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Students' Acquisition of Agricultural and Entrepreneurship (Agripreneurship) Knowledge and Skills: Does Instructional Approach and their Sex Matter?

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Keywords

lecture method, project-based learning (PjBL), supervised agricultural projects (SAPs)

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Abstract

Agricultural and entrepreneurship education are interdisciplinary due to amalgamating the natural sciences and social sciences. These disciplines have gained interest of those looking to equip youth with skills for self-reliance. Teachers employ various instructional approaches, including student-centric approaches such as project-based learning (PjBL) and teacher-centric methods, for example, the lecture method, to facilitate learning. Existing research, however, suggests that students' learning can be influenced by other factors, for example, learning styles, socio-cultural norms, sex stereotypes, and the instructional approach(es) used. We examined the impact of using the lecture method (counterfactual group) versus PjBL (treatment group) approaches on student acquisition of agricultural knowledge in the context of poultry science and their intentions to become agripreneurs. A statistically significant disordinal interaction with a medium effect size was found at $p < .05$ between groups and student sex for poultry science knowledge. The female students performed better under the PjBL, while the males excelled under lecture-based instruction. We also found a statistically significant and positive ($p < .05$) association between students' sex and their intent to become agripreneurs for the treatment group. More female students than males in the treatment group indicated they were either likely or highly likely to become agripreneurs in the future. These findings imply that females in the treatment group benefited more from the intervention, PjBL, than their male peers. Additional research should be conducted to measure the long-term impacts of using various teaching approaches on students' learning of agriculture and entrepreneurship content depending on their sex.

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Introduction

Agricultural education is interdisciplinary and "serves as the bridge between agricultural science and other disciplines" (Barrick, 1989, p. 27). It combines concepts from the natural sciences, such as biology, with the social sciences, including entrepreneurship (Phipps et al., 2008). Entrepreneurship education also intertwines concepts from the natural and social science disciplines (Yi & Duval-Couetil, 2021). In recent times, entrepreneurship as a discipline has gained interest of many stakeholders and is now taught across many universities' colleges other than business (Stenard, 2023), including in agricultural colleges and schools.

In the United States, entrepreneurship is embedded in the supervised agricultural experiences component of the three-circle model of school-based agricultural education [SBAE] (Phipps et al., 2008). Developing countries such as Uganda have also incorporated entrepreneurship education in their secondary school agricultural education curriculum to promote creativity, innovation, opportunity recognition, and job creation for students' self-reliance (Mukembo, 2017; Mukembo, Edwards, & Watters, 2020; National Curriculum Development Centre [NCDC], 2020).

Entrepreneurship education involves training individuals to recognize, evaluate, and pursue opportunities to create value while mitigating risks (Jones & English, 2004). As such, different instructional approaches, including student-centric teaching, especially project-based learning (PjBL), and teacher-centric instruction, e.g., the lecture method (Bhakare, 2014), have been used to teach agricultural and entrepreneurship education. Each of these instructional approaches have strengths and limitations. For instance, although the lecture method requires fewer resources, less time, and teachers have significant control over the teaching-learning process, it often limits students' active engagement, including their ability to apply what was taught in the real-world (Bligh, 2000). On the other hand, PjBL facilitates more student engagement, and is rooted in empowering students to take a proactive role in developing innovative solutions to real-world problems (Blumenfeld et al., 1991; Mukembo, Edwards, & Robinson, 2020).

When students do not receive opportunities to have *hands-on, minds-on experiences* in real-world settings, it likely limits their learning. To put this in perspective, teaching agriculture and entrepreneurship without incorporating practical learning opportunities is akin to "teaching someone to swim without a pool" (Sherman et al., 2008, p. 29). As such, using a PjBL approach helps students to comprehend, apply, and reflect on the practical and scientific principles embedded in the curriculum. In Uganda, for example, through a PjBL approach, students learned poultry science knowledge and related

entrepreneurship opportunities, including brooding, management, value-addition, and marketing. Integration of agriculture and entrepreneurship or *agripreneurship* using a PjBL approach assists students acquiring entrepreneurial competencies and life skills as they learn to transfer content knowledge across disciplines to achieve their desired goals, such as starting their own business ventures (Mukembo, 2017; Mukembo & Edwards, 2020). However, PjBL requires a substantial amount of time and resources to implement effectively (Nilson, 2010).

