Original Research Article

Evaluating the Effectiveness of a Digital Knowledge Pack in Enhancing Agricultural Experiential Learning: Case of Egerton University, Kenya

Abstract

One of the roles of higher education is the formation of professionals who are competent for job markets. Experiential Learning Abilities (ELAs); which can be acquired through field attachment programmes, is a useful pathway for students to acquire competences to improve employability skills. This approach is however only effective where students have been prior knowledge about their field learning experiences. Research has shown that students on field attachment; including the Farm Attachment Program; (FAP) of Egerton University (EU) required prompt reliable and accurate information, ~~for effective experiential learning~~ ELAs abilities. The aims of this study ~~was to evaluate~~ the effectiveness of using a Digital Knowledge Pack (DKP) innovation to enhance ~~Farm Attachment Programme (FAP)~~ design attributes and improve ~~Experiential Learning Abilities~~ (ELAs) among students of EU. These abilities included; willingness to get actively involved in the learning experience, abilities to reflect, analyze, solve problems, make decisions in addition making continuity arrangements for innovations/projects initiated in students' hosting farms. Specifically, the study set out to (1) ~~To~~ determine the levels obtained on ELAs with each DKP innovation design attribute (ii) ~~To~~ determine the effects obtained on ELAs with each DKP innovation design attribute iii) To evaluate the extent to which the use of a DKP innovation design improved the ELAs levels among students. The study employed Participatory Research Design (PAR). Thirty students who had completed either their third or fourth years and hosted by Farmers in Njoro ward, Nakuru County, Kenya, were selected, between July and December 2019. The selection of students was based on students' eagerness to undertake innovative tasks. A digital knowledge pack was designed first then students were allowed to proceed on FAP for a period of three weeks after which they were taken through a training on the design attributes of the DKP including weekly structure, DKP implementation enablement, DKP students' portfolio and DKP resources. The students were then allowed to use the DKP from their Fourth week of attachment. A 5-point continuum scale was used by students to rate the levels of DKP design attributes. An analysis was then conducted to determine the effects obtained on experiential learning ability with each DKP design attribute. An evaluation of the effectiveness of DKP in improving students ELAs was conducted in 2020 after completion of FAP. This was an online activity due to covid 19 Protocols. The use of the DKP innovation resulted in high (M=4.07, SD= 0.13) levels of Experiential learning ability among Egerton university students. The results revealed that the DKP weekly structure had a significant effect on the students ELAs. The size effect of the DKP weekly structure was significant (F (10,29) =8.49, P=.001) and accounted for 72% of the variation in in students' ELAs. The effect of the DKP student's portfolio on ELAs was also found to be significant (F (9,29) = 6.95, P =.001) at 5% level of significance and accounted for 74% of the variation in ELA. The DKP implementation enablement and DKP resourceattributes had significant (F (3,26) 87.410, P<.0001) and (F (16,29) =2.86, P =.03) respectively, effects on ELAs and had effect sizes of 64.9% and 50.6% respectively. Further analysis revealed that there was multicollinearity among the DKP variables and this was resolved by conducting a Principal Component Analysis (PCA). A scree plot was drawn which showed a one component solution The results revealed there was a one component solution that explained 91.18% of variance in the regression model.; The component Eigenvalue was 3.647. This meant that the four DKP attributes could be explained by one component variable referred to in this study as DKP innovation Design (DID) attribute. The ELA value obtained while using the DKP was then compared to established ELA values of FAP. The results showed that using a DKP significantly improved ELAs (M=2.79, SD=0.51 to M=4.07, SD=0.13) at a 95% confidence interval of the mean 1.356 [1.005, 1.706]. In conclusion the study showed that the use of a DKP innovation enhanced the FAP design attributes and improved experiential learning abilities among Egerton University students at 95% confidence level. The higher levels of the abilities allowed students to gain more competences from their farm experiences and improve students' employability skills.

Comment [bs1]: The case study of **Egerton University's students**

Comment [bs2]: are in competitiveness on job' s markets.

Comment [bs3]:

Comment [bs4]: been

Comment [bs5]: Farm Attachment Program; (FAP)

Comment [bs6]: required

Comment [bs7]: reliabilities and accuracies

Comment [bs8]: aims

Comment [bs9]: were to evaluated

Comment [bs10]: on

Comment [bs11]: were

Comment [bs12]: involving

Comment [bs13]: learning experiences

Comment [bs14]: on initiating of

Comment [bs15]: Specifically

Comment [bs16]: i

Comment [bs17]: please correcting and make the English consistently

Keywords: [Digital Knowledge Pack, Farm attachment Programme, Egerton University, Agricultural Experiential learning]

1. INTRODUCTION

One of the roles of higher institutions of learning is that of forming professionals who are competent for the job markets. According to [1], experiential learning is an approaching proven to provide the competencies required by students. Field attachment including Farm Attachment Programme of Egerton University (EU), Kenya has been shown to provide opportunities for experiential learning. However; experiential learning does not just happen but requires certain experiential learning abilities; which according to [2] ~~include: the~~ willingness of students to get actively involved in the learning experience, ability to reflect, analyze, solve problems and make decisions and for the purpose of this study make continuity arrangements for the initiated projects or innovations in the host farms. Field Attachment programme is a session when students go out to real-life working stations to get exposed and to familiarize themselves, with the working environment in their areas of specialization. Over the years, attachment for students undertaking agricultural related training has been focused on government parastatals and agri-based companies with little interaction with farmers, contrary to other countries like Zimbabwe [3]. Yet, attachment on farms provides students with an opportunity to learn and to utilize theoretical knowledge acquired in class, understand the opportunities and challenges that a farmer deals with and propose mitigation approaches to some of the challenges. Farm attachment programme of EU is designed, such that students are attached to the same farm(s), continuously ~~for~~ at least 3 consecutive years. Each cohort of students were built on ~~and~~ follows-up on recommendations of the previous group. The first cohort of students were focused on making a general appraisal of the farm. Subsequent; cohorts build on what was initiated by previous cohorts.

