting for more information on the process. Thirty-nine teachers initially expressed interest. Of those, 27 teachers chose to participate in the semester-long project. These teachers were divided into one of six topic groups determined by matching teachers with others who reported teaching the same course topics during the test semester, spring of 2021.

While 27 teachers began the lesson study process, only 26 completed all aspects of the project. Table 2 below contains demographic information on the participants. A majority of the participants identified as female (72.0%) and under the age of 30 (75%). While 60% of the participants had been teaching for three years or less, the sample also included two teachers teaching 29 and 30 years, respectively, and one student teacher collaborating with a cooperating teacher. The majority of the sample held a traditional teaching license (84.0%).

Table 2*Demographic Description of Lesson Study Participants*

Variable	<i>n</i>	%
Gender		
Female	18	72.0%
Male	7	28.0%
Age		
Under 30	18	75.0%
30-39	3	12.5%
40-49	1	4.2%
50-59	1	4.2%
60 and over	1	4.2%
Years Teaching		
1 year	4	16.0%
2 years	5	20.0%
3 years	6	24.0%
4 years	2	8.0%
5 years	3	12.0%
6 to 15	2	8.0%
16 to 30	3	12.0%
Teaching License		
Traditional	21	84.0%
Alternative	4	16.0%

Procedures

The research objectives for this project were explored using a data triangulation mixed methods approach, collecting both qualitative and quantitative data (Creswell & Plano Clark, 2007). Participants completed a pretest questionnaire before their lesson study experience and a posttest questionnaire after their lesson study experience. After completing their lesson study experience, all participants were asked to participate in a virtual interview about their experience.

Pretest and Posttest Questionnaire

The pretest and posttest questionnaires included questions to measure teachers' perceived confidence in knowledge and skills using questions adapted from research on lesson study with a sample of junior high teachers (Jhang, 2020). The scale includes nine questions to measure pedagogical competence. While the original scale had a 5-point Likert scale, the current study increased the scale to a 9-point Likert scale (1=Do not agree; 5=Neither agree nor disagree; 9=Strongly agree) to allow participants more room for individual variance in their answers between the pretest and posttest (Lehmann & Hubert, 1972) and to match the other survey scales in the study's questionnaire.

Next, eleven questions related to teacher confidence in a more specific set of pedagogical constructs were included. This list included nine questions used in a teacher self-evaluation survey previously used to measure lesson study in a sample of primary and secondary schools (Godfrey et al., 2019). The questions utilized a 9-point Likert scale (1=Do not agree; 5=Neither agree nor disagree; 9=Strongly agree). From input gained from two SBAE teachers who reviewed the initial draft of the survey, two questions were

added, one asking teachers' confidence in evaluating their own teaching practices and one asking their confidence in evaluating their peers' teaching practices.

During both the pretest and posttest questionnaires, participants were asked to complete a social network analysis, asking for the names of the top five people they would turn to for assistance with (1) teaching the content of their classes and (2) classroom management (Wasserman & Faust, 1994). Demographic questions, including gender, age, and years of teaching, were included in the pretest but not the posttest. Lastly, participants were asked open-ended questions about their expectations for lesson study during the pretest and the benefits and challenges of lesson study during the posttest. Participants were asked their names to allow researchers to connect their pretest and posttest answers. Names were removed from the quantitative and qualitative analyses and replaced with unique numerical identifiers.

Participant Interviews

Interview questions were designed to gather data from the participants about their experiences in lesson study related to the research objectives and triangulate with the quantitative data, specifically, their experiences related to (1) knowledge and skills growth in content and instructional practices; (2) confidence related to content and instructional practices; and (3) experiences of social support during lesson study.

Data Collection

Questionnaire administration for pretest and posttest instruments occurred virtually through the Qualtrics XM® platform. The pretest was provided through a link and QR code at the beginning of the first lesson study training. The posttest was sent via email link to group members once their lesson study group identified that they had completed the lesson study process. Simultaneously, participants were contacted individually to schedule a virtual interview session. Interviews were conducted and recorded on the Zoom video conferencing platform over the two months following the completion of lesson study groups. The Zoom automated transcription provided the initial transcribing. These transcripts were compared to the audio versions to correct errors.