Agricultural and Entrepreneurship Education and Differences by Sex Depending on Instructional Approaches

Until the late 1960s, SBAE in the United States and its related careers was dominated by males (Enns & Martin, 2015). However, this changed, and today more female students are active in agricultural course-taking, including participation in related organizations such as FFA and Young Farmers' Clubs (Mukembo et al., 2014, 2015). The instructional approaches in SBAE have evolved from focusing on production-oriented agriculture on farms to include equipping learners with knowledge and skills to pursue livelihoods along the agricultural and food production value stream (Barrick, 1989), i.e., agribusiness enterprises in numerous sectors.

Even, though most women (60% to 70%) in developing countries are employed in the agricultural sector (Quijano, 2022), agricultural resources, including land and related business ventures are owned predominantly by males (Food and Agriculture Organization, 2022). This limited access to resources, social stereotypes that entrepreneurship is masculine oriented, lower perceived entrepreneurial self-efficacy, a deficit of support, and the teaching styles of many instructors (Johansen & Foss, 2013; Pech et al., 2021) contributes to the prevalence of fewer female agricultural entrepreneurs. Therefore, increasing the enrollment of female students in entrepreneurship (Cochran, 2019) and agricultural education (Mukembo et al., 2017) is critical to growing a pipeline of future female entrepreneurs for the agriculture and food sectors.

Colleges have modified their agricultural and entrepreneurship instruction to meet the needs of diverse learners through more student-centric approaches (Shoemaker et al., 2015). Existing research, however, suggests that the acquisition of knowledge and skills by students can be influenced by factors, such as learning styles, perceived self-efficacy, student's sex, socio-cultural norms, and teachers' instructional approach(es) [Joy & Kolb, 2009; Philbin et al., 1995]. These factors contribute to the differences in student performance and career choices pursued by both sexes, especially in the science, technology, engineering, and mathematics fields (Kulturel-Konak et al., 2011), and the pursuit of agripreneurship ventures (Mukembo, 2017). Researchers have posited that due to

some social constructs, women more than men are likely to benefit from instructional approaches encouraging collaboration and making connections between theory and its applicability to real-world situations (Kulturel-Konak et al., 2011).

Further, females tend to prefer student-centric instructional approaches (Barrett, 2006), including PjBL, in which the teacher facilitates learning, rather than taking an authoritative approach to transmitting knowledge to the learners, which is often the case with traditional methods such as lecture. Philbin et al. (1995) reported that whereas "men seemed to find congruence between traditional education and their learning style" (p. 485), this was not the case with women. Here, we refer to *learning style* as the individual differences by which learners prefer to receive, process, and comprehend information to gain an understanding about a phenomenon within a given learning context (Kolb, 2014), which may be influenced by many variables, including the learner's sex and the instructional approach used (Philbin, 1995).

Based on a review of related literature, we found a gap regarding how various instructional approaches may impact students' acquisition of agriculture and entrepreneurship knowledge and skills, and their intent to become agricultural entrepreneurs, i.e., *agripreneurs*, a livelihood choice traditionally dominated by males (Mukembo et al., 2017). Most of the existing studies were conducted in the context of the STEM disciplines as taught in developed nations. Regarding another male-dominated discipline, Kulturel-Konak et al. (2011) asserted:

> When taking their first courses in information science, some women find that they fail to thrive because of an *invisible barrier* [emphasis added] disconnecting them from the information that the instructor is trying to convey. That invisible barrier may be due to teaching methods which favor one or two learning styles, ignoring the ones that women tend to prefer. (p. 10)

Purpose, Objectives, and Hypotheses

This study's purpose was twofold: (a) compare students' agricultural knowledge in the context of poultry science based on the instructional approach used, and (b) describe the relationships between the students' characteristics and selected variables, including their intent to become agripreneurs. Three objectives and four null hypotheses guided the study: (a) describe students' personal characteristics; (b) compare students' agricultural knowledge in the context of poultry science knowledge based on the instructional approach used: PjBL featuring agripreneurship versus traditional, lecture-based instruction was tested; (i) Ho: No statistically significant interaction ($p < .05$) existed between group and sex for poultry science knowledge based on the instructional approach used; (ii)

