



The integration and frequency of use of 21st Century Learning Skills in Agriculture Education

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Recommended Citation: Shisia, T. A., Muyekho, F. N., & Wekullo, C. S. (2026). The integration and frequency of use of 21st century learning skills in agriculture education. *African Quarterly Social Science Review*, 3(3), 1068–1078.

<https://doi.org/10.51867/AQSSR.3.3.104>

ABSTRACT

The embedding of 21st Century learning skills is crucial to ensuring that learning prepares learners to tackle complex, dynamic and technologically lit environments. But some evidence suggests that application of these competencies in classroom practice is not always consistent. This study focused on the integration and the use of 21st Century learning skills in Agriculture education in public secondary schools of Vihiga Sub-County, Vihiga County, Kenya. In particular, the study aimed to identify the level of integration of 21st Century learning (21CL) skills in Agriculture education, the frequency of their application in the teaching-learning process and the differences observed in the levels of integration and application of some chosen skills. Constructivist Learning Theory was used as the study's guidance and a descriptive cross sectional survey research design was adopted that incorporated a correlational component. The target population was 1100 Form Four Agriculture students, 28 Agriculture teachers and 28 school administrators. A multi-stage sampling process was employed to select 20 schools, 466 students and 20 Agriculture teachers and 20 school administrators. Questionnaire and structured interview schedules were used for data collection and descriptive statistics and thematic analysis were used in data analysis. The results indicated that there was low level of integration and use of 21st century learning skills. The skills most integrated and used most often were critical thinking and problem solving, with 55.7% of students saying they were integrated and 56.0% saying they were always used. The lowest integration was in collaboration and teamwork with 75.4% of students disagreeing that the skills were integrated. Global and cultural awareness was the least frequently used skill, with 41.6% reporting that it was never used. It can be concluded from the study that Agriculture education has not adopted the wide spectrum of 21st Century learning skills completely. The study suggests that Agriculture education teachers need to be trained specifically on how to integrate the balanced use of all the 21st Century learning skills and that Learning and Instructional strategies in Agriculture education should be based on the learner and improved ICT materials should be used to promote such balanced and consistent integration.

Keywords: Agriculture Education, Critical Thinking, 21st Century Learning Skills, Digital Literacy, Frequency of Use

I. INTRODUCTION

In the twenty-first century, people increasingly expect education to equip learners with skills and abilities that go beyond the mere reproduction and accumulation of knowledge on the subject. Due to rapid technological development, globalization, changing labor market needs, environmental problems and the complexity of today's social and economic life, the need for learners to acquire transferable skills to adapt, innovate, cooperate, and solve complex problems has arisen. These skills are often referred to as 21st Century learning skills, which include critical thinking, problem solving, communication, collaboration, creativity, digital literacy, self-direction and global awareness (Trilling & Fadel, 2009). These skills are seen as key in equipping learners for effective engagement in knowledge-based economies and in solving today's social problems.

The idea of 21st Century learning skills focuses on the enhancement of the 21st Century skills: Higher order cognitive skills, Interpersonal skills and Intrapersonal skills. Critical thinking can be used to analyze information, evaluate evidence and make informed judgments and problem solving can be used to identify and challenge any issues, come up with some alternatives and take the necessary action. Communication and collaboration help share ideas and ideas from a community of learners, while creativity helps to generate new and contextually relevant ideas. Digital literacy is about accessing, evaluating, creating and communicating information with digital technologies, and self-direction is about being autonomous and responsible. Global awareness also helps students to comprehend the interrelated social, economic, environmental, and cultural issues (Binkley *et al.*, 2012; Trilling & Fadel, 2009). Such

skills are now being seen as complementary, not separate skills and are best developed when learners are given the opportunity to use them in authentic learning environments.

Agriculture education is an important context for development and use of 21st Century learning skills because agriculture is very practical, problem-solving and has close connections with contemporary economic, environmental and technological issues. People with the ability to analyse complex production challenges, adapt to climate variability, consider and assess new technologies, have access to and interpret agricultural information, work with a variety of stakeholders and create innovative and sustainable solutions are needed in modern agriculture. Agriculture education, therefore, should not only impart knowledge in agriculture, but should also provide opportunities for learning in which the learner acquires the skills needed to use the knowledge in real agricultural situations in life. The need to equip learners with the necessary skills for the dynamic agricultural systems and labour markets has been increasingly highlighted in the international context of agricultural education (Musasia et al., 2012).

The integration of 21st Century learning skills in Agriculture education is a conscious effort to embed the skills into the curriculum, lesson plans, instructional methods, student activities, and evaluation procedures. Teachers must plan to explicitly create learning opportunities where critical thinking, creativity, communication, collaboration, problem solving and the use of digital technologies are integrated with the learning of agricultural knowledge. Problem-based learning can allow the students to explore local agricultural issues and come up with some solutions, collaborative activities can foster teamwork and communication, and the hands-on projects can be a chance for creativity, innovation, and self-directed learning. Effective integration of the skills will depend on teachers' deliberate attempts to integrate the skills into their regular teaching, instead of using them as an extra or a stand-alone item on the learning agenda (Voogt & Roblin, 2012).

