Readiness for Competence Based Learning of Agriculture Education in Secondary Schools in Uasin Gishu County, Kenya

OUMA, P.O[a], TOROMO, A[b]., WANAMI, S[a], WASWA, P.K.[a], KABESA, S[a]. MUBICHAKANI, J.M[a] & SIMIYU, K.S[c]

[a] School of Education, University of Eldoret Box 1125 Eldoret
[b.] School of Engineering, University of Eldoret Box 1125 Eldoret
[c.] School of Agriculture, University of Eldoret Box 1125 Eldoret

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Abstract- The study conducted in Uasin Gishu County focused on competencies and perception towards secondary school agriculture. The objective was to establish the readiness of schools for implementation of competency-based learning. Using descriptive research design, a purposive sample of 358 secondary school students from fourteen schools participated in the study. Questionnaires, interview schedules, and observation checklists were used for data collection. Only 24.1% of the teachers were able to design assessment rubrics for competency-based learning while 75.9% needed further training. Creativity and imagination were acquired by 8% of the learners. Other core competencies were acquired by less than 10 % of the learners. About 35.7% of students acquired students' leadership skills. Despite the low level of agricultural technology used in schools, the teachers attributed low crop yields to poor weather. There was no relationship between the teaching method and the competencies manifested (P (χ2=2.266, df 8) =0.972 at α 0.05).

Index Terms- Agricultural Education, Competency-Based Learning (CBL), Competencies, techniques, and technologies in agriculture

I. INTRODUCTION

Education is the most effective development investment a country can make and is one of the critical pathways to promote social and economic development (World Bank, 2016). Mass public education emerged in the mid-19th Century to meet the needs of the Industrial Revolution and, was organized on the principle of mass production and standards to ensure accountability and efficiency (Kafu, 2019). About 1.8 billion young people worldwide are 10 to 24 years and 90% of them live in less developed countries (UNFPA, 2014). Kenya Vision 2030 places great emphasis on the link between education and the labor market, the need to create entrepreneurial skills and competencies, and strong public and private sector partnerships (RoK, 2019). Evidence has since shown the widening gap between human capital skills and 21st Century workforce needs. Education and training are fundamental to the social transformation envisaged under the social pillar of Vision 2030. The Social Pillar in Kenya's Vision 2030 aims at creating a comprehensive, equitable, and just society based on democratic ideals. Under this pillar, education and training are the principal catalyst towards the realization of Vision 2030.

Governments in Sub-Saharan Africa are undertaking education reforms to shift from a knowledge-based to a competency-based curriculum, with a greater emphasis on both technical and transferable skills (RoK, 2010; Wario, 2019). The Government of Kenya launched the Competency-Based Education and Training (CBET) or Competency-Based Curriculum (CBC) in 2018 in an effort to place great emphasis on competency. The main purpose was to provide every Kenyan learner with world-class standards in the skills and knowledge that they deserved, and which they needed to thrive in the 21st century (Kenya Institute of Curriculum Development (KICD), 2018). Competency-based teaching and learning entail identifying the competencies that a learner will be required to attain at different points of their education (Lippman & Laura, 2015; Orina 2020). This shall be accomplished through the provision of excellent teaching, school environments, and resources, and a sustainable visionary curriculum that provides every learner with seamless, competency-based high-quality learning that values every learner.

Competency-Based Education and Training (CBET) is a structured learning approach that is directed to individual learners to assist them in the development of cognitive skills, psychomotor skills, affective skills, and values that would enable them to function optimally in the world environment (Sheng-Shiang & Hui-Chin, 2019). Unlike the content-based system, each unit of learning is fine-grained for the learner to master specific skills in every learning area (International Bureau of Education, IBE-UNESCO, 2020). Furthermore, CBET is learner-centered and adaptive to the ever-changing needs of students, instructors, and society in a given learning environment. The capabilities include skills and basic competencies required in the world of work while values imply those soft skills, personality traits, non-cognitive abilities, character skills, and socio-emotional lifelong skills (also known as 21st Century skills). CBET is based on John Hattie's (2012) visible learning theory that observes that globally, fundamental changes in education systems have important implications for curriculum reform. Learners need the ability to

think about and solve problems, work in teams, communicate through discussions, take initiatives, and bring diverse perspectives to their learning.

Basic Education will be organized into three (3) levels: Early Years Education, Middle School Education, and Senior School (RoK, 2019). In the early years of education Agriculture education is integrated into Environmental Activities (Science, Social, and Agriculture Activities) where learners are equipped with basic knowledge and skills for the exploration of the immediate environment as well as learning and enjoyment so as to lay a foundation for sustainable development concepts that will be learned at a higher level. Middle School Education is comprised of three years of upper primary and three years of junior secondary education. It is a three-year program where learners are to be exposed to a broad curriculum and allowed exploration and experimentation in agriculture as a learning area to build on competencies introduced in lower primary under the learning area (Orina, 2020). Besides, students need to learn more, yet they have little time available to learn it (Areba, 2019).

