Direct Research Journal of Education and Vocational Studies

Vol. 7(1), Pp. 7-15, February 2025,

https://journals.directresearchpublisher.org/index.php/drjevs

Research Article
ISSN: 2734-2174

Bottlenecks in applying Chemistry knowledge for commercial purpose as viewed by graduates' students of Ignatius Ajuru University of Education

Chinda, Worokwu

Department of Chemistry, Faculty of Natural and Applied Sciences, Ignatius Ajuru University of Education, Rumuolumeni, Port Harcourt, Nigeria.
Author email: wororolly@gmail.com

ABSTRACT

The study examined the bottle necks in applying chemistry knowledge for commercial purpose as viewed by graduate student in Ignatius Ajuru University of Education. A descriptive survey research design was employed, three (3) research questions and three (3) hypotheses was adopted. The population of the study comprises of all 2023 Chemistry graduate in Ignatius Ajuru University of Education. A sample size of 115 students was selected through simple random sampling. Data was collected using a self-structured questionnaire titled "Bottlenecks for applying chemistry knowledge questionnaire" (BCKQ) and was validated by experts in the Science education department of Ignatius Ajuru University of Education, Rumuolumeni. The reliability of the instrument was obtained through a test re-test and a reliability coefficient of 0.82 The method of data analysis was obtained using mean scores and standard deviation for research questions while t-test and ANOVA was used to analyze the hypotheses at 0.05 level of significance. The findings of this study indicate that while chemistry graduates recognize the value of laboratory facilities for their training and have positive attitudes towards applying their knowledge in commercial settings, they encounter significant challenges in accessing the necessary funding and resources for commercialization. The study recommends among others to develop and integrate more hands-on laboratory experiences and industry internships into the curriculum to provide students with practical skills and exposure to commercial applications of chemistry.

Keywords: *Bottlenecks, Chemistry knowledge, commercial purpose*

Article information
Received 14 January 2025;
Accepted 10 February 2025
Published 17 February 2025
DOI: https://doi.org/10.26765/DRJEVS41082569

Citation: Worokwu, C. (2025). Bottlenecks in applying Chemistry knowledge for commercial purpose as viewed by graduates' students of Ignatius Ajuru University of Education. *Direct Research Journal of Education and Vocational Studies*. Vol. 7(1), Pp. 7-15. This article is published under the terms of the Creative Commons Attribution License 4.0.

INTRODUCTION

Science education is designed to create well-informed citizens who possess the right mix of intelligence, creativity, and practical skills. These individuals will be able to use their hands, hearts, and heads to create jobs and become financially independent (Okoli, 2019, Igbo, 2011). According to Njoku (2014), the teaching of chemistry as an intellectual quest entailing the investigation of scientific explanations, an activity vital to the present-day pursuit of economic and technological advancement. Along the same fruitless, Humber, 2019 provide a description of chemistry education as an instructional process that mostly takes place in educational institutions with the goal of enhancing students' environmental literacy and equipping them with the ability to conduct systematic investigations. All chemistry students in some industrialized nations, including Japan, the United Kingdom, and the United States, participate in a school-to-work curriculum that emphasizes the development of entrepreneurial skills. In addition to helping chemistry majors develop marketable skills, the curriculum eases their transition from university to the workforce, Muelium, (2014). The rate of entrepreneurship education is low in Nigeria, as it is in the majority of developing nations. The main reason why secondary school science students don't have the skills they need to succeed is because they get what is known

as "academic education"—a literal education that trains people for white-collar occupations. There is a strong focus on subject understanding and passing prescribed exams in this kind of education, which is credential aware but de-emphasizes skill growth.

Therefore, certifications are the deciding factor in employment, rather than a person's potential or skills. In other words, the education system prepares its graduate mainly for "white collar jobs or paid employment Okoli, (2019. The result is that the graduates from Nigeria education system are not equipped with appropriate skills and competencies necessary for self-employment and self-reliance. The challenge facing Nigeria today is how to develop entrepreneurial skills in students through effective teaching and learning of chemistry subject in secondary schools.

According to Humber, (2019), entrepreneurship is the willingness to seek out investment opportunities in an environment and be able to establish and run an enterprise successfully based on the identified opportunities. Also, entrepreneurial skills are in-built capabilities or tools that enable an entrepreneur to carry out an entrepreneurial task. An entrepreneur possesses the following attributes: self-discipline, self-nurturing; highly energetic, tolerance of uncertainty, innovativeness, action-oriented and ability to improvise. Teaching of chemistry for skill acquisition therefore, must be directed towards the use of local materials and the materials must be those obtained from the learner's environment. This is why Mkpa, (2013), posited that the best way to help the students to achieve in-built skills is to teach them with local materials which they are familiar with within the localities.

