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Unravelling student gains in agricultural practical skills from experiential learning approach of the student-to-farmer university outreach in Northern Uganda

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Abstract

This study sought to assess the extent by which students acquired crop and livestock husbandry practical skills under Gulu University's field attachment experiential learning program. Cross-sectional survey data gathered from 140 randomly selected alumni of the University's Faculty of Agriculture and Environment (FAE) field attachment program were analyzed using 2-tailed paired t-test. Results indicate improved competences in livestock husbandry from contemplation to preparation level as follows: fish farming and management (MD=0.63, $p \leq 0.001$), animal nutrition (MD=0.85, $p \leq 0.001$), fodder storage and management (MD=0.66, $p \leq 0.001$), and general animal breeding (MD=0.69, $p \leq 0.001$). In addition, the results indicate significant improvements in students' competences from preparation to action level in crop husbandry-related tasks: soil, disease and pest management (MD = 0.88, $p \leq 0.001$), record keeping and farm tools storage (MD =1.02, $p \leq 0.001$), nursery and seedbed operations (MD=1.00, $p \leq 0.001$), and post-harvest and marketing (MD=0.86, $p \leq 0.001$). Overall, students were found to have comparably attained higher competence levels in crop enterprise-related practical skills after the field attachment program than in livestock practices. It is concluded that the field attachment strategy for university students enhances practical skill competences and its utility in improving employable crop husbandry students' competences prior to graduation, recommended. Further, the difference in animal and crop competence acquisition points to the need to search for enterprise-based predictors of gains in students' skills from outreach programs.

Keywords - agricultural skills, experiential learning, field attachment, Gulu University, Uganda.

Introduction

Experiential learning is widely applauded for its potential to boost practical competence development in university education and increase learners' potential to start up gainful employment (Parker & Thomsen, 2019; UNESCO, 2013). Almeida et al. (2012) define experiential learning as an approach where learners are facilitated to advance their own experiences into curriculum reconstruction, enabling them to develop relevant competences for undertaking future professional-oriented tasks. Higher education institutions (HEIs) are adopting experiential learning for its promise to mitigate the challenges of rapidly changing patterns of skills demanded in the labor market and rising youth unemployment.

University student-centered outreach (SCO) programs, also known as outreach programs or student-farmer attachments, are a form of experiential learning implementation strategies. In Africa, SCO learning is majorly being recorded in a few central and southern African universities (Preece, 2013). In the east African region, student-centered university outreach models are a novel approach, especially

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in agricultural-related university training programs. These outreach programs also have a long-standing history of being practiced in non-African universities, such as the service learning program at EARTH university in Costa Rica (Sherrard & Alvaro, 2017) as well as the supervised agricultural enterprise and the land-grant universities model in the United States of America (Liu, 2014; Mukembo, 2017).

Field attachment is a form of university community engagement strategy through which most of the degree-awarding universities ensure that learners connect theoretical knowledge with practical situations under supervised mentorship in a real fieldwork environment (Lock et al., 2016). The model fits in the argument that the “university farm” model used in agricultural trainings for most universities works well in areas where the agricultural landscape has advanced into commercial scale. For developing countries such as Uganda, where agriculture is dominated by smallholder farmers, the university farm model is deemed less practical because it is difficult to imitate the conditions of smallholder farmers in a university farm set-up (Kalule et al., 2016b). Gulu, Makerere and Egerton are among the universities in east Africa where agricultural students take part in field outreach programs (Mungai & Njuguna, 2016; Odongo et al., 2017; Opolot et al., 2016).

Gulu University (GU), is a relatively young public University, having been established in 2003 as part of a comprehensive strategy by the government of Uganda to rehabilitate the northern region that had been engulfed in a series of civil wars for over two decades. From its inception, the university’s mission emphasized integrating community engagement as one of its core functions (Odongo et al., 2017). GU’s SCO program is part of the skilling strategies of the university’s content delivery of the Agricultural curriculum (Kalule et al., 2016a). GU’s student outreach is said to follow a tripartite knowledge and information flow framework involving the university faculty members, individual farmers, and students. The program’s theory of change elevates the students as the main agent. The students lead knowledge, skills, and experiences exchange, identify farmer problems and respond appropriately with support from academic staff. The students also collect agricultural enterprise specific problems requiring advanced research attention and transmit them to the faculty (Kalule et al., 2016b). Products of researched problems are then packaged as technologies or improved practices and disseminated for uptake by the smallholder farmers through different cohorts of students. By design, students regularly interact with farmers in the university’s neighborhood, which are the Gulu and Amuru districts for a minimum of one year (Kalule & Ongeng, 2016).

The above student-centered outreach can be deemed as a new approach for many of African universities (Kalule et al., 2019). This makes it necessary to undertake studies that aim to understand the capacity of outreach programs to facilitate skills enhancement. Efforts to understand how outreach programs enhance farmers’ skills have already started. For example, Kalule et al. (2019) studied the social cognitive factors in farmer learning behavior of 283 host participants of the student outreach program of Gulu University. They found that social outcome expectations, social influence and farmers’ formation of intentions significantly predicted farmer learning behavior. Kalule et al. (2016a) also used a sample of farmers who had hosted the students and demonstrated that 93.6% and 90% of farmers rated the knowledge quality and attitudes of students as good and very good, respectively. They also showed that students improved farmers’ access to market information, especially information regarding product processing (63.6%) and access to potential farmer product buyers (60.9%). However, with noticeable focus given to farmers’ learning, little knowledge is available regarding how the outreach program is enhancing students’ skills. This is tangential to the core assumption of the program. Given that SCO was modeled to replace the university model, students’ learning is and would be a priority, with farmer learning as a secondary goal.

