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Sustaining Global Food Systems with Youth Digital Livestock Production Curricula Interventions and Adoption to Professionally Develop Agents of Change

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Abstract: Improving the sustainability of global food systems requires competent and impactful change agents who are tasked with disseminating knowledge to stakeholders in local communities. Agricultural Extension agents and agricultural educator, who provide mentorship and preparation of youth, are pivotal for the positive outcomes of youth livestock production programs. Digital professional development, as one intervention for both formal and nonformal educators, can be a more effective use of an educator's time. This study examined the needs and competency levels of agents and teachers related to their capacity for training youth livestock exhibitors. Through an online course, participants completed a pre-posttest within an interactive module. The data revealed that agents and agricultural teachers were proficient in Texas, USA, youth livestock production programs. This study found that the majority of both groups scored over 90% on the curricula's assessment. There was a significant difference; agricultural education teachers reported higher mean scores than Extension agents on the Effective Teaching assessment. Both groups reported agreement with the Time to Complete, Tool Navigation, and Effective Teaching assessments. The data indicated that participants should additionally receive training materials on ethics policy and livestock validation. Livestock production digital professional development for nonformal agents of change is essential for sustaining global food chains.

Keywords: experiential learning; transformational learning; youth development; youth livestock projects; 4-H; FFA

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1. Introduction

The Sustainable Development Goals from the United Nations highlight the need to enhance sustainability, not just in one region of the world but in both hemispheres [1,2]. The need for sharing sustainable livestock system information and attributes with local stakeholders are more essential today given global climate and sustainability demands [3]. The need to engage, provide, and prepare youth in sustainable agricultural practices has never been higher [4]. To develop future mindsets that are positive towards sustainability

and openness to sustainable farming concepts, youth development and experiences with sustainable farming practices are critical [5]. The role of youth livestock production in the improvement of sustainable food chains needs further analysis [6]. Intensive livestock production is not only non-sustainable but has adverse effects on climate change [7]. Agricultural systems need to focus more on advancing youth's knowledge and behavior to ensure food production and land sustainability for future generations [8]. Youth are leaving agriculture on a global level, which is causing crises in agriculture at a global level. The need to engage with youth in agriculture, and encourage innovation, technical skills, and combat stereotypes of agriculture amongst youth, will be essential in working towards global food security goals. Also, encouraging youth entrepreneurship and engagement with sustainable production methods will combat the environmental impacts of livestock farming.

The maturation of youth toward adulthood brings advanced opportunities for independent and autonomous thought as they seek to separate from the family and are influenced more by formal and informal mentors [9]. Mentors outside the family can provide youth with positive progress toward career and educational goals, as well as provide experiences to develop social capital [10]. Extension agents and agricultural educators are important mentors for youth and serve as contacts for families and outside representatives involved in youth livestock projects [11]. Both Extension agents and agricultural education teachers may mentor and teach youth in livestock projects that improve food security and economic vitality in rural communities [12]. Open-access digital livestock validation curricula are paramount for educators to better equip and impact youth in livestock projects at their convenience [13]. Youth's involvement in production agriculture at a young age is an intervention that influences their interest and participation in the food and agricultural sciences' post-secondary programs and as a future career [14].

Effective curriculum development accompanies measurable evaluation strategies. Benge et al. [15], Lee et al. [16], and Seitz et al. [17] studied competencies necessary to be an effective Extension agent and nonformal educator. The aspects of agricultural science education in and outside the classroom can make Supervised Agricultural Experiences (SAE) more practical-application related. Youth's livestock project involvement is a primary example of an SAE, as it provides agricultural educators with the ideal time to educate youth on livestock ethics. Agricultural-educator-provided SAEs (a) develop life skills (i.e., employability and record-keeping), (b) act as a component of participant recognition procedures, and (c) are one–third of the agricultural education model [18]. SAE successes and impacts improve youth livestock programs and other youth development programs [19,20]. Teachers, mentors, family members, and social systems influence one's knowledge, skills, habits, and behaviors [21].