Academic entrepreneurship has the sole objective of commercialization of innovations developed by academic scientists in universities and research institutes via patenting, licensing, startup creation, and academic/university-industry partnerships (Siengel, Veugelers & Wright, 2017; Rothaermel et al., 2017). The concept of academic entrepreneurship became prominent in the US especially in the days of decreasing funding of universities during the Reagan Administration (Grimaldi et al., 2011).

It is necessary to make an effort to teach chemistry in order for science courses to be offered in universities, and this is because chemistry is a science that society needs, so teaching it helps to inculcate scientific knowledge and encourages students to have a science-oriented attitude. Chemistry is both a difficult and rewarding subject; studying it teaches you to think critically, how to ask good questions, and how to solve problems, and it also gives you process skills.

Ababio (2013) listed several chemistry-related occupations, including teaching, health care, food processing, petroleum and photochemical seminars, manufacturing, extractive industries, agriculture, and forestry, among many others. Chemistry is fundamental to nearly every part of modern life and graduates from chemistry programmes can choose from a wide variety of jobs, some of which may not even directly involve chemistry.

Having regular practical classes will help students translate and understand chemical knowledge in relation to scientific facts, laws, and theories, which is one of the main obstacles to the practical application of chemical knowledge (Oginni, Awobodu, Alaka & Saibu 2013). Today is the age of science, and more and more people are working in scientific fields that need chemistry knowledge. Unfortunately, many of our traditional ways of teaching fail to adequately prepare students for success in these fields

Developing the most relevant curriculum for particular student groups is another daunting task (Eilks and Hofstein, 2015). By "most relevant," we mean either preparing students for further study, for a career in chemistry, or for wider citizenship. On the other hand, we mean students' perceptions of what is relevant to their lives, interests, and concerns, which may or may not overlap. Learners' perceptions of the relevance of a course have a significant impact on their motivation to complete the course, their achievement in it, and whether or not they progress to other courses.

The field of chemistry education research has recently grown into its own entity, with its own journals, research groups, conferences, etc. Once again, a major focus of chemistry education research has been on how students think and learn within specific subject areas, with a lot of focus on how students understand canonical chemical concepts and the nature of their own conceptions (Taber, 2018).

Despite chemistry's ubiquitousness, pervasiveness, and indispensability, as well as the vast career possibilities it offers, there is a noticeable and alarming decline in enrollment in the subject in Nigerian universities, especially private ones (Abanikannda, 2016). In some instances, there are as few as four students enrolled, and in other extreme cases, there is no enrollment at all. Several other studies have confirmed and documented this phenomenon of low chemistry enrollment in Nigerian tertiary institutions (Aina & Akanbi, 2013; Aderemi, Hassan, Siyanbola, & Taiwo, 2013; Osokoya, 2015). Glory (2020) pointed out that chemistry was noticeably absent from the list of 21 most popular courses in Nigerian universities. Science, according to Okoro (2013), is the study and use of natural phenomena for the benefit of humankind via methodical examination. Chemistry is at the heart of the movement towards sustainable economic development on a global scale. It is essential in many areas, including agriculture (fertilizers and insecticides), textiles, construction (cement, concrete, steel, and bricks), healthcare (drugs), and transportation (fuel, alloy materials). At the moment, humanity is living through a period of rapid scientific and technological advancement

that impacts every aspect of his life. Almost every product we use on a daily basis is base. Chemistry education is the process of systematically acquiring the fundamental knowledge about the universe. With this knowledge, man can shape and reshape his world for his benefit. Therefore, the development of a nation is typically measured by the growth it experiences through science education, and chemistry education is a gateway to this growth. Chemistry education is the means by which people in need of development capacities and potentials receive chemical knowledge and skills. Additionally, chemical education addresses the social objective of substance development, as education is now a primary means of empowerment, participation, cultural preservation, social mobility, and equity (Emmanuel, 2013).

According to Hornby, (2010), chemistry plays an important role in bringing manufacturing inventories and sculpting, designing, etc. to bear. It is argued that an improvement in this position requires the further development of the nature and quality of chemical education to chemical industries through intensive and extensive research. Chemistry education is needed in the professional development of chemical industries required in the establishment of modern technology and operation of chemical industries.

Chemical education also helps with the social goal of substance development, which is important since education is one of the main ways to promote equality, empowerment, cultural preservation, social mobility, and participation (Emmanuel, 2013).

Okunug & Ajeyalemi (2018) investigated the knowledge and skills required of chemists in chemical-based industries were compared to those in the undergraduate chemistry curriculum in Nigeria to establish whether there were gaps between the two. In a questionnaire survey, 120 chemists in 20 chemical-based industries gave their views of the extent to which the chemistry curriculum reflected industry needs for knowledge and skills. The data generated were analyzed using means and paired sample *t*-tests. The results indicate that the Nigerian university chemistry curriculum is broad-based and sufficiently relevant to meet the theoretical knowledge requirements of chemical-based industries, but that it fails to meet their minimal skills requirements. While chemistry graduates have greater knowledge than is required for work in chemical-based industries, their skills level is below the industry requirement. The curriculum therefore needs to be restructured so that its skills acquisition component is improved.

Okolie et al. (2021) investigated how Nigerian higher education institutions can facilitate industry involvement in the design of programmes and activities that enhance the development of students' knowledge and skills for business start-ups, leading to job creation. Using interview and focus group methodologies, the researchers obtained rich information from 50 participants, including higher education teachers, final year undergraduate students who had taken part in the compulsory Student Industrial Work Experience Scheme and industry executives with an understanding of how industry can make a meaningful contribution to learning in higher education. Focusing on four dominant themes from the thematic analysis, the authors analyze the factors that contribute to students' knowledge and skill development. Building on human capital theory, they make recommendations for curriculum restructuring, renewed pedagogical approaches and competencies, building linkages between higher education and industry and career training and mentoring to enhance the development of students' knowledge and skills for job creation.

Szeberényi et al. (2022) investigated the perception and awareness level of renewable energy among various groups of people around the world. Not much is known about the perception and knowledge level of undergraduate engineering students in Nigeria towards renewable energy, even though her engineering students have a crucial role to play in ushering the country into the net-zero carbon economy of the future. This research was carried out to provide answers to questions concerning the perception and awareness level of engineering students in Nigeria towards renewable energy. Quantitative data obtained via a questionnaire survey showed that 98.1% of the engineering students agreed to have heard about renewable energy, while only 24% are highly confident about their understanding of renewable energy. 76% agreed that renewable energy is not part of their undergraduate curriculum, and 90.1% want renewable energy to be included in their curriculum. From the findings it was observed that there is an equal understanding of renewable energy among male and female engineering students in Nigerian universities. The challenges associated with introducing renewable energy into undergraduate engineering programs and the strategies for deploying renewable energy into the undergraduate curriculum for engineering students were discussed. A new curriculum with renewable energy education was proposed. This study would be beneficial to the Nigerian government and relevant university regulatory bodies in Nigeria, such as the Nigerian Universities Commission (NUC), and the Council of Registered Engineers in Nigeria (COREN), in making decisions as regards engineering students in Nigeria and in drafting renewable energy policies.

Akanbi and Omoniyi (2024) determined the awareness and the interest of chemistry students on the usage of chemical concepts in tie and dye for entrepreneurship skills development in Kwara State. The populations were all science students in the public secondary schools in Kwara state and the sample consisted of 110 SSII science students. Two instruments are used in collection of data. A pilot test was conducted involving 20 non participants and the reliability coefficient of r = 0.82 and r - 0.83 was

establish using Cronbach Alpha. Research questions were answered using means and standard deviation while research hypotheses were tested at p = 0.05 using t-test. The results showed that there is significant difference in the male and female awareness and interest at (p>0.05)). The study concluded that male and female secondary school students in Kwara State have high awareness and interest on the usage of knowledge of chemical concepts in tie and dye for entrepreneurship skills development in Kwara State. The study therefore recommended that there is an urgent need for the government and education stakeholders to develop a comprehensive framework to see how entrepreneurship skills acquisition could be part of core course in the chemistry school curriculum and teacher should see chemistry teaching beyond the classroom situation.

Ojokuku et al. (2015) examined the influence of Students Industrial Work Experience Scheme on Professional Development of Library and Information Science Students in South-West, Nigeria. Descriptive research design was adopted for the study and total enumeration sampling technique was used to select 277 respondents covering three institutions; Adeleke University, Ede Osun state, University of Ibadan, Ibadan and Tai Solarin University of Education, Ijebu Ode, Ogun state. The respondents are students who have gone through student industrial experience scheme. Questionnaire was the instrument used for data collection. Data collected was analysed using descriptive statistics and simple percentages. Findings revealed that majority of LIS students understudied had their trainings in the libraries. The facilities available at the places of training included: computer laboratories, internet services, e-libraries and audio-visuals. Computer laboratory and internet facilities had the greatest frequencies 207(93.7%) each These accounted for the students' perceptions that SIWES influences professional development positively with response rate of 216 (97.7%) agreement, and that SIWES exposed them to new work methods also with response rate of 216 (97.7%) agreement. It was also discovered that SIWES provides avenue for technical skill development with response rate of 208(94.1%) in agreement. Noticeable challenges facing SIWES include finance, students' placements as a result of non-acceptance of students by some employers into their establishments, inadequate supervision of trainees as well as irregularity in academic calendar of institutions among others. It was recommended that institutions and other stakeholders should look keenly into the modalities and operations of the scheme to allow the scheme achieve its stated objectives.

Bandele and Faremi (2012) investigated the challenges facing the implementation of Technical College Curriculum in South West, Nigeria. The purpose was to determine whether the Teachers and Instructors that implement the curriculum are professionally qualified or not and to investigate other challenges facing the teaching and learning of Technical and Vocational Education in Technical Colleges. The study employed survey research design; the sample consisted of 120 Basic Science Teachers and Technical Instructors selected from Technical Colleges in two States (Ondo & Ekiti) using multistage sampling technique. Questionnaire on Challenges Facing Curriculum Implementation (QCFCI) with reliability coefficient of 0.72 was used to collect necessary data. The data collected were analysed using descriptive and inferential statistics. The study revealed that 65.83 percent of the Teachers and Instructors are professionally qualified to teach in Technical Colleges. The study highlights the following as the major challenges facing the implementation of the modular Curriculum in South West, Nigeria: lack of in-service training and poor condition of service of Teachers and Instructors, outdated equipment, unstable government policy; lack of standard workshop for practical work and lack of related modern instructional materials. The study also revealed that there was no significant difference between the view of the Instructors and Teachers on the challenges facing the implementation of the curriculum. In conclusion many factors are responsible for poor implementation of Technical College Curriculum as identified in the study. It was recommended among others that the government should provide the necessary and required human and nonhuman resources needed in Technical Colleges. Baro et al. (2017) investigated the extent to which academic staff members in tertiary institutions in Nigeria access research grants, and to bring to light the factors that hinder their effort to accessing research grants. An online questionnaire was designed using the Survey Monkey software to collect the qualitative data from academic staff in tertiary institutions in Nigeria. The study revealed that only a few number of academic staff members in the tertiary institutions in Nigeria have received research grants. The study also revealed that a large number of research works carried out by academic staff are funded by themselves from the meager salary they receive. It also emerged that Tertiary Education Trust Fund is the highest funding body that academic staff have received research grants from. Different research funding agencies/organizations both local and international that support studies in Nigeria were also mentioned to create awareness for others to utilize. Politics in the selection of research proposals, inadequate publicity/advertisement for research grants applications and lack of knowledge about funding agencies/organizations were identified as the most mentioned hindrances to accessing research grants in Nigeria. These results show the need for the introduction of climate change studies in Nigerian universities, with over 71% of participants believing that climate change studies should be included as a required course in both undergraduate and postgraduate studies.

Mainga et al. (2022) examined the perceptions of business

students on their employability skills at the point of graduation. The study was partially driven by past research which identified lack of soft skills as one of the main contributing factors in younger workers' dismissal from work, and the need to understand the level of employability skills younger graduates have at graduation. An exploratory descriptive research methodology was used for the study. A survey was administered to 189 fourth-year business students. In total, 90 students filled-in the questionnaire, representing a 47.6% response rate. Based on a structured survey questionnaire administered to final-year undergraduate business students, the four most important employability skills for recruitment to entry-level positions are communication skills, learning skills, positive attitudes and behaviours, and problem-solving skills. The main prominent result was that 'learning skills' were ranked the second most important employability skills. In today's fast-paced, rapidly changing work environments that are characterised by rapid knowledge obsolescence and an unknown future, willingness to learn and proactive lifelong learning are key to sustaining long-term graduate employability. Students seem to be satisfied with their perceived level of academic, personal management, and teamwork skills they possessed at the point of graduation. However, there are possible areas for further improvement regarding creativity and innovative skills, and ability to 'resolve and management conflicts' in teamwork. The study found that students used a combination of traditional and student-centred learning methods and pedagogies to acquire employability skills. As business students approach graduation, it is important to focus on areas they can improve and emphasize self-directed lifelong learning throughout their careers. The study confirms the role of external factors—labour market demand—in influencing *perceived employability*.

Aim and objectives of the study

The aim of this study is to examine the bottle necks in applying chemistry knowledge for commercial purpose as viewed by graduate student in Ignatius Ajuru University of Education. Specific Objectives includes:

(a) To examine the availability of laboratory facilities and resources for the effectiveness of practical training in chemistry education based on gender.
(b) To ascertain the attitudes of graduates towards the application of their chemistry knowledge in commercial endeavor based on their first degree obtained.
(c) To determine the challenges chemistry graduates face in accessing funding and resources necessary for commercial research and knowledge based on age.

Research questions

The following Research Questions guided the study:

(a) What is the mean response of graduates on the availability of laboratory facilities and resources affecting the effective practical training in chemistry education based on gender?
(b) What is the attitude of graduates towards the application of their chemistry knowledge in commercial endeavor based on their first degree obtained?
(c) What are the challenges do chemistry graduates face in accessing funding and resources necessary for commercializing their research and knowledge based on age?

Hypotheses

(a) There is no significant mean differences on the responses of male and female graduates on the availability of laboratory facilities and resources affecting the effective practical training in chemistry education.
(b) The attitude of graduates towards the application of their chemistry knowledge in commercial endeavors based on their first degree obtained do not differ significantly.
(c) There is no significant mean differences on the responses of chemistry graduates concerning challenges face in accessing funding and resources necessary for commercializing their research and knowledge based on age.

METHODOLGY

Research design

This study adopted descriptive research survey design .The design was suitable for the study as the study sought to examine the challenges in applying chemistry knowledge for commercial purpose by graduate student in Ignatius Ajuru University of Education.

Population of the study

Population of a study is a group of persons or things the researcher is interested in gathering information relevant the challenges in applying chemistry knowledge for commercial purpose by graduate student in Ignatius Ajuru University of Education. A total number of One Hundred and Twenty (120) students in Ignatius Ajuru University of Education will be selected as the population of the study.

Sample and sampling technique

The sample was made up of One Hundred and Twenty (120) Chemistry graduate students in Ignatius Ajuru University of Education. Out of One hundred and Twenty (120) questionnaires, One Hundred and fifteen (115) questionnaires were returned. The researcher employed simple random sampling technique to ensure a successful

sample selection.

Instrument for data collection

The instrument used for the collection of data is the questionnaire. It contained fifteen (15) constructed questions. Section A were to examine the availability of laboratory facilities and resources for the effectiveness of practical training in chemistry education based on gender, section B were to ascertain the attitudes of graduates towards the application of their chemistry knowledge in commercial endeavor based on their first degree obtained, while section C were to determine the challenges chemistry graduates face in accessing funding and resources necessary for commercial research and knowledge based on age. The questionnaire was constructed on modified points as four (4) points, strongly agreed (SA), three (3) points Agreed (A), two (2) points Disagreed (D), Strongly Disagreed (SD) one (1) point.

Validity of the Instrument

The instrument was validated by experts in the Science education. The instrument used in data collection that is, the questionnaire was certified, accurate and suitable for its purpose. The questionnaire constructed was such that it reflects the objectives of the study.

Reliability of the instrument

The reliability coefficient of the instrument was 0.82 determined by test retest method using Pearson Product Moment Correlation coefficient formula.

Administration of instrument

The administration and data collection of questionnaire was done by the researcher. A total of One hundred and Twenty (120) copies was distributed to the graduates and One Hundred and fifteen (115) were completed and returned.

Method of data analyses

Mean and standard deviation was used to answer the research questions, while t-test and ANOVA was used to test the null hypotheses, at 0.05 level of significance.

RESULTS

Research Question One: What is the mean response of graduates on the availability of laboratory facilities and resources affecting the effective practical training in chemistry education based on gender?

Table 1 shows the research question on the Availability of Laboratory facilities and Resources for effective practical training in Chemistry, however the analysis of the table shows that majority of the respondents agreed and strongly agreed from item 1 – 5 with their mean score greater or equal to 2.5, which is accepted.

Research Question Two: What is the attitude of graduates towards the application of their chemistry knowledge in commercial endeavor based on their first degree obtained?

Table 2 shows the research question on the graduate students Attitude towards the application of Chemistry Knowledge in commercial endeavours. However the analysis of the table shows that from item 1 – 5 has the highest percentage of respondents that agreed and strongly agreed with their mean score greater or equal to 2.5 which is accepted.

Research Question Three: What are the challenges do chemistry graduates face in accessing funding and resources necessary for commercializing their research and knowledge based on age?

Table 3 shows the research questions on the Challenges chemistry graduates in accessing fund and resources for commercializing their Chemistry Knowledge. However, the analysis of the table shows that majority of the respondents agreed and strongly agreed from item 1 – 5 with their mean score greater or equal to 2.5 which implies that all the item are challenges encountered by graduates.

HO_1: There is no significant mean differences on the responses of male and female graduates on the availability of laboratory facilities and resources affecting the effective practical training in chemistry education**.**

Table 4 shows the t-test analysis of the gender differences in responses regarding the availability of laboratory facilities and resources. The result indicates that the t-value is -1.03, with a significance level of .304, which is greater than the 0.05. This means that there is no significant difference between the responses of male and female graduates. Hence, the null hypothesis (HO_1) is accepted. This suggests that both male and female graduates share similar views regarding the availability of laboratory facilities for effective practical training in chemistry education.

HO_2: The attitude of graduates towards the application of their chemistry knowledge in commercial endeavors based on their first degree obtained do not differ significantly.
Table 5 presents the t-test analysis of the difference in graduates' attitudes towards applying their chemistry knowledge in commercial endeavors based on their

Table 1: Availability of Laboratory facilities and Resources for effective practical training in Chemistry.

Items	SA 4	A 3	D 2	SD 1	N	FX	$\bar{X}$	Remarks
The lack of up-to-date laboratory facilities hinders students' ability to conduct advanced experiments.	45	53	12	5	115	356	3.1	Accept
Well-maintained laboratory facilities improve my overall learning experience in practical chemistry sessions.	50	42	14	9	115	363	3.2	Accept
Regular maintenance and calibration of laboratory equipment ensure accurate and reliable experimental results.	39	60	16	-	115	368	3.2	Accept
The presence of safety equipment and protocols in the laboratory enhances students' ability to perform experiments safely.	52	48	15	-	115	382	3.3	Accept
Availability of technical support and guidance during laboratory sessions improves the effectiveness of my practical training.	65	30	15	5	115	385	3.3	Accept

Table 2: Graduate students attitude towards the application of chemistry knowledge in commercial endeavors.

Items	SA 4	A 3	D 2	SD 1	N	FX	$\bar{X}$	Remarks
I believe my chemistry knowledge can significantly contribute to commercial innovations.	50	40	20	5	115	365	3.1	Accept
The commercialization of chemistry research is a priority in my academic program.	52	48	15	-	115	382	3.3	Accept
I believe that commercializing chemistry research can lead to significant career advancements.	60	55	-	-	115	405	3.5	Accept
I perceive sufficient support from my university for commercializing chemistry research.	43	55	11	6	115	365	3.1	Accept
I think collaborating with industry partners is essential for commercializing chemistry knowledge.	52	58	5	-	115	392	3.4	Accept

Table 3: Challenges chemistry graduates in accessing fund and resources for commercializing their Chemistry Knowledge.

Items	SA 4	A 3	D 2	SD 1	N	FX	$\bar{X}$	Remarks
Lack of awareness about available funding opportunities hinders my ability to commercialize my research.	55	40	16	4	115	376	3.2	Accept
Insufficient mentorship and guidance on commercializing research pose a challenge.	60	30	15	10	115	370	3.2	Accept
The high cost of patenting and protecting intellectual property is prohibitive.	65	40	10	-	115	400	3.4	Accept
Inadequate entrepreneurial training and business skills limit my ability to attract investors.	55	40	18	2	115	378	3.2	Accept
The limited availability of grants specifically targeting the commercialization of chemistry research is a barrier.	50	40	20	5	115	365	3.1	Accept

degree obtained. The t-value of -1.08 and the significance level of .279, which is greater than 0.05, indicate that there is no significant difference between the responses of graduates with B.ED/B.SC.ED/ degrees and those with B.SC degrees. Therefore, the null hypothesis (HO_2) is accepted, meaning that graduates with different degree types hold similar attitudes towards commercializing their chemistry knowledge.

HO_3: There is no significant mean differences on the responses of chemistry graduates concerning challenges face in accessing funding and resources necessary for commercializing their research and knowledge based on age.

Table 6 shows the ANOVA analysis of the responses of chemistry graduates concerning the challenges they face in accessing funding and resources for commercializing their knowledge based on age. The F-value of 1.154 and a significance level of .319, which is greater than 0.05, suggest that there is no significant difference among the age groups. Thus, the null hypothesis (HO_3) is accepted,

Table 4: Mean, standard deviation and t-test analysis of gender differences in the availability of laboratory facilities and resources.

Variable		N	Mean	SD	T	Df	Sig	Decision
Gender	Male	53	18.83	1.105	-1.03	113	.304	HO_1 Accepted
	Female	62	19.03	.991				

NS = Not significant, P (.304) > 0.05 level of significance.

Table 5: Mean, Standard deviation and t-test analysis based on degree obtained in the attitudes of graduates towards the application of their chemistry knowledge.

Variable		N	Mean	SD	T	df	Sig	Decision
Degree	B.ED/B.SC.ED/	73	12.66	1.030	-1.08	113	.279	HO_2 Accepted
	B.SC	42	12.88	1.109				

NS = Not significant, P (.279) > 0.05 level of significance

Table 6a: Summary of ANOVA analysis on the responses of chemistry graduates based on age.

Variable		N	Mean	SD
Age	20 – 29 year	26	13.62	1.134
	30 – 39 years	69	13.68	1.254
	40 and above	20	14.10	.968

Table 6: b

SV	SS	df	Ms	F	Sig	Decision
Between Group	3.235	2	1.617	1.154	.319	NS
Within Group	156.939	112	1.401			
Total	160.174	114				

NS = Not significant, P (.319) > 0.05 level of significance

implying that graduates from different age groups experience similar challenges in accessing funding and resources for the commercialization of their chemistry research.

DISCUSSION

The findings show that graduates perceive the availability of laboratory facilities and resources as a key factor influencing the effectiveness of practical training in chemistry education. The majority of respondents agreed or strongly agreed with statements about the lack of up-to-date laboratory facilities, regular maintenance of equipment, presence of safety protocols, and technical support. The result reveals that there is no significant gender-based difference in the responses of graduates regarding the availability of laboratory facilities and resources for practical chemistry training this aligns with Akanbi and Omoniyi (2024) and Bandele and Faremi (2012) research that suggests well-maintained laboratory environments are crucial for enhancing learning experiences in science education. The presence of safety measures and technical guidance ensures that students can perform experiments safely and confidently, contributing to a more robust understanding of chemistry concepts. This finding emphasizes the need for continuous investment in laboratory infrastructure to maintain a high standard of practical training in chemistry education. The result reveals that graduates have a positive attitude towards applying their chemistry knowledge in commercial endeavors. Graduates acknowledge the potential of their chemistry knowledge to contribute to commercial innovations and career advancements. Furthermore, they express a belief in the importance of industry partnerships and commercialization of research, which aligns with global trends towards translating academic research into marketable products and services. This finding underscores the importance of embedding entrepreneurship and commercialization components into chemistry programs to equip graduates with the skills needed to pursue career opportunities beyond academia. This finding suggests that irrespective of the degree type, graduates share similar views on the importance and applicability of their chemistry knowledge in commercial settings. The results agrees with Akanbi and Omoniyi (2024);Mainga et al. (2022) and Ojokuku et al. (2015) that universities should provide more structured support for commercialization efforts, as the respondents believe it is an essential aspect of their academic experience.

The result shows no significant differences across age groups regarding the challenges chemistry graduates face in accessing funding and resources for commercializing their research. This suggests that the barriers to commercialization, such as lack of funding, mentorship, and entrepreneurial skills, are uniformly experienced across different age groups. This is consistent with literature that identifies systemic issues, such as limited access to research grants, high costs of patenting, and

inadequate institutional support, as widespread challenges affecting all researchers, regardless of age. The findings agrees with Baro et al. (2017) need for universities and policymakers to implement broad-based interventions to address these barriers, such as providing entrepreneurial training, improving access to commercialization funding, and creating better partnerships between academia and industry.

Conclusion

The effective application of chemistry knowledge for commercial purposes by graduate students of Ignatius Ajuru University of Education is impeded by several key factors. To bridge the gap between academic learning and commercial application, it is essential to tackle these bottlenecks comprehensively. Enhancing practical experience, improving resource availability, and fostering strong industry connections are vital steps toward achieving this goal. By addressing regulatory challenges, providing entrepreneurial training, and supporting intellectual property management, the university can better prepare its students to convert their research into viable commercial opportunities.

Recommendations

The following recommendations were made:

(a) Develop and integrate more hands-on laboratory experiences and industry internships into the curriculum to provide students with practical skills and exposure to commercial applications of chemistry.
(b) Invest in modern laboratory equipment, chemicals, and research facilities to ensure students have access to the necessary resources for conducting high-quality research and development.
(c) Establish and expand collaborations with industry partners to facilitate student internships, joint research projects, and exposure to real-world commercial applications.

REFERENCES

Ababio, O. Y. (2013*). New school chemistry for senior secondary schools* (6th ed.). Africana First Publishers.

Abanikannda, M. O. (2016). Influence of problem-solving instructional strategy and locus of control on achievement in genetics among Nigerian college students. *Journal of Education and Practice, 7*(32), 55-61.

Akanbi, A. O., & Omoniyi, A. O. (2024). Awareness and interest of chemistry students on the usage of chemical concepts in tie and dye for entrepreneurship skills development in Kwara State. *Journal of Science Education, 15*(2), 123-135.

Bandele, S. O., & Faremi, Y. A. (2012). An investigation into the challenges facing the implementation of technical college curriculum in South West, Nigeria. *Journal of Education and Practice, 3*(16), 14-20.

.Eilks, I., & Hofstein, A. (2015). *Relevant Chemistry education: From t theory to practice*. Sense Publishers.

Emmanuel, A. O. (2013). Effects of problem-solving and cooperative learning strategies on senior secondary school students' achievement in physics. *Journal of Research & Method in Education, 3*(5), 7-11.

Glory, A. (2020). The 21 most popular courses in Nigerian universities. EduCeleb.

Grimaldi, R., Kenney, M., Siegel, D. S., & Wright, M. (2011). 30 years after Bayh–Dole: Reassessing academic entrepreneurship. *Research Policy, 40*(8), 1045-1057.

Hornby, A. S. (2010). Oxford advanced learner's dictionary of current English. Oxford University Press.

Humber, A. (2019). Entrepreneurship education: Scope, trends and best practices. *International Journal of Management, 10*(1), 22-30.

Mainga, W., Mwiti, E., & Juma, R. (2022). Business students' perceptions of their employability skills at graduation. *Industry and Higher Education, 36*(3), 243-257.

Muelium, S. O. (2014). Entrepreneurship education for self-reliance and economic development in Nigeria. *International Journal of Education and Research, 2*(10), 327-338.

Njoku, Z. C. (2014). Fostering the application of science education research findings in Nigerian classrooms: Strategies and need for teachers' professional development. In 55th Annual Conference Proceedings of Science Teachers Association of Nigeria. 13-26.

Oginni, A. M., Awobodu, V. Y., Alaka, M. O., & Saibu, S. O. (2013). School factors as correlates of students' achievement in chemistry. *International Journal for Cross-Disciplinary Subjects in Education, 3*(3), 1516-1523.

Ojokuku, B. Y., Emeahara, E. N., Aboyade, M. A., & Chris-Israel, H. O. (2015). Influence of students' industrial work experience scheme on professional development of library and information science students in South-West, Nigeria. *Library Philosophy and Practice,* (1),12-22.

Okolie, U. C., Nwosu, H. E., Eneje, B. C., & Oluka, B. N. (2021). Reclaiming education: Rising above rhetoric of quality and learning outcomes – the Nigerian experience. *International Journal of Educational Development, 81*, 102-124.

Okoro, S. U. C. (2013). Enhancing scientific and technological literacy through science education: Problems and prospects. *Journal of Science Teachers Association of Nigeria, 48*(1), 86-95.

Okunug, A. O., & Ajeyalemi, D. (2018). University chemistry curriculum and workplace needs: A case study of an industrially developed nation. *Chemistry Education Research and Practice, 19*(3), 849-860.

Osokoya, M. M. (2015). Determining the performance of students in introductory chemistry courses. *African Journal of Chemical Education, 5*(1), 101-112.

Rothaermel, F. T., Agung, S. D., & Jiang, L. (2017). University entrepreneurship: A taxonomy of the literature. *Industrial and Corporate Change, 16*(4), 691-791.

Szeberényi, A., Adedoyin, A. A., & Oladipo, A. O. (2022). Perception and awareness level of renewable energy among engineering students in Nigeria. *Renewable Energy Focus, 40*, 1-12.

Taber, K. S. (2018). Alternative conceptions and the learning of chemistry. *Israel Journal of Chemistry, 58*(6-7), 686-694.