Of the scanty related studies, such as Nakitto (2018), the tendency has been to pool data from students hosted on crop, animal and advisory services, such market information. The pooling of data could be problematic, given that Laker and Powell (2011) and more recently, Botke et al. (2018), suggest that acquisition and transfer of skills whose nature, context and structure differ tends to follow different trajectories. The fact that the farms hosting students in GU student outreach programs are dealing in either animal or crop enterprise, it could be challenging to presuppose a similar skill acquisition outcome for students hosted on farms dealing in different enterprises. Thus, a knowledge void exists on the overall level of students’ acquisition of skills from the outreach program and whether crop- and animal-related skills were acquired the same way. The qualitative study by Roberts and Edwards (2017) has attempted to fill the gap by examining the adequacy of skills acquisition among students. In their conclusions, Robert and his colleague noted that Gulu University's model of experiential learning might not be yielding adequate skill improvement on the part of the students. However, such a finding might not be conclusive given the fact that the blanket observation does not offer detailed analytical insights on components of the SCO. It fails to distill the aspects of experiential learning that have performed well from those which have been less successful. This has far-reaching implications for outreach programs for African universities. The managers of universities, such as Gulu University, may not for example see the content of outreach programs that needs improvement for student lifelong learning. Undertaking a study to find out if animal and crop skills are transferred was deemed necessary. Therefore, this study, sought to assess the extent to which university students gain various crop and animal husbandry skills from the student field attachment outreach program of Gulu University.

Conceptual Framework

The field attachment outreach program is one of the effective models to improve the quality of skills possessed by the labor force supplied by higher education institutions (HEIs) (Maertz et al., 2014). Sheridan and Linehan (2011) argue that skills acquired through outreach programs are transferable and enhance employability. Several studies identify crop husbandry, animal husbandry, marketing, entrepreneurship, problem solving, self-management, interpersonal and communication skills and leadership skills as some of the agriculture-related practical skills that were acquired through university field attachment programs (e.g. Oladele et al., 2011; Opolot et al.,2014).

In Uganda for instance, students taking the Bachelor of Science in Agriculture at Makerere University were reported to have acquired 22% crop husbandry skills, 18% animal husbandry skills, 25% facilitation skills, 16% for management and communication skills respectively but with, 3% agri-entrepreneurial skills and 0% acquisition of marketing and/or communication skills reported (Opolot et al., 2014). In the Australian context, results indicate a significant improvement in the perceived ability to perform all the employability skills of undergraduates trained during placement under work integrated learning program (Jackson, 2013).

Further, practical competencies were similarly reported to have improved in 31 out of the 47 areas of soil science, crop and animal production but the least improvement was registered in most activities related to farm engineering as a result of field attachment amongst students of Botswana College of Agriculture (Oladele et al., 2011). These findings vividly reveal that not all skills were improved as a result of an outreach program. In addition, some students were reported to have remained incompetent in performing some tasks after placement whereas some other students reported to have been already competent at performing particular tasks prior to placement. By contrast, Fikre's (2015) study revealed that student competence in clinical practice improved as years of study increased.

Based on the context of the above mentioned studies, field attachment programs may lead to skill acquisition, zero skill acquisition or a decline in competence levels for possessed skills. Thus, competence acquisition could probably be better assessed in terms of process. This is particularly so, given that percentage improvement, where an individual is deemed to have gained, not gained or declined in competence based on 'before and after' intervention percentage scores, could mask insightful details regarding learners' utility of skill before or after outreach activities. Therefore, Prochaska et al.'s (2013) stages of change (SoC) model has been adapted in this study to analyze competence acquisition.

From an SoC perspective, competence acquisition may be viewed as a five-stage process involving 'pre-contemplation', 'contemplation', 'preparation', 'action', and 'maintenance'. Pre-contemplation and contemplation are deemed as cognitive stages (matching behavioral intentionality) (Vet et al., 2007) because a person mentally applies a new idea to his or her present or expected future state before deciding whether or not to try it (Ndaula et al., 2020). Preparation involves the assemblage of implementation assets, which gives way for trial activities (action) before one later decides to maintain practicing the acquired skills (Ndaula, 2022). In using SoC-based competence acquisition assessment framework (Figure 1), the aim was to support students to self-assess the level of competence one had when starting (entry competence) and exiting