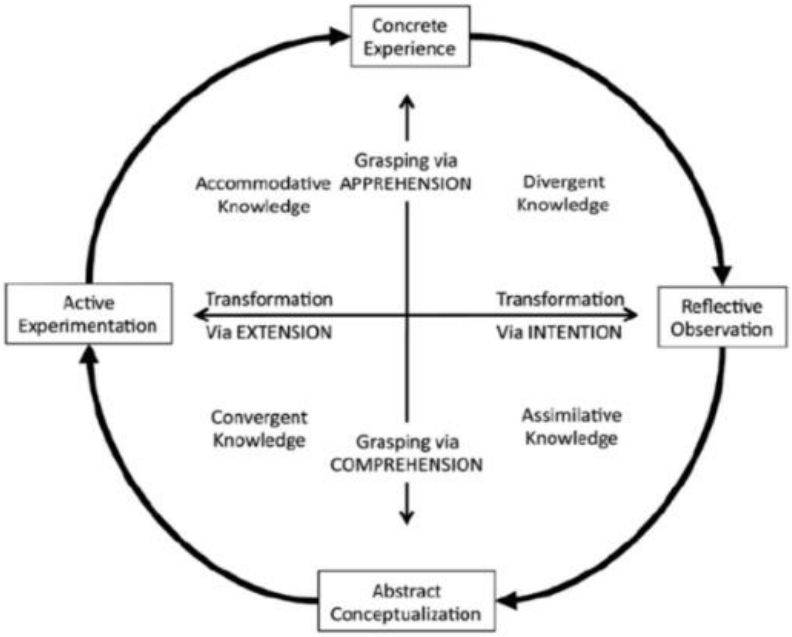
Ho: No statistically significant differences ($p < .05$) existed between groups for poultry science knowledge based on the instructional approach used; and (iii) Ho: No statistically significant differences ($p < .05$) existed between sexes for poultry science knowledge based on the instructional approach used; (c) describe the associations between the students' characteristics and selected variables, including their intent to become agripreneurs: Ho: No statistically significant relationships ($p < .05$) existed between students' characteristics and other selected variables such as intent to become agripreneurs in the future.

Conceptual and Theoretical Frameworks

Kolb's (2014) experiential learning theory [ELT] (see Figure 1) guided this study. The ELT outlines four learning styles that individuals may use to acquire knowledge, i.e., diverging style, assimilating style, converging style, and accommodating style (Kolb, 2014). Individuals in the accommodating quadrant use active experimentation and concrete experience, and learn better through the hands-on, learning-by-doing approach, and collaboration (Joy & Kolb, 2009). Those in the diverging quadrant use both concrete experience and reflective observation to cogitate multiple-whole picture perspectives of how knowledge could be applied to real-world situations (Kolb, 2014). Assimilators embody both reflective observation and abstract conceptualization, and may benefit from teaching approaches that facilitate observation, reflection, and logical deduction (Kolb & Kolb, 2017; Kurt, 2020). Convergers use both abstract conceptualization and active experimentation and excel at transforming and applying abstract ideas through deductive reasoning and experimentation to solve problems (Kolb, 2014). However, each learner has preferred way(s) of acquiring new concepts and understandings which evolve as they undergo and reflect on new experiences (Kolb, 2014).

The concepts espoused in Kolb's ELT and learning styles undergird most of the student-centric methods used in the teaching of both agriculture and entrepreneurship through hands-on, minds-on experiential learning approaches (Baker et al., 2012; Mukembo, 2017; Mukembo & Edwards, 2015). Moreover, reflection and experimentation are essential for practicing both agriculture and entrepreneurship (Neck & Greene, 2011). As such, the ELT was an appropriate theoretical frame for this study.

Figure 1
Kolb's Model of the Experiential Learning Process



Note. Adapted from "Experiential Learning: Experience as the Source of Learning and Development" (p. 42), by D. A. Kolb, 1984. Copyright 1984 by Prentice Hall, Inc.

Study's Design, Participants, Limitations, and Data Analysis

We employed a quasi-experimental, nonrandomized control group design (Campbell & Stanley, 1966). A sample of 320 participants were selected from a population of 894 Senior Two students, who attended boarding secondary schools (two girls' and two boys') in Uganda. We used a stratified sampling technique (Creswell, 2014) from existing class groupings known as *streams* (Sukhnandan & Lee, 1998), which constituted the study's strata. Stratified sampling increases the likelihood of capturing "a more representative sample than [does] simple random sampling" (Ary et al., 2009, p. 154). Due to ethical issues and other factors, we could not randomly assignment participants, so various internal and external threats to the study's validity were possible (Campbell & Stanley, 1966). However, by using a quasi-experimental, nonrandomized control group design, we attenuated some of the risks to internal validity such as history, maturation, mortality, testing, and selection (Campbell & Stanley, 1966).