Texas is the second largest producer of food and agricultural products in the United States and the number one U.S. producer of livestock. Successful youth livestock projects within the U.S., such as 4-H and FFA programs, depend on educating youth who pursue small or large livestock management and life skill development [22]. The role of Extension agents, agricultural educators, and volunteers is to lay the foundations in this process. The foundations are more than caring for animals. Nurturing elite showmanship in Texas, USA, major livestock shows leads to winning championships associated with monetary outcomes. Of equal importance, youth involved in the livestock projects attain knowledge and skills that build their capacities and aptitudes to become leaders that positively influence local food and agricultural systems [23]. Because of Texas's prominent role in livestock production and the proliferation of youth engaged in livestock, it is ideally situated as a model of how to engage youth in sustainable livestock practices that could change livestock production in the future. There is a need for strong technical training and the understanding of environmental management in livestock, but there are barriers to accessing this. While there is a system in the U.S., lessons reflecting on how to develop these competencies can have implications and/or lessons for other systems and countries.

The objective of livestock validation is to certify that designated livestock are managed and cared for by the youth exhibitor within a predetermined date and timeframe. Besides

horses, livestock, including steers, heifers, lambs, goats, and swine, provide a sample of hair and are tagged. Also, a record of the youth participant, a record of the livestock project, and a form for a code of ethics are submitted. Annual validations verify the youth owner of the specific livestock. A validation committee oversees and directs the Texas, USA, youth livestock validation process.

This sustainable food system research was guided by a combination of Kolb's [24] experiential learning and Mezirow's [25] transformative learning theories. Yardley et al. [26] described this combination as a four-stage experiential learning cycle: Concreate Experience, Reflective Observation, Abstract Conceptualization, and Active Experimentation. Stage one delineates a concrete experience that enables teachers and agents to experience the livestock validation curricula [24]. Reflective Observation, the second stage, requires Extension agents and agricultural education teachers to lean on their own feelings and beliefs to form opinions of the online curricula. In the third stage, Abstract Conceptualization, participants use ideas and logic versus feelings to comprehend issues to address [27]. Active experimentation, the final stage, involves agents and teachers not only seeking to improve their professional development but also starting practical strategies to be actively involved in solving problems or filling gaps [28].

Transformational learning is a constructivist paradigm. Through the development of the methods, students understand and reassess experiences essential to learning and making meaning of respective experiences [25]. Transformational learning theory focuses on an individual's task-oriented learning ability and communicative learning to enhance learning through task-oriented assignments [29]. Transformative learning is a theory with the thesis that learning can transform an adult's beliefs and actions [30]. Transformative learning lets individuals comprehend the information acquired from past experiences [25].

This study explored Extension agents' and agricultural education teachers' comprehension of livestock validation standards and the effectiveness of a digital curricular experience. The study had four specific objectives:

(1) Describe livestock project management validation.
(2) Understand specific subjects that are professional development training gaps for agents and teachers.
(3) Measure the impact of the digital web-based system.
(4) Assess the differences between Extension agents and agricultural education teachers on Time to Complete, Tool Navigation, and Effective Teaching regarding the online livestock curricula and assessments.

2. Methods

2.1. Research Design

Our study utilized an electronic survey design using Qualtrics. Data collected were used to describe livestock project validation, professional development gaps, assess the digital curricula, and examine differences between Extension personnel and agricultural teachers.

2.2. Population and Sample

Five hundred sixteen (N = 516) Extension personnel and agricultural teachers made up the study population. The participants were located across Texas, USA, and consisted of Agricultural Extension personnel (not university faculty but members of the Texas A&M University System) and agricultural teachers (secondary school educators). All members of both groups had earned, at minimum, a bachelor's degree, with slightly less than half of the total population having earned a master's degree. Researchers utilized a census in early 2023 to all 516 participants to best address the research objectives. Of the 516 participants in the sample, 89 were Texas, USA, Extension agents, and 82 were Texas, USA, agricultural education teachers in livestock projects, yielding a 33.12% (N = 171) response rate [31].