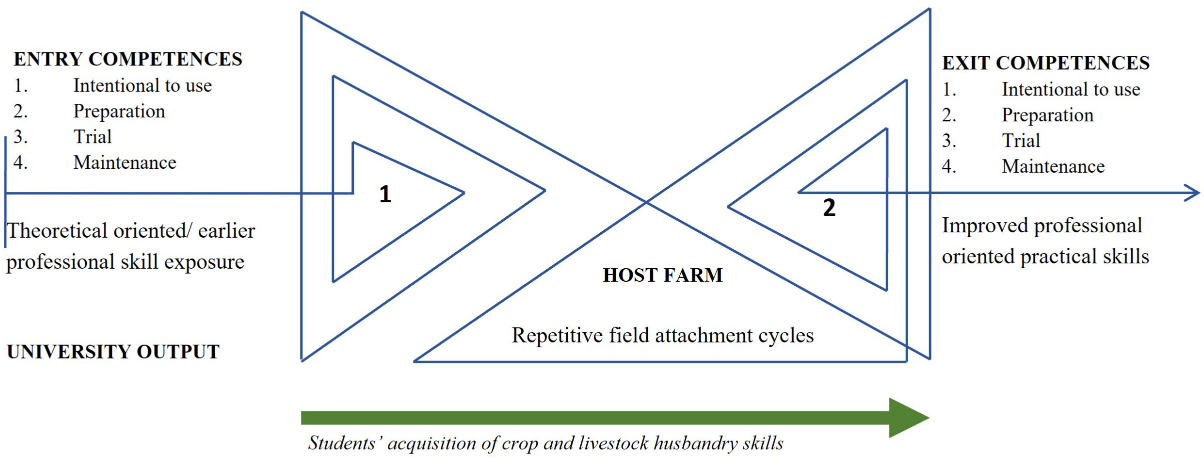


Figure 1. Study conceptual framework.

(exiting competence) the outreach program.

Entry level competence, conceptual framework sector 1 (left) is acquired through cycles of university-based learning and exposure given to students before being attached to host farms (first, second and third academic years). The level can be at intention to use, preparation, trial and maintenance. The level of competence at the time of completing the attachment service, see conceptual framework sector 2, right side, is conceptualized as the exit competence. Exit competences are developed via cycles of involvement of a student in farming activities during the fourth year. This was premised on the assumptions that through repeated host farm visits, students' practical skills in animal- and crop-related management skills will improve relative to the entry competence levels into the outreach program (university output). Therefore, the hypothesis this study aimed to test was whether students acquire significant crop and livestock husbandry skills from Gulu University's student field attachment outreach program.

Methodology

Description of Study Population

A cross-sectional survey was conducted on a purposively selected sample of alumni of the outreach program of Gulu University. Targeted students were the 202 alumni of the Faculty of Agriculture and Environment (FAE) who had completed field attachment from 2013 up to 2016. The cohorts were chosen because they had relatively fresh field attachment experiences at the time the study was conducted, in mid-October 2016; thus, they could easily recall and respond to questions.

Sampling

Cochran's sample size determination formula was used to arrive at the sample size of 115 participants (Bartlett et al., 2001). The sample size was raised by 40% to address the possible low response rate for email-based surveys. Thus, the researchers aimed to collect data from 115 × 1.40 = 161 alumni. Study participants were selected using simple random sampling, aided by MS Excel, to offer equal selection chances of participation to all eligible alumni. The sampling frame used for random selection was based on the SCO alumni list of the target years obtained from the college dean.

Research Instrument

A two-section questionnaire was used to obtain data from the participants. The first section assessed participants' socio-demographic attributes, including age, sex, duration of field attachment and host-farm enterprise distribution. The second section aimed to assess participants' valuation of their achievement in skill acquisition on a 62-item list of agricultural practical tasks trained through outreach program. The items were adapted from studies on outreach programs and Gulu University outreach program baseline documents (e.g. Maertz, Jr. et al., 2014; Patel, 2015). Participants rated the items on a five-point Likert scale (1-5) interpreted respectively, as: no intention of becoming active at engaging in hands-on practice; thinking about starting to become physically active at hands-on practice; making small changes in hands-on practice but still not being perfect at performing the task as expected; meeting an expected criterion for performing hands-on practice perfectly, only recently but cannot train others; meeting the expected criterion for performing hands-on practice perfectly and can train others even after graduation from university. The scale points corresponded to the five stages of change (1=Pre-contemplation, 2=Contemplation, 3=Preparation, 4=Action, 5=Maintenance) adapted from stages of change theory (Moulding et al., 1999). Each stage assessed participants' self-perceived ability regarding acquisition of practical skills for each agricultural skill, before and after field attachment, retrospectively.

Retrospective evaluation was used because completing retrospective ratings at posttest provides participants an opportunity to reflect on how much they had learned as a function of their work in the program (Hill & Betz, 2005). It is most appropriate when the goal is to subjectively describe change as experienced by beneficiaries. It provides more direct assessment when the aim is to understand the way participants feel about the effectiveness of a program and their personal growth or skill acquisition (Bhanji et al., 2012).

The questionnaire was pretested on 20 alumni of the Gulu University outreach program. Following Cronbach's alpha reliability analysis, and in line with Taber (2018), only items with coefficients greater than 0.70 were used for subsequent data collection. The Cronbach's alpha values for the items used to assess the five categories of perceived skill levels ranged from 0.75 to 0.85, indicating that the scales used had strong internal consistency and reliability.