Data Analysis

The pretest and posttest questionnaires were compared using descriptive and inferential statistics to identify participants' perceived changes in knowledge, skills, and confidence with lesson study. As the objectives of the study were to evaluate specific areas of knowledge, skill, and confidence changes, the questions were analyzed individually and not as part of the original scales.

The interview data auto transcripts were downloaded from the Zoom platform. The automatic transcription was edited for accuracy by comparing the transcription data to the actual audio recordings. The three researchers did preliminary, independent descriptive coding of the interviews using MAXQDA and came together to create group consensus for initial codes (Saldaña, 2016). From the initial codes, the researchers came to a consensus around three identified themes: Lesson Study Process, Learning from Lesson Study, and Social Support. Within these themes were eleven codes, described in Table 3. The researchers completed a second round of independent coding using the established codes. The quantitative and qualitative data were then analyzed together using results-based integration to determine the concurrence of findings (Thierbach et al., 2020).

Table 3*Summary of Emergent Themes and Associated Codes*

Themes and Associated Codes	Description
Social Support	
Social Support: Other Ag Teachers	Teachers receive support from other agriculture teachers they know.
Social Support: Other Teachers in Building	Teachers receive support from other teachers who teach different subjects but work in their building.
Building Social Support	Teachers express that they still determine who to turn to for support and guidance.
Lesson Study Process	
Lesson Study Group Process	Events and processes when the lesson study group worked together.
Self-Lesson Recording Feedback	Reflections of when the teacher reviewed the recording of their own teaching.
Individual Adaptations	Reflections on changing the group lesson before teaching.
Learning from Lesson Study	
Content Learning	Description of knowledge, skills, and techniques related to teaching content gained from lesson study.
Content Attitude Change	Change in attitude or beliefs about specific lesson content.
Instructional Practices Learning	Description of knowledge, skills, and techniques related to instructional practices.
Instructional Practices Attitude Change	Change in attitude or beliefs about specific instructional practices.
Learning from Peers	Specific mentions of learning new content or practice from the lesson study group peers.

To complete the social network analysis, the lists of persons to be contacted for content knowledge or classroom management knowledge were compared between the pretest and posttest answers. The posttest responses were also compared against the participants' lesson study group to determine if any group members were added to each list.

Results

At the end of the lesson study period, five of the six groups successfully created a revised lesson plan from their work in a format to share with others, therefore completing the lesson study process. The group that did not complete a lesson reported challenges related to scheduling meetings and COVID-related class requirements that hindered their completion. Of the lesson study group participants, 26 completed the lesson study process, 25 (92.6%) completed the pretest survey, 23 (85.2%) completed the posttest survey, and 22 (81.5%) participated in interviews.

Change in Knowledge and Skills

Results from the pretest survey were compared to results from the posttest survey using paired sample t-tests. For perceived teacher competency, the mean response increased between the pretest and posttest for all questions except one, as displayed in Table 4 below. Respondents reported a mean decrease in their perceived teaching competence after lesson study in regard to understanding student learning and

individual differences among students (Pretest Mean = 8.14; Posttest Mean = 8.05). For many concepts, the difference between the pretest and posttest means was relatively small. Mean responses for two of the nine questions significantly increased between the pretest and posttest. Specifically, participants, on average, reported that after the lesson study, they were more likely to (a) understand how to teach students the subject knowledge of the lesson clearly ($t(21)=2.40$, $p=.03$) and (b) motivate students to learn ($t(21)=3.73$, $p=.00$).