The selected students were equally divided, i.e., 160 females from the two girls' schools and 160 males from the two boys' schools were split equally and allocated to the study's treatment and counterfactual groups. The treatment group, therefore, was composed of 80 girls and 80 boys, and they received training on agripreneurship in the context of poultry science using the PjBL approach as implemented through a supervised agricultural project (SAP). As part of their SAP, the *treated students* were provided 200 one-day-old broiler chicks and all the inputs needed to raise the broilers to a marketing stage. In addition, they received instruction and mentoring from their agriculture and entrepreneurship teachers on topics such as brooding, feeding, vaccination, marketing, value addition, opportunity recognition, and writing business plans among other business concepts taught. On the other hand, the counterfactual group received instruction on agripreneurship in the context of poultry science through traditional, lecture-based instruction without conducting a SAP. Both groups of students were instructed for eight weeks. The students were assessed on their agricultural knowledge in the context of poultry science, and their intentions to pursue agriculture-related business ventures in the future. To ensure treatment fidelity, we provided professional development to the agriculture and entrepreneurship teachers involved in the study (Mukembo, 2017). We also worked with the teachers to develop training modules integrating entrepreneurship and agriculture in the context of poultry science based on Uganda's national curriculum for lower secondary education (NCDC, 2020). This helped ensure that teachers delivered the intervention to participants as intended by the study (Breitenstein et al., 2010).

Data from both groups of students were collected using pre- and post-treatment questionnaires developed by the researchers and reviewed for content and face validity by a panel of experts from the Department of Agricultural Education, Communications, and Leadership, and the School of Entrepreneurship at Oklahoma State University. The questionnaires were also reviewed by four teachers specializing in secondary school agriculture and entrepreneurship education in Uganda to ensure alignment with the curriculum. The construct reliability coefficients for the study's questionnaire ranged from 0.69 to 0.84. These coefficients were within the range of acceptable estimates, i.e., 0.68 to 0.95, according to Field (2013) as well as Tavakol and Dennick (2011). Two-hundred and eighty of the 320 participants completed both the pre- and post-treatment questionnaires; the remaining 40 students completed one or the other, but not both, which made their data incomplete for the purpose of analysis. We analyzed data from the 280 students who completed both pre- and post-questionnaires using the SPSS statistical software version 21.

Data Analysis

We conducted a Two-Way-Analysis of Covariance [ANCOVA] (Cook & Campbell, 1979) to address objective two. Cramer's *V*, Point-biserial correlation coefficient, and Spearman's correlation coefficient was computed to measure the strength of association associations (Field, 2013). Phi coefficients were used to describe the strength of relationships between selected dichotomous variables (Bryman, 2012). We set an a priori of $p < .05$ to determine if the relationships were statistically significant (Kirk, 2013). Before computing the ANCOVA, a One-Way Analysis of Variance (ANOVA) indicated that students' pretest agricultural knowledge in the context of poultry science between groups was statistically significantly different at $p < .05$ with a small effect size. However, Levene's test ($p = .631$) was not statistically significant at $p < .05$. The mean score for the treatment group was significantly higher than for the counterfactual group. A statistically significant positive and low correlation existed between the scores for students' poultry science knowledge ($r = .25$, $p < .001$) before and after the study's treatment.

As a result of the statistically significant mean score differences between the counterfactual and treatment groups, the pretest scores for poultry science were used as a covariate to adjust for the post-treatment group mean differences (Dimitrov & Rumrill, 2003). We conducted a Two-Way ANCOVA, i.e., between-subjects factor: group (counterfactual, treatment); sex (male, female); covariate: pretest to compare students' agricultural poultry science knowledge depending on the instructional approach used: A PjBL learning approach featuring agripreneurship versus traditional, lecture-based instruction.

Findings/Results

Objective #1: Describe Students' Personal Characteristics

Two-hundred and eighty students provided usable responses for data analysis, i.e., students who completed both the pre- and post-treatment questionnaires. Both males and females were equally split between the treatment and counterfactual groups. The participants' ages ranged from 12 to 20 years, with an average age of 14.59 years. The modal age for all participants was 14 years.