Experiential learning refers to learning through “reflection on doing” [4]. It is an example of unguided or minimally guided instructional approaching that are very popular and intuitively appealing [1]. However, minimally guided instruction is less effective and less efficient than instructional approaches that place a strong emphasis on guidance of students in the learning process [5]. The minimal guidance approach in experiential learning begins to recede only when learners have sufficiently high prior knowledge in their field of experience, to provide "internal" guidance [6]. [2] posits that effectiveness of experiential learning is dependent on four abilities namely; willingness to be actively involved in the learning process, ability to reflect on learnt experiences, possessing analytical skills, ability to make decisions and solve problems. The students at Egerton University work with the farmers with the backstopping of the project coordinators, lecturers and existing extension officers in synthesizing the report and proposing appropriate recommendations to the farmers. Concurrently, the student is nurtured as an analytical observer to be part of the solution that provides coordinated knowledge. Experiential learning has been studied widely and ELA levels among Egerton University students on FAP have been found to be low [7]. A review of literature has shown that where prompt and accurate knowledge is required in the field, the content can be packaged digitally to enhance

Comment [bs18]: FAB

Comment [bs19]: ;

Comment [bs20]: gone out

Comment [bs21]: been

Comment [bs22]: regulations

Comment [bs23]: interact

Comment [bs24]: such as

Comment [bs25]: ;

Comment [bs26]: guiding

Comment [bs27]: have been

Comment [bs28R27]:

Comment [bs29]: were less effectiveness

Comment [bs30]: The literature review

Comment [bs31]: was

Comment [bs32]: could be

learning among the students. Further, studies on field attachment programme posits that using a student portfolio during attachment can encourage students to have a meaningful reflection on what they do during attachment. Effectiveness in learning is modelled by theories of learning that states that learning has to take place from known to unknown, from simple to complex and from concrete to abstract content.

[8] posited that, there is need to provide students on FAP with adequate, prompt and accurate knowledge. However preliminary studies show that Egerton university students on FAP do not have access to prompt knowledge. There are about four major sources of knowledge to student on FAP including; knowledge obtained from the internet which, according to students is not localized to the needs of the host farmers. Moreover, searching for this unstructured knowledge requires the use of internet bundles which is very expensive for the students. In addition, some students are hosted by farmers in remote areas where there is poor internet connectivity. The next alternative source of knowledge demands carrying of lecture notes and books for references during FAP. These sources are very bulky and the students may not carry adequate references to help them solve problems and make decisions for most challenges they face while on attachment. Students can make calls and consult their faculty members but this has not been possible as most students have complained of not accessing the lecturers when they most need them. The agricultural officers in the field would be reasonable sources of knowledge but majority of the students have complained that the officers are too busy and, in most cases, not available for consultation [9]. Review of literature have shown that providing students with knowledge can be useful to them [10]. There are many sources of knowledge that may be used by students during FAP, some of which may be in digital format which may resolve the source of knowledge bulkiness challenge and provides access to structured knowledge whose implementation design is enabled for effectiveness. This knowledge can be used anywhere even in places with poor internet connectivity. A digital knowledge pack has been designed and students allowed to use it during FAP. No evaluation has been done to assess the effectiveness of the DKP in improving their ELAs. The purpose of this study was to determine the effects of DKP design attributes, operationalized as: DKP weekly structure, DKP students' portfolio, DKP implementation enablement and DKP resources attributes, on the experiential learning abilities among Egerton University students on FAP. Specific objectives of the study included: (1) To determine the levels obtained on ELAs with each DKP innovation design attribute (ii) To determine the effects obtained on ELAs with each DKP innovation design attribute iii) To evaluate the extent to which the use of a DKP innovation design improved the ELAs. If the effects are found to be significant, the DKP can be provided to students for use during FAP. This would go a long way in enhancing FAP and consequently improve the students ELAs. This would make FAP a more meaningful programme in providing experiential learning to students and thus improve their levels of competencies in knowledge, skills and attitudes that can enhances student employability skills.

Comment [bs33]: English grammatical must be corrected all

2. Research methodology

2.1 Research design

The Participatory Action Research (PAR) was employed in this study. PAR design is defined as an approach in which the action researcher and a client collaborate in the diagnosis of a problem and in the development of a solution [11]. This is in contrast with other research designs in which disinterested researchers emphasize on re-productivity of findings [12]. PAR entails four phases including: the diagnostic, planning, action and evaluation or reflective phases [13]. In this study, the diagnostic phase was executed by allowing students to proceed for their FAP in their first three weeks of FAP before attending a training workshop towards the end of the week. During the workshop a focus group discussion was organized and students were supposed to narrate their FAP experiences in their host farms for the three weeks. The narrations and findings gathered from literature review, helped to bring out the gaps that existed in the FAP. The students brought out the gaps in FAP in the narratives and this coupled with literature review findings were used in designing a digital knowledge pack that was used by students to enhance their FAP attributes and improve their experiential learning. According to [1] effectiveness of experiential learning is also dependent on the level of prior agricultural knowledge among students. These among other considerations guided in the designing of the DKP. The Action phase entailed allowing students to use the designed DKP by downloading the APP in their laptops or Smart phones. To allow for real time interactions during FAP and to address challenges in the use of the

Comment [bs34]: The

DKP, an online google group was also created where students would post their FAP documents and ask questions. On completion of FAP, which lasted for eight weeks, the DKP was evaluated to determine its effectiveness in enhancing FAP design attributes to improve students' ELAs.

The action phase of the study was conducted among students hosted by farmers in Njoro ward in Nakuru county. The ward was selected due to its proximity to Egerton University. Most farmers around the university had participated in the FAP programme and therefore were capable of hosting the students. Furthermore, proximity to the university enabled students to operate from their usual residences where host farmers were not able to accommodate the students. Njoro ward covers an area of 124.46 sq km and comprises *Mukungugu, Subuku, Migaa* and *Njoro* Sub–Locations of Nakuru County. This study targeted a population of 600 farmers and students who had participated in the FAP since the programme's inception in 2014. A sample size of 30 students were purposively selected based on their innovativeness. According to [14] people can be classified into five categories depending on the rate at which they adopt innovations. These categories are innovators, early adopters, early majority, late majority and laggards. It was important in this study to work with the innovators because of the short duration of the FAP i.e., 8 weeks. The innovators were able to go through the training on use of DKP and they were able to use it they were able to use it but this was not going to be possible if the laggards were allowed to participate in the study. The number 30 was chosen to manage the costs of buying the digital packs toolkits. In addition, action research is better managed when dealing with small numbers. All the 30 students who used the DKP toolkit during FAP became the subjects of the study. Three instruments were used to collect data namely; Focus group discussion topic guides, google groups observation proforma and a DKP evaluation structured questionnaire. Piloting of the instruments were done and a reliability coefficient of r= 0.70 was obtained. The validity of the DKP toolkit was determined by experts in the Department of Agricultural Education and Extension of Egerton University.