The inclusion of 21st Century skills in policy texts and in curriculum resources does not mean that they are actually consistently put into practice in the classroom. Good integration involves teachers having sufficient pedagogical knowledge, content knowledge, pedagogical content knowledge, professional competence, pedagogical materials, and pedagogical confidence to teach learner-centred learning. Teachers also need to be able to break down broad competency expectations into observable learning outcomes, strategies for teaching, and meaningful learning activities for assessment. Research has shown that teachers can face difficulties in implementing competency-based approaches, especially when professional development is limited, instructional materials and technology support facilities are inadequate, and institutional support is lacking (Ertmer & Ottenbreit-Leftwich, 2010; Voogt & Roblin, 2012).

Teacher preparedness is thus a crucial issue that impacts on how and when 21st Century learning skills are integrated in teaching and learning. Teachers' preparedness can be in terms of their learning of the skills, their pedagogical ability to integrate the skills into lessons, their ability to use learner-centred instructional strategies, and their confidence in their ability to facilitate practical and inquiry tasks. Consistent use of these skills in classrooms may be more likely to happen if these skills are integrated by those teachers who have greater knowledge and pedagogical competence. However, in some cases the teachers might not be well prepared to use learner-centred approaches, even when they understand the significance of the 21st Century skills, due to the limited use.

Another major aspect of classroom implementation is how often the 21st Century learning skills are used. The use of these skills is considered under integration by determining if teachers include these skills in Agriculture and, if so, how; while frequency of use is considered by determining the regularity with which teachers give learners opportunities to practise and demonstrate these competencies. According to Roberts and Ball (2009) exposure to critical thinking, collaboration, problem solving, creativity, communication or digital technologies may not be enough to support the systematic development of these skills. In order to develop complex competencies, learners need to have repeated experiences of meaningful learning that involve the application of knowledge, interaction with others, reflection on learning, and solving authentic problems (National Research Council, 2012).

There are many opportunities to consistently apply 21st Century learning skills to agriculture education. These competencies can be developed in authentic contexts through practical activities, field investigations, school agricultural projects, experiments and demonstrations, group discussions, problem-solving activities, digital learning activities, or inquiry-based projects. Learners might for example use critical thinking in analysing the causes of crop failure, or problem-solving skills in determining strategies for the management of pests, being creative in planning agricultural enterprises, communicate and collaborate skills in completion of group projects, and use digital literacy in accessing agricultural information or using technology-supported learning materials (Roberts & Ball, 2009). Whether these opportunities are regularly used in the normal course of Agriculture teaching is an empirical matter, however.

The significance of elements of instructional organization, teacher clarity, scaffolding, and effective pedagogies for learner engagement and achievement has been highlighted in previous studies. Hattie (2012) noted some factors that affect learning outcomes, such as teacher clarity and effective teaching practices. Science and technical education research also focused on the role of structured teaching, active involvement of students, real-life experiences and adequate instructional support in the context of meaningful learning (Musasia et al., 2012). Such views indicate that developing 21st Century learning skills require more than just curriculum intentions; it also requires regular opportunities for students to be active and make use of them in the learning process.

Although competency-based and 'learning centred' education is becoming more prominent, the findings of the education research indicate that in many contexts, the inclusion of the 21st Century learning skills in learning processes is challenging. The typical teaching strategies that focus on the teacher's role, coverage of content, memorization and preparation for exams can diminish opportunities to experience higher order thinking, group work, creative thinking, inquiry, and problem solving. These practices can lead to a mismatch between the skills students are expected to acquire and what is being taught in the classroom (Voogt & Roblin, 2012). In Agriculture education, the situation is crucial as learners are expected to develop skills that can be transferred not only to the classroom, but also to the farm, entrepreneurship, food security, environmental management and sustainable development. Rarely using 21st Century learning skills can then impact the ability of learners to put agricultural knowledge into practice to address real-world problems. It is therefore critical to know how integrated and how often these skills are used in Agriculture education when assessing the implementation of the modern education competencies.

The present study, therefore, will be limited to the integration and use of 21st Century learning skills in Agriculture education. In particular, the study aims to identify the extent of critical thinking, problem-solving, communication and collaboration, creativity, digital literacy, self-direction and global awareness skills that Agriculture teachers incorporate into their instruction and to determine how often these skills are used in Agriculture teaching and learning. The study will provide empirical evidence about classroom practices and will help to understand the implementation of 21st Century learning skills in Agriculture education.

1.1 Statement of the Problem

Learning skills for the 21st Century have emerged as a significant goal of modern education, with learners needing skills to enable them to think critically, solve complex problems, communicate effectively, cooperate with others, be creative, use digital technologies and adapt to the changing social and economic contexts (Binkley *et al.*, 2012; Trilling & Fadel, 2009). The competencies are very well suited to agriculture education, which is hands-on, experimental, problem-solving, innovative, entrepreneurial and faced with real world environmental or production issues. Therefore, the key competencies of the 21st Century skills should be intentionally embedded in Agriculture instruction and opportunities for students to use them should be frequent.

The use of the 21st Century competencies in learning systems and in learning expectations does not guarantee that the competencies are consistently included and used in classroom practice. Some teachers may encounter difficulties due to pedagogical inexperience, lack of professional development experience, inadequate instructional resources, limited access to digital technologies, large classes, time constraints and continued focus on exams-based teaching (Ertmer & Ottenbreit-Leftwich, 2010; Voogt & Roblin, 2012). At times these may lead to critical thinking, problem solving, collaboration, communication, creativity, and digital literacy skills being limited in their integration and/or use with Agriculture lessons.