Objective #2: Compare Students' Poultry Science Knowledge based on the Instructional Approach used

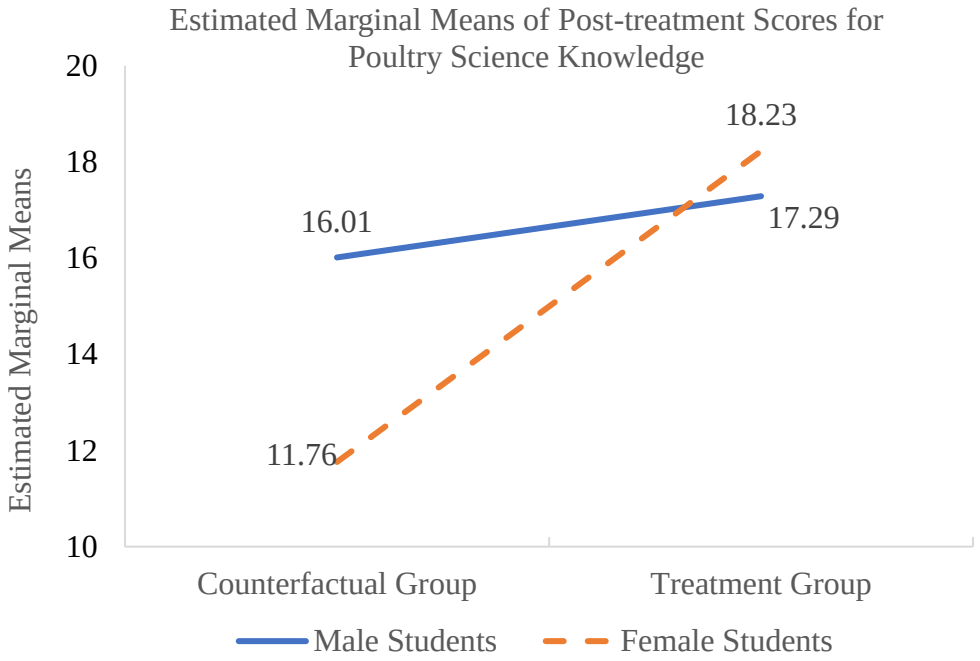
After controlling for the covariate pretest scores, a statistically significant disordinal interaction ($p < .05$) was found between students' group and sex with a medium effect size [$F(1, 275) = 35.48$, $p < .001$, $\eta_p^2 = .114$] (see Table 1 & Figure 2). Males in the counterfactual group had higher adjusted marginal and observed mean scores (*Adj. M* = 16.01, *S.E.* = .47; *M* = 15.99, *SD* = 3.95) for poultry science knowledge than females in the same group (*Adj. M* = 11.76, *S.E.* = .34; *M* = 11.60, *SD* = 2.88). However, females in the treatment group had higher adjusted marginal and observed mean scores (*Adj. M* = 18.23, *S.E.* = .32; *M* = 18.44, *SD* = 2.66) for the post-treatment scores of poultry science knowledge than males in the same group (*Adj. M* = 17.29, *S.E.* = .53; *M* = 17.26, *SD* = 4.46). A statistically significant main effect with a large effect size was found between group and students' post-treatment scores for poultry science knowledge [$F(1, 275) = 78.96$, $p < .001$, $\eta_p^2 = .223$] (see Table 1). Also, a statistically significant main effect with a medium effect size was found for students' post-treatment scores for poultry science knowledge based on their sex [$F(1, 275) = 15.17$, $p < .001$, $\eta_p^2 = .052$] (see Table 1).

Table 1
ANCOVA Results for Students' Post-treatment Scores of Poultry Science Knowledge depending on the Instructional Approach their Teachers used

Source	*S.S.*	*df*	*M.S.*	*F*	*p*	Partial Eta Squared (η_p^2)
Pretest poultry science knowledge scores	46.559	1	46.559	3.696	.056	.013
Group	994.527	1	994.527	78.956	.000**	.223
Sex	191.106	1	191.106	15.172	.000**	.052
Group * Sex	446.951	1	446.951	35.484	.000**	.114
Error	3463.870	275	12.596			

Note. R Squared = .357 (Adjusted R Squared = .347)
**Statistically significant difference at $p < .05$. Effect sizes Partial Eta Squared (η_p^2): Small effect size = .01; medium effect size = .06; large effect size = .14 (as cited in Lakens, 2011)

Figure 2
Statistically Significant Disordinal Interaction between Students' Group and Sex



Covariates in the model were analyzed using the following value: Students' Pre-treatment scores for poultry science knowledge = 10.38.

Objective #3: Describe Associations between the Students' Characteristics and Selected Variables

Association between Students' Sex and Their Intent to become Agripreneurs in the Future before the Study by Group

Before the study's intervention, when students' data were analyzed by group, i.e., counterfactual group versus treatment group, no statistically significant association was found at $p < .05$ for either group between students' sex and their intent to become agripreneurs in the future. Cramer's $V = .116$, *Sig.* = .767 for the counterfactual group and Cramer's $V = .213$, *Sig.* = .197 for the treatment group, respectively (see Table 2).