The framework shown in Figure 1 was used to conceptualize the study. The vulnerability context of the students was the need for prompt accurate knowledge by students on FAP. The independent variables were the DKP design attributes while the dependent variables entailed the improvement of the ELAs specifically referring to the levels of willingness to get actively involved in the learning experiences and the abilities to reflect, analyze, solve problems and make decisions during the learning experiences. In addition, and for the purpose of this study was ability to make continuity arrangements for the innovations or projects initiated in the host farms.

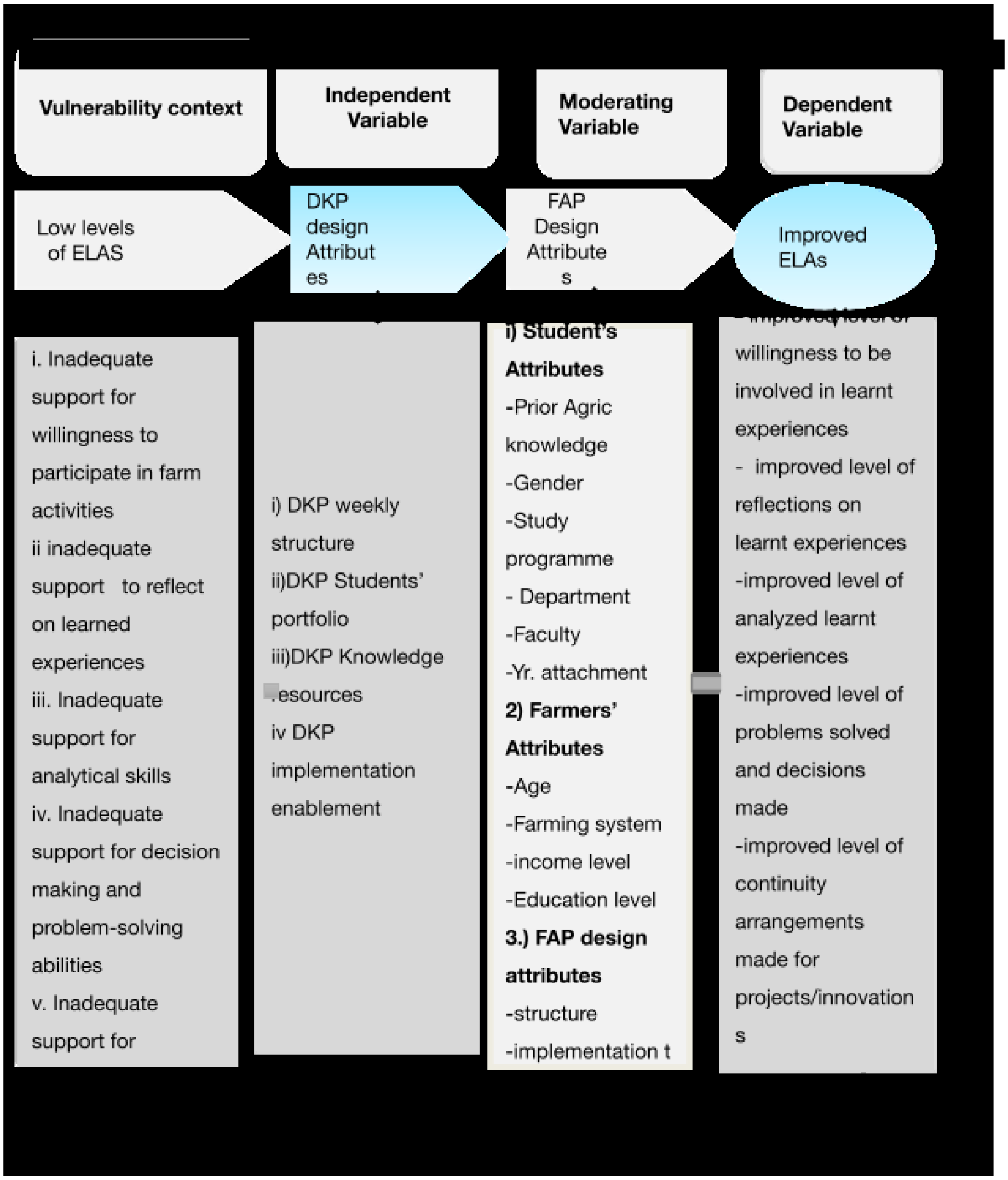

Fig. 1: Relationship between DKP design attributes and the experiential learning abilities indicators

2.2 Data collection and analysis

Four methods were used to collect data for evaluating the effectiveness of using a DKP to enhance the FAP design attributes and improve the students' ELAs. FAP baseline questionnaire was used to collect data that allowed estimation of the levels of ELAs before introducing the DKP. This was a face-to-face activity. Data from the baseline questionnaire was also used to identify some gaps in the FAP design attributes and consider it in the designing the DKP intervention. Students were allowed to proceed on FAP for the first three weeks without the DKP after which they were invited for a training workshop. During the training, focus group discussions were set up and students put in groups of three to narrate their experiences in their host farms during their first three weeks of attachment. These narrations brought out more gaps that would be addressed in designing of the FAP intervention. Analysis was then done to determine the levels and effects on ELAs obtained with each level of DKP design attribute and to determine the size effects of the attributes on ELAs among Egerton university students. An evaluation was later conducted to determine the extent to which use of the DKP improved the ELAs among students. A DKP google group was created to guide in the implementation of the DKP for the next five weeks of attachment duration after the training. The online google group also allowed for real time interactions between the researcher and the students hosted in the farms. DKP documents were uploaded in google group for assessment by the researcher and the feedback given to students via same platform.

Students were asked to rate the DKP design attributes based on the extent to which the attributes affected their levels of ELAs. The means were obtained from a 5 -point continuum scale ratings on ELAs with a minimum of one and a maximum of five. Measures of central tendencies specifically the means were used to estimate the levels of experiential learning among students. ANOVA was used to determine the significance ($P \leq .05$) of the variations in ELAs obtained with each FAP design attributes. The indicators used to measure ELAs which were adopted from [1] and included; willingness to get actively involved in the learning experiences in the host farm and ability to; reflect, analyze, solve problems, make decisions and make continuity arrangement for the projects/ innovations initiated on the host farms by the students. The effect sizes of the DKP design attributes on ELAs were determined using the General Linear Model and the effects estimated using partial Eta squared at 5% level of significance.

Comment [bs35]: Eng. ?? correction were all needed

3. RESULTS AND DISCUSSION

3.1 Students' Demographics

A total of 30 students participated in the action phase of the study. Figure 2 shows percentage distribution of the students according to gender. Eighty-three (83%) percent of the student's population that participated in the action phase of the study were males while 17 % were females. The overall percentage representation of the female students in FAP was generally low. It is important to note here that the only criteria used to select participants was their eagerness to get actively and digitally involved in the study.