2.3. Data Collection

Dillman et al.'s [32] tailored design method guided the implementation of social exchange theory attributes to solicit a larger response rate from the population. Articulate was used to develop a digital course published on the Texas, USA, web-based system (https://www.texaslivestockvalidation.com/) of Agricultural Extension accessed on 1 July 2023. Qualtrics delivered a 55-item online survey to study participants. The Cronbach's [33] alpha reliability coefficient for the instrument was 0.89, indicating that it was very reliable [34]. The reliability coefficients of subject matter scores ($\alpha = 0.91$), validation subject matter areas ($\alpha = 0.84$), Time to Complete ($\alpha = 0.88$), Tool Navigation ($\alpha = 0.86$), and Effective Teaching ($\alpha = 0.89$) indicated data reliability throughout [33].

Notification emails, reminder notifications, and incentives such as coupons and project supplies helped increase survey completion. The initial notification was sent out three days before the course link to provide ample time. Reminder notification emails were sent after two weeks and again three days before the survey closed. We considered Texas, USA, agricultural teacher coordinators and the Texas, USA, Extension 4-H directors as gatekeepers to the accessible population through existing professional development programs and through administering annual certifications and licensures for this audience to increase the response rate [32].

2.4. Data Analysis

Researchers utilized R as the statistical software to examine the content assessment. Pre-test and post-test statements were analyzed individually and then compared. Agricultural Extension livestock specialists examined and approved the questions, statements, and participant answers to confirm instrument fidelity and validity. The content assessment included multiple choice, true/false, and short answer items to provide diversity in how content questions were asked and answered. Texas A&M University researchers and Extension specialists assessed the instrument's content validity, and the instrument was revised to improve validity [35].

Descriptive and inferential statistics helped examine the data. The final validation score, produced at the course's conclusion, was the dependent variable. Each statement and question in the module was essential in understanding participant competencies and requisites in each distinctive validation subject. A group of independent variables was about personal characteristics, including job position, years of experience, age, gender, education level, and type of residence.

3. Results

Table 1 illustrates the mean score for 171 participants regarding questions about the effectiveness of the online learning module (100 maximum). The result is consistent: Extension agents and agricultural educators were highly favorable to the online livestock validation curriculum, with over 96 mean and minor standard deviation scores.

Table 1. Descriptive statistics of youth livestock validation subject matter scores.

Subject Matter Scores	*n*	*M*	*SD*
Extension Agents	89	97.06	3.70
Agricultural Educators	82	96.61	3.72

Note: Overall $M = 96.85$, Overall $SD = 3.71$.

Means and standard deviations of individual statements, including the grand mean and standard deviation, are illustrated at the conclusion of each table (see Table 2). One hundred forty-one participants had perfect scores in fifteen out of twenty-seven competency areas. After completing the digital curricula, only one hundred twenty-nine participants knew the correct contact who should order the validation identifications for youth exhibitors.

Table 2. Descriptive statistics of recommended content for youth to participate in the livestock program.