Data Collection Procedure

Data collection commenced in mid-October 2016, a period that corresponded with the time when Gulu University was in lecturing session. Prior to data collection, written permission to engage beneficiaries as study participants was obtained from the FAE Dean. Given that a proportion of the respondents had left the university, the instrument was administered using both face-to-face and email posting. To enroll the participants on this study, an introductory letter was sent out through email to all students who had been sampled. The letter stated the purpose of the study and an assurance of confidentiality. Participants were requested to indicate the option (soft or hard copies) that would be convenient for him/her to receive the questionnaire. All the 161 selected participants chose the soft version, and 98 of them wanted to receive the hard copy as well. The questionnaire return time stretched for two and half months (from mid-October to late December 2016), prompted by the slow response characterized by the email-based surveys. Some of the participants of this survey were in hard-to-reach areas whereas others had many work-related commitments. To ensure that the selected participants remained committed to returning a fully completed questionnaire, eight email reminders were sent each fortnight, and phone call reminders were done at the beginning of the last week of the set date of returning the questionnaires. One hundred forty alumni of the outreach program returned fully completed survey tools (46 via email and 94 via hard copy), corresponding to an 87% response rate. Out of the 161 selected alumni, 21 were dropped from the study (8 gave incomplete responses, and 13 did not return the questionnaires).

Data Analysis

Data analysis was mainly done in three steps using SPSS version 20.0. First, principal component analysis (PCA) was done. The Kaiser-Meyer-Olkin (KMO) test of sampling adequacy and Bartlett's test of sphericity, with eigenvalues set at 1 was performed to reduce the number of items into a parsimoniously manageable dataset (Field, 2013). KMO measure of sampling adequacy obtained for the extracted factors were higher than the recommended 0.5 and the Bartlett's test of sphericity was also significant ($p \leq 0.001$). Eigenvalues were above Kaiser's criterion of 1, which indicated that it was acceptable to proceed with the analysis.

Second, retained posttest and pretest items for each of the rotated factors were then converted to scale scores for further data analysis. This was done by taking the average of each student's responses to the posttest and pretest items in each rotated factors to form scale scores (Fortune et al., 2008). The differences between posttest and pretest scores were assessed to describe gains in skills as "improvement/acquisition", "no improvement" or "declined acquisition". Lastly, a paired sample t-test was conducted to establish the levels and significance of improvement in competence after the outreach program.

Results and Discussion

Descriptive Statistics (Socio-demographics)

The socio-demographic characteristics examined were gender, age, duration of field attachment and host-farm enterprise distribution. Six of every ten participants (60%) were male, a proportion that corresponded to the ratio of male and female students in Gulu University. In universities that enjoy world recognition in Uganda, such as Makerere University, the ratio of female admission tends to be higher than that of males possibly due to the fact that the government of Uganda gives female students a 1.5 point advantage (free entry point) for admission across all courses in all public universities in the country. Upcoming universities such as GU could have more males as result of increasing entry failures for males on professional courses in favored universities. The participants were also mostly aged 25 years, a figure which corresponded with the average completion age for a student of a four-year course who would have initially been directly admitted to the university from advanced level. Most of the respondents had been hosted at mixed farms for an average period of six months. The farms dealt in both crop- and animal-related enterprises, including managing a variety of crops, apiary, poultry and fish farming.

Descriptive Statistics (Skill Acquisition)

Table 1 and Table 2 summarize the most important skills associated with the learning domain under livestock and crop husbandry (30 and 32 skills, respectively). Columns 2 and 3 of both tables present students' overall ratings of the status of their skills before and after the attachment program. Taken together, starting skills and exit skills for livestock husbandry were both relatively below those of crops husbandry. This could be interpreted that students learned crop-related competences more than livestock competence from the exposure they received from outreach program. Opolot et al. (2014) also studied students' gain in skill from agricultural attachment program of Makerere university and found crop skills to be more transferred than livestock. Again, the results point to a possibility of students' predispositions that are being shaped by the widespread crop activities within the contexts of students' origin (former schools or households). This is particularly possible, given that it is relatively easier and cheaper for farming units (households and schools) to start as well as sustain crop-related enterprises than starting livestock enterprises. Further, the means of the students' skills in fish farming before the community engagement were notably very low (Factor 2) compared to that of other factors within the livestock husbandry category. According to students, curriculum delivery on fish farming was largely theoretical, occasioned with one to two visits to distant fish farming facilities. For, example, 'Monica – not real name' an alumnus of the outreach program noted in a follow-up interview that her cohort "practically visited only the Aquaculture Research and Development Centre (ARDC), Kajjansi to get an appreciable feeling of fish farming". Noteworthy, Gulu University and the fish facility in Kajjansi are 353 Km apart, and a bus drive journey between the two would last 6 hours.

Before further analysis, the 62 practical skills were reduced to 14 factors using principle component analysis, based on the factor loadings of the extracted components shown in Column 4 of Tables 1 and 2. Eight skills were extracted for livestock and labeled as: poultry production and parasite management, fish farming, animal disease diagnosis and parasite control, bee keeping and management, animal nutrition, marketing and value addition in animal products, fodder storage management, and general animal breeding, depending on the skills that loaded with highest coefficients. Six transferable skills were extracted for the case of crop husbandry, including soil conservation, plant disease and pests management, record keeping and storage of farm tools, nursery bed and seedbed operations, greenhouse operations, post-harvest handling and marketing, and response to plant nutrient problems.

Preliminary Status Skills Acquisition

Figure 2 presents the summary of skill gain in the eight livestock areas, based on students' self-rating (in percentage terms). Livestock disease diagnosis and parasite control (76%) skills were rated as the highest areas in which study participants gained competence. Other livestock husbandry practices with outstanding skill gains were poultry production (70%) and products marketing (70%). The least rated livestock management practices in skills gains were fish farming (54%), general animal breeding (59%), fodder management (59%), and bee keeping (58%). This was due to the fact that fish farming, fodder management, animal breeding and bee keeping are relatively specialized areas of agriculture and what farmers do is often tangential

Table 1. Mean score for livestock husbandry skills before and after, and factor loadings generated using varimax rotation under Principal Component Analysis.