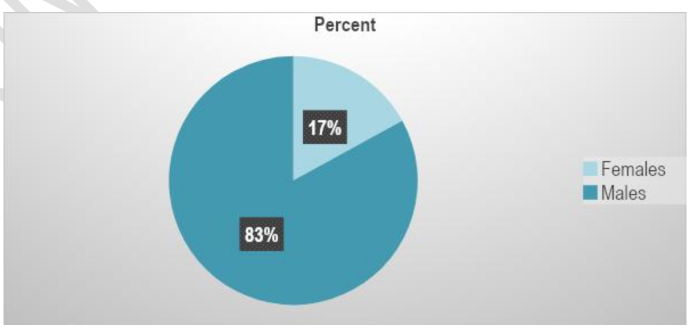

Fig. 2. Students' distribution by gender

According to [14] theory of adoption of an innovation, it may be concluded that the females were not as eager as the males to engage in new innovative tasks. While that argument may be true, there were other factors that may have affected the low representation of the female students in this study some of which included; majority of the farmers preferred male to female students and generally the overall representation of the female student in FAP was low. In addition, there are a number of thinkers who engage with gender theories and issues related to women and technology. Such thinkers include, for example, Donna Haraway, Sadie Plant, Julie Wosk, Sally L. Hacker, Evelyn Fox Keller, Janet Abbate, Thelma Estrin, and Thomas J. Misa, among others [15]. Janet Abbate, examines the history of programming and how gender bias shifted the demographic of programmers [16]. The main argument made by Janet Abbate in this book was that women are discriminated against in the technology field and are not given the same opportunities as men. This is a problem in the world today because everyone should be treated equally and not judged based on their gender. It is unfair for someone to be overlooked and not given the same opportunities to showcase their skills. This finding suggests that support and encouragement are the two most important aspects that can influence women participation in computing /digital world. In order for women to be more receptive to the field is if the environment became a more welcoming place by their male counterparts [17].

The students were requested to indicate the type of digital devices accessible to them during FAP. This was important because the digital toolkit (DKP) was designed to work with a device that would display the content packaged. The results shown in Figure 3 revealed that majority (63.3%) had access to a smart phone and a small (10%) percentage said they had access to computers in the commercial centers.

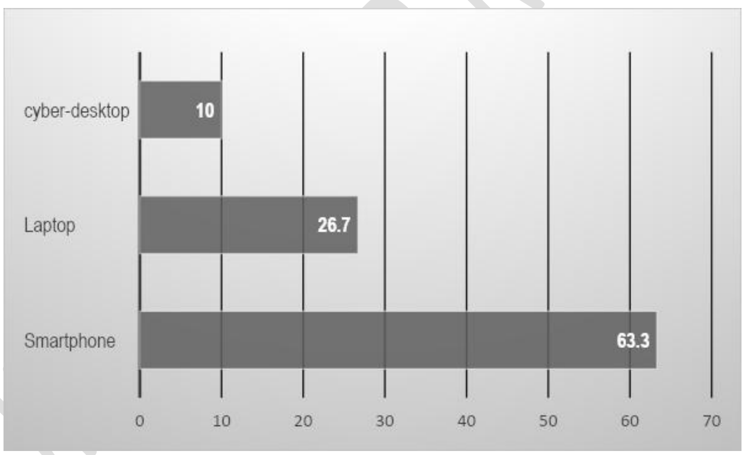

Fig. 3. Distribution of students based on type digital devices accessible during FAP

The other demographic characteristic was the academic departments where students were drawn from. The results shown in Figure 4 revealed that that majority (63.3%) of the students were drawn from the department of agribusiness and Agricultural Economics. 23.3% of the students were drawn from the department of Horticulture, Crops and Soils (CHS) while 13.3% were drawn from the department of Agricultural education and extension. The selection was done on basis of students' eagerness to be innovative.

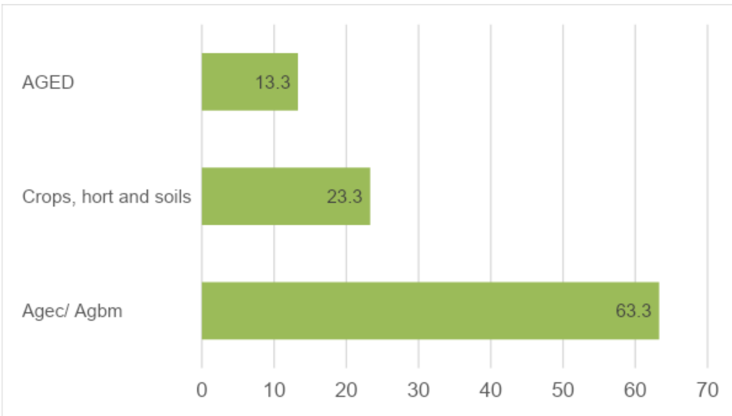

Fig. 4. Percent distribution of students according to academic departments at the university

The students were asked to state their sources of knowledge during FAP. The results shown in Figure 5 indicated that majority (70%) of the students used internet as their source of knowledge. The source least utilized by the students was their lecturers.

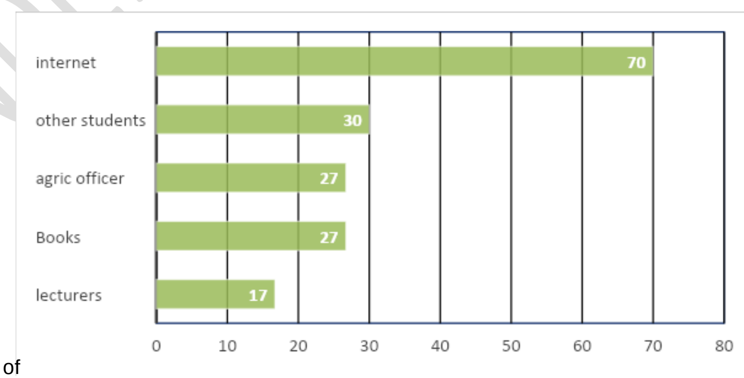

Fig. 5. Percent distribution of students according to their sources of knowledge during FAP

The students were then asked to narrate the challenges they encountered with the sources of knowledge available to them. The results are shown in Figure 6. Majority (79.3%) of the of the students said that they could not access relevant text books during FAP as the host farms were located far from library facilities. They also added that the books were bulky and it was not possible to carry them to the host farms. 65% of the students reported that there was poor internet connectivity in their farms and could not access knowledge online. Either they were not able to access the internet due to high cost of internet bundles or the internet signals were poor. Some of the sources of knowledge presented some challenges. For instance, the printed sources e.g. textbooks had static photographs that could not demonstrate certain skills like would audio-visual sources.