Approximately 80% of secondary schools provide agriculture education while 20% is provided by universities and Technical and Vocational Education and Training (TVET) institutions (Hassen, Sokora & Taha, 2016). Currently, the teaching and learning of agricultural education in secondary school is based on constructivism theories (Aholi *et al.*, 2018). These theories emphasize that learning occurs through observable changes in behavior that result from stimulus-response based on a conditioned process by which a person acquires a new response and motivation to act which results from the stimulus (Kauchack & Eggen, 2011). Among proponents of constructivist theories are Dewey, Vygotsky, Piaget, Brunner, and more recently Gardner and Hattie (Syomwene, Nyandusi & Yugungu, 2017). The learner develops competencies in communication and collaboration, critical thinking and problem solving, creativity and imagination, learning to learn, and self-efficacy (Rivera & Alex, 2008). Based on their career progression path the learners of agriculture ought to be exposed to Agricultural Technology which is a technical course focusing on crop and livestock production, their entrepreneurial components, and related agricultural production technologies.

Each level of education should, therefore; provide training on relevant competencies that learners can use to better society (Maguire, 2012). Agricultural Education Training (AET) will concern with the provision and maintenance of sound education and training to support environmentally and economically sustainable agriculture (Hassen, Sokora & Taha, 2016). At the present, AET in the nation is provided by a variety of statutory, non-statutory, and private institutions. Several Universities, national polytechnics, and colleges of agriculture and vocational training colleges offer various tertiary AET programs that are nationally accredited. The TVET institutions are a vital element of the overall transformation of society through agricultural technologies. Agriculture education, being an applied science focuses on crop production and livestock production, as well as entrepreneurial components and related agricultural production technologies. Therefore, the study sought to establish the readiness of teachers for implementation of CBC in secondary school through the teaching of agriculture; to find out the agricultural technologies currently applied in crop production in Uasin Gishu County; to determine the perception of students of agriculture and the school in general on the major limitations that bring about inadequate yields basing on the current curriculum.

Statement of the Problem

It has been realized that students especially in developing countries lack the required skills in their lives after graduation and at various levels of school learning (Wario, 2019). Such skills include collaboration, creativity and imagination, communication and self-efficacy, critical thinking and problem-solving issues, digital literacy, and learning to learn (Owuor, 2019). To respond to more evolving issues towards sustainable development, the Kenyan government, like other nations has continued to reform the education sector (Areba, 2019). Among the educational reforms include Sessional Paper No. 2 of 2015 that recommended a reformed curriculum that adapts a competence-based approach. Whereas it is important to have proper curriculum provisions, the teachers and schools are a very important link for its implementation. Despite this scenario and the initial cohort of CBC being just two years away from joining secondary school very little is being done to in preparation towards providing this important link.

Study area

The study was conducted in Uasin Gishu County due to its high agricultural potential and the fact that farming is a source of livelihood for 60% of the population. It is comprised of six sub-counties in Uasin Gishu namely: Turbo, Soy, Moiben, Ainabkoi, Kesses, and Kapsaret. The county lies between longitudes 34 0 50' East and 35 0 37' West and latitudes 00 03' South and 00 55' North. It covers a total area of 3,345.2 Km^2. It is a highland plateau ranging from 1500m – 2700m above sea level and soils ranging from red-brown loam to clay. In terms of climate, the rainfall received is between 900mm to 1200mm per annum of rainfall with its peak in May and October while temperatures range from 8.4 ^{0}C to 26.2 ^{0}C (a mean of 18 ^{0}C). Arable land covers 2,995 km2, 332.78 km2 is non-arable (hilly and rocky), 23.4 km2 is water mass and 196 km^2 is urban. According to UasinGishu County Integrated Development Plan (CIDP) 2017-2022, the current population of Uasin Gishu stands at approximately 1.2 million with over 55% being youths aged between 14 years to 49 years (GoK, 2017). The County has a total of 129 secondary schools with a Gross Enrolment Rate (GER) of 65%. The GER does not compare well with the national average standing at 78%. Therefore, enhancing competency in agriculture was a sure way of limiting food insecurity.