While prior research has confirmed the relevance of 21st Century learning skills to the needs of society and the economy, significant empirical research is needed to understand how the skills are embedded in particular subject areas and how often they are utilised in the classroom. It is not clear whether teachers regularly offer opportunities for learners to practise and apply these competencies during their daily teaching and learning activities in Agriculture education. The absence of these pieces of evidence makes it hard to determine the contribution of Agriculture education to the development of competencies needed for innovation, sustainable agricultural development, entrepreneurship and solving today's agricultural problems.

This study aims therefore to study the integration and usage of 21st Century learning skills in Agriculture education. The study is to provide empirical evidence on the level of integration of these skills within the context of Agriculture teaching and the frequency of opportunities for the learners to develop and apply these skills. The results could help to enhance teaching and learning in Agriculture education, teacher professional development and competency-based Agriculture education implementation.

1.2 Research Objectives

- i. To determine the extent to which 21st Century learning skills are integrated into Agriculture education.
- ii. To establish the frequency of use of 21st Century learning skills during the teaching and learning of Agriculture.
- iii. To examine the differences in the integration and frequency of use of selected 21st Century learning skills in Agriculture education.

II. LITERATURE REVIEW

2.1 Theoretical Review

2.1.1 Constructivist Learning Theory

Constructivist Learning Theory was the basis for this study, which is attributed to Jean Piaget and Lev Vygotsky. Learning is an active process in which the learner creates knowledge by interacting with his/her environment,



experiences, learning materials, teachers, and other learners. Learning is not a passive process, but an active process of exploration, inquiry, problem-solving, reflection and knowledge construction (Piaget, 1972; Vygotsky, 1978).

Cognitive constructivism theory, developed by Piaget, focuses on learners' construction of knowledge by interacting with the environment, with their cognition structures being changed through assimilation and accommodation. In addition to the importance of social interaction, collaboration, and teacher scaffolding in supporting learning and cognitive development, Vygotsky's social constructivist perspective highlights the significance of (Piaget, 1972; Vygotsky, 1978). These views are reflected in learner-centred learning strategies that help learners build and use knowledge. Constructivist Learning Theory is applicable to 21st Century learning skills as skills like critical thinking, problem solving, creativity, communication, collaboration and self-direction are built through active involvement in meaningful learning experiences. Inquiry-based, problem-based, collaborative, and experiential learning methods offer opportunities for students to build their own knowledge, and to work on transferable skills that are needed in the modern world (Binkley *et al.*, 2012; Voogt & Roblin, 2012).

Agriculture education is practical and problem oriented and the theory is a significant one in the context of Agriculture. Agricultural learning offers learners opportunities to explore real life issues, experiment, engage in projects, work with others and come up with solutions to problems in agriculture. These experiences are similar to constructivist principles of learning that focus on using knowledge in a real learning context (Roberts & Ball, 2009). The three aims of the present study are more comprehensively understood from the point of view of constructivism. Firstly, the theory underpinning it allows the integration of 21st Century learning skills through the use of learner centred instructional approaches. Second, it highlights the need for repeated engagement and practice in the development of complex competencies. Third, it acknowledges that learning experiences and instructional methods used to foster specific competencies may foster these skills in different ways, leading to differences in the ways in which individual 21st Century learning skills are integrated and used (National Research Council, 2012; Voogt & Roblin, 2012).

The constructivist learning theory therefore offers a suitable theoretical background to study the integration and frequency of use of the 21st Century learning skills in Agriculture education. The theory informed the study in analyzing how opportunities are provided for learners to engage in critical thinking, problem solving, communication, collaboration, creativity, digital literacy, self-direction, and other pertinent skills when teaching and learning in the field of Agriculture (Vygotsky, 1978; Voogt & Roblin, 2012).

2.2 Empirical Review

2.2.1 Integration of 21st Century Learning Skills into Agriculture Education

The integration of 21st Century learning skills means intentionally including 21st Century skills, such as critical thinking, problem solving, communication, collaboration, creativity, digital literacy, self-direction, and global awareness in learning content, learning design, learning activities, and assessment. These skills have become a priority in modern education structures, which call for them to be nurtured in the learning and teaching of content knowledge (Binkley *et al.*, 2012; Trilling & Fadel, 2009). Once the 21st Century competencies were analyzed across international frameworks, there was much commonality in terms of the importance of critical thinking, problem solving, communication, collaboration, creativity, and digital literacy (Voogt & Roblin, 2012). The study did, however, show that the competencies were not always present in the classroom and/or being implemented effectively in the classroom. The researchers found a disconnect between the curriculum expectations and actual teacher practices.

The results of the research conducted by Voogt and Roblin (2012) indicate that teachers' ability to transform general competencies into practice-based teaching and learning activities is a key factor in successful integration. The study concentrated mainly on curriculum frameworks and failed to determine the degree of implementation of the skills in the different subjects (including Agriculture). This is the reason that there is a need to conduct subject specific studies on how the teachers are integrating the 21st century learning skills within the classroom.