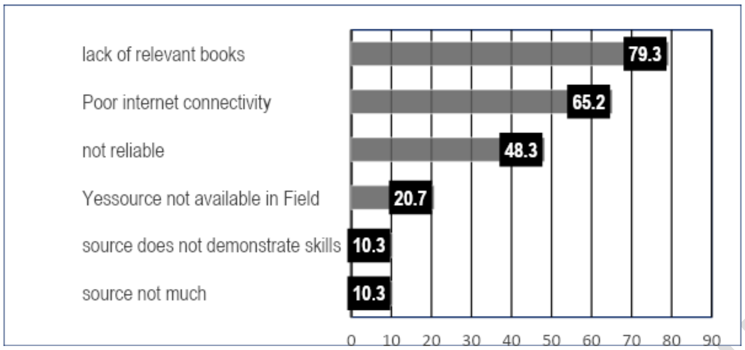

Fig. 6. Percent distribution of students according to challenges in using knowledge sources

Students were exposed to various farm enterprises during FAP. In order to understand the type of prior knowledge required, students were asked to qualitatively list the types of crops, livestock and economic activities in their host farms. This was done in a training workshop three weeks after reporting for FAP. Table 1 is a summary of types of crops, livestock and economic activities as listed by students.

Comment [bs36]: in order to be understanding

Table 1. Common enterprises found in FAP's Host Farms

Host farm enterprises		
1. Maize	2. spinach	3. Marketing of farm produce
4. Beans	5. wheat	6. Buying input supplies
7. cabbages	8. Dairy animals	9. Value additions
10. potatoes	11. Sheep and goats	12. Farm management
13. carrots	14. poultry	15. Farm records
16. Garden peas	17. Barley	18. Tractor and farm machinery operations
19. onions	20. Pyrethrum	21. Diagnosis of pest and diseases
22. kales	23. Tomatoes	24. Farm structures

Comment [bs37]: values added

3.2 Students' levels of ELAs before and after introduction of DKP

Experiential learning ability indicator levels for the thirty students who participated in the action phase of this study were determined first. These indicators were taken from Kolbs (1984) and included: willingness to actively participate in the learning experiences, ability to reflect on learnt experiences, ability to analyze learning experiences, ability to solve problems and make decisions and finally ability to make continuity arrangements for initiated projects in the host farms. Relevant constructs were chosen to measure the experiential learning ability indicators. These constructs were carefully selected to measure each of the indicators of experiential learning abilities before and after the introduction of the DKP toolkit. The procedure followed in measuring the constructs has been discussed in the methodology section. The thirty students who participated in the action phase of this study were requested to rate the constructs selected in this study to measure experiential learning ability indicators DKP in a continuum scale of 1-5. The results shown in Table 2 reveal that before introducing the DKP the average experiential learning ability for students on FAP was (M=2.633, SD= 0524). However, after introducing the DKP, the experiential learning ability level among students was found to be high (M=4.07, SD=0.13). The DKP rating on ability to make a reflection on learned experiences was the highest (M=4.27, SD=0.58) while the rating on ability to analyze the learning was rated lowest (M=3.87, SD= 0.82)

Table 2. Experiential learning ability indicator levels before after introducing the DKP

DKP Experiential learn. ability indicators	N	Min	Max	Mean	SD	Rating	
FAP rating on reflection ability	30	2	5	2.65	0.05	low	before
DKP Rating on Reflection	30	3	5	4.27	0.58	high	After
Fap rating on decision making ability	30	1	5	2.59	0.13	low	Before
DKP Rating on decision making	30	2	5	4.2	0.89	high	After
FAP rating on continuity arrangement	30	2	5	2.60	0.24	low	Before
DKP Rating continuity arrangement	30	2	5	4.1	0.71	high	After
FAP rating on problem solving ability	30	2	5	2.61	0.30	low	Before
DKP Rating on problem solving	30	2	5	4.0	0.95	high	After
FAP rating on willingness ability	30	2	5	2.7	0.14	low	Before
DKP Rating on willingness	30	3	5	3.97	0.76	moderate	After
FAP rating on ability to analyze	30	2	5	2.62	0.10	low	Before
DKP Rating on analyze	30	2	5	3.87	0.82	moderate	After
FAP experiential learning ability index	**30**	**1**	**5**	**2.63**	**0.52**	**Low**	**Before**
DKP experiential learning Ability Index	**30**	**1**	**5**	**4.07**	**0.13**	**high**	**After**

3.3 Effects obtained on ELAs with each DKP Innovation design attributes

Students were asked to rate the DKP innovation design in relation to enhancing improvement of experiential learning abilities. The DKP innovation design included; DKP weekly structure, DKP implementation enablement, DKP student's portfolio, and DKP resources.

3.3.1 Effects obtained on ELAs with DKP Weekly structure attributes

The scatter diagram for the DKP experiential learning ability against DKP Weekly Structure index (DSWi) revealed that there was a positive effect between the two variables. This meaning that improving the DKP weekly structure resulted in improvement of the students' ELAs. The students may have found the power point presentations provided every week in the weekly structure to guide students useful. There was a positive and linear effect of the DKP weekly structure and the DKP experiential learning ability. Figure 7 is a scatter diagram showing the graphical effect of the weekly structure attribute on the ELA levels.