II. METHODOLOGY

Research design

The research design used was descriptive. The center of focus was the teachers of agriculture and the learners taking agriculture in secondary schools. Sub-county schools were purposively sampled since they host the bulk of the students that reside in the locality and are likely to have a greater impact on the practices (MOEST, 2014). In each Sub-county, at least two secondary schools were sampled. Convenient sampling was done in 14 secondary schools targeting headteachers, teachers of agriculture, farm employees, and Form three students taking

agriculture (Cresswell, 2014). Form three students were selected because they had already selected agriculture as their optional technical subject of choice upon prior exposure to a broader curriculum that covers several subjects in their first two years in secondary school (Oluoch, 2002; Kenya Institute of Education (KIE), 2006). A set of four tools namely; student questionnaire, Agriculture teacher questionnaire, school farm employee questionnaire, Head teacher's questionnaire, and observation schedules were used to collect data. From the form three students of agriculture in the county, the sample size was derived using the following Fischer's formulae (Mugenda, 2008).

$$n = \frac{z2(p)(q)}{d2}$$

Where n= sample size

z = standard normal deviate set at 1.96 and corresponding to 95% confidence level ± 5

p = proportion of the population with the desired attribute

q = 1.0- p

d = desired precision level allowed ± 5

$$n = \frac{(1.96)2(0.5)\ (0.5)}{(0.05)2}$$

= 384

III. FINDINGS AND DISCUSSION

The study sought to document the current status of teaching and learning of agriculture in secondary school. Baseline information on the demographics of teachers of agriculture was obtained upon analysis of the tools used. The average land size for teaching agriculture in secondary schools was 1.73 hectares. Most schools had adequate land for teaching agriculture and a few schools also had fallow or uncultivated with the primary reason idle land being for infrastructure development or to be used as a playground. The majority of the teachers of agriculture were holders of Bachelor's degrees. Their average age was 32 years and about 9 years post qualification experience. The average class size was 59 students taking agriculture, above the World Bank recommendation of 40-55 class size with the majority were females (1.62) (Ndethiu *et al*., 2017).

Agriculture teachers' readiness for the execution of the competency-based curriculum

Readiness refers to the ability of the teacher to help, guide, and counsel his/her students so that his/her students can get the good achievement (Kumar 2013). The study examined the readiness of teachers in secondary schools to impart core competencies as well as personal competencies among the learners. Crop production practices were specifically identified for ease of discernment and measurement of the competencies acquired by learners. The crop categories were legumes, cereals, tubers, fruits, and agroforestry. The focus was on the area planted, quantity produced, and major constraints in growing each crop. Crop production is classified in the learning area of Career and Technology Studies in senior school in the CBET curriculum. Figure 1 shows the core competences of learners currently going through a knowledge-based curriculum computed in percentage by students taking agriculture

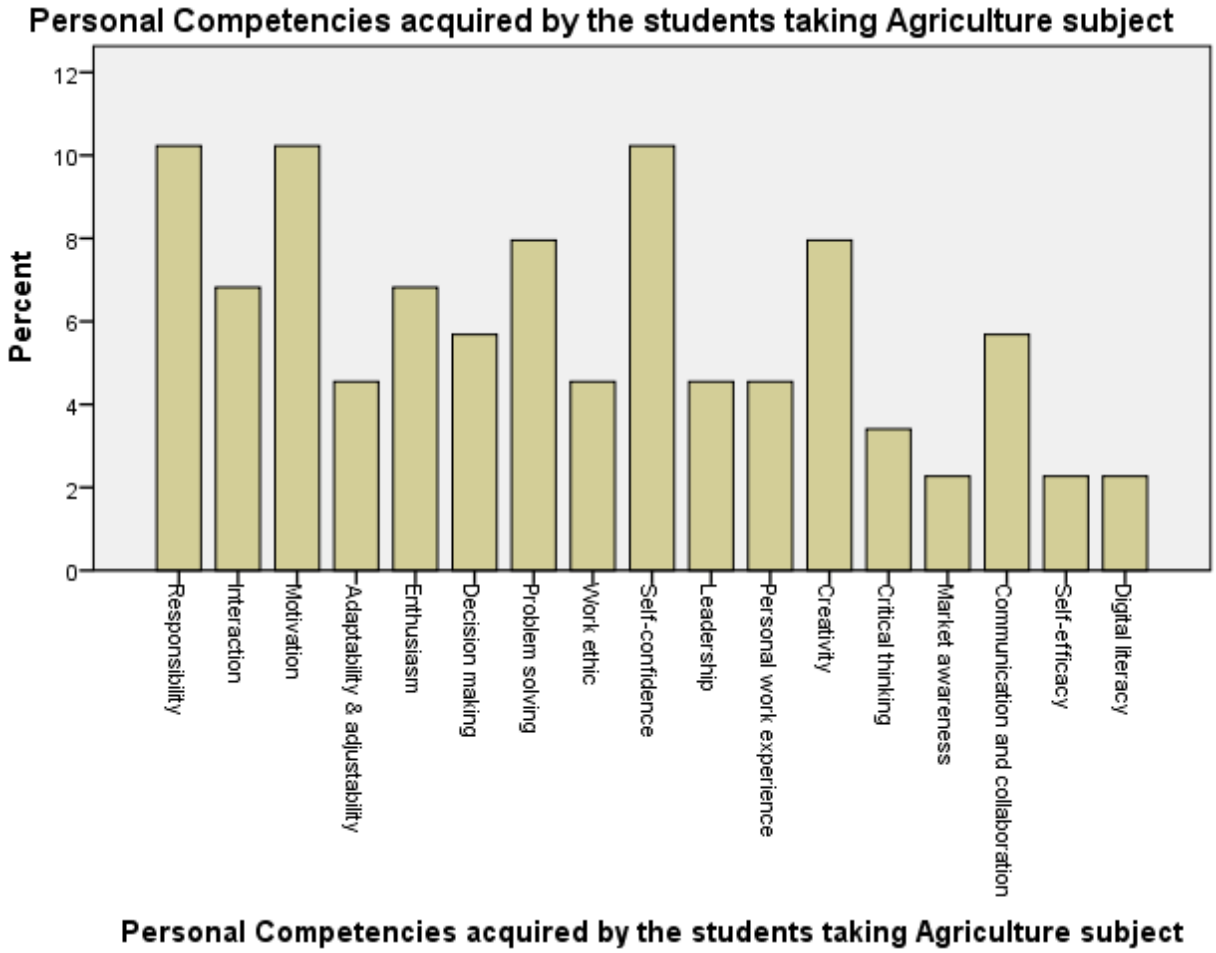

Fig 1: Comparison of Personal Competencies against the Percentage of Agriculture Students who acquired the Competencies.

Based on the existing teaching approach the highest acquired competencies were responsibility (10%), motivation (10%), and self-confidence. Competencies related to 21st Century skills such as digital literacy and critical thinking were rated very low that is at 2% and 3% respectively. Observation schedules were used to measure core competencies by social skills possessed by the learners who were being taught using the knowledge-based approach currently in use. According to Mosha, 2012 competency refers to knowledge, skills, and behaviors that one ought to have attained to be able to execute given tasks at school and in society. Core competencies include communication and collaboration, digital knowledge, critical thinking, problem-solving, learning to learn, self-efficacy, creativity and imagination, and good citizenship. Where crop production is effectively taught it builds on the competencies acquired in lower secondary and equips learners with attitudes, knowledge, skills, and values that are required in the world of work (vocational) or further training in TVET or universities (RoK, 2017). Studying crop production, therefore, prepares students for careers in farming, farm management, and agriculture.

Quality of teaching is a function of professional competence (knowledge of the subject matter, pedagogical competence, knowledge of curriculum, teaching experience, and certification) as well as his effectiveness to deliver (Wayne &Youngs, 2003). According to Ignatowski, 2017 involvement in social activities is important in nurturing soft skills and this could be done through the reduction of rigidity and complexity of the curriculum to provide space for the promotion of soft skills. A competency-based approach enables meaningful connections within and between subject areas through a focus on competencies. Personal competencies are those that relate to particular disciplines which were computed from activities such as identification of major pests, farm operations, weed identification and control, surveying and topography, agricultural economics skills, soil science, agricultural marketing, fertilizer application, soil and water management, and soil science.

Fertilizer application and weed control were most acquired competencies at 12.5 %. Other core competencies were acquired by less than 10% of the learners. Competency-based learning in crop production should focus on sustainability. Sustainability involves the growing of crops in a manner that is not only ecologically sound but is also ethically responsible (United Nations, 2016). Certain practices for example pesticide application may be localized but lack of proper competencies may create unsustainable effects on the ecosystem. Pesticides' bioactive toxic substances directly or indirectly influence soil productivity and agro-ecosystem quality (Alewu & Nosri, 2011). Long-term effects of nitrogen, phosphorous, and potassium-based

fertilizers include changes in soil organic carbon, nitrogen content, PH, moisture variation, and nutrient availability to microbes (Wu *et al*., 2012). The synthetic fertilizers also bring toxicity effects of heavy metals and pesticides such as copper, cadmium, and cypermethrin on soil flora (Xie *et al*., 2009). Ecologically sound practices are observed through the responsible use of farm inputs like pesticides, fertilizers, herbicides, crop hormones that do not damage the ecosystem but can lead to higher yields over time. Ethical practices include fair treatment of workers, provision of personal protective equipment, and empowerment and sustenance of local communities.