Binkley *et al.* (2012) defined 21st Century skills as being composed of four, namely: ways of thinking, ways of working, tools for working, and living in the world. The framework highlighted the importance of using creativity, critical thinking, communication, collaboration, information literacy, and technology literacy in education. The framework does not offer any evidence of how these competencies are being infused in the classroom in Agriculture education, but it does offer a conceptual foundation. Because of the hands-on, experiential, and problem-solving nature of agriculture education, it offers a very valuable setting for the inclusion of 21st Century learning skills. Agricultural learners can be developed in critical thinking skills by analyzing the problems of agricultural production, problem-solving skills by providing solutions to the problems of agricultural production, collaboration skills through group projects and innovation skills through innovation in agricultural activities (Roberts & Ball, 2009). The level of teachers' intentional use of these competencies in everyday classroom instruction, however, is contingent upon classroom practices.

Research on current teaching has also revealed that teachers' knowledge, pedagogical skills, learning skills, and pedagogical materials can affect the implementation of the 21st century learning skills. While some teachers realize that these skills are important, they struggle to make them part of the objectives, instructional methods, activities, and

assessments of their lessons (Ertmer & Ottenbreit-Leftwich, 2010; Voogt & Roblin, 2012). The literature reviewed indicates that 21st Century learning skills are being recognised in the learning environment, and Agriculture education can offer opportunities for developing them. But much of the literature is related to curriculum frameworks and teacher perceptions or general practices of instruction. There is little evidence of the extent to which the individual 21st Century learning skills are developed in this context of routine Agriculture education. The present study aims to fill this void by exploring the degree to which these skills are incorporated into Agriculture education (Binkley *et al.*, 2012; Voogt & Roblin, 2012).

2.2.2 Frequency of Use of 21st Century Learning Skills During the Teaching and Learning of Agriculture

Frequency of use of 21st Century learning skills: Frequency with which teachers make opportunities available for students to practise and apply skills like critical thinking, problem-solving, digital literacy, communication, collaboration and creativity. Frequency is concerned with the regularity with which learners access and practice the competencies during teaching and learning activities, while integration is concerned with whether they are integrated into the instruction or not (National Research Council, 2012). National Research Council (2012) has highlighted that complex and transferable competencies are built through multiple experiences of practice and application across learning contexts. On an ongoing basis, learners will be more likely to gain critical thinking, communication, collaboration, and problem solving skills if they are regularly engaged in activities that require them to analyse, interact, investigate and apply knowledge; rather than sometimes.

Voogt and Roblin (2012) discovered that the 21st Century competencies were known in the educational framework but not consistently applied in classrooms. This fluctuation implies that pupils may not be being given equal opportunities to build up these skills through the teaching strategies used by their teachers. The study pointed out the need to look at the realities of the classroom and not just what was intended in the curriculum. The 21st Century learning skills can be used often in agriculture education in a variety of practical activities, conducting field investigations, conducting experiments, demonstrating skills, performing agricultural projects, discussing in groups, and problem solving. When students are regularly engaged in real-life agricultural experiences, these activities can foster critical thinking, creativity, collaboration, communication and practical problem-solving skills (Roberts & Ball, 2009).

The extent to which teachers incorporate such learning activities, however, might be affected by teacher preparedness, pedagogical competence, instructional resources, access to technology, class size, time allocation and curriculum demands. While teachers may wish to employ learner-centred and practical approaches, they may be inconsistent in their use because they lack knowledge, resources, or institutional support (Ertmer & Ottenbreit-Leftwich, 2010; Voogt & Roblin, 2012). Educational frameworks that include 21st Century competencies, therefore, have not been shown to automatically translate into the regular use of these competencies in classrooms. Despite a few studies that have investigated how teachers perceive and face challenges in using 21st Century learning skills, there is little empirical research that focuses on the use of individual 21st Century learning skills in Agriculture teaching and learning process. This study is aimed at filling this gap in the literature by determining the frequency of these skills being utilized in Agriculture education (National Research Council, 2012; Voogt & Roblin, 2012).

2.2.3 Differences in the Integration and Frequency of Use of Selected 21st Century Learning Skills in Agriculture Education

Although 21st Century learning skills are frequently presented as a collective set of competencies, individual skills may differ in their extent of integration and frequency of use. Critical thinking, creativity, communication, collaboration, problem-solving, and digital literacy require different instructional strategies, learning environments, teacher competencies, and resources. Consequently, teachers may integrate and use some competencies more frequently than others (Binkley *et al.*, 2012; Voogt & Roblin, 2012).

Binkley *et al.* (2012) categorized 21st Century competencies into different domains, including ways of thinking, ways of working, tools for working, and living in the world. This categorization demonstrates that the skills are conceptually distinct and may require different pedagogical approaches. For example, critical thinking and problem-solving may be promoted through inquiry and problem-based learning, while communication and collaboration may be enhanced through discussions and group activities. Voogt and Roblin (2012) further demonstrated that different educational frameworks place varying levels of emphasis on specific 21st Century competencies. While skills such as critical thinking, creativity, communication, and collaboration were widely represented, other competencies received varying levels of attention. This variation suggests that differences may also occur in how teachers prioritize and integrate individual skills into classroom instruction.