Table 4*Lesson Study Participant Perceived Teaching Competence in Knowledge and Skills*

Question	Pretest		Posttest		$t(21)$	p	Cohen's d
	M	SD	M	SD			
I am familiar with subject knowledge of the lesson my group chose to examine.	6.95	1.53	7.59	1.10	1.72	.10	.37
I understand how to teach students the subject knowledge of the lesson clearly.	6.95	1.40	7.73	1.16	2.40	.03	.51
I understand student learning and individual differences among students.	8.14	.99	8.05	.95	-.39	.70	-.08
I am able to design curriculum-based activities.	7.95	1.09	8.00	.87	.19	.85	.04
My instructional design takes students from different backgrounds into consideration.	7.45	1.34	7.77	.97	1.23	.23	.26
I am able to motivate students to learn.	7.36	1.22	8.14	.83	3.73	.00	.80
I am able to take advantage of educational resources inside and outside my school.	7.95	1.25	8.14	.83	.68	.51	.14
I am able to use multiple assessment methods to evaluate students' learning and their performance.	7.86	1.21	8.27	.70	1.68	.11	.36
I am able to adjust teaching methods according to outcome evaluation.	8.00	.93	8.23	.87	1.23	.23	.26

Note: Questions answered on a 9-point Likert Scale (1=Do not agree; 5=Neither agree nor disagree; 9=Strongly agree)

The interview analysis supported the change in knowledge and skills, especially among those interviewees with less than five years of teaching experience. An interviewee found value in both the content and the instructional techniques sharing:

I had literally no knowledge as far as what to teach, when to teach it, and even how to teach agriculture lab-based classes since I haven't done things like that since my student teaching experience...I thought it was really good and I did learn a lot about what to do in those certain situations in classes. (male, 4th year teacher)

Another interviewee described the benefit of learning and applying new instructional practices or pedagogy during lesson study:

It was really nice to be able to have a new way [to teach the content], not necessarily that I know the material, but I didn't really know how to teach it and make it interesting. So it wasn't necessarily the content I learned, it was more the delivery. (female, 2nd year teacher)

Individual Adaptations to Lesson Study Materials

While lesson study is designed for teams to create one shared lesson plan that different teachers can teach in the same style and format, interview data revealed that the SBAE teachers involved in this lesson study made individual modifications for their implementation. Even while shared materials were created, each teacher adapted the lesson in various ways to meet individual needs. Some of this adaptation was due to the variety of delivery methods in schools at the time, based on changes to instruction practices for COVID-related safety precautions (alternating between in-person teaching, virtual teaching, or both simultaneously). Furthermore, teachers reported changes in their school's education delivery method between when the lesson was developed and when it was time to teach it. While this inconsistency is indeed a solid reason to explain the individualization of lesson plans, the SBAE teachers spoke more of a desire to make the lesson their own before teaching. A third-year teacher who identifies as female said, "It was kind of neat to see the uniqueness that all of us are able to bring to the lessons, even if we're using the same lesson plan." Another interviewee described the experience:

The way that I teach something and the way that you teach something- no one teaches things exactly the same, which I think was a good virtue of this project was that we got to see four or five different people teach virtually the same lesson. Even though it was the same lesson plan, everyone still did things differently and everyone still did have their own style and their own attitude of what they did in their lesson plan. (first-year teacher, male)

Learning from Peers

Teachers also valued watching and learning from their peers' teaching styles. As SBAE teachers seemed to add their own variations to teaching the lesson, the other group members could watch and learn various ways to teach the same information. Teachers mentioned that they learned more from watching their peers teach and were able to evaluate their own teaching strategies. A female second-year teacher said, "I just like the idea of seeing what other teachers are doing in their classroom and then comparing it to you because then you can either draw from them and take what they're doing, or vice versa." Another female second-year teacher felt that by collaborating with other teachers, "I feel like it made me look at it through a different lens, or maybe like they gave suggestions that maybe I didn't think of."

Change in Confidence in Teaching Practices

In a pre and posttest comparison, participants reported increased confidence in teaching practices. All eleven items included an increase in the mean perception of the skill, and seven were statistically significant, as shown in Table 5. Specifically, respondents reported an increase in their confidence to (a) assess and evaluate their own teaching practices ($t(21)=2.04$, $p=.05$); (b) consider student voice in curriculum development ($t(21)=2.54$, $p=.02$); (c) understand the pedagogic process ($t(21)=3.14$, $p=.01$); (d) incorporate longer-term learning outcomes ($t(21)=2.83$, $p=.01$); (e) build on students' prior learning and experience ($t(21)=3.04$, $p=.01$); (f) use a variety of teaching strategies ($t(21)=5.11$, $p=.05$); and (g) develop higher-order thinking and metacognition ($t(21)=3.69$, $p=.00$).

Table 5

Lesson Study Participant Perceived Confidence in Teaching Practices

Question	Pretest		Posttest		<i>t</i> (21)	<i>p</i>	Cohen's <i>d</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			
<i>How confident are you in the following practices...</i>							
Assessing or evaluating your own teaching practices.	7.09	1.51	7.73	1.35	2.04	.05	.43
Assessing or evaluating peers' teaching practices.	7.23	1.15	7.59	1.18	1.50	.15	.32
Considering student voice in curriculum development.	7.27	1.49	7.91	1.19	2.54	.02	.54
Understanding the pedagogic process.	6.50	1.79	7.59	1.53	3.14	.01	.67
Incorporating longer-term learning outcomes.	6.73	1.64	7.77	1.23	2.83	.01	.60
Building on students' prior learning and experience.	7.36	1.18	8.09	.92	3.04	.01	.65
Scaffolding student learning.	7.36	1.29	7.77	1.27	1.18	.25	.25
Using a variety of teaching strategies.	6.77	1.44	8.09	.87	5.11	.05	.46
Developing higher-order thinking and metacognition.	6.77	1.54	7.77	1.11	3.69	.00	.79
Embedding assessment into instruction.	7.64	1.26	8.05	.84	1.62	.12	.35
Creating an inclusive classroom environment.	7.55	1.18	7.82	1.10	1.24	.23	.26

Note: Questions answered on a Likert Scale 1=Do not agree; 5=Neither agree nor disagree; 9=Strongly agree

Participants discussed in their interviews that the increased knowledge from lesson study led to confidence in teaching both content and new instructional techniques. In addition, the participants reported a new appreciation of self-recording and peer evaluation of teaching. Our virtual lesson study format required the teachers to video themselves teaching to allow for evaluation and feedback on the lesson instead of the traditional lesson study approach of partnering teachers watching the lesson live. While SBAE teachers in this study expressed anxiety about the process, they also talked about the value of watching video recordings of themselves teaching and self-evaluation from the student's perspective. A second-year teacher who identified as female said, "I've never been super great at, like, recording and watching myself. But it was really nice to be able to see how sometimes what I do in front of the classroom looks to the kids."

Reviewing the videos gave teachers an opportunity to see their reactions to student responses from a new perspective. Some mentioned noticing habits they did not realize they had. An interviewee discussed their observations as:

One thing that kind of got pointed out to me that I didn't realize that I did it was we were talking about breeds of dogs and somebody said golden retriever and Rottweiler and Pitbull and everything like that, and then somebody said Golden Doodle, and I just looked at the kid and went, "um, no." I guess I didn't realize that's how I respond to students, which I guess maybe works for me and works for my students. They understand that's it's how I respond to their questions, but seeing that on the recording and having it pointed out to me was definitely interesting. (female, third-year teacher)

Change in Social Support

After participating in lesson study, only one participant added a person from their lesson study group to their list to contact for content knowledge. Two participants listed a lesson study group member on both the pretest and posttest list to contact for content knowledge, revealing they already saw that group member as someone to offer support.

While the specific naming of individuals did not show an increase in potential contacts as part of an immediate support social network, in the posttest comments about lesson study, 12 participants specifically mentioned a benefit of lesson study was engaging with teachers from other areas of the state with whom they might not usually interact.