Livestock husbandry skill categories (factors)	Mean before	Mean after	Factor loadings
Poultry production and parasite management items (Factor 1)			
Proper care for eggs, chicks & brooder unit management	2.62	3.33	0.786
Performing de-beaking of poultry birds	2.51	3.15	0.773
Performing proper vaccination of poultry birds	2.62	3.24	0.742
Participating in the use of disinfectants	2.61	3.39	0.645
Proper feeding and management and re-use of poultry wastes	2.77	3.58	0.545
Construction and general cleanliness of simple poultry structures	2.31	2.99	0.455
Fish farming items (Factor 2)			
Caring & management of fish and ponds	1.90	2.61	0.889
Feeding of fish in ponds	1.98	2.64	0.882
Harvesting of fish from ponds	1.81	2.40	0.859
Construction of improved fish ponds	1.84	2.39	0.798
Animal disease diagnosis and parasite control items (Factor 3)			
Performing disease diagnosis, prevention, & control	2.71	3.58	0.819
Performing parasite identification & control	2.71	3.50	0.717
Proper handling and management of animal wastes	2.84	3.36	0.628
Spraying, dipping & de-worming against external & internal parasites in animals	2.47	3.01	0.559
Construction & management of animal structures (e.g. calf pens, piggery unit) from locally available materials	2.97	3.91	0.515
Performing proper cleanliness of animal structures	2.61	3.25	0.434
Bee keeping and management items (Factor 4)			
Proper handling, care and management of bees and hives	2.29	2.80	0.824
Performing proper harvesting of honey	2.08	2.58	0.811
Construction of beehives from locally available materials	2.27	2.84	0.763
Proper management of bees & hives	2.67	3.27	0.450
Animal nutrition items (Factor 5)			
Performing feed mixing & animal feeding	2.46	3.49	0.765
Performing Hay and silage making	2.47	3.21	0.747
Provision of clean drinking water & salt leaks to animals	2.24	3.03	0.727
Marketing and value addition in animal products items (Factor 6)			
Participating in value addition of animal products (yoghurt making from milk)	2.57	3.21	0.733

Table 1. Continued...

Sharing with farmers on proper marketing of their animals & animal products	2.71	3.55	0.732
Preservation of animal products (like refrigeration of milk)	2.41	3.01	0.549
Fodder storage management items (Factor 7)			
Planting, proper storage & management of pastures	2.26	2.91	0.687
Construction of fodder storage structures from locally available materials	2.12	2.80	0.583
General animal breeding items (Factor 8)			
Proper castration & identifying animals on heat (for mating)	1.96	2.51	0.790
Performing proper selection of animals for cross-breeding	2.21	3.04	0.407

Table 2. Mean score for crop husbandry skills before and after, and factor loadings generated using varimax rotation under Principal Component Analysis.

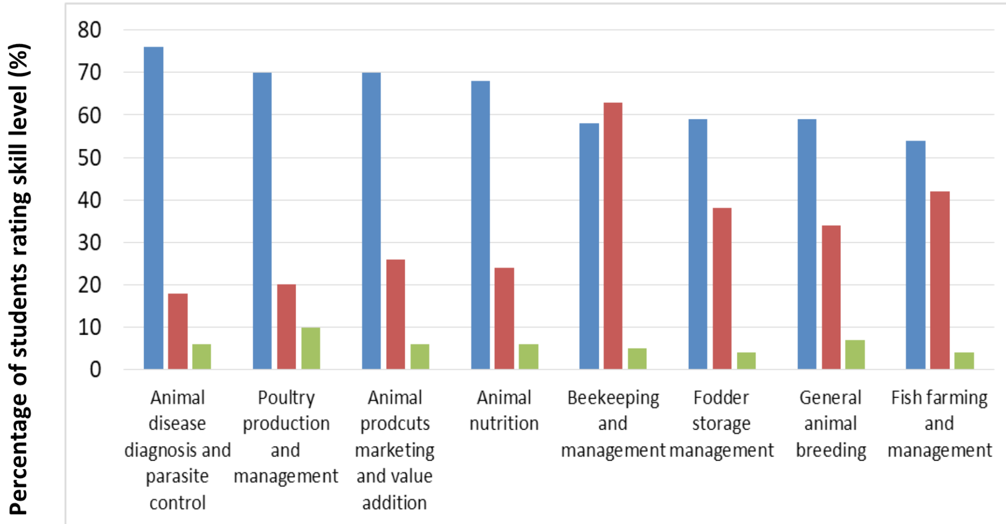
Crop husbandry skill categories (factors)	Mean before	Mean after	Factor loadings
Soil conservation, plant disease and pests management items (Factor 9)			
Recommending suitable soil and water conservation measures for specific farm crop enterprises	2.88	3.76	0.723
Performing pesticides/herbicides handling, storage & use	3.05	4.01	0.705
Pest and disease identification and control from main garden	2.90	3.74	0.606
Performing basic plant diseases diagnosis	2.83	3.61	0.576
Performing proper planting material (seeds, suckers, clones, stem cuttings, etc.) selection	3.01	3.85	0.524
Performing proper planting, spacing, weeding, thinning, staking & pruning operations	3.07	4.05	0.501
Record keeping & storage of farm tools items (Factor 10)			
Shared ideas with host-farmer on how to go about record keeping considering costs & benefits as a daily routine	3.07	4.15	0.802
Sharing ideas with host-farmer on ensuring proper storage of farm tools & implements after use	3.04	4.11	0.753
Cleaning of farm tools and implements prior to storage	2.89	3.94	0.746
Ensuring good storage conditions for farm tools, equipment and implements	2.94	3.98	0.668
Constructing storage structures (local stores)	2.94	3.89	0.549
Performing use of farm implements & equipment (e.g., calibration of knapsack sprayers, cleaning of hoes, secateurs)	2.91	3.84	0.417
Nursery bed and seedbed operations items (Factor 11)			
Performing nursery bed operations & management	3.06	4.16	0.856
Seed bed operations & management	3.19	4.15	0.791