Within agriculture education, the practical nature of the subject may provide greater opportunities for some competencies than others. Critical thinking and problem-solving may be promoted through analysing agricultural challenges, while communication and collaboration may be developed through group practical activities. Creativity may emerge through innovation and agricultural enterprise projects, whereas digital literacy may depend on the availability of technological resources and teachers' capacity to use them effectively (Roberts & Ball, 2009). The integration of

digital literacy may particularly differ from other skills because it depends substantially on technological infrastructure and teacher competence. Ertmer and Ottenbreit-Leftwich (2010) argued that the integration of technology into teaching is influenced by teachers' knowledge, beliefs, confidence, and access to technological resources. Consequently, schools with limited technological infrastructure may demonstrate lower integration and frequency of digital literacy compared with skills that can be promoted through conventional classroom activities.

Differences may also result from teachers' familiarity and confidence in promoting particular competencies. Teachers may find it easier to facilitate communication and collaboration through group discussions but experience greater challenges when promoting creativity, critical thinking, digital literacy, or self-directed learning. Variations in teacher competence and pedagogical preparedness may therefore influence which 21st Century skills are integrated and used most frequently in classroom practice (Ertmer & Ottenbreit-Leftwich, 2010; Voogt & Roblin, 2012). The reviewed literature suggests that differences are likely to exist in the integration and frequency of use of individual 21st Century learning skills because the competencies require different instructional strategies, resources, and levels of teacher preparedness. However, limited empirical studies have systematically compared these differences specifically within Agriculture education. The present study therefore seeks to address this gap by examining whether selected 21st Century learning skills differ in their integration and frequency of use during Agriculture teaching and learning (Binkley *et al.*, 2012; Voogt & Roblin, 2012).

III. METHODOLOGY

3.1 Research Design

The study was descriptive, cross sectional and correlational in nature. The design was suitable to establish the level of integration and frequency of use of 21st Century learning skills in Agriculture education, and to review the differences between selected learning skills. The descriptive survey design allowed data to be gathered about current instructional and/or learning practices, and correlational and comparative analyses helped examine relationships and differences among the study variables (Creswell & Creswell, 2018).

3.2 Study Area

The study was carried out in public secondary schools of Vihiga Sub-County, in Vihiga County, Kenya. The selection of the area is due to the concerns identified about food insecurity and reduced enrolment and performance in Agriculture since 2022, which makes the effective teaching of Agriculture an important educational concern according to County Statistics Education Office in 2024. The public secondary school was deemed suitable because it offers Agriculture as a subject and the context in which the integration and frequency of use of 21st Century learning skills can be studied.

3.3 Target Population

The target population included 1100 Form Four Agriculture students, 28 Agriculture teachers and 28 school administrators in the Vihiga Sub-County public secondary schools. The Form four students were chosen due to their long term experience with Agriculture teaching and thus their ability to provide data about the integration and frequency of the use of 21st Century learning skills. The Agriculture teachers were added because directly involved in design and implementation of teaching and learning activities, and the school administrators had institutional views on Agriculture teaching and learning.

3.4 Sampling and Sample Size

A multistage sampling procedure was used to select study participants. Stratified sampling was employed for the selection of 20 public secondary schools which were selected based on the school category and gender composition. Secondly, the sampled schools were used in the selection of the students by cluster sampling and systematic random sampling and a total of 466 form 4 Agriculture students were sampled. The agriculture teachers and school administrators were selected purposively because they are directly involved in the Agriculture instruction and school supervision. There were a total of 20 Agriculture teachers and 20 school administrators who participated in the study. Thus, the respondents for the study were 506 in total.

3.5 Data Collection Instruments and Procedures

The data were obtained from the researcher designed questionnaires and structured interview schedules. The questionnaires were given to form 4 Agriculture students to gather the quantitative data for the integration and frequency of the use of the 21st Century learning skills in Agriculture lessons. Structured interviews were conducted with Agriculture teachers and school administrators to gather data about the integration and use of the skills, teacher preparedness, instructional practices and strategies for strengthening such integration and use. The research instruments were first tested in two secondary schools which were not part of the study. The test of instruments for clarity, relevance,

validity, and reliability was carried out in the pilot study. The instruments were modified in light of the pilot study data before the data collection for the main study (Williamson, 2004).

3.6 Data Analysis

The Statistical Package for the Social Sciences (SPSS) Version 27 was used to code and analyse quantitative data. Descriptive statistics such as frequencies, percentages, means, and standard deviations were employed to find the level of integration and frequency of use of the 21st Century learning skills. Comparative statistical analyses were used to determine the differences in the level of integration and use of selected 21st Century learning skills. Interviews (qualitative) were used to collect data, which was then analysed thematically by recognising, grouping and highlighting the commonalities and themes. The findings derived from the quantitative and qualitative analyses were then combined in interpreting the study results to gain a holistic view of the study results. To ensure the appropriateness of the statistical procedures selected, statistical assumptions were tested prior to conducting the inferential analyses, the most relevant being normality and multicollinearity (Hosmer *et al.*, 2013).

3.7 Ethical Considerations

Ethical clearance was sought at Masinde Muliro University of Science and Technology (MMUST) while research permit was obtained from the National Commission for Science, Technology and Innovation (NACOSTI). Further, permission was obtained from the relevant education authorities and the participating schools. The aim of the study was explained to the participants and participation was voluntary and informed consent was obtained. Confidentiality, anonymity and privacy were respected during the study and the data gathered were solely for academic research.