During interviews, SBAE teachers most often mentioned social support for content-related questions from contacts with their past high school agriculture teacher, their cooperating teacher during student teaching, and instructors and peers from their time finishing their undergraduate degree programs in agricultural education. A male teacher in his thirtieth year said that lesson study “gave me an opportunity to meet new people and see how they do a lesson very similar, and I think that it will give us an opportunity in the future also to ask questions of each other.” An interviewee described their interest in lesson study as related to social support.

It was nice to get to know other teachers that I never really interacted with, so that was kind of cool. It was like a networking thing as well, which honestly is what kind of intrigued me about [lesson study] initially. (female, third-year teacher)

Future Participation in Lesson Study

When asked in the posttest survey how likely they were to participate in lesson study in the future, 65% of the teachers said they would participate again, and 30% said they might participate. Only one responded that they would not participate in lesson study in the future. This person stated that their primary reason for not participating again was moving out of the state. All survey respondents listed at least one way that lesson study had impacted their teaching, from learning different ways to teach a lesson reflecting on their teaching to gaining content knowledge.

Conclusion

Lesson study is a professional development delivery method that allows teachers to lead their own professional development journey, honoring shared expertise as an influential method of learning more about the instructional methods that are most impactful in their classrooms. Virtual lesson study takes away the barrier of travel constraints and allows teachers from different school districts to participate together, a characteristic important to SBAE teachers who often do not have other teachers in their schools teaching the same classes.

The impact of teaching during the COVID pandemic seemed to cloud the experience of virtual lesson study for many participants. The challenges related to everything happening in a virtual environment and fatigue from virtual meetings created a barrier that was not present when this project was envisioned before March 2020. Some teachers expressed the desire for an in-person lesson study, which mirrors Stokes et al.'s (2020) findings that an in-person lesson study was more impactful than a virtual lesson study. However, future lesson study opportunities with agriculture teachers in Illinois would likely occur virtually due to the barrier of distance between schools, which adds significant drive time to the requirements of lesson study participation.

An over-arching goal of lesson study is to build the link between theory and practice (Huang & Shimizu, 2016) and built-in assessments to measure the student-centered learning research question based

on the lesson (Bjuland & Mosvold, 2015). Research has shown that many lesson study groups do not meet the level of reflective practice that is a signature requirement of lesson study (Myers, 2012; Parks, 2008). In this current project, the extent of reflective practice was not explicitly measured, but many participants focused on the content learning and the creation of the lesson over the reflection on student-centered outcomes the group chose to address at the beginning of the project. Reflections from participants about pedagogical ideas learned from lesson study were not from their shared research but from their observations of other teachers in their lesson study groups, equating to perceived best practices instead of documented evidence-based approaches.

The participants also did not report changes in processes related to assessment and evaluation. A key focus of lesson study is embedding a student-centered research question into the lesson implementation (Yoshida et al., 2021). While the SBAE teachers began their lesson study journey by developing student-centered questions, these questions were not fully formed into measurable items and did not become the focus of future lesson study discussions.

One of the reasons for this absence of focus on a research question is the lack of specific direction given by the researchers and the lack of understanding of research and evidence-based practice by the lesson study facilitators. They only learned near the end that all but one lesson study facilitator felt this research process was beyond their current skill sets. If repeated, a longer and more complex training will be conducted for lesson study facilitators, including specific directions on literature reviews, determining evidence-based practices, and techniques to assess the research goal.

The shortage of focus on theoretical underpinnings to instructional practices could have added to the participants' individualization of the content delivery within each lesson study group. As mentioned earlier, participants reported both teaching the lesson in unique ways and observing and learning from their group members' individual teaching styles. If some time spent researching and applying pedagogical techniques had been included in the lesson design, participants may have been more likely to stick to the lesson-related instruction instead of choosing individualized instructional methods.

Allowing for peer evaluation and feedback and engaging in critical discussions about teaching strategies is often the most anxiety-ridden part of lesson study (Kvam & Munthe, 2021). While lesson study facilitators reinforce that the feedback is about analyzing the lesson, not the teacher, teachers can still feel their teaching style is being evaluated. The SBAE teachers in our study discussed their trepidations about recording their teaching practices and having to watch themselves teach. Watching recordings to provide feedback may add to the anxiety related to peer feedback that is already present in the lesson study process.

Through the lesson study process and in survey responses, participants did not describe their consideration of students from different backgrounds or creating an inclusive environment as part of their classroom implementation. While some research has shown that lesson study can decrease the achievement gap (Teele et al., 2015) or provide skills in adaptive teaching (Schipper et al., 2018), other studies have found that the lesson study process may inadvertently cause teachers to look at teaching through only one frame or adopt habits that are not student-focused (Parks, 2008). Reminding teachers of culturally responsive teaching and learning practices should be implemented into lesson study design to keep inclusion centered in lesson study practice.

Limitations

While other researchers can learn from this study, the findings are not generalizable for all SBAE teachers completing lesson study. While the teachers who participated in lesson study expressed positive experiences with the professional development process, this sample chose to participate. It is reasonable to believe that teachers choosing lesson study are also interested in learning new methods of instruction and continually improving their teaching techniques. Teachers who may not have the same attitude toward

instructional improvement may feel that the amount of work required by lesson study outweighs the potential benefits. In addition, this study only looked at teacher knowledge and belief changes, not Desimone's (2009) final two stages of change in instruction and student learning. Follow-up with the participants would be needed to determine if lesson study led to long-term action change.

Discussion and Implications

Lesson study is about developing one lesson that all group members teach in the same way (Lewis & Hurd, 2011). None of the SBAE lesson study group members in this project seemed to teach their lessons in the same exact format, adding their own style to meet their needs and their students' perceived needs. However, all lesson study groups seemed to come to a consensus on shared lesson plans. Perhaps the content of agricultural education lends itself more to individualized approaches than math or English classes. The need for individualization might be from unspoken, perceived expectations in agricultural education for teachers to develop their own teaching style, unique from other teachers. If this perception exists, are there ways to alleviate the pressure of constantly adapting lessons, especially for new teachers attempting to understand all the different requirements and expectations of teaching responsibilities? As teacher retention continues to be challenging for SBAE programs (Smith et al., 2022), the perceived need to take curricular resources and adapt from a set delivery method could be an added yet unnecessary burden.

Our lesson study participants included teachers with a mix of experiences and years of teaching. All shared an interest in improving their teaching practices. Perhaps future use of lesson study could focus on the early career teachers who are still figuring out their instructional practices and developing their social support network. In addition, further research should evaluate the impact of lesson study on alternatively licensed teachers compared to traditionally licensed SBAE teachers. Alternatively certified SBAE teachers report a greater need for professional development than traditionally certified teachers and teachers certified in a different subject area (Coleman et al., 2020). Other studies have found that, alternatively, certified teachers have a lower teacher sense of efficacy than traditionally certified teachers (Duncan et al., 2013). The social network analysis of this study brings to light the impact of the traditional licensure pathway on access to social support. Many traditionally licensed teachers in this sample mentioned social support from relationships built through their educational process: their college instructors, cooperating teachers, and peers in their college courses. Alternatively, licensed teachers may not have the same contacts. As we consider more ways to recruit and retain teachers, perhaps lesson study could create a network of social support that may be missing from the alternative licensure pathway.

Lesson study offers a unique method of professional development from the one-day seminar or one-hour professional development seminar at a conference. It requires a semester-long commitment and engaging with one lesson for an extended period of time. Lesson study advocates feel that teachers will take the concepts learned in lesson study and apply them to other areas of their teaching, which may create a greater impact on teacher actions than participating in shorter-term professional development. While lesson study teachers need support to complete the lesson study process, it is still a process directed by the interests and expertise of the teachers and, therefore, worthwhile to add to the professional development toolkit.

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