The teacher remains at the center of the education system as we think of curriculum execution and value orientation to the learners (Ugochukwu and Harrison, 2016). The readiness of the teachers was also established by their ability to conduct a valid, reliable, fair, flexible, and actionable assessment of achievement of intended learning outcomes. Competency involves the ability to meet complex demands by mobilizing psychosocial resources (Sullivan & Bruce, 2014). A variety of ways should be used to collect information on the learning process and progress of individual learners. The information should be collated as a continuous process and should be recorded constantly giving importance to the uniqueness of each learner and the period taken to learn. The teacher should provide feedback that will lead to positive action and help the learner. From the tools administered to teachers of agriculture only 24.1% were able to design assessment rubrics for competency-based assessment while 75.9% needed the training to execute the same. Kracker and Lansu, 2007 argued that learning should focus on integrative competencies required for professional life. Competency measurement also guides the selection of future courses, certification, and promotion to the next progression level. Competency-based assessment involves the determination of one's ability to apply a set of related knowledge and skills to successfully perform critical tasks in a defined setting. A competency is more than just knowledge and skills. Education is the major tool that is required for sustainable development which determines people's capability towards their vision and realism (IBE-UNESCO, 2017).

Observation schedules were also used to corroborate the information provided by the teachers of agriculture and farmworkers in different schools. It was noted that the majority of the students (64.3%) were meeting expectations or were exceptional in land preparation and fertilizer application while another 35.7% were not competent. On the other hand, 14.3% of observed students were below expectation in soil and water conservation, only 42.9% were meeting expectations on this aspect of soil and water conservation. No respondent displayed exceptional compliance; implying the existence of a gap in terms of teaching and learning competencies. It was clear that no records were kept. Farming was therefore conducted very crudely and schools could not determine the accurate gross margins

Agricultural Technologies Used in Crop Farming in Secondary Schools

The second objective was to find out various crop farming technologies used by the secondary schools teaching agriculture. Commonly used agricultural technologies often used in most parts of Kenya to either increase yield or reduce post-harvest losses were explored through observation and respondents were to select the ones they used in the school farm. Particular focus was on the learners' responses since even if the school used any of the technologies without involving the learners then they would still not acquire the requisite competencies. Figure 2 compares the various agricultural technologies against the percentage of users.