Table 2. Continued...

Raising seedlings from nursery beds	2.95	3.94	0.780
Transplanting of seedlings from nursery beds to seedbed/ main garden	2.93	3.88	0.658
Greenhouse operations items (Factor 12)			
Transplanting of seedlings from nursery beds to greenhouse	2.34	2.92	0.834
Raising tree seedlings from greenhouse	2.14	2.54	0.772
Constructing green house & its proper management	2.09	2.61	0.769
Transplanting of seedlings from greenhouse to the main garden/ seedbed	2.41	3.04	0.757
Post-harvest handling and marketing items (Factor 13)			
Advising farmers on proper post-harvest handling & transportation of farm produce	3.11	4.11	0.716
Performing & advising farmers on proper harvesting & storage of various farm produce	3.12	4.08	0.703
Planning & carrying out appropriate harvesting for various crops	2.82	3.64	0.659
Proper post-harvest handling of various crop products	2.97	3.77	0.645
Sharing with farmers experiences on proper marketing of crop products	2.36	2.98	0.511
Advising the host-farmer on value addition (e.g. agro-processing, etc.)	2.91	3.89	0.411
Response to plant nutrient problems items (Factor 14)			
Determining plant nutrient problems	2.56	3.36	0.830
Recommending appropriate correction procedures for plant nutrient problems	2.46	3.31	0.803
Performing proper fertilizer mixing, application on crops	2.65	3.58	0.669
Planning & implementing land preparation procedures for crops	2.91	3.86	0.502
Selecting appropriate planting methods for various crop seeds	2.08	2.63	0.466

to what is recommended in science. Oladele et al. (2011) reported 0% transfer of the farm engineering skills in Mozambique. On the other hand Opolot et al. (2014) revealed facilitating skills to have been more transferred in Makerere university's outreach program. In line with the probable causes argued in this study, farm engineering skills belong to technical and higher investment skills whereas facilitating skills are less technical.

The fish farming skills could also have been affected by the low competences students had at entry level, which could have constrained students' learning abilities evidenced by the large percentage of students who did not register improvement in skills (42%; see Figure 2). Using the narrative by ‘Monica’, seen earlier, farms in the ‘neighborhood’ of Gulu University could be deemed to have low quality or missing fish farming facilities. Thus, only a few students could have had access to host farms with fish farming units. In such a case, it would have been difficult for students to acquire uniform or even meaningful skill gains. For example, Charles, an alumnus of the engagement program, expressed excitement for having participated in extensive fishing farming activities on the farm he had been attached to. By contrast, John, another alumnus, gained only limited skills because the farm he had



	Animal disease diagnosis and parasite control	Poultry production and management	Animal prodcuts marketing and value addition	Animal nutrition	Beekeeping and management	Fodder storage management	General animal breeding	Fish farming and management
Acquisition	76	70	70	68	58	59	59	54
No Change	18	20	26	24	36	38	34	42
Decline	6	10	6	6	5	4	7	4

Figure 2. Percentage distribution of livestock husbandry practical skills acquisition.

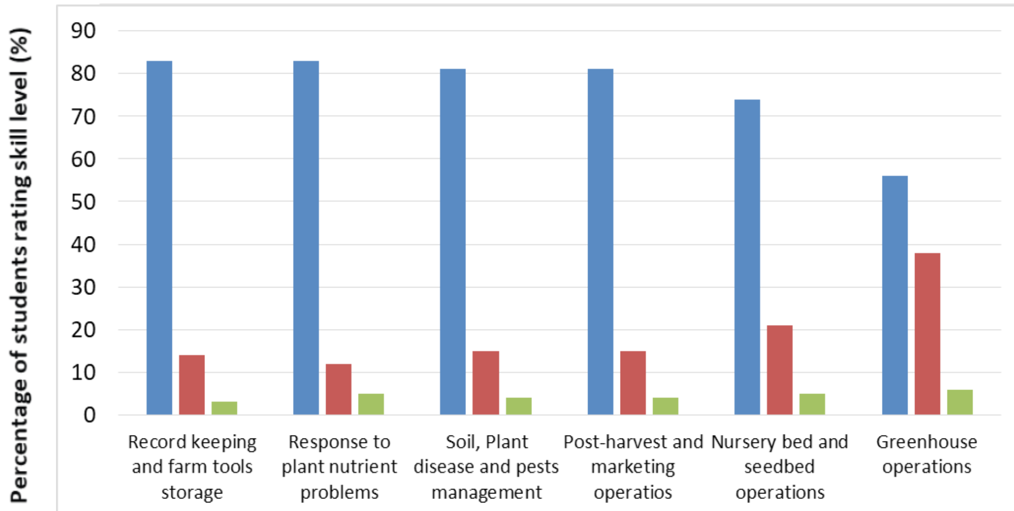
been attached to had a pond that had been left to thrive under the conditions offered by nature. John recalled that he was able to “harvest fish, clean the pond but feeding and stocking the pond was never of interest to the host farmer”.