Validation Subject Matter	*n*	*M*	*SD*
Agents and teachers should the only be the validation committee members.	171	1.0	0
Validation is proof of _____.	171	1.0	0
Major livestock and local exhibition entries are guaranteed upon successful completion of the validation digital curricula.	171	1.0	0
If both agents and teachers agree, volunteers can be permitted to serve as committee members for local youth livestock validation assessments.	171	1.0	0
A validation committee may not have less than ____ members.	171	1.0	0
If the livestock will not be under the direct care of a youth participant for 141 h or more, ____ is required to provide authorization beforehand.	171	1.0	0
{blank} is appointed by the validation committee to lead the committee.	171	1.0	0
The address documented on the ethics policy is {blank}.	171	1.0	0
During livestock project feeding timeframes, {blank} is the primary mentor for youth participants and their families.	171	1.0	0
The validation committee must approve in advance the livestock not under the explicit supervision of the youth participant beyond {blank}hours.	171	1.0	0
What signatures are not required on livestock validation documents?	171	1.0	0
You are allowed and encouraged to conduct project checks.	171	1.0	0
Youth can be disqualified for violating rules outlined in the validation's ethics policy.	171	1.0	0
At all times it is important to remember the ___ best interests when livestock project issues may occur.	171	1.0	0
Extension personnel and teachers do not have responsibilities prior to the exhibition when validations have been successfully completed.	171	1.0	0
The validation chair is required attend validation events.	171	0.98	0.14
Several validation events are recommended days to prepare youth exhibitors multiple validation experiences to qualify for the livestock program.	168	0.98	0.14
Which protocol should occur when an participant or family member of the participant two counties away, submits a 40 day request to halter break an animal?	167	0.98	0.14
Market livestock projects can be exhibited by ___.	166	0.96	0.20
A family can complete and sign one ethics policy?	166	0.96	0.20
Youth are required to successful pass {blank}program before being admitted to participate in major local, regional, district, and state livestock exhibitions.	165	0.94	0.24
During breeding livestock's exhibition eligibility, youth participants are required to provide regular care.	165	0.94	0.24
A youth participant earned validation in the county they reside. The youth attends school in a different county. They are a club/chapter member at that school. The youth wants to exhibit under the classification of their school's county. Would this be approved?	165	0.94	0.24
Which example is NOT a part of a chain of ownership?	164	0.92	0.28
Each time you perform project assessments at the youth's livestock location, you realize the animal is not available for inspection. What is the recommended practice to solve the issue?	163	0.90	0.31
When does the feeding period begin for state validated animals?	161	0.88	0.33
Who is responsible for ordering validation identifications?	159	0.85	0.36

Note: Overall $M = 0.93$, $SD = 0.26$.

We examined validation specialized content responses from both groups in order to address objective two's goal of identifying Extension agents' and agricultural teachers' livestock production sustainability professional development needs. Participant means were larger in the posttest of the assessment, but not all participants earned 100% success, which is a goal of the digital training. The data provided content areas that should be improved. Eight ($n = 8$, 16.7%) respondents earned <93% success on the livestock validation assessment. Questions earning less than 95% success are content areas illuminating potential gaps for additional training or professional development from university researchers and Extension livestock specialists (see Table 3). The results indicated specific competencies, and content researchers and Extension specialists need to help localized Extension personnel and agricultural teachers to improve as they teach and mentor youth in livestock projects.

Table 3. Extension personnel and agricultural educator assessment results of validation topics.

Questions	% Correct
Youth are required to successful pass {blank}program before being admitted to participate in major local, regional, district, and state livestock exhibitions.	94
A youth participant earned validation in the county they reside. The youth attends school in a different county. They are a club/chapter member at that school. The youth wants to exhibit under the classification of their school's county. Would this be approved?	94
Which example is NOT a part of a chain of ownership?	92
Each time you perform project assessments at the youth's livestock location, you realize the animal is not available for inspection. What is the recommended practice to solve the issue?	90
When does the feeding period begin for state validated animals?	88
Who is responsible for ordering validation identifications?	85

Objective three evaluated the overall effectiveness of the online learning module. The research team provided three itemized statements to discern the effectiveness, navigation ease, and the completion in a timely manner of the digital curricula, measured as 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree. An additional statement was provided to participants to offer feedback and their testimonials regarding the digital module's effectiveness. Table 4 provides the mean and standard deviations of the three statements. Though participants agreed that the module's Time to Complete and Tool Navigation increased knowledge, participants were less in agreement that the module provided Effective Teaching to improve the knowledge of Extension personnel or agricultural teachers.

Table 4. Descriptive statistics of agreement level of the online module in increasing knowledge.

Online Delivery Module	*n*	*M*	*SD*
Time to Complete	171	4.27	0.61
Tool Navigation	171	4.13	0.76
Effective Teaching	171	3.94	0.86

Note: Overall $M = 4.11$, Overall $SD = 0.76$. Scale: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree.

The data revealed there was no significant difference between Extension agents and agricultural education teachers regarding Time to Complete of the online livestock management curricula and assessments (see Table 5). Not only were both groups similar in their responses, but program administrators can utilize these data to know, when planning to revise the module, that the module's Time to Complete is advantageous for Extension personnel and agricultural teachers.

Table 5. *t*-test results for Time to Complete.