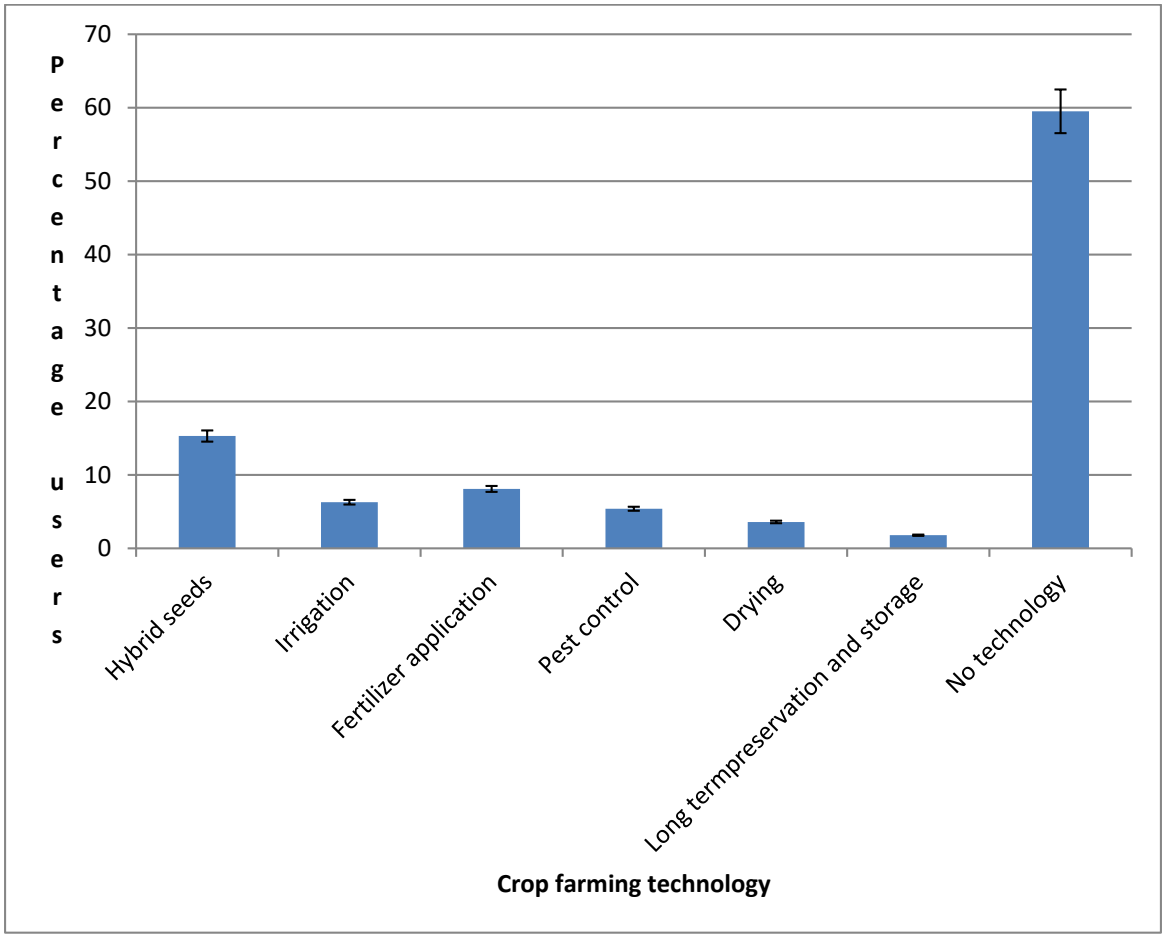

Fig 2: Comparison of various agricultural technologies against the percentage users.

Agricultural technology is a technical and engineering course in senior school that focuses on crop and livestock production, entrepreneurship in agricultural technology, and related technologies (RoK, 2019). Out of the 111 learners who responded to the question of technology, 66 respondents indicated that they did not use any agricultural technology. Of these respondents, 15.3% used hybrid seeds, 6.3% used irrigation, and 8.1% practiced fertilizer application while only 1.8% practiced long-term preservation and storage of farm produce. Chi-square tests were used to test the differences in various agricultural technologies concerning class size, farm size, and age as an independent variable and documented in table 2.

Table 2: Descriptive Statistics and Relationship between Agricultural Technologies and Learner Competencies based on Teaching Method

Agricultural technologies used	Mean	SD		Value	Asymp. Std. Error[a]	Approx. Sig.
Hybrid seeds	17.85	2.85	Pearson's R	.614	.099	.000[c]
Irrigation	17.85	1.17	Spearman Correlation	.643	.116	.000[c]
Fertilizer application	16.76	1.42				
Pesticides	17.83	1.17				
Drying of produce	17.33	1.53				
Long term preservation/storage	18.17	1.17				

The results indicated significant differences in agricultural technologies in terms of the farm size (P (χ2 = 114.611, df 84) = 0.015 at α 0.05, class size (P (χ2 = 375.683, df 215) = 0.000 at α 0.05) and age (P (χ2 = 79.355, df 50) = 0.005at α 0.05). In terms of planting methods, 88.8 % of learners believed they were competent in various planting methods (p (χ2=53.441, df 20) =0.000 at α 0.05). The study established from students that they were comfortable with and confident about competencies in the

following key areas; 89.1% agreed that they are competent in fertilizer application (p (χ2=83.687, df 20) =0.000 at α 0.05), 90.8% stated that they were able to farm different crops, 88.4% were able to carry out weed identification and control (p (χ2=115.445, df 20) =0.000 at α 0.05). Further analysis of the correlation between agricultural technologies and competencies based on the teaching method was done. The results showed positive correlation (r= 0.099). This means that when more practical methods like demonstration or project methods are used the learners gain experience and confidence as they acquire the knowledge hence become more competent. The less usage of such practical methods the lower the competencies acquired.

Further analysis was conducted on the common techniques that schools apply in crop production.

A range of choices was provided with options for multiple responses and the addition of any other techniques not captured in the choices. The techniques included organic farming, intercropping, crop rotation, green manuring, ploughing in of crop, contour ploughing, fallowing, mixed farming, permaculture, agroforestry, low or zero tillage, and composting. Figure 3 shows the graphical representation of the techniques used in crop farming in various secondary schools.