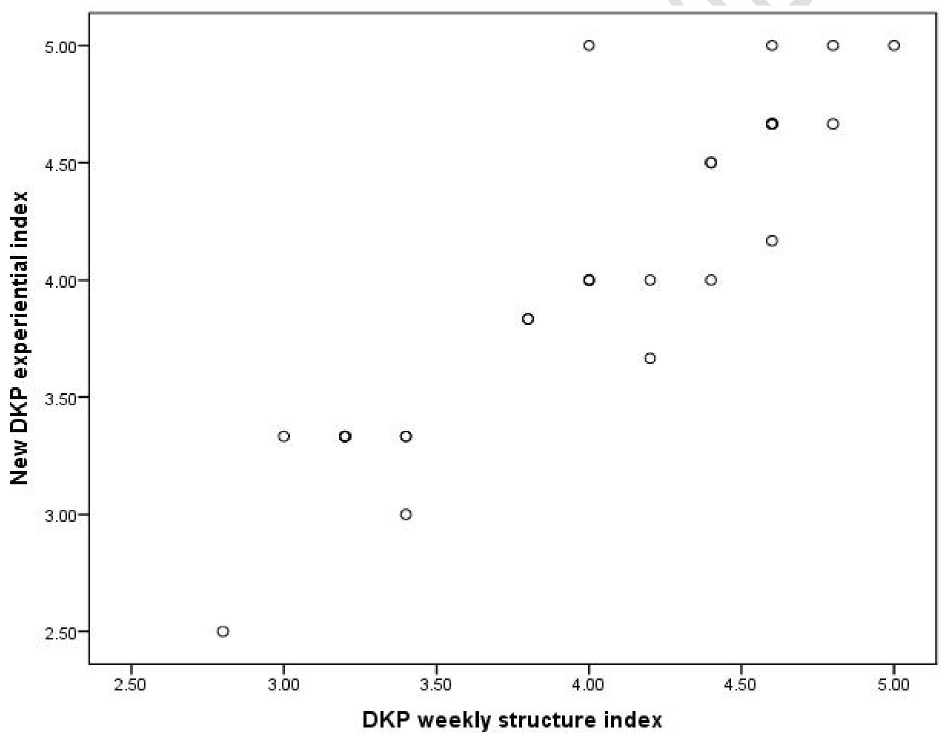

Fig. 7. Scatterplot of New DKP Experiential learning index against DKP weekly structure index

3.3.2 Effect obtained on ELAs with DKP students portfolio attributes

A third scatterplot diagram shown in figure 8 was drawn to show the effect of the DKP students' portfolio on experiential learning ability index as a result of using the DKP. The results revealed that that there was a positive and linear effect. Student were required to identify farm enterprises present in their host farms and record them in their portfolios. Further the students were required to carry out job and task analysis and prepare daily jobsheets. These documents were then uploaded in the students' portfolios. The result depicting a positive and a significant effect between the students portfolio and the students' experiential learning ability implied that the activities involving identification of farm enterprises, job analysis, task analysis and jobsheet preparation improved students' experiential learning ability which in this study is interpreted as: willingness of the students get actively involved in the farm experiences, helped students to become more reflective and analytical improved their abilities to solve problems and make sound decisions in addition to making continuity arrangements for initiated projects/innovations.

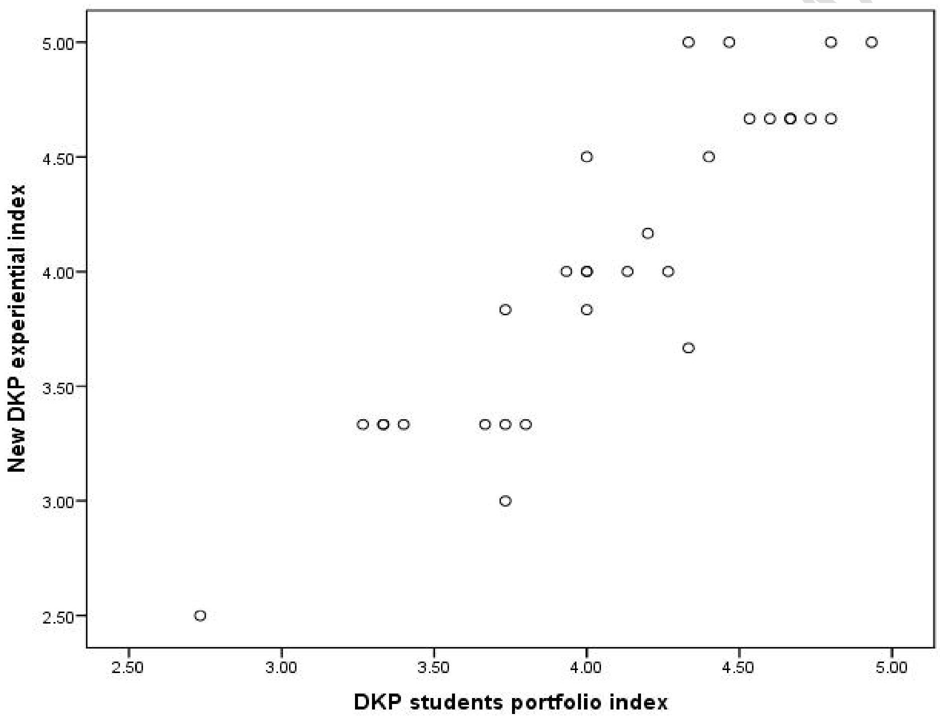

Fig. 8. Scatterplot of the experiential learning ability index against student's portfolio index

3.3.3 DKP Effects obtained on ELAs with DKP implementation enablement attributes

Finally, a scatter plot was drawn to graphically represent the effect of the DKP implementation enablement index on ELAs. The results showed that there were a positive and linear effect of the implementation index and the ELAs. The training workshop, the hyperlinks used to navigate the DKP and the online google groups used during the implementation of the DKP innovation helped to improve the students' ELAs.

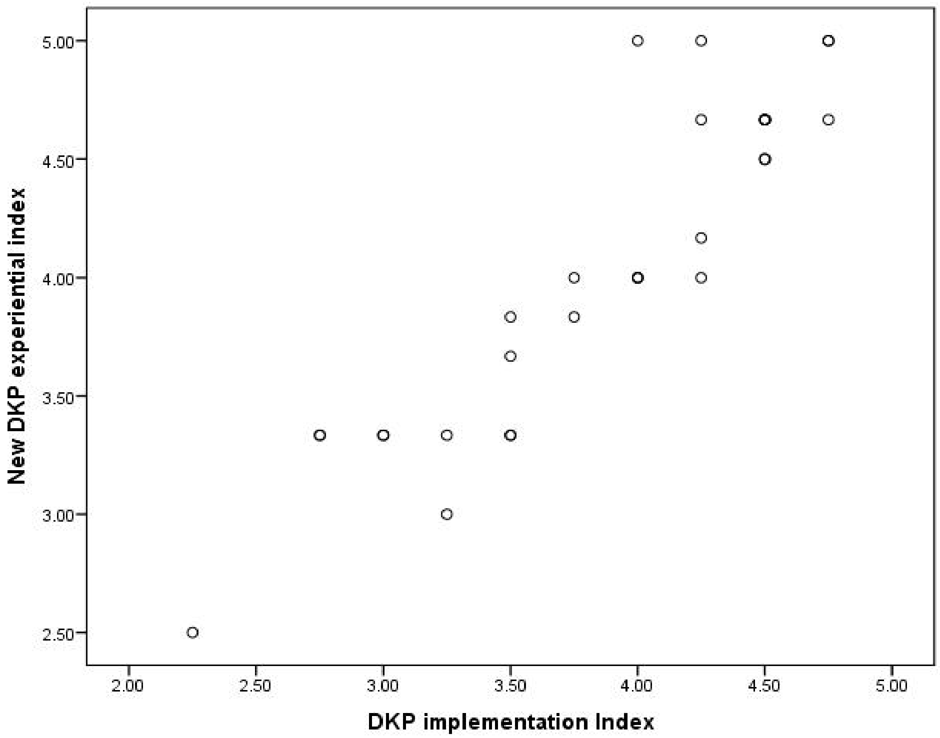

Fig. 9. Scatterplot of the DKP ELA index against DKP implementation enablement index