IV. FINDINGS & DISCUSSION

4.1 Findings

The results of this study are presented on the basis of its objectives. The findings are based on how 21st Century learning skills were incorporated in Agriculture education, how often the skills were used during teaching and learning and the differences in how the skills were integrated and how often they were used.

4.1.1 Integration of 21st Century Learning Skills into Agriculture Education

The first objective sought to determine the extent to which 21st Century learning skills were integrated into Agriculture education. Table 1 presents students' responses regarding the integration and frequency of use of selected 21st Century learning skills during Agriculture lessons.

Table 1

Integration and Frequency of 21st Century Learning Skills in Agriculture Education

21st Century Skill	Agreed (%)	Undecided (%)	Disagreed (%)	Always (%)	Often (%)	Sometimes (%)	Rarely (%)	Never (%)
Critical Thinking & Problem Solving	55.7	12.8	31.5	56.0	12.8	12.8	20.9	10.3
Communication	23.9	18.2	57.9	33.5	0.0	18.5	22.2	25.9
Collaboration & Teamwork	13.3	11.3	75.4	24.4	0.0	18.5	34.5	22.7
Creativity & Innovation	23.9	18.2	57.9	34.8	0.0	13.3	25.9	26.4
ICT Integration/Digital Literacy	34.7	12.8	51.9	22.6	0.0	10.4	40.6	26.4
Self-Direction & Initiative	55.7	12.8	31.5	11.1	0.0	4.4	29.1	55.4
Global & Cultural Awareness	27.1	14.3	58.7	17.8	0.0	5.9	35.5	41.6

Note. Data were extracted from student survey responses. Percentages represent the proportion of respondents in each category.

Table 1 shows that, there was a wide range of responses regarding the extent of the incorporation of 21st Century learning skills across the selected competencies for Agriculture education. The most high level of integration was with critical thinking and problem solving, with 55.7% of students saying that this skill was integrated into Agriculture lessons. Likewise, self-direction/independence was not an area of consensus with 55.7% agreement. The other skills showed comparatively low levels of integration, however.

There was not good integration of communication with 57.9% of students disagreeing that it was integrated into Agriculture lessons. Likewise, creativity and innovation had 57.9% disagreement and global and cultural awareness had

58.7% disagreement. There was also an inadequate integration of ICT in the curriculum and digital literacy, with 51.9% of the students disagreeing. The skill of collaboration and team work had the lowest integration with 75.4% of the students disagreeing that the skill was integrated in Agriculture education. The results thus indicate that there was a lack of uniformity in the implementation of learning skills of the 21st Century. Most of the social, technological, creative and global competencies were not well integrated into the lessons of Agriculture, although critical thinking and problem solving seemed to be given a relatively higher focus. From students' agreement responses, it seemed self-direction and initiative were quite integrated, but were not used very often.

4.1.2 Frequency of Use of 21st Century Learning Skills During the Teaching and Learning of Agriculture

The second goal aimed to determine the frequency of the 21st Century learning skills in the teaching and learning process of Agriculture. As can be seen in Table 1, critical thinking and problem solving skills were most commonly reported as being always used by 56.0% of the students. Twenty per cent (20.9%) said the skills were rarely used, however, 10.3% said that they were never used. There was a lack of consistent use of communication during Agriculture lessons. Communication was always used by 33.5% of students, rarely used by 22.2% and was never used by 25.9% of students. Likewise, 34.5% said that they rarely used collaboration and team work and 22.7% said that they never used the skill.

Limited frequency of use was also shown with creativity and innovation. The proportion using the skill was always (34.8%), rarely (25.9%) and never (26.4%). The competencies that were least reported as being used were: ICT integration (22.6% of students said this skill was always used); and digital literacy (22.6% of students said this skill was always used). 40.6% reported rare use while 26.4% reported that it was never used. There was a significant difference in terms of self-direction and initiative. 55.7% of the students agreed that the skill was in Agriculture education, while 11.1% reported use of the skill 'always'. In addition, 29.1% reported rare use and 55.4% said that the skill was never used in the teaching of Agriculture. The least used of the skills was global and cultural awareness. It was always used by only 17.8% of the students, rarely used by 35.5% and not used at all by 41.6%. In general, the results showed that the application of 21st Century learning skills in Agriculture teaching and learning was not consistent, critical thinking and problem solving competencies were more emphasized than the other competencies selected.

4.1.3 Differences in the Integration and Frequency of Use of Selected 21st Century Learning Skills in Agriculture Education

The third goal aimed to investigate the variations between the integration and use of selected 21st Century learning skills in Agriculture education. The descriptive results in Table 1 indicated that there were clear differences between the selected skills. The highest level of integration was for critical thinking and problem solving, as 55.7% of students indicated integration, and the highest frequency of use was for critical thinking and problem solving, 56.0% of students indicated it was always used. On the other hand, collaboration and team work had the lowest integration level with 75.4% of students disagreeing that the skill was integrated. Global and cultural awareness had the lowest frequency of regular use with 17.8% stating that the skill was always used and 41.6% stating that the skill was never used.

The two most significant differences between integration and frequency of use were self-direction and initiative. While 55.7% agreed that the skill was integrated 11.1% reported that the skill was always used, and 55.4% reported that it was never used. This discovery suggests a disconnect between reporting of integration and classroom application of the skill. For the integration and frequency of use of ICT integration and digital literacy, these results indicated that there was low integration as 51.9% of students disagreed that the skill was integrated, while 40.6% stated that the skill was rarely used. Communication and creativity and innovation also had high levels of disagreement (57.9% both) about integration, and significant numbers of pupils indicated that they rarely or never used the skills.