Table 2

Association between Students' Sex and Their Intent to become Agripreneurs in the Future before the Study by Group

		How likely are you to become an agricultural entrepreneur in the future?													
		Counterfactual Group (Traditional, Lecture-based Instruction)							Treatment Group (Project-based Learning Approach featuring Agripreneurship)						
		Not likely at all	Unlikely	Not sure/ Undecided	Likely	Highly likely	Total	Cramer's *V* *Sig.*	Not likely at all	Unlikely	Not sure/ Undecided	Likely	Highly likely	Total	Cramer's *V* *Sig.*
Sex of Students	Males	7	3	23	24	12	69		2	4	19	19	20	64	
	Females	5	1	25	22	15	68		0	3	14	32	20	69	
Total		12	4	48	46	27	137	.116 .767	2	7	33	51	40	133	.213 .197

Note. Male was coded 1 and female 2. No statistically significant correlations were found at $p < .05$. Cramer's *V* ranges in value from -1 to +1. Values near 0 indicate a very weak relationship, and values near 1 indicate a very strong relationship. Cramer's $V = .10$ (small effect size); Cramer's $V = .30$ (medium effect size); and Cramer's $V = .50$ (large effect size) [Green et al., 1997].

Association between Students' Sex and Their Intent to become Agripreneurs in the Future after the Study by Group

After the study, analysis of the participants' data by group, i.e., treatment group versus counterfactual group, indicated a statistically significant association at $p < .05$ with a small effect size between students' sex and their intent to become agripreneurs in the future for the treatment group (Cramer's $V = .284$, *Sig.* = .026) [see Table 3]. More female students ($n = 60$) than males ($n = 56$) in the treatment group indicated being either *likely* or *highly likely* to become agripreneurs in the future after the study (see Table 3). Moreover, the number of females ($n = 7$) who were *not sure/undecided* about their likelihood of becoming agripreneurs in the future was approximately six-tenths of that of males who indicated the same ($n = 11$) [see Table 3].

No statistically significant association was found at $p < .05$ between students' sex and their intent to become agripreneurs in the future after the study for the students in the counterfactual group (Cramer's $V = .251$, *Sig.* = .073) [see Table 3]. However, more male ($n = 54$) than female students ($n = 41$) indicated being either *likely* or *highly likely* to become agripreneurs in the future after the study (see Table 3). Further, about one-half fewer male students ($n = 12$) than female students ($n = 22$) in the counterfactual group were *not sure/undecided* about their likelihood of becoming agripreneurs after the study (see Table 3).

Table 3

Association between Students' Sex and Their Intent to become Agripreneurs in the Future after the Study by Group

		How likely are you to become an agricultural entrepreneur in the future?													
		Counterfactual Group (Traditional, Lecture-based Instruction)							Treatment Group (Project-based Learning Approach Featuring Agripreneurship)						
		Not likely at all	Unlikely	Not sure/ Undecided	Likely	Highly likely	Total	Cramer's *V* *Sig.*	Not likely at all	Unlikely	Not sure/ Undecided	Likely	Highly likely	Total	Cramer's *V** *Sig.*
Sex of Students	Males	0	1	12	34	20	67		1	1	11	18	38	69	
	Females	2	4	22	27	14	69		0	1	7	36	24	68	
Total		2	5	34	61	34	136	.251 .073	1	2	18	54	62	137	.284 .026

Note. Male was coded 1 and female 2. *Statistically significant correlation at $p < .05$. Cramer's *V* ranges in value from -1 to +1.

Values near 0 indicate a very weak relationship, and values near 1 indicate a very strong relationship. Cramer's $V = .10$ (small effect size); Cramer's $V = .30$ (medium effect size); and Cramer's $V = .50$ (large effect size) [Green et al., 1997].

Association between Students' Sex and Their Enrollment in Entrepreneurship as a Subject before the Study

Phi coefficient analysis revealed a statistically significant negative and low association (*Phi* = -.251, $p < .001$) between students' sex and enrollment in entrepreneurship as a subject before the study. More females ($n = 77$) than males ($n = 43$) indicated they had previously or were currently enrolled in entrepreneurship as a subject before the study.

