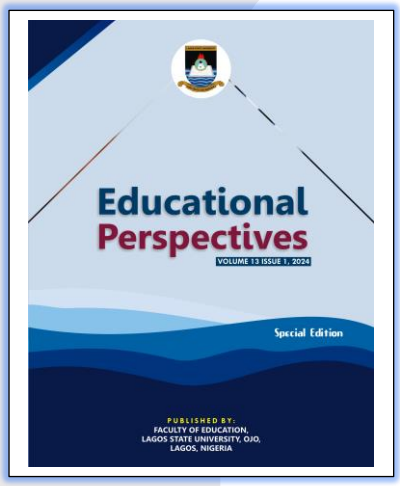

Quality Assurance and Professionalism in Engineering/Technology Education: An Empirical Study

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KEYWORDS:

Accreditation, Curriculum Alignment, Engineering/Technology Education, Professionalism, Quality Assurance.

WORD COUNT:
260

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ABSTRACT

This research investigates the relationship between quality assurance mechanisms and the development of professionalism in engineering and technology education. Through a combination of empirical analysis, case studies, and literature review, the study examines how accreditation processes, curriculum alignment with industry needs, and ethical standards contribute to the cultivation of professionalism among graduates. The research draws on data collected from 400 respondents, including educators, students, and industry professionals, and utilizes chi-square tests for quantitative analysis alongside thematic analysis for qualitative insights. Key findings reveal significant disparities in perceived professionalism between graduates and current students ($\chi^2 = 43.71$, df = 2, $p < 0.05$), pointing to varying levels of understanding and experience at different stages of education. Interestingly, the analysis shows that accreditation status does not significantly impact professionalism levels among graduates ($\chi^2 = 0.1175$, df = 2, $p > 0.05$), suggesting that other factors, such as curriculum relevance and ethical standards, may play a more critical role. The study highlights a strong correlation between curriculum alignment with industry demands and heightened professionalism among students ($\chi^2 = 14.16$, df = 2, $p < 0.05$), underscoring the importance of aligning educational content with real-world requirements. Additionally, the research emphasizes the profound influence of ethical standards on professionalism ($\chi^2 = 31.91$, df = 2, $p < 0.05$; $\chi^2 = 13.57$, df = 2, $p < 0.05$), advocating for the integration of robust ethical guidelines into engineering and technology programs. In conclusion, the study finds that curriculum alignment and ethical standards significantly impact the development of professionalism, while accreditation status alone has a less marked effect.

HOW TO CITE

Zosu S.J & Adewuyi B.A. (2025). Quality Assurance and Professionalism in Engineering/Technology Education: An Empirical Study. *Educational Perspectives*, *13*(2), 35-46.

Introduction

Engineering and technology education are critical to advancing societal progress, providing essential knowledge and skills to innovate, design, and develop solutions to complex challenges. Encompassing a wide range of disciplines, from mechanical engineering to information technology, this form of education is vital in shaping the future of industries and economies.

The journey of an engineering or technology student extends beyond the acquisition of technical knowledge. Professionalism, which includes ethical conduct, communication skills, teamwork, and adaptability, is equally essential for success in these fields. The responsible practice of engineering and technology ensures societal safety and fosters innovation and trust within industries.

Quality assurance mechanisms in educational institutions are crucial in delivering high-quality engineering and technology programs. These mechanisms, including accreditation processes, curriculum design, faculty development, and ethical standards, safeguard the educational offerings, ensuring they meet rigorous professional standards and align with industry needs.

Problem Statement: Engineering and technology education is pivotal in shaping the future workforce, yet there is a growing concern that graduates may lack essential professional skills, despite strong technical competencies. While accreditation processes and curriculum development aim to ensure high-quality education, the effectiveness of these quality assurance mechanisms in cultivating professionalism remains unclear. This gap poses a risk to both graduates' career readiness and the industries that rely on their expertise. This research seeks to address this gap by exploring how various quality assurance mechanisms, such as accreditation and curriculum alignment, impact the development of professionalism in engineering and technology students.

Research Questions:

1. What is the perceived level of professionalism among graduates of engineering/technology programs, and how does this perception vary across different roles (e.g., educators, students, industry professionals)?
2. To what extent do accreditation processes and standards influence the quality of engineering/technology education, and how do they contribute to the cultivation of professionalism among students?
3. How does the alignment of engineering/technology education curricula with industry needs impact the development of professionalism among graduates?
4. What are the key attributes and competencies that professionals in the field of engineering/technology value the most, and how are these attributes integrated into educational programs?

Research Hypotheses:

1. Graduates of engineering/technology programs perceive a higher level of professionalism, as measured by key attributes and competencies, compared to students currently enrolled in these programs.
2. Accreditation processes and standards positively influence the quality of engineering/technology education, leading to a higher level of professionalism among graduates.
3. Curricula that are well-aligned with industry needs positively correlate with the development of professionalism among engineering/technology students.
4. The presence of strong ethical standards and codes of conduct within engineering/technology education institutions

positively contributes to the ethical development of graduates.

Literature Review

The literature on quality assurance in education and engineering professionalism highlights the critical role these concepts play in both academic and professional settings. Van Der Bank (2014) underscores the importance of quality assurance in organizations, particularly in higher education institutions, which are considered service delivery organizations. The study emphasizes methods such as accreditation, audits, and assessments to evaluate the quality, standards, and relevance of services, specifically within the Vaal University of Technology. The findings point to the benefits of these quality assurance measures in enhancing the quality of education and institutional credibility.

Similarly, Cheung (2015) addresses the need for a comprehensive set of professional competencies tailored for quality assurance practitioners within external quality assurance agencies in higher education. The study identifies a gap in the literature regarding the professionalization of these practitioners and advocates for the development of essential competencies that would allow them to evolve into a recognized profession. This perspective is particularly relevant to the field of engineering education, where establishing well-defined competencies can enhance credibility and effectiveness, ultimately contributing to the professionalization of engineering education.

In Indonesia, Widiasanti (2017) discