NAU Journal of Technology and Vocational Education
Volume 11, No. 2, April 2026

# EMERGING TECHNOLOGIES FOR QUALITY AGRICULTURAL EDUCATION DELIVERY IN ACHIEVEMENT OF SUSTAINABLE DEVELOPMENT GOALS (SDGS) IN TERTIARY INSTITUTIONS IN ABIA STATE, NIGIERIA

**[1]Oketoobo, Emmanuel Akintunde (PhD), [2]Umoren, Nkereuwem Jonah & [3]Isiwu, Edward Chukwuka (PhD)**
[1,2,3]Department of Agricultural and Vocational Education, Michael Okpara University of Agriculture Umudike
[1]oketooboea@gmail.com [2]nkerelife4u@gmail.com [3]disiwu50@yahoo.com

**Abstract**
*The study examined emerging technologies for quality Agricultural Education delivery in Achievement of Sustainable Development Goals (SDGs) in tertiary institutions in Abia State. The study was guided by three research questions and three null hypotheses. Descriptive survey research design was adopted. The population for the study was 80 comprising 25 Agricultural Educators and 55 final year Agricultural Education students in three tertiary institutions. The population was selected using census sampling technique. The instrument for data collection was a structured questionnaire validated by three experts. The reliability coefficient of 0.81, 0.82 and 0.78 was obtained using Cronbach Alpha statistic. The data collected were analyzed using Mean and Standard deviation while t-test statistic was used to test the null hypotheses at 0.05 level of significance. The findings of the study revealed among others that emerging technology tools required for quality Agricultural Education delivery include: Interactive Whiteboard, Google classroom, Flipped classroom, Projectors, Laptop Computer, Smartphones, Internet, Virtual Farms/Labs. Based on the findings, it was recommended that: there is need for United Nations Educational, Scientific and Cultural Organization to collaborate with tertiary institutions especially to provide emerging technology tools required for quality Agricultural Education delivery in tertiary institutions for Achievement of Sustainable Development Goals (SDGs).*

**Keywords:** *Emerging Technologies, Agricultural Education, Tertiary Institutions and Sustainable Development Goals*

## Introduction

Quality Agricultural Education in the 21st century is a necessity for promoting sustainable practices, building a skilled workforce to tackle complex global challenges like climate change and resource scarcity through integration of modern technology for ensuring food security. Agricultural Education is a specialized programme of study that prepares individuals to acquire knowledge and skills for productive careers in farming, agribusiness, teaching and related agricultural enterprises (Oyovwi & Akarue, 2025). Agricultural Education aims to equip learners with practical experience in agricultural production processes as well as instructional strategies for teaching agriculture. It serves as a form of vocational training that fosters the development of competencies required in various farming operations. Its overarching goal is to develop skilled professionals who can contribute to the education sector, agro-allied industries, and rural development initiatives. By providing learners with theoretical knowledge, practical experience, and positive attitude toward agriculture, the program supports workforce development and national agricultural advancement. Ultimately, Agricultural Education serves as a crucial component of the broader educational system, empowering students to understand and contribute meaningfully to the food and natural resource sectors while fostering innovation and sustainability in agricultural practices (Phipps et al., 2018).

Agricultural Education in the 21st century required significant transformations due to advancements in technology, particularly the integration of emerging technologies into instructional activities to make teaching and learning more interesting to the learners. This advancement in technology is significant for transformations across various aspects of society, including how businesses operate,

how people learn and how governments function. These changes are driven by the integration of emerging technologies and the growing need for individuals and organizations to adapt to the digital age where business and educational activities are hinged on emerging technologies (Shiekuma et al., 2020).

Emerging technologies in education according to Aka and Onoyima (2023) refer to the new and innovative tools and applications that are reshaping the way teaching and learning take place. These technologies are not only enhancing the educational process but also revolutionizing traditional classroom environments by offering more engaging, personalized, and efficient learning experiences. Kufeoglu (2022) added that emerging technologies encompass range of innovations including educational technology, information and communication technology, nanotechnology, biotechnology, robotics, learning analytics, adaptive learning, mobile learning, immersive classrooms, and artificial intelligence. In view of the researchers, emerging technologies can be described as innovations developed in forms of equipment, devices and their applications to better human interaction with the environment in diverse areas including teaching. These emerging technologies include but not limited to, mobile devices, Internet of Things (IoT), global positioning system (GPS), and artificial intelligence (AI), Interactive Whiteboard, Google classroom and Flipped classroom.

Emerging technologies integration in Agricultural Education delivery in view of Mormah and Bassey (2019) can enable students to manage digital farms, check crop disease and control pests in simulations, seeing real-time impacts on sustainability without real-world risks. Offers immersive experiences, letting students visualize complex biological processes or explore farm operations. Teach students to use drones for crop monitoring, soil analysis, and spraying, providing real-time data for resource management., students can also learn spatial analysis to map fields, monitor soil health, and optimize fertilizer/water use, connect students with experts and peers globally through forums and social media for collaborative problem-solving and deliver content and facilitate online activities, offering personalized learning paths. According to Oyovwi and Akarue (2025) these technologies makes learning more interactive and motivating, closes the gap between classroom knowledge and workplace skills, prepares graduates for the evolving digital landscape of modern farming through quality Agricultural Education for achievement of Sustainable Development Goals.

Sustainable Development Goals (SDGs) is a universal appeal to eliminate poverty, safeguard the environment, and enhance overall quality of life by 2030 established in 2015 and was adopted by the United Nations in 2016. Specifically, SDG 4 aims to guarantee comprehensive, fair access to high-quality education and encourage continuous learning opportunities (National Teachers Institute (NTI), 2020). This fourth goal of the SDGs focuses on enhancing teaching and learning, contributing to advancements in education. Thus, integration of emerging technologies into education system is pivotal for achieving Sustainable Development Goals (SDGs) especially SDG 4. The transformative potential of emerging technologies cannot be overstated, as they offer innovative solutions to address key challenges and facilitate progress towards a sustainable and inclusive education system (Aka & Onoyima, 2023).

The Sustainable Development Goals provide a comprehensive framework to tackle global issues, including quality education, reduced inequalities, and sustainable communities. By harnessing the power of emerging technologies, such as interactive learning platforms, virtual classrooms, and data analytics, the quality of education can be enhanced, promote equal access to learning resources, and better monitor student progress in tertiary institutions (Aka & Onoyima, 2023). According to Egenti and Obumse (2021), tertiary institution is any post-secondary educational establishment, like a university, college, or vocational school that provides advanced learning, degrees, diplomas, and professional training beyond high school, focusing on specialized skills, research, and community service for societal growth and workforce development. These institutions offer the final stage of formal education, producing skilled manpower and fostering innovation.

Therefore, integration of emerging technologies in Agricultural Education in tertiary institutions in the submission of Shings et al. (2021) remain imperative in achieving SDG since these technologies creates personalized learning opportunities, provide opportunities for adaptive assessments, automated feedback, and intelligent tutoring systems, addressing diverse student needs, offers immersive, engaging simulations (e.g., virtual science labs, historical field trips) that transcend physical

limitations, making learning more inclusive and effective. Thus, despite the potential of emerging technologies in achieving SDG 4, integration in Agricultural Education according to Okafor and Anyanwu (2025) is limited due to some constraints as some educators appear to lack awareness of how some emerging technology tools can be integrated to enhance teaching and learning, some institutions also face epileptic power, and inadequate development of the educators in addition to poor infrastructure are the topmost challenges. Anderson and Kim (2023) revealed that cultural and institutional environment promotes the use of emerging technologies in promoting efficient service delivery but many educators do not make use of these technologies due to challenges of inadequate skills and technical kwon-how and poor training necessary to integrate technologies. Eyamekware and Oyovwi (2023) added that integration of technologies requires adequate measures such as educators training to equip them with the skills to integrated technology along with other instructional strategies to improving learning. Anderson and Kim (2023) also added that adoption of technology also required supply of the required technological tools, supervision and mentorship of educators on application among others. Consequently, it is on this backdrop that the researchers sought to examine emerging technologies for quality Agricultural Education delivery in tertiary institutions in Achievement of Sustainable Development Goals (SDGs) in Abia State, Nigeria.

**Statement of the Problem**

The integration of technologies has become an integral component of every sectors of human life, its rapid emergence and adoption in diverse areas of human endeavours including education is expected to facilitate the actualization of objectives of Agricultural Education in achieving Sustainable Development Goals through students' exposure to essential digital competencies to enhance their employability and job creation abilities. Therefore, the need for integration of emerging technologies to equip students with requisite knowledge and skills in Agricultural Education for achieving Sustainable Development Goals remains sacrosanct.

Unfortunately, integration of emerging technology tools for quality Agricultural Education delivery in tertiary institutions in Nigeria and particularly in Abia State seems to be avoided. This is because many Agricultural educators lack adequate technical know-how and digital compliance in adoption of relevant technology for teaching. More so, many educators are confronted with limited availability of emerging technology tools while where some are available they lack adequate technical support to adopt the available technology tools to compliment the traditional teaching approach. This is because most vocational educators are not digital enthusiastic and are not provided with robust training to update their competency to embrace digital technologies in teaching and learning while many institutions also lack modern technological tools to facilitate teaching and learning. As such contributes to half-bake Agricultural Education graduates which lead increase gradates unemployment. Thus, it is against this backdrop it became necessary to examine with empirical evidence on emerging technologies for quality Agricultural Education delivery in Achievement of Sustainable Development Goals (SDGs) in tertiary institutions in Abia State, Nigeria.

**Purpose of the Study**

The purpose of this study is to examine emerging technologies for quality Agricultural Education delivery in Achievement of Sustainable Development Goals (SDGs) in tertiary institutions in Abia State, Nigeria. Specifically, the study sought to:

1. examine emerging technology tools required for quality Agricultural Education delivery in Achieving Sustainable Development Goals (SDGs) in tertiary institutions.
2. ascertain emerging technology tools utilized for quality Agricultural Education delivery in Achieving Sustainable Development Goals (SDGs) in tertiary institutions.
3. find out the constraints to integrating emerging technology tools in Agricultural Education Delivery for Achievement of Sustainable Development Goals (SDGs) in tertiary institutions.

**Research Questions**

The following research questions guided the study:

1. What are the emerging technology tools required for quality Agricultural Education delivery in Achieving Sustainable Development Goals (SDGs) in tertiary institutions?
2. What are the emerging technology tools utilized for quality Agricultural Education delivery in Achieving Sustainable Development Goals (SDGs) in tertiary institutions?
3. What are the constraints to integrating emerging technology tools for quality Agricultural Education delivery in Achieving Sustainable Development Goals (SDGs) in tertiary institutions?

**Research Hypotheses**

The following null hypotheses were formulated and tested at 0.05 level of significance.

**H0$_1$**: There is no significant different between the mean responses of agricultural educators and students on the emerging technology tools required for quality Agricultural Education delivery in Achieving Sustainable Development Goals (SDGs) in tertiary institutions.

**H0$_2$**: There is no significant different between the mean responses of agricultural educators and students on the emerging technology tools utilized for quality Agricultural Education delivery in Achieving Sustainable Development Goals (SDGs) in tertiary institutions.

**H0$_3$**: There is no significant different between the mean responses of agricultural educators and students on the constraints to integration of emerging technology tools for quality Agricultural Education delivery in Achieving Sustainable Development Goals (SDGs) in tertiary institutions.

**Methodology**

The design of the study was descriptive survey research design. Nkwocha and Akanwa (2017) described survey research design as a design which seeks or uses the sampled data of an investigation to document, describe and explain what is in existence, or non-existence, or present status of a phenomena being investigated. The population of the study was 80 comprising 25 Agricultural Educators and 55 final year Agricultural Education students in three tertiary institutions in Abia State which include Michael Okpara University of Agriculture, Umudike, Abia State University, Uturu and College of Education Arochukwu, Abia State (Tertiary Institutions Academic Staff and students Record, 2025). The entire population was selected in the study using census sampling technique since it was manageable by the researcher. The instrument for data collection was a structured questionnaire developed by the researchers and validated by three experts, two from Agricultural and Vocational Education and one from Measurement and Evaluation, all from College of Education, Michael Okpara University of Agriculture, Umudike. The questionnaire was designed using four-point response scales of: Very Highly Required (HR) 4, Highly Required (R) 3, Slightly Required (SR) 2 and Not Requird (NR) 1 for research question one and Strongly Agree (SA) 4, Agree (A) 3, Disagree (D) 2 and Strongly Disagree (SD) 1 for research question two and three. The reliability coefficient of the instrument was 0.81, 0.82 and 0.78 for each cluster and overall reliability coefficient of 0.80 obtained using Cronbach Alpha statistic considered adequate for the study. The instrument was administered by the researcher with the help of three research assistants adequately briefed to facilitate high rate of questionnaire returns. A total of 80 copies of questionnaire were administered and 72 copies were retrieved completely filled which representing 90% rate of returns. Data collected from the respondents were analyzed using Mean and Standard deviation to answer the research questions that guided the study while t-test statistic was used to test the null hypotheses at 0.05 level of significance. Therefore, the mean cut-off mark of 2.50 and above was considered as required/agreed while the mean cut off below 2.50 was considered as not required/disagreed. The standard deviation was used to ascertain the homogeneity of the respondents' response to the items in the instrument. The decision rule in testing the hypotheses; the p-values were compared with the alpha level. The null hypothesis was accepted if the p-value is greater than 0.05 alpha level of significance and rejected when it is otherwise.

**Results**

**Research Question 1:** What are the emerging technology tools required for quality Agricultural Education delivery in tertiary institutions in Achieving Sustainable Development Goals (SDGs)?

**Table 1:** *Mean and Standard Deviation Responses of the Respondents on the Emerging Technology Tools Required for Quality Agricultural Education Delivery in Tertiary Institutions in Achieving Sustainable Development Goals (SDGs)*

| S/N | ITEM STATEMENTS | $\bar{X}_1$ | $S_1$ | $\bar{X}_2$ | $S_2$ | Rmrks. |
|---|---|---|---|---|---|---|
| 1. | Interactive Whiteboard | 3.50 | 0.64 | 3.30 | 0.75 | Required |
| 2. | Google classroom | 3.44 | 0.50 | 3.04 | 0.65 | Required |
| 3. | Flipped classroom | 3.34 | 0.77 | 3.18 | 0.39 | Required |
| 4. | Projectors/Overhead Projectors | 3.36 | 0.48 | 3.30 | 0.69 | Required |
| 5. | Laptop Computer | 3.52 | 0.70 | 3.09 | 0.81 | Required |
| 6. | Smartphones | 3.32 | 0.68 | 3.18 | 0.58 | Required |
| 7. | Smart Educational Tablets | 3.62 | 0.63 | 3.53 | 0.63 | Required |
| 8. | Internet | 3.58 | 0.73 | 3.18 | 0.58 | Required |
| 9. | **Virtual Farms/Labs** | 3.42 | 0.64 | 3.13 | 0.63 | Required |
| 10. | Zoom Cloud | 3.60 | 0.53 | 3.22 | 0.61 | Required |
| 11. | Camcorders/Video Cameras | 3.74 | 0.48 | 3.23 | 0.68 | Required |
| 12. | Internet of Things (IoT) Sensors | 3.68 | 0.58 | 3.19 | 0.58 | Required |
| 13. | Drones | 3.32 | 0.65 | 3.27 | 0.45 | Required |
| 14. | Handheld GPS devices | 3.50 | 0.67 | 3.15 | 0.71 | Required |
| 15. | Automated planting/spraying systems/robotic weed control systems | 3.36 | 0.72 | 3.04 | 0.78 | Required |
| | **Grand Mean** | **3.48** | **0.62** | **3.20** | **0.63** | Required |

*Keys: $\bar{X}_1$-mean of Agricultural Educators, $\bar{X}_2$- mean of Agricultural students, $S_1$-standard deviation of Agricultural Educators, $S_2$- standard deviation of Agricultural students, Rmrks = Remarks.*

Table 1 above shows that the mean responses of the respondents range from 3.04-3.74 which are all above the cut-off point of 2.50. This implies that the 15 items are the emerging technology tools required for quality Agricultural Education delivery in tertiary institutions in Achievement of Sustainable Development Goals (SDGs). Also, the standard deviation of all the 15 items ranges from 0.39-0.81 which shows that the responses of the respondents are close to one another in their responses and that they were not far from the cluster mean.

**Hypothesis 1:** There is no significant different between the mean response of agricultural educators and students on the emerging technology tools required for quality Agricultural Education delivery in tertiary institutions in Achieving Sustainable Development Goals (SDGs).

**Table 2:** *t-test Analysis of the Mean Responses of Agricultural Educators and Students on the Emerging Technology Tools Required for Quality Agricultural Education Delivery in Tertiary Institutions in Achieving Sustainable Development Goals (SDGs)*

| Variables | X | SD | N | Df | t-calculated | p-value | Remark |
|---|---|---|---|---|---|---|---|
| Agricultural Educators | 3.48 | 0.62 | 22 | | | | |
| | | | | 70 | 1.75 | 0.42 | Not Significant |
| Agricultural Students | 3.20 | 0.63 | 50 | | | | |

The data presented in Table 2 show a p-value of 0.42 which is greater than the alpha level of 0.05. This indicates that there was no statistically significant difference between the mean responses of agricultural educators and students on the emerging technology tools required for quality Agricultural Education delivery in tertiary institutions in Achievement of Sustainable Development Goals (SDGs). Therefore, the hypothesis of no significant difference between the mean responses of agricultural educators and students on the emerging technology tools required for quality Agricultural Education delivery in tertiary institutions in Achievement of Sustainable Development Goals (SDGs) was not rejected.

**Research Question 2:** What are the emerging technology tools utilized for quality Agricultural Education delivery in tertiary institutions in Achieving Sustainable Development Goals (SDGs)?

**Table 3:** *Mean and Standard Deviation Responses of the Respondents on the Emerging Technology Tools Utilized for Quality Agricultural Education Delivery in Tertiary Institutions in Achieving Sustainable Development Goals (SDGs)*

| S/N | ITEM STATEMENTS | $\bar{X}_1$ | $S_1$ | $\bar{X}_2$ | $S_2$ | Rmrks. |
|---|---|---|---|---|---|---|
| 1. | Interactive Whiteboard use for dynamic and engaging lessons delivery using videos and animations | 2.48 | 0.88 | 2.23 | 0.63 | Disagreed |
| 2. | Google classroom for managing course content, assignments, and grades | 2.48 | 1.21 | 2.32 | 1.01 | Disagreed |
| 3. | Flipped classroom for active and interactive learning before and during class | 2.44 | 0.92 | 2.18 | 0.62 | Disagreed |
| 4. | Projectors/Overhead Projectors use to display presentations (e.g., PowerPoint slides) or other visual aids to the class | 2.36 | 0.70 | 2.19 | 0.60 | Diagreed |
| 5. | Laptop Computer for accessing educational software, online resources, and creating presentations | 3.39 | 0.95 | 3.14 | 0.85 | Agreed |
| 6. | Smartphones used for communication accessing e-learning platforms, and as instructional tools for interactive learning | 3.32 | 0.47 | 3.19 | 0.74 | Agreed |
| 7. | Educational Tablets for accessing educational resources, and tasks delivery | 2.48 | 0.86 | 2.22 | 0.65 | Disagreed |
| 8. | Internet for research, accessing current information and sharing of learning resources in Agricultural Education | 3.14 | 0.96 | 3.09 | 0.98 | Agreed |
| 9. | Virtual Farms/Labs for training and experimentation to bridge the knowledge and practical application gap where physical access is limited or hazardous | 2.47 | 0.88 | 2.25 | 0.79 | Disagreed |
| 10. | Zoom Cloud use to facilitate remote and blended learning, enabling communication, content sharing, and collaboration | 2.46 | 0.88 | 2.30 | 0.52 | Disagreed |
| 11. | Camcorders/Video Cameras used for recording simulated teaching sessions for later review and analysis | 2.40 | 0.71 | 2.20 | 0.83 | Disagreed |
| 12. | Internet of Things (IoT) Sensors use in teaching students how to monitor and understand environmental conditions and optimize resource usage | 2.10 | 1.25 | 2.02 | 1.15 | Disagreed |

| | | | | | | |
|---|---|---|---|---|---|---|
| 13. | Drones use for aerial field monitoring, crop health assessment, irrigation management, and targeted agrochemical application | 2.32 | 0.94 | 2.12 | 0.95 | Disagreed |
| 14. | Handheld GPS devices use for teaching field mapping, data logging, and variable rate application of seeds or fertilizers | 2.34 | 1.22 | 2.26 | 0.68 | Disagreed |
| 15. | Automated planting/spraying systems/robotic weed control systems for teaching coding, and operation through practical training | 2.46 | 0.81 | 2.35 | 0.81 | Disagreed |
| | **Grand Mean** | **2.57** | **0.90** | **2.40** | **0.78** | Disagreed |

Table 3 show that the mean responses of the respondents on item 1,2,3,4, 7, 9,10, 11, 12, 13, 14 and 15 ranged between 2.02- 2.48 and were below the mean benchmark of 2.50. This indicated the 12 items are the emerging technology tools not utilized for quality Agricultural Education delivery in tertiary institutions in Achievement of Sustainable Development Goals (SDGs). Furthermore, the data also show that the respondents on item 5, 6 and 8 ranged between 3.09- 3.39 and were above the mean benchmark of 2.50. This indicated that the respondents agreed on the 3 items as the emerging technology tools utilized for quality Agricultural Education delivery in tertiary institutions in Achievement of Sustainable Development Goals (SDGs). Also, the standard deviation of all the 15 items ranges from 0.47-1.25 which shows that the responses of the respondents are close to one another in their responses and that they were not far from the cluster mean.

**Hypothesis 2:** There is no significant different between the mean response of agricultural educators and students on the emerging technology tools utilized for quality Agricultural Education delivery in tertiary institutions in Achieving Sustainable Development Goals (SDGs).

**Table 4:** *t-test Analysis of the Mean Responses of Agricultural Educators and Students on the Emerging Technology Tools Utilized for Quality Agricultural Education delivery in tertiary institutions in Achieving Sustainable Development Goals (SDGs)*

| Variables | X | SD | N | Df | t-calculated | p-value | Remark |
|---|---|---|---|---|---|---|---|
| Agricultural Educators | 2.57 | 0.90 | 22 | | | | |
| | | | | 70 | 0.76 | 0.11 | Not Significant |
| Agricultural Students | 2.40 | 0.78 | 50 | | | | |

The data presented in Table 4 show a p-value of 0.11 which is greater than the alpha level of 0.05. This indicates that there was no statistically significant difference between the mean responses of agricultural educators and students on the emerging technology tools utilized for quality Agricultural Education delivery in tertiary institutions in Achievement of Sustainable Development Goals (SDGs).

**Research Question 3:** What are the constraints to integrating emerging technology tools for quality Agricultural Education delivery in tertiary institutions for Achievement of Sustainable Development Goals (SDGs)?

**Table 5:** *Mean and Standard Deviation Responses of the Respondents on the Constraints to Integrating Emerging Technology Tools for Quality Agricultural Education Delivery in Tertiary Institutions in Achievement of Sustainable Development Goals (SDGs)*

| S/N | ITEM STATEMENTS | $\bar{X}_1$ | $S_1$ | $\bar{X}_2$ | $S_2$ | Rmrks. |
|---|---|---|---|---|---|---|
| 1. | Poor availability of emerging educational technology tools | 3.31 | 0.83 | 3.18 | 0.83 | Agreed |

| | | | | | | |
|---|---|---|---|---|---|---|
| 2. | High cost of purchasing and maintaining advanced emerging technology tools | 3.32 | 0.86 | 3.27 | 0.78 | Agreed |
| 3. | Insufficient funding required to procure emerging educational technology tools | 3.20 | 0.82 | 3.18 | 0.60 | Agreed |
| 4. | Limited technical knowledge and digital literacy among staff and students | 3.14 | 0.81 | 3.09 | 0.83 | Agreed |
| 5. | Persistent shortage of qualified agricultural educators | 3.34 | 0.88 | 3.27 | 0.78 | Agreed |
| 6. | Absence of clear, comprehensive institutional and government policies for technology integration | 3.35 | 0.85 | 3.27 | 0.90 | Agreed |
| 7. | Rigid curricula affecting the integration of new technologies | 3.29 | 0.82 | 3.27 | 0.46 | Agreed |
| 8. | Resistance to change by some agricultural educators | 3.33 | 0.91 | 3.18 | 0.98 | Agreed |
| 9. | Insufficient training to effectively use emerging technologies | 3.35 | 0.93 | 3.27 | 0.78 | Agreed |
| 10. | Inadequate specialized technicians to perform repairs | 3.28 | 0.79 | 3.27 | 0.90 | Agreed |
| | **Grand Mean** | **3.29** | **0.85** | **3.22** | **0.78** | Agreed |

Table 3 above shows that the mean responses of the respondents range from 3.09-3.35 which are all above the cut-off point of 2.50. This implies that the 10 items are the constraints to integration of emerging technology tools for quality Agricultural Education delivery in tertiary institutions for Achievement of Sustainable Development Goals (SDGs). Also, the standard deviation of all the 10 items ranges from 0.46-0.98 which shows that the responses of the respondents are close to one another in their responses and that they were not far from the cluster mean.

**Hypothesis 1:** There is no significant different between the mean response of agricultural educators and students on the constraints to integration of emerging technology tools for quality Agricultural Education delivery in tertiary institutions for Achievement of Sustainable Development Goals (SDGs).

**Table 4:** *t-test Analysis of the Mean Responses of Agricultural Educators and Students on the Constraints to Integration of Emerging Technology Tools Required for Quality Agricultural Education delivery in tertiary institutions in Achievement of Sustainable Development Goals (SDGs)*

| **Variables** | **X** | **SD** | **N** | **Df** | **t-calculated** | **p-value** | **Remark** |
|---|---|---|---|---|---|---|---|
| Agricultural Educators | 3.29 | 0.85 | 22 | | | | |
| | | | | 70 | 0.32 | 0.14 | Not Significant |
| Agricultural Students | 3.22 | 0.78 | 50 | | | | |

The data presented in Table 6 show a p-value of 0.14 which is greater than the alpha level of 0.05. This indicates that there was no statistically significant difference between the mean responses of agricultural educators and students on the constraints to integration of emerging technology tools for quality Agricultural Education delivery in tertiary institutions for Achievement of Sustainable Development Goals (SDGs).

**Discussions**

The findings of the study were discussed in accordance with the research questions and hypotheses that guided the study as follows:

It was found from the study that the emerging technology tools required for quality Agricultural Education delivery in tertiary institutions in Achievement of Sustainable Development Goals (SDGs) include: Interactive Whiteboard, Google classroom, Flipped classroom, Projectors/Overhead Projectors, Laptop Computer, Smartphones, Smart Educational Tablets, Internet, **Virtual**

**Farms/Labs,** Zoom Cloud, Camcorders/Video Cameras, Internet of Things (IoT) Sensors, Drones, Handheld GPS devices and Automated planting/spraying systems/robotic weed control systems. Also, the hypothesis tested revealed that there was no statistically significant difference between the mean responses of agricultural educators and students on the emerging technology tools required for quality Agricultural Education delivery in tertiary institutions in Achievement of Sustainable Development Goals (SDGs). This implies that emerging technology tools are required for quality Agricultural Education delivery in tertiary institutions in Achievement of Sustainable Development Goals (SDGs). The findings relate to the study of Kufeoglu (2022) that emerging technologies include educational technology, information and communication technology, nanotechnology, biotechnology, robotics, learning analytics, adaptive learning, mobile learning, immersive classrooms, and artificial intelligence. Also, the finding is in agreement with the study Oyovwi and Akarue (2025) who revealed that Camcorders/Video Cameras, Internet of Things (IoT) Sensors, Drones, Handheld GPS devices are some of the emerging technology tools for quality Agricultural Education delivery.

It was revealed further that Laptop Computer, Smartphones and Internet, were the emerging technology tools utilized for quality Agricultural Education delivery in tertiary institutions in Achievement of Sustainable Development Goals (SDGs). Meanwhile, the corresponding hypothesis tested indicated that there was no statistically significant difference between the mean responses of agricultural educators and students on the emerging technology tools utilized for quality Agricultural Education delivery in tertiary institutions in Achievement of Sustainable Development Goals (SDGs). This implies that emerging technology tools were not adequately utilized for quality Agricultural Education delivery in tertiary institutions in Achievement of Sustainable Development Goals (SDGs). The findings relate to the study of Shings et al. (2021) that technologies are utilized to personalized learning opportunities, provide opportunities for adaptive assessments, automated feedback, and intelligent tutoring systems, addressing diverse student needs, offers immersive, engaging simulations (e.g., virtual science labs, historical field trips) that transcend physical limitations, making learning more inclusive and effective. This also relate with study of Oyovwi and Akarue (2025) who reported that technologies make learning more interactive and motivating, closes the gap between classroom knowledge and workplace skills, prepares graduates for the evolving digital landscape of modern farming.

Lastly, it was found that the constraints to integrating emerging educational technology tools in Agricultural Education Delivery in tertiary institutions for Achievement of Sustainable Development Goals (SDGs) include: poor availability of emerging educational technology tools, high cost of purchasing and maintaining advanced emerging technology tools, insufficient funding required to procure emerging educational technology tools, limited technical knowledge and digital literacy among staff and students, and persistent shortage of qualified agricultural educators among others. The corresponding hypothesis tested indicated that there was no statistical significant difference between the mean responses of agricultural educators and students on the constraints to integration of emerging technology tools for quality Agricultural Education delivery in tertiary institutions for Achievement of Sustainable Development Goals (SDGs). The findings align with the study of Okafor and Anyanwu (2025) revealed that constraints such as lack of awareness, epileptic power, and inadequate development of the educators in addition to poor infrastructure as the limited factors to integration of emerging technology tools in enhancing teaching and learning. The findings is supported by Anderson and Kim (2023) who revealed that cultural and institutional environment promotes the use of emerging technologies in promoting efficient service delivery but many educators do not make use of these technologies due to challenges of inadequate skills and technical kwon-how and poor training necessary to integrate technologies.

**Conclusion**

From the findings of the study, it was concluded that emerging technology tools required for quality Agricultural Education delivery in tertiary institutions for Achievement of Sustainable Development Goals (SDGs) include: Interactive Whiteboard, Google classroom, Flipped classroom, Projectors/Overhead Projectors, Laptop Computer, Smartphones, Smart Educational Tablets, Internet, **Virtual Farms/Labs,** Internet of Things (IoT) Sensors, Drones, Handheld GPS devices and Automated planting/spraying systems/robotic weed control systems among others. Also, Laptop Computer, Smartphones and Internet, were the emerging technology tools utilized for quality Agricultural Education delivery in tertiary institutions in Achievement of Sustainable Development Goals (SDGs) while constraints to integrating emerging educational technology tools in Agricultural Education Delivery include: poor availability of emerging educational technology tools, high cost of purchasing and maintaining advanced emerging technology tools, insufficient funding required to procure emerging educational technology tools, limited technical knowledge and digital literacy among staff and students, and persistent shortage of qualified agricultural educators among others.

**Recommendations**

Based on the findings it was recommended that:

1. There is need for United Nations Educational, Scientific and Cultural Organization to collaborate with tertiary institutions especially in Abia State to provide emerging technology tools required for quality Agricultural Education delivery in tertiary institutions in Achieving Sustainable Development Goals (SDGs).
2. Agricultural Educators should endeavours to engage in diverse technology training to boost their competencies to enhance the utilization of emerging technology tools for quality Agricultural Education delivery in tertiary institutions in Achieving Sustainable Development Goals (SDGs).
3. The Federal Government of Nigeria along with Abia state Government should endeavor to address the constraints retarding quality Agricultural Education delivery in terms of adequate funding, provision of technology tools and adequate training of educators among others for Achievement of Sustainable Development Goals (SDGs).

**References**

Anderson, J., & Kim, S. (2023). Data-driven decision making in education: The Role of Artificial Intelligence. *Educational Research Review*, 25(3), 112-130.

Aka, C. & Onoyima, N. (2023). Emerging technologies required for Sustainable Development Goals (SDGs) in secondary school administration in Enugu State. *ESUT Journal of Education (EJE)*, 6(1), 196-204.

Egenti, U. P. & Obumse, N. A. (2021). Basic information and communication technology (ICT) competencies required for occupational efficiency of guidance and counselling lecturers in tertiary institutions in southeast Nigeria. *Sapientia Foundation Journal of Education, Sciences and Gender Studies (SFJESGS)*, 3(1), 1 – 12.

Eyamekware, P. & Oyovwi, E. O. (2023). Adopting questioning instructional strategy in biology curriculum delivery to enhance students' achievement and interest in Delta Central Senatorial District. *International Journal of Research in Education and Sustainable Development*, 3(9) 25-38.

Kufeoglu, S. (2022). Emerging technologies. Value Creation for Sustainable Development. Department of Engineering, University of Cambridge, Cambridge UK

Mormah, M. C., & Bassey, I. F. (2019). Impact of emerging technologies on classroom engagement and learning outcomes. *Journal of Educational Innovations*, 5(2), 15–28.

National Teachers Institute (2020). Information and Communication Technology Module for retraining of Basic Teachers in Nigeria. FME/NTI Kaduna, Sustainable Developmental Goals (SDGs) Project.

Nkwocha, P. C. & Akanwa, U. N. (2017). *Comprehensive educational guide with illustrations: for students and researchers*. Owerri: Mercy Divine Publishers.

Okafor, W. N. & Anyanwu, A. N. (2025). Teachers' awareness and utilization of Artificial Intelligence (AI) tools for curriculum implementation in secondary schools in Anambra State, Nigeria. *Journal of Guidance and Counselling Studies (JGCS), 9 (*1), 152-161.

Oyovwi, E. O. & Akarue, B. O. (2025). Enhancing Agricultural Education in The 21st Century through comprehensive teacher training. *International Journal of Academic Multidisciplinary Research (IJAMR),* 9 (7), 154-162.

Phipps, L.J., Osborne, E.W., Dyer, J.E. & Ball, A.I. (2018). *Handbook on agricultural education in public schools*. Delmar Learning.

Shiekuma, F. T., Apagu, L. & Segun, J. O. (2020). Information and communication technology skills application in teaching and research by lecturers in some selected universities in Nigeria. *Covenant Journal of Library & Information Science,* 3(1) 1-11.

Shings, J. A.& Lah, B.& Mono, D. A. (2021). Crises between quality and quantity education in Nigeria. *ABSU Journal of Educational Studies, 8* (1) 137-144.