Professionals	*n*	*M*	*SD*	*F*	*p*
Extension Agents	89	4.34	0.54	−0.92	0.21
Agricultural Education Teachers	82	4.20	0.68		

Note: Scale: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree.

The results indicated no significant difference between Extension agents and agricultural education teachers regarding Tool Navigation of the online livestock management curricula and assessments (see Table 6). Similar to Time to Completion, program administrators can use this analysis when revising or reporting on the module's effectiveness for the target audience. Both groups of participants were in agreement that the module was simple to navigate. This attribute also was positively indicated by participants as an element in advancing their knowledge of sustainable livestock production practices.

Table 6. *t*-test results for Tool Navigation.

Professionals	***n***	***M***	***SD***	***F***	***p***
Extension Agents	89	4.19	0.48	−1.04	0.33
Agricultural Education Teachers	82	4.07	0.62		

Note: Scale: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree.

In Table 4, we illustrated that Effective Teaching (M = 3.94, SD = 0.86) earned the lowest mean score of the three. However, Table 7 illustrates a *t*-test depicting a significant difference between Extension personnel (M = 4.17, SD = 0.61) and agricultural education teachers (M = 3.71, SD = 0.56) on Effective Teaching, $F(4, 136) = 2.67$, $p \leq 0.05$, $\omega^2 = 0.57$, representing a medium effect size [36,37]. Practically, the effect size informs program administrators that agricultural teachers need further study as to why their score was more neutral. Potentially, teachers may need professional development for specialists or program administrators. An inquiry into the procedures for Extension personnel training and agricultural teacher training or development prior to the module experience is necessary. Also, a separate mixed-methods study of agricultural teacher's feedback on the Effective Teaching paradigm of the module is recommended. These data would assist program administrators and specialists to modify the module and change agents' professional development.

Table 7. *t*-test results for Effective Teaching.

Professionals	***n***	***M***	***SD***	***F***	***p***
Extension Agents	67	4.17	0.61	2.68	0.02 *
Agricultural Education Teachers	74	3.71	0.56		

Note. * $p < 0.05$. Scale: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree.

4. Conclusions

Thousands of youth participate in livestock projects around the world. A limitation of our study is the location in one region of the world and that region's two groups hired to elicit change in targeted populations. While the study was in a region of the world in which livestock production is the number one agricultural commodity, global implications are generated under the auspice of change agents thinking globally about food system sustainability by making positive impacts regionally or locally. The study was conducted in an area where livestock production is the number one agricultural commodity, which makes the global implications relevant as these change agents are charged with developing food systems that are sustainable on a local and national scale. The extent to which youth are taught and mentored in sustainable livestock production concepts around the world may vary. We conclude that Extension agents and agricultural educators had high levels of knowledge by which to mentor youth participating in livestock programs, though there is room for improvement. The core validation competencies are the overall management of the validation process, including ordering and obtaining materials and supplies, understanding the ethics policy (e.g., chain of care, feeding practices, drug use), and enforcing requirements of quality counts. The data highlighted the discrepancies or areas indicating the largest competency discrepancies for both Extension personnel and agricultural teachers. Opportunities remain to improve nonformal agents of change in livestock production knowledge, as does the opportunity to improve the module in a way that would allow it to be perceived as effective by a variety of stakeholders. The data indicated that most participants agreed that the livestock digital curricula's completion time was appropriate and simple to navigate. However, both groups of educators reported the Effective Teaching attribute has room for improvement. It is plausible that the module's developers may not have had formal training in pedagogical digital instruction techniques. This would help explain the findings, from both groups of participants, that the module

lacked components to be assessed as an effective digital instructional tool. Additionally, it can be a challenge for content experts to disseminate pedagogically sound instruction for adults or youth. The module needs revisiting to identify elements that could be improved in order to enhance the learning of Extension professionals and agricultural teachers.