3.3.4 Effects obtained on ELAs with DKP Resource attributes

Another scatterplot (Figure 10) was drawn between DKP experiential learning ability index (DKP $_{exp)}$ and the DKP resources index (DRi). The results showed that there was a positive and linear effect between the two variables. The resources packaged in the DKP therefore may have enhanced the experiential learning abilities of those students who used the DKP during FAP. The resources included knowledge in livestock, crop production, knowledge in agribusiness/ economics and knowledge in agricultural engineering entailing; farm tools and equipment, tractor operations, farm machinery, and farm structures. Video resources were also added that cut across all the knowledge areas stated above.

The knowledge in livestock farming that was packaged in the DKP resource section included, zero grazing, livestock nutrition, diagnosis of livestock parasites and diseases, dairy farming management, poultry farming (emphasis was put on management of indigenous breeds of poultry), pig farming among others. In resources under crops, knowledge on maize, beans, cabbages, carrots, onions, website links on how to identify crop pests and what registered products to use for each of the pests and diseases among other topics were packaged. Under agribusiness management there was knowledge on input supply, marketing of farm produce, farm management, record keeping, and value additions among other topics. In agricultural engineering, farm structures, tools and equipment were the main topics covered. Fam machinery was also added to the resource in agricultural engineering.

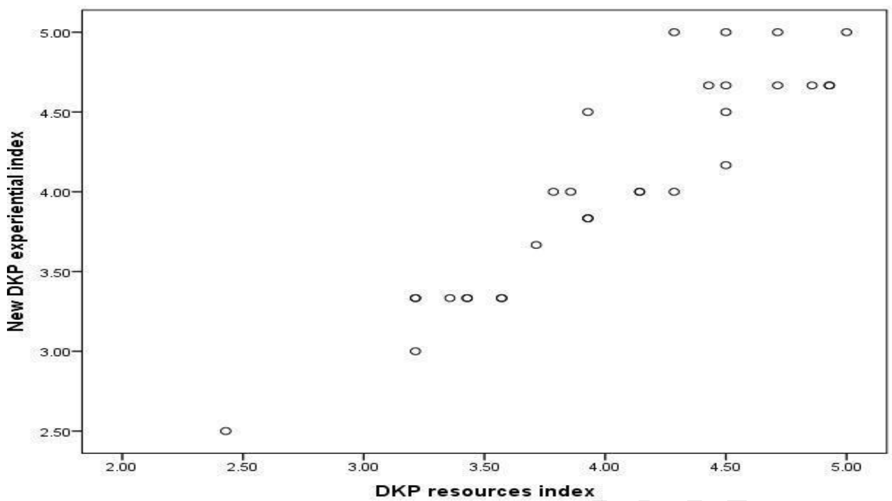

Fig. 10. Scatterplot of Experiential learning ability index against DKP resources index

To predict the effect of each DKP design attributes on improvement of experiential learning abilities in FAP of Egerton University, a stepwise Multiple Linear Regression was used to evaluate whether DKP weekly structure index (DWSi), DKP resources index (DRi), DKP student's portfolio index (DSPi) and DKP Implementation Index (DIMi) mean scores could predict students' Experiential learning ability index. The linear regression summary model is shown in Table 3. The results showed that the predictors i.e., constant, DKP weekly structure index, DKP resources index and DKP implementation enablement index accounted for 90.4% (Adjusted R square, coefficient of determination=.904) of the variation in the DKP experiential learning ability index.

Table 3. Regression Model Summary

Model	R	R Square	Adjusted R Square	Std error of estimate
1	.958a	0.917	0.904	0.21268

a Predictors: (Constant), DKP implementation Index, DKP student's portfolio index, DKP resources index, DKP weekly structure index

Using SPSS, the Principal Component Analysis (PCA) method was used to analyze the correlation of the variances found in the independent variables by first producing the correlation matrix shown in Table 4. The results showed that there was a high correlation between all the independent variables. For instance, there was a high correlation between DKP resource index and DKP weekly structure index (.864). There was a high correlation between DKP implementation index and DKP resources index (.903). The correlation between the DKP resources index and DKP student's portfolio index was .854.

	DR*i*	DWS*i*	DIM*i*	DSP*i*
DR*i*	1.000	.864	.903	.854
DWS*i*	.864	1.000	.885	.943
DIM*i*	.903	.885	1.000	.846
DSP*i*	.854	.943	.846	1.000

Table 4. Principal component Analysis (PCA) for the independent variables

Correlation

Correlation Matrix[a]

To check the assumptions of the principal component analysis, Kaiser-Meyer -Olkin measure of sampling adequacy was performed and Bartlett's test of sphericity was used to test the significance of the coefficient matrix. In other words, to test whether it was appropriate to run the correlation matrix. The results in Table 5 showed a high significance (p=.001) level. The sampling adequacy was acceptable (KMO=.807) and Bartlett's test of sphericity demonstrated that correlations between the independent variables were large enough for PCA ($\chi2(6)$ =149.968, p=.000). The SPSS program sets KMO to .5 when the correlation matrix is identity matrix, avoiding the problem of carrying out divisions by zero.

Table 5. Kaiser-Meyer-Olkin Measure of Sampling Adequacy

KMO and Bartlett's Test		0.807
Bartlett's Test of Sphericity	Approx. Chi-Square	149.968
	Df	6
	Sig.	.001

KMO values greater than 0.8 can be considered as a good indication that principal component analysis will be useful in analyzing the variable in question. This occurs when most zero-order correlations are positive. KMO values are less than 0.5 when most zero order correlations are negative. A scree plot, shown in Figure 11 was plotted to explore on the number of component solutions that were available in order to resolve the issue of multicollinearity. The results produced a one component solution to the multicollinearity problem encountered in the regression analysis.