Based on the descriptive findings, then cognitive, specifically critical thinking and problem solving, were more integrated and often used than collaborative, technological, self-directed, creative and global competencies. The observed differences indicate that the skills of 21st Century learning were not equally applied to the selected competencies when implemented in Agriculture education. Note that the difference presented in this section is descriptive percentages from Table 1. So, this means that the findings are observed differences, not statistically significant differences. However, statistical significance is only possible with the proper inferential analysis.

4.2 Discussion

4.2.1 Integration of 21st Century Learning Skills into Agriculture Education

The results indicated that critical thinking skills and problem solving skills are most integrated 21st Century skills and 55.7 % of the students agreed that the skills have been integrated into Agriculture lessons. This can be explained by the problem solving and applied character of Agriculture education, in which the student has to analyse a problem and suggest solutions in agriculture. The finding is in line with the opinion of Roberts and Ball (2009) which stated that agricultural education offers genuine authentic learning opportunities for higher order thinking and problem-solving skills. The slightly higher level of critical thinking and problem solving also aligns with the framework proposed

by Binkley *et al.* (2012) which identified critical thinking and problem solving as important modes of thinking in today's education. Likewise, Constructivist Learning Theory places importance on problems-solving experiences, investigations and meaningful learning related to constructing solutions, as a way to gain deeper understanding (Piaget, 1972; Vygotsky, 1978).

The results indicated, however, that communication, collaboration, and teamwork, creativity and innovation, the integration of ICT, digital literacy, and global and cultural awareness were not well integrated. For instance, 57.9% of the students disagreed about communication and creativity and innovation being integrated, and 75.4% of them disagreed about collaboration and teamwork. The results confirm what Voogt and Roblin (2012) reported: that 21st Century competencies are highly encouraged in education systems, but they are not consistently used in the implementation of education. The low degree of integration of ICT integration and digital literacy (51.9% of students felt it was not integrated) can be attributed to access to technology, teachers' technological competence and institutional support issues. Ertmer and Ottenbreit-Leftwich (2010) also found that teacher knowledge, beliefs, confidence in technology and access to technological resources were significant factors in integrating technology.

The finding of 58.7% of students disagreeing that global and/or cultural awareness was integrated implies that global aspects and/or cultural awareness in Agriculture is not seen as important and is not addressed extensively. While global awareness is a competency of the 21st Century, it is not guaranteed to come naturally when it is being integrated with traditional content areas, and may necessitate intentional teaching (Binkley *et al.*, 2012; Trilling & Fadel, 2009). In general, it can be concluded that the 21st Century learning skills in Agriculture education were implemented selectively not comprehensively. Other competencies were found not to be well integrated, however, critical thinking and problem solving were relatively more emphasized. This result corroborates existing research suggesting that curriculum frameworks might acknowledge the use of 21st Century skills without consistent implementation in the classroom (Voogt & Roblin, 2012).

4.2.2 Frequency of Use of 21st Century Learning Skills During the Teaching and Learning of Agriculture

The results revealed that students' skills in critical thinking and problem solving were the most common skills with 56.0% stating that the skill was always used. This indicates that Agriculture lessons offered fairly consistent learning opportunities to analyse agricultural issues and propose solutions. The discovery aligns with the National Research Council (2012) which argued that "higher order competencies arise through repeated and meaningful activity with authentic problems.

Although critical thinking and problem solving skills were used relatively well, the other skills were used inconsistently. 25.9% of students reported that they never used communication, 34.5% reported that they rarely used collaboration and teamwork, and 22.7% reported that they never used collaboration and teamwork. The results of these indicate that students might not have actively participated in group discussions, collaborative projects, or organized peer learning activities. This is in direct opposition to Vygotsky's (1978) social constructivist theory where interaction and collaboration are key to learning and cognitive growth.

Creativity and innovation were also used inconsistently, with 25.9% of students saying that they rarely used the skill and 26.4% saying that they never used the skill. The restricted application of creativity could limit the potential of learners to have new ideas and create new solutions to agricultural problems. This is not aligned with current educational systems, which focus on creativity as a key skill in innovation and adaptation in the face of new challenges and opportunities in social and economic life (Trilling & Fadel, 2009). The competencies that were least used were in the areas of ICT integration and digital literacy. While only 22.6% of students reported that ICT skills were always used, 40.6% reported rare use and 26.4% reported that they were never used. This result aligns with Ertmer and Ottenbreit-Leftwich (2010) who determined that teacher resources, teacher competency, teacher confidence and institutional support are all factors that influence the regular incorporation of technology in the classroom.

The analysis of self-direction and initiative showed that there is considerable difference between the extent of integration and the extent to which learning is integrated into the classroom. While 55.7% of students agreed the skill was integrated, 55.4% said it was never used and 11.1% said it was always used. This implies that the skill is addressed in the teacher's intent in teaching or planning the lessons but is not always manifested in activities that foster the autonomy and initiative of learners. The National Research Council (2012), likewise, noted that opportunities for learners to decide, manage tasks, and be responsible for their learning must be repeated to develop self-regulation and independent learning. Global and cultural awareness was the least common competency with 41.6% of students saying it was never used and 35.5% saying it was used rarely. The discovery indicates that there was less opportunity for the learners to relate Agriculture education to the global developments, cultural diversity, environmental sustainability and International food systems. This agrees with Binkley *et al.* (2012) who stated that it is important to make deliberate efforts to integrate global content into learning activities.