Point-biserial Correlation Coefficients between Students' Selected Personal Characteristics

Point-biserial correlation coefficients examined the relationships between students' ages and their sex; between students' sexes and poultry science scores (pre-treatment and post-treatment); and between students' poultry science scores and their poultry keeping. A statistically significant negative and low correlation at $p < .05$ was found between students' sexes and ages ($r_{pb} = -.273$, $p < .001$) [see Table 4]. The older the student, the more likely to be a male. No statistically significant correlation existed at $p < .05$ between students' sexes and pretest poultry science scores ($r_{pb} = .065$, $p = .276$) [see Table 4]. Regarding the students' post-treatment poultry science scores, a statistically significant negative and low correlation at $p < .05$ was found between students' sexes and their post-treatment scores for poultry science ($r_{pb} = -.182$, $p = .002$) [see Table 4]. Male students were more likely to have higher post-test scores for poultry science.

Table 4

Point-biserial Correlation Coefficients between Students' Selected Personal Characteristics

Characteristics	Correlation Coefficients	*Sig.*
Association between students' sexes and their pre-treatment poultry science knowledge scores	.065	.276
Association between students' sexes and their post-treatment poultry science knowledge scores	-.182**	.002

Note. Male was coded 1 and female 2. **Correlation was statistically significant at $p < .05$ (2-tailed). Correlation coefficients were used as measures of effect size and ranged from -1 to +1: ±.01 to ±.09 = *negligible*, ±.10 to ±.29 = *low*, ±.30 to

±.49 = *moderate*, ±.50 to ±.69 = *substantial*, ±.70 to ±.99 = *very high*, and ±1.0 = *perfect* (as cited in Miller, 1994).

Spearman's rho Correlation Coefficients between Students' Selected Personal Characteristics

Spearman's rho correlation coefficient examined relationships between students' knowledge of agripreneurship and their likelihood of becoming agripreneurs in the future before the study. It was revealed that no statistically significant relationship (r_s = .109, p = .115) [see Table 5] existed at $p < .05$ between students' knowledge about agripreneurship and their likelihood to become agripreneurs in the future before the study. However, a statistically significant low and positive relationship was found at $p < .05$ between students' perceptions of learning about poultry keeping in school and their agripreneurship knowledge before the study (r_s = .200 p = .003) [see Table 5]. Students who indicated learning more about poultry science in school perceived they knew more about agripreneurship. In addition, a statistically significant low and positive relationship was found between students' perceptions of learning about poultry science in school and their likelihood of becoming agripreneurs in the future before the study (r_s = .217, $p < .05$) [see Table 5]. The more learning students perceived to have about poultry keeping before the study, the more likely they perceived becoming agripreneurs in the future.

Table 5
Spearman's rho Correlation Coefficients between Selected Students' Personal Characteristics

Characteristics	Correlation Coefficients	*Sig.*
Association between students' perceptions of agripreneurship knowledge and their likelihood to become agripreneurs in the future before the study	.109	.115
Association between students' learning about poultry keeping in school and their perceived knowledge of agripreneurship before the study	.200**	.003
Association between students' perceptions of learning about poultry keeping in school before the study and their likelihood of becoming agripreneurs in the future	.217**	.000

Note. **Correlation was statistically significant at $p < .05$ (2-tailed). Correlation coefficients were used as a measure of effect size and ranged from -1 to +1: ±.01 to ±.09 = *negligible*, ±.10 to ±.29 = *low*, ±.30 to ±.49 = *moderate*, ±.50 to ±.69 = *substantial*, ±.70 to ±.99 = *very high*, and ±1.0 = *perfect* (as cited in Miller, 1994).

Conclusions and Implications

Participants in this study were Senior Two students, in Uganda's education system and equally distributed by sex in both the counterfactual and treatment groups. Their ages ranged from 12 to 20 years, with a modal age of 14 and mean of 14.59 years.

Regarding objective two, all the related null hypotheses were rejected because they were statistically significant at $p < .05$. A statistically significant disordinal interaction (Bailey, 2008; Kirk, 2013; Field, 2013) with a medium effect size was found between students' group and sex. Examination of the student's adjusted mean scores and the interaction plot (see Figure 2) indicated that female students performed better under the PjBL (treatment) while males did so under the lecture-based instructional approach (counterfactual group). This implied that the female students benefited more from the treatment, i.e., PjBL, than their male counterparts. This finding supports previous studies that reported female students tended to benefit more from student-centric approaches such as PjBL which encouraged collaboration, reflection, and making connections between theory and its applicability to real-world situations (Barrett, 2006; Joy & Kolb, 2009; Kolb, 2014; Kulturel-Konak et al., 2011). The higher performance of male students under the lecture-based method is supported by Philbin et al. (1995) who reported that "men seemed to find congruence between traditional education and their learning style" (p. 485).