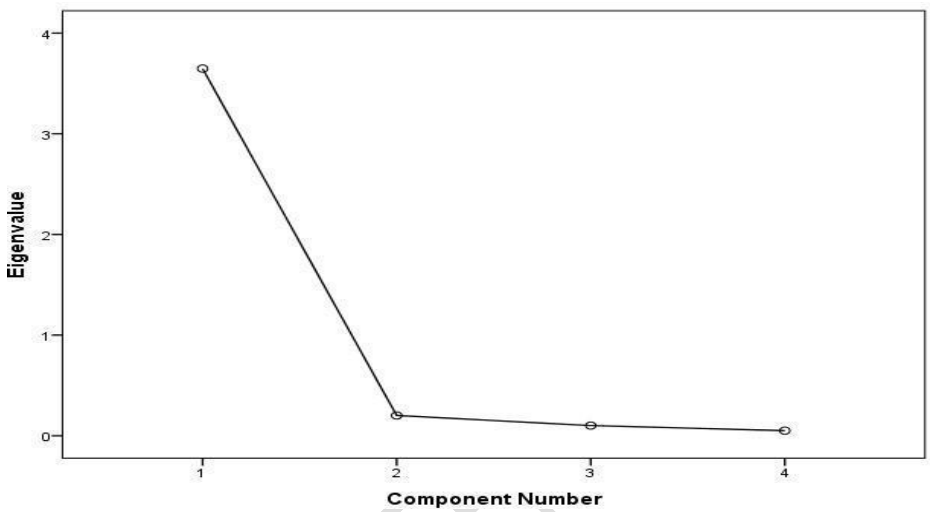

Fig. 11: Scree plot showing component solution of DRi, DWSi, DSPi and DIMi predictor variables

A PCA was run for the four independent variables. The results revealed there was a one component solution that explained 91.18% of variance in the regression model. The component Eigenvalue was 3.647. Eigen value is a scalar associated with a given linear transformation of a vector space and having the property that there is some nonzero vector which when multiplied by the scalar is equal to the vector obtained by letting the transformation operate on the vector especially a root of the characteristic equation of a matrix.

4. CONCLUSION

In conclusion, this study revealed that after using the DKP during FAP, the levels of ELAs among students on FAP improved from what has been documented in Chege et at., (2021) from 2.63 to 4.07 measurements rated in a continuum scale of 1 to 5. All the attributes of the DKP including the DKP weekly structure, DKP student's portfolio, DKP implementation enablement and DKP resources were found to have a positive and significant effects on the levels of ELAs. However, multicollinearity was also detected among the independent variables. A scree plot drawn to show the number of principal components that could be used to explain the variations in the levels of ELAs revealed a one component solution. this component was given the name DKP innovation design attribute. The attribute explained 91% of the variation observed in the ELAs among Egerton University students on FAP at 5% level of significance.

Ethical approval (where ever applicable)

All authors hereby declare that all surveys have been approved by Egerton university board of graduate studies and performed in accordance with approved standards.

References

1. Moon, J. A. (2004). A handbook of reflective and experiential learning: Theory and practice. Routledge
2. Kolb, D. A. (1993). The Process of Experiential Learning. In M. Thorpe, R. Edwards, and A. Hanson (Eds.), Culture and processes of adult learning. New York: Routledge.
3. Edziwa, X., Chakamba, J., Jumo, C., and Chiweshe, M. (2012). Experiential learning in agriculture education: A Zimbabwean experience. International Journal of Humanities and Social Science, 2(21), 280–285
4. Jan, L. G., de Kruif, A., and Valcke, M. (2012). Differential impact of unguided versus guided use of a multimedia introduction to equine obstetrics in veterinary education. *Computers & Education, 58*(4), 1076–1084
5. Kirschner, P. A., Sweller J., and Clark, R.E., (2006) Why Minimal Guidance During Instruction Does Not Work: An Analysis of the Failure of Constructivist, Discovery, Problem-Based, Experiential, and Inquiry-Based Teaching, Educational Psychologist, 41:2, 75-86, DOI: 10.1207/s15326985ep4102_1
6. Miettinen, R. (2000). The concept of experiential learning and John Dewey's theory of reflective thought and action. *International journal of lifelong education*, *19*(1), 54-72.
7. Chege, N. W., Ombati,J.M., Mungai, N. W., (2021). The Effect of Farm Attachment programme on Experiential Learning Ablity among Egerton University students

8. Mungai, N. W., Ambula, M., Ombati, J., Opiyo, A., Bebe, B. O., Ayuya, O. I., and Wambua, T. (2016). Experiential learning for agricultural students in institutions of higher learning: The case of Egerton University. African Journal of Rural Development, 1(3), 229–237.
9. Kibwika P. Learning to make change: Developing innovation competence for recreating the African university of the 21 st century. Wageningen University and Research; 2006.
10. Mungai, N. W., Njuguna, V. W., Books, R., OER, R., SCARDA, R., and Tenders, R. (2016). Linking universities to communities: The case of Egerton University. RUFORUM Working Document Series, 14(1), 415–420.
11. McIntyre, A. (2007). Participatory action research (Vol. 52). Sage Publications.
12. Chevalier, J. M., and Buckles, D. J. (2019). Participatory action research: Theory and methods for engaged inquiry. Routledge.
13. Kemmis, S., McTaggart, R., and Nixon, R. (2013). The action research planner: Doing critical participatory action research. Springer Science & Business Media.
14. Rogers E.M. (1983). Diffusion of Innovations, Third Edition. Macmillan Publishing Co. Inc. New York.
15. Bandy, J. (2011). Challenges and Opportunities of Community Engaged Teaching. Vanderbilt University Center for Teaching. Retrieved [27th August 2021] from https://cft.vanderbilt.edu/guides-sub-pages/challenges-and-opportunities-of-community- engaged-teaching/
16. Smith, Erika E (2013). "Recognizing a Collective Inheritance through the History of Women in Computing". CLCWeb: Comparative Literature and Culture. **15** (1). doi:10.7771/1481-4374.1972.
17. Abbate, Janet. (2017). Recoding gender : women's changing participation in computing. MIT Press. ISBN 978-0262534536. OCLC 978591547.
18. Cheryan, Sapna; Drury, Benjamin J.; Vichayapai, Marissa (2013). "Enduring Influence Of Stereotypical Computer Science Role Models on Women's Academic Aspirations". Psychology of Women Quarterly. **37** (1): 72–79. doi:10.1177/0361684312459328. S2CID 2494433.

Definitions, Acronyms, Abbreviations

DKP Digital Knowledge Pack
FAP Farm Attachment programme
EU Egerton University
EL Experiential Learning
ELA Experiential learning Ability
ELAs Experiential Learning Abilities
DWS DKP weekly Structure
DIM DKP implementation Enablement
DSP DKP Students Portfolio
DR DKP resources