Optimal levels of global livestock production sustainability will not occur without a competent and impactful corps of change agents at the community level teaching and mentoring youth in fundamental food and land sustainability concepts. To strengthen the state of sustainability in livestock production, change agents should be equipped with the necessary knowledge and tools to properly train youth in key agricultural sustainability concepts. Lastly, future research is needed to discern the recruitment, development, and involvement of underrepresented youth in livestock projects. Understanding the gender and ethnic backgrounds of both youth and change agents would be valuable in understanding the broader impacts and barriers to the experiential and transformational learning and innovation-adoption [38] of sustainable livestock production processes.

5. Discussion

Future studies are critical to extending global Extension agents', agricultural educators', and volunteers' understanding of livestock project management topics. Concrete experiences, as delineated by Kolb [24], were Extension staff and agricultural teachers' participation in the digital sustainable livestock production validation curricula. The imperative exists for worldwide Extension personnel, agricultural teachers, and volunteers to increase their livestock production sustainability competency levels to better produce transformational learning in youth [25] with respect to sustainable livestock production. By enhancing the level at which Extension agents and agricultural education teachers comprehend the Texas, USA, standards [24], internationally based agents and teachers can not only educate but also adequately prepare youth [25] to have a livestock project that follows their own regional standards or Texas's livestock validation rules. A variation in curricula topics is needed to expand our understanding further. The data indicated that participants should receive training in ethics policies and topics central to acquiring materials to teach validation techniques. Topics might include avoiding carcass residues during preparation for exhibitions, primary entry guidelines for livestock shows, and developing a holistic positive representation of youth livestock programs to the public, consumers, livestock industries, volunteers, mentors, and youth.

We recommend that future regional or global studies explore teachers, Extension professionals, and mentors to understand the levels of effectiveness with digital learning delivery tools in other regions and countries that require validation or participation guideline certification for youth livestock exhibitors. Also, the researchers propose that future studies should evaluate adult leaders and mentors involved in livestock projects and validation responsibilities in their district, chapter, region, or county. Leaders' and mentors' participation are essential in aiding Extension personnel and agricultural teachers in their district, parish, region, county, community, or chapter to instruct and facilitate youth's livestock projects [13]. Thus, developing a comprehension of volunteer, mentor, and instructor competencies [15] is advantageous in the development of digital curricula to improve agricultural sustainability and potentially enhance stakeholder impact [22]. Understanding the needs of agents and teachers may result in learning techniques to best prepare youth when beginning their certification to qualify for livestock exhibitions. Beyond this, given the significant difference between the Extension agents and agriculture teachers' perceptions of the effectiveness of teaching, future research should explore the educational design of the module to ensure that transformational learning can occur for the widest audience and be transferable in order to advance sustainability in global contexts. A revised educational design could enhance adult and youth leaders in livestock projects. As a result of launching professional development experiences covering aspects of youth livestock program supervision, Extension professionals, agricultural teachers, and volunteers charged in mentoring and instructing youth participants will have a reliable source from which to

learn and expand their understanding [17]. SAE and youth livestock project achievements and impacts enhance the vitality of 4-H, FFA, and other youth groups [16,18,20]. The resulting impact from youth's participation needs to be better shared with stakeholders and decision-makers to synergistically assist researchers and practitioners in developing youth who are knowledgeable and impactful leaders in sustaining current and future global food systems [12].

As we focused on the sustainability of global food systems through the improvement of teaching and mentoring the next generation in sustainable livestock production practices, other investigations into youth's role or alignment with sustainable food systems are essential. There is a shortage of literature on the topic of climate smart livestock programs for youth. Those existing programs need investigation and reporting to assist global researchers and practitioners to better understand attributes that may influence youth or adult's adoption of climate smart sustainable livestock practices. The nexus of food security and land sustainability in livestock production paradigms warrants further study. Our team recommends further study of change agents and youth involved with sustainability in nutrition, precision or climate smart agriculture, forestry, food security, climate change, and carbon zero and/or carbon sequestration programs. Though critical to Texas, the USA, and other countries and global regions, livestock production may not be the dominant agricultural industry in other locations. However, all regions that have global agricultural infrastructures warrant future study in sustainability for stakeholders, farmers, community and government leaders, industry representatives, volunteers, mentors, change agents, teachers, and, maybe most importantly, the next generation of all of these—today's youth.

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