The null hypothesis for objective three was rejected because statistically significant relationships were found at $p < .05$ between students' characteristics and some selected variables. For example, we found a statistically significant and positive association between students' sex and their intent to become agripreneurs in the future for the treatment group after the study. More female students than males in the treatment group indicated being either *likely* or *highly likely* to become agripreneurs in the future (see Table 3). This may imply that females in the treatment group benefited more from the study's intervention (Barret, 2006; Philbin et al., 1995), and were motivated by their experiences implementing a SAP. And, perhaps more than the male students, they perceived agripreneurship opportunities as future livelihood possibilities leading to self-reliance and were inspired by such.

Further, through implementation of their SAP, it is likely that the females' perceived self-efficacy regarding entrepreneurship, including agricultural

ventures, improved. To this point, other researchers have reported that individuals' perceptions of entrepreneurial self-efficacy were found to have much stronger influence for teenage girls to become entrepreneurs than for boys (Kickul et al., 2008). Female participants were also more likely to be younger than their male peers (see Table 4). As such, Wilson et al. (2007) posited: "For teen girls, it appears that their perceptions that they have the abilities or skills to succeed as entrepreneurs are simply more important in considering future career options than for boys" (p. 388).

Moreover, a statistically significant low and positive relationship was found at $p < .05$ between students' learning about poultry keeping in school and their agripreneurship knowledge before the study. Students who indicated learning more about poultry science in school perceived that they knew more about agripreneurship. Of note, before the study, a statistically significant low and positive relationship was revealed between learning about poultry keeping in school and students' likelihood of becoming agripreneurs in the future. This may imply that the more learning students perceived to have about poultry keeping, as acquired in school, the higher their perceived knowledge about agripreneurship and their intent to become agripreneurs in the future. This may mean that the students likely reflected on their learning experiences (Kolb, 2014) [see Figure 1], and made connections between learning about poultry keeping and identifying potential agripreneurship opportunities, and, therefore, their intent to pursue such in the future for livelihood sustainment and their self-sufficiency.

Recommendations for Practice and Additional Research

Our recommendations may be applicable to teachers interested in promoting entrepreneurship and agricultural education among male and female students to equip them with knowledge and skills for self-reliance. The findings from this study indicated that the females benefited more from the intervention, i.e., PjBL than their male counterparts. However, we also recognize that confounding variables such as age differences could have impacted the students' learning. Also, learners have different preferences for acquiring new concepts and understandings which evolve as they undergo and reflect on new experiences (Baker et al., 2012; Kolb, 2014). Therefore, rather than following a one-size-fits-all approach to teaching, we recommend that depending on the topic, teachers ought to vary their instructional approaches to include teacher-centered and student-centered approaches to address the needs of leaners with different preferred learning styles, as supported by ELT (Kolb & Kolb, 2017).

The study's post-treatment data showed that more female students than males indicated being either *likely* or *highly likely* to become agripreneurs. In addition, fewer females were *not sure/undecided* about their likelihood of

becoming agripreneurs in the future compared to the males. This may imply that females more than males had their perceptions toward becoming agripreneurs positively reinforced or changed because of participation in the PjBL approach. Therefore, using PjBL to teach females agripreneurship knowledge and skills may increase their perceived entrepreneurial self-efficacy, including the intention of becoming agripreneurs, and, therefore, lead to greater self-reliance while creating employment opportunities for themselves and others in a field traditionally dominated by males (Koellinger et al., 2008).

Most related studies were conducted in developed countries in the context of STEM (Kulturel-Konak et al., 2011). As such, additional research should be done to establish the impact of using various teaching approaches on students' learning agricultural and entrepreneurship concepts depending on their sex. Using larger samples and replication of this study in different regions of Uganda or other developing countries could help expand our understanding of the impact of various teaching approaches on students of different sexes, especially in resource constrained contexts.

These quantitative findings only provided a general picture of the participants' performance. Therefore, following up with a qualitative study may help to better explain some of the study's findings. For example, interviewing the treatment group participants regarding their experiences implementing the SAP through a PjBL approach may help explain why the female students' intentions to become agripreneurs were statistically significant after the study compared to the non-significance of their male counterparts. A longitudinal study could also help establish how many of the students who had intentions of becoming agripreneurs followed through on that aspiration as adults.

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