Figure 3 summarizes skill gain in the six extracted crop husbandry skills using PCA. Participants reported to have acquired skills in all the six cropping practices. The highest skills were acquired in the areas of record keeping and farm tools storage (83%), identifying plant nutrition problems (83%), soil, plant disease and pests management (81%) as well as post-harvest and marketing operations (81%). Least skill acquisition was reported in green house operations (56%), which is a highly technical and high investment enterprise. In sum, preliminary results revealed higher skill acquisition in crop husbandry relative to those acquired in livestock management, although skill acquisition in either case of learning domain was above average. This coincides with findings of Roberts and Edwards (2017) who reported that some Gulu University students did not view some host farms as offering an intersection between professional learning gain from university. Farmers regarded highly specialized skills students carry to host farms as silly and disconnected from their survival (Roberts & Edwards, 2017). This could suggest that outreach programs negatively enhance students’ attitudes towards taking on agricultural career by structuring the mindset of students that agriculture is an unskilled labor-intensive career, that requires much hard work (Roberts & Edwards, 2017).

Advancement in Skill Acquisition

This study hypothesized that students acquire significant crop and livestock husbandry skills from Gulu University student outreach program. Skill acquisition was assessed as a five-staged journey learners pass through iteratively, from pre-contemplation through to maintenance, as they are continuously exposed to the outreach program activities. Generally, the 2-tailed paired t-test results (Tables 3 and 4) supported the assertion, indicating that agricultural field placement programs enhanced the competences of students in practical skills.

Table 3 shows the mean level of self-perceived ability for each skill area under livestock husbandry before and after training. Students significantly progressed from contemplation (level 2) to preparation (level 3), evidenced by a significant mean difference



	Record keeping and farm tools storage	Response to plant nutrient problems	Soil, Plant disease and pests management	Post-harvest and marketing operatios	Nursery bed and seedbed operations	Greenhouse operations
Acquisition	83	83	81	81	74	56
No Change	14	12	15	15	21	38
Decline	3	5	4	4	5	6

Figure 3. Percentage distribution of crop husbandry practical skills acquisition.

(MD) in fish farming and management (MD=0.63, p ≤ 0.001), bee keeping and management (MD=054, p ≤ 0.001), animal nutrition (MD=0.85, p ≤ 0.001), fodder storage and management (MD=0.66, p ≤ 0.001), and general animal breeding (MD=0.69, p ≤ 0.001) skills. Resonating findings from Oladele et al. (2011), some students in this study were found to have remained with the same competence level even after completing the outreach program. Areas where students did not advance into a new competence level included, animal disease diagnosis and pest control (MD=0.72, p ≤ 0.001), animal product marketing and value addition (MD=0.69, p ≤ 0.001), and poultry production and management (MD=0.71, p ≤ 0.001). This suggests that competence exposure received at host farmers could have been necessary but not sufficient for the students to advance to action level with respect to these areas of livestock husbandry skills.

Table 4 shows the mean level of self-perceived ability for each skill area under crop husbandry before and after training. Table 4 shows that most participants started the outreach program for most skills at close to preparation (level 3). This reflected higher entry level competences for crop skills given that the entry level skills for most livestock husbandry competences were at contemplation (level 2). This finding is in line with the suggestion of Nezami et al. (2016) and Vancouver and Purl (2017), who reported interventions to finding beneficiaries at different competence levels due to past practical encounters. In resonance with the earlier argument, participants may have had varied starting level of skills due to differences in theoretical preparedness and prior experiences. The fact that the difference in the entry competence varied across animal and crop skills points to the likelihood of existence of competence-acquisition constraints that are enterprise specific. Transfer of skills varies by contexts and nature of contents (Laker & Powell, 2011; Botke et al., 2018). Therefore, it may be problematic to presuppose a similar skill acquisition outcome for all students because host farms are heterogeneous in structure with a large magnitude of the undertaken enterprises. In this case, the skill sets that are likely to suffer most are those whose enterprises are the most difficult to establish among host farms. This could be particularly so because there would be very limited levels of opportunity to learn in such areas.

Noteworthy, Table 4 shows that for crop husbandry skills such as soil disease and pest management (MD=0.88, p ≤ 0.001), record keeping and farm tools storage (MD=1.02, p ≤ 0.001), nursery and seedbed operations (MD=1.00, p ≤ 0.001), and post-harvest and marketing (MD=0.86, $p \leq 0.001$), students significantly progressed from preparation (level 3) to action (level 4). In line with the observation of Kingombe (2012), crop enterprise/activities relatively require less startup finance and are often easy to duplicate, than animal enterprises/ activities. Hence, the probable availability of crop enterprises could have offered wide learning prospects for students at host farms, consolidating already learnt skills from several previous encounters. Similarly, crop enterprises/activities are equally within a student's reach to be started, especially after completing University, which can compound self-rated responses on skill acquisition.

Kingombe (2012) observes that whereas experiential training can develop appropriate skills, the use of acquired skills would depend on several additional factors, such as the availability of and access to incentives for investment. Students who lack such factors end up not applying the acquired practical skills. Thus, students' progress to action level and implementation level probably was constrained by investment incentives. Taken together, the acquisition of skills that require specialized skills and intensive use of financial resource were found to be comparably minimal. For example, greenhouse operation skills were revealed to have been started off from contemplation and advanced to preparation level (MD=0.53, $p \leq 0.001$). Also students remained within the preparation competence level regarding responding to plant nutrient problems, despite registering a significant skill acquisition change (MD=0.82, $p \leq 0.001$). The high cost and technological requirements for the students to carry out these skills may have made them less available at host farms and after that, less accessible and duplicable by students. No evidence was, however, found in support of decline in skills as a result of students being exposed to university field attachment as earlier revealed in the study by Oladele et al. (2011). This could have been because in this study, skill acquisition was assessed based on learning stages rather than percentage measure of perceived knowledge.

Table 3. Mean differences paired t-test of livestock husbandry skills before and after experiential training.

			Skill advancement Mean difference (MD)		
Skill Areas	**Period**	**M**	**3—>3**	**2—>3**	***t*-value**
Poultry production and management	Before	2.57	0.71***		8.95
	After	3.28			
Fish farming and management	Before	1.88		0.63***	8.22
	After	2.51			
Animal disease diagnosis and pest control	Before	2.72	0.72***		10.32
	After	3.44			
Bee keeping & management	Before	2.33		0.54***	8.58
	After	2.87			
Animal nutrition	Before	2.39		0.85***	10.12
	After	3.24			
Fodder storage and management	Before	2.19		0.66***	9.98
	After	2.85			
Animal products marketing and value addition	Before	2.56	0.69***		10.09
	After	3.26			
General animal breeding	Before	2.08		0.69***	8.29
	After	2.78			

1=pre-contemplation; 2=contemplation; 3=preparation; 4=action; 5=maintenance
df = 139; *** $p \leq 0.001$

Table 4. Mean differences paired t-test of crop husbandry skills before and after experiential training.

Skill Areas	Period	M	Skill advancement Mean difference (MD) 3—>3	2—>3	3—>4	*t*-value
Greenhouse operations	Before	2.25		0.53***		8.17
	After	2.78				
Response to plant nutrient problems	Before	2.53	0.82***			13.52
	After	3.35				
Soil, disease & pest management	Before	2.96			0.88***	13.01
	After	3.84				
Record keeping and farm tools storage	Before	2.96			1.02***	14.42
	After	3.99				
Nursery and seedbed operations	Before	3.03			1.00***	12.60
	After	4.03				
Post-harvest and marketing	Before	2.88			0.86***	12.26
	After	3.74				

1=pre-contemplation; 2=contemplation; 3=preparation; 4=action; 5=maintenance
df = 139; *** $p \leq 0.001$

Conclusion and Recommendations

Generally, the findings of this study point to the role of field attachment in enhancing practical skill competences of university students undertaking agricultural related courses. The students gained higher levels of competence in practical skills in crop husbandry and related practical tasks than in livestock husbandry. Also, the entry level competences were lower for livestock husbandry practical tasks. In a nutshell, the study concludes that the approach of experiential learning for students in the student-to-farmer university outreach program is more effective in developing practical skills for crop husbandry practices compared to livestock-based practical learning tasks. This leads to the recommendation that universities such as GU that implement outreach programs need to invest in livestock management facilities to bring students' outreach entry level competence to a fairly equal match to that of crop husbandry practices for all students. In addition, under existence of such unequal/heterogeneous learning exposure to specialized enterprises, outreach programs such as that of Gulu University are bound to produce students with competence parities, which leads to the recommendation that GU outreach programs should be pursued as a complementary strategy rather than a replacement to university farm institute model, especially as regards the enhancement of specialty competences and those that require investment levels beyond the capacity of the host farms. The low involvement of students in practice during learning (such as that reflected for fish farming) that correspondingly matched poor access to fish farming facilities in host farms, point to the possibility that low skills for the engagement program affect the availability of various facilities or programs within the host farms. This study deepens the understanding of agricultural outreach programs by pointing out the likelihood of livestock and crop practicals being enhanced differently. This suggests that future studies seeking to arrive at predictors of students' competence enhancement need to control for such differences, for example through using multi-grouped structural equation modeling analysis strategies. Again, this study points to the need for future studies to utilize longitudinal study design. This could permit the capturing of students' competence at entry point into an academic study program and as they progress from one academic year to another. This is likely to accrue into an understanding of factors that are likely to lead to the homogeneity of competence enhancement under the heterogeneity of host farm contexts used by university outreach programs in Africa.

Limitation and Future Reseach

This study used a cross-sectional design, and as such succumbs to its limitations. One such limitation is the inability to accurately gain access to information that was never captured at program or project passed time. Specifically in this study, host farms and the profiles of the host farmers and that of students'/ alumni's, such as their background (farm-family background, owns land, working in an agricultural firm) were not in the outreach program at Gulu University. This limited the options of situating the discussion within the context in which the outreach program was implemented. Future research could consider capturing benchmark data on students and host farm/farmer to aid the interpretation of the life-long learning of both the students and farmers participating in the outreach program.

Disclosure Statement

No potential conflict of interest was declared by the authors.

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