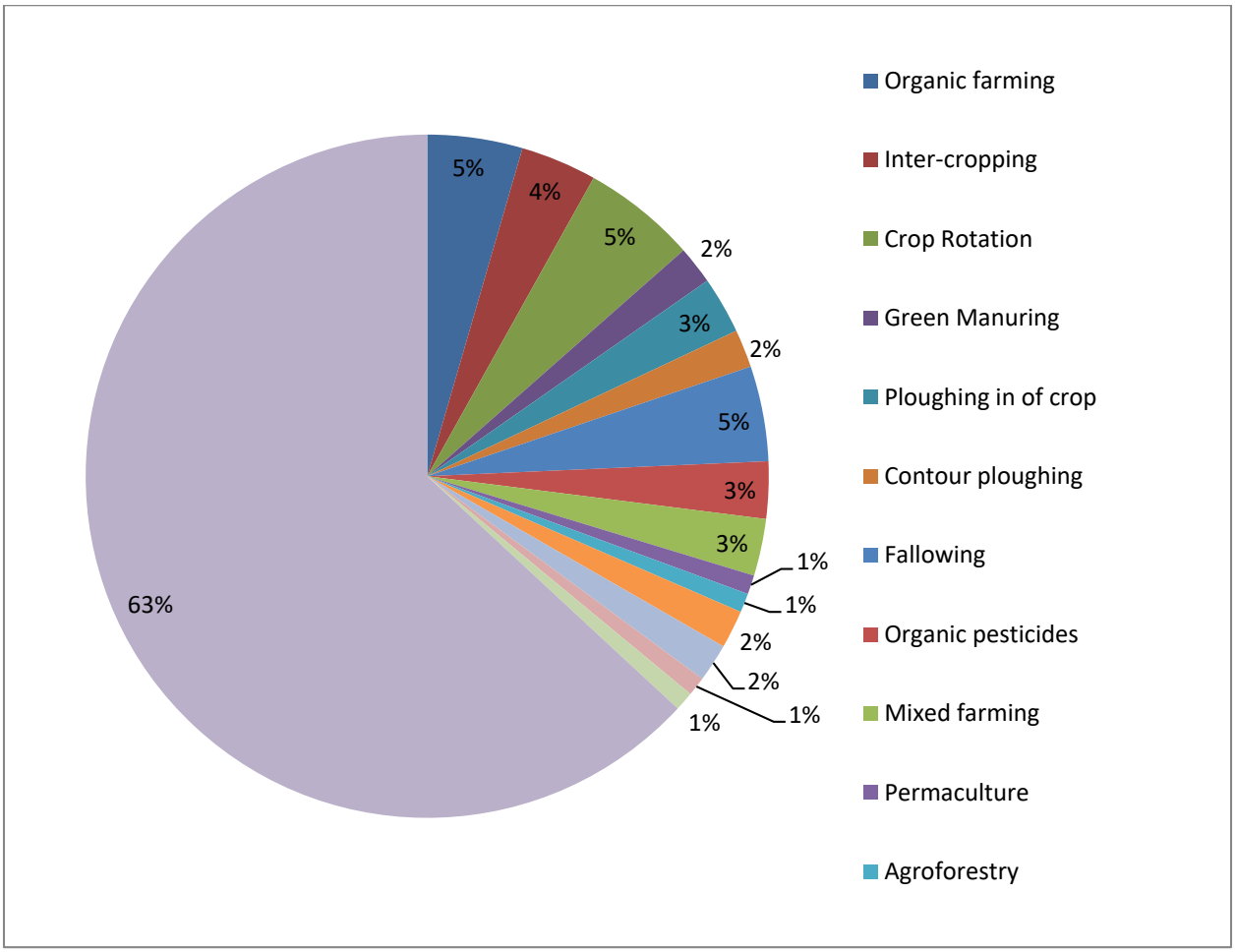

Fig 3: Comparison of Techniques Used in Crop Farming in various Secondary Schools in Percentages.

Only 36.9% of the respondents indicated the various farming techniques while 63.1% had no responses implying that even if the school practiced the same then the learners were not involved. Traditional crop farming techniques in practice included organic farming, crop rotation, and fallowing (5%). More integrated techniques that help to ameliorate soil conditions and the environment such as zero tillage, agroforestry; permaculture, and mixed farming were practiced by very few students (average 1%). Crop farming techniques were subjected to chi-square tests based on farmland size, size of agriculture class compared with competencies on the basis. The results obtained indicated significant differences in agricultural technologies in terms of the farm size (P (χ2 = 114.611, df 84) = 0.015 at α 0.05, class size (P (χ2 = 470.214, df 344) = 0.000 at α 0.05) and age (P (χ2 = 189.914, df 80) = 0.000 at α 0.05). The correlation between agricultural techniques and competencies was done. The results showed positive correlation (r= 0.059). This means that when more integrated techniques are used the learners gain better competencies in agriculture. The less integrated the techniques the fewer competencies the learners gain. Countries that have succeeded in the Competence-Based Curriculum such as Canada, Finland, and Scotland invested heavily in technology as well as their integration. Pre-service training of teachers should include

making of resources that can be shared among schools within a given surrounding.