Results overall show that the use of the 21st Century learning skills was not consistent and was low for most competencies. The findings align with earlier research that found that the incorporation of 21st Century competencies

into learning frameworks does not guarantee that they are being consistently applied to learning activities within the classroom (National Research Council, 2012; Voogt & Roblin, 2012).

4.2.3 Differences in the Integration and Frequency of Use of Selected 21st Century Learning Skills in Agriculture Education

The results showed clearly descriptive differences in the integration and use of the selected skills of the 21st Century learning. The highest results for both integration and regular use of critical thinking and problem-solving were on this item, with 55.7% of respondents indicating that critical thinking was integrated and 56.0% saying it was always used. The pattern indicates that the content competencies of cognitive and problem-oriented learning have greater overlap with practical agricultural content and problem-solving activities in real context that makes them easier to integrate into the Agricultural Education classroom (Roberts & Ball, 2009). The skill of collaboration and teamwork, on the other hand, had the lowest score with 75.4% of students disagreeing with how well the skill was integrated into Agriculture lessons. Thirty-four per cent of students never used the skill, as did 22.7 per cent. The disparity indicates that individual cognitive activities have been emphasized more than social/cooperative learning. The social constructivist approaches put emphasis on interaction with peers as an important process in knowledge development (Vygotsky 1978), but collaborative learning is a central process in these approaches.

The findings also showed there were significant differences in self-direction and initiative integration and frequency of use. The results indicated that 55.7% of the students agreed that the skill was integrated, 11.1% reported using it always and 55.4% reported never using it. The difference between the curricular report and classroom use indicates that curriculum reporting does not always equal classroom use. Similar (intended competencies vs. what is actually taught) gaps have been identified in research regarding the implementation of 21st Century learning skills (Voogt & Roblin, 2012). There were also differences between digital literacy and critical thinking and problem solving in terms of integration and frequency of use. Agriculture lessons were rarely integrated with ICTs and digital literacy (40.6%) and more than half (51.9%) disagreed. This may be attributed to the fact that a school with a strong commitment to digital learning would need extra infrastructure, technology, and teacher skills to effectively promote digital learning (Ertmer & Ottenbreit-Leftwich, 2010).

Global and cultural awareness also had relatively low integration and use, with 58.7% of students disagreeing about the integration of the skill and 41.6% saying that it was never used. This discovery suggests that competencies that are more social, cultural and global in nature might not be given as much attention as competencies more associated with the subject matter and classroom problem-solving. Binkley *et al.* (2012) also defined global citizenship and awareness from cognitive skills, suggesting that various skills might demand different learning opportunities and pedagogical approaches.

There are differences observed in the implementation of 21st Century learning skills in Agriculture education which show that it was not uniformly implemented. Collaboration, digital literacy, global awareness, creativity and self-direction were used less consistently, and critical thinking and problem-solving were more frequently emphasized. The results confirm Voogt and Roblin (2012), who suggested that there may be uneven implementation of different competencies due to the need for different pedagogical approaches, teacher knowledge, and instructional resources. Thus, the findings indicated the need to adopt a more balanced approach to instruction that was purposeful and integrated (and often applied) the entire spectrum of 21st Century learning skills. In addition to the critical thinking and problem-solving skills already noted, teacher professional development needs to cover practical strategies to build communication, collaboration, creativity, digital literacy, self-direction and global awareness skills (Binkley *et al.*, 2012; Trilling & Fadel, 2009).

V. CONCLUSION & RECOMMENDATIONS

5.1 Conclusion

The study findings indicated that 21st Century learning skills were still not integrated and not frequently used in Agriculture education, especially in Indonesia. Communication, collaboration and team work, creativity and innovation, ICT integration and digital literacy, global and cultural awareness, and critical thinking and problem solving were the most integrated and frequently used skills, while the other skills were given limited attention. The self-direction and initiative were integrated, but not well used in instruction, suggesting that the concept was not practiced often or as intended. The study therefore concludes that Agriculture education has not been well and consistently integrated with the wide spectrum of the 21st Century learning skills needed to equip learners with the capacity to respond to the challenges of today's agriculture and be active actors in a new and dynamic agriculture which relies on technology.

5.2 Recommendations

The study calls for the deliberate and systematic implementation of all the 21st Century learning skills during lesson planning, in teaching and learning activities and in the assessment process for Agriculture teachers and



stakeholders in the education system. Teacher professional development programmes should pay special attention to specific strategies to enhance communication, collaboration, creativity, innovation, digital literacy, self-directed learning, and global awareness in addition to critical thinking and problem-solving skills. Schools and education authorities should also make more available and accessible to learners the appropriate ICT resources and support learner centred teaching methods such as collaborative teaching and learning projects, inquiry-based learning, problem-based learning, practical investigations and independent learning tasks. These interventions would encourage the balanced and regular use of 21st Century learning skills and foster the learners' ability to tackle practical issues in agriculture.

Declaration of Interest

The authors declare that they do not have any known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Funding Declaration

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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