To determine the perception of students of agriculture and the major limitation that brings about inadequate yields in crop production.

An item on the questionnaire sought the perception of learners for the cause of poor crop yields in the farm. The quantitative responses showed that 32.5% of the students believed it was due to bad/ unpredictable weather, 30% attributed it to pests, and another 22.5% to diseases. Poor farming practices, theft or pilferage as well as soil fertility issues jointly accounted for less than 10%. Head teachers and teachers of agriculture opined that weather challenges were beyond what schools could afford at the moment due to competing financial interests and prevailing government policies. In one of the schools, the principal expressed the challenge of how to handle weather-related challenges:

"Sometimes we have long periods of drought following wet seasons. During such seasons one has to make tough choices as to whether they should attend to the students or crops. The government policy for free day secondary school does not allow us to charge any extra levy for capital development such as irrigation systems yet if we engage the students it amounts to child labor"

Other extreme weather conditions like cold temperature, frost, and high humidity also existed but they were unique to particular regions. The schools had mechanisms of handling such conditions especially by growing crop varieties suitable for each region and proper timing. Issues related to pests and diseases could be handled by teachers of agriculture if sufficient resources were provided promptly. The teachers of agriculture expressed thus;

"We often place our orders for agrochemicals with the school before we start our agriculture project but some diseases attack when you least expect. Some pests like Fall Armyworms are also new to us so we do not know the appropriate pesticides to use. Last year we sprayed ours in school but the farmers in the village did not and the pests eventually attacked our crops."

The major crops grown in most schools were maize (38.5%), and Kales (61.5%), for school consumption. From the 14 schools studied the leading challenge was weather aspects experienced in 12 schools followed by pests in 7 schools and post-harvest losses experienced in 4 schools. Some schools experienced more than one challenge. The least was a theft in two schools. The sampled schools faced challenges during crop production notably unreliable and inadequate rainfall (41.7%), pests (33.3%), diseases (16.7%), and theft (8.3%). For schools that practiced irrigation, the learners were not involved hence did not acquire any competencies. Poor farming practices could be addressed by embracing competency-based teaching of agriculture with more focus on productivity rather than performance in the national examinations. The syllabus content can still be covered with appropriate adjustments.

IV. CONCLUSION AND RECOMMENDATIONS

The study concluded that teachers of agriculture were not adequately prepared to execute competency-based learning. The highest acquired competencies were responsibility (10%), motivation (10%), and self-confidence. Competencies related to 21st Century skills such as digital literacy and critical thinking were rated very low that is at 2% and 3% respectively. Besides, the teachers could not conduct a valid, reliable, and actionable assessment of the achievement of intended learning competencies. As things stand, the current system of teaching agriculture just produces academic bullies who are only good at creating excuses rather than creating alternative ways of sustaining high yields for crops (Anderson & Lee, 2018; Schneider, 2016). Commonly used agricultural technologies such as hybrid seeds, irrigation, fertilizer application, and long-term preservation and storage of farm produce often used in most parts of Kenya to either increase yield or reduce post-harvest losses were only used by 34 % of the students taking agriculture. The remaining 66% of the students did not use any technology. The stakeholders in schools attributed poor crop yields to bad weather, especially erratic and unpredictable rainfall patterns. The study recommended the following intervention measures:

1. Ministry of Education should address some of the gaps identified for successful implementation of the competence-based skills which are critical for sustainable development.
2. Universities and training colleges that offer agricultural education should infuse competence-based learning in the curriculum for effective implementation of the competency-based curriculum in the process of teacher training.
3. Intensified use of irrigation by farmers in Uasin Gishu County to overcome weather-related challenges especially during dry months of the year.
4. Secondary schools taking agriculture should embrace the use of modern technology in crop production and provide limited extension services to the community to increase production and change learner perception towards agriculture.

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AUTHORS

First Author - Ouma, Peter O., Center for Teacher Education, School of Education, University of Eldoret Box 1125 Eldoret
Second Author- Toromo, Ambrose. Agriculture and Biosystems Engineering, School of Engineering, University of Eldoret Box 1125 Eldoret
Third Author -Wanami, Simon., Technology Education, School of Education, University of Eldoret Box 1125 Eldoret
Fourth Author and Fifth Author - Waswa, Peter K. & Mubichakani, Joseph M, Center for Teacher Education, School of Education, University of Eldoret Box 1125 Eldoret
Sixth Author - Kabesa, Stella., Curriculum and Instruction, School of Education, University of Eldoret Box 1125 Eldoret
Seventh Author – Simiyu Kennedy S,. Seed Crop and Horticulture, School of Agriculture, University of Eldoret Box 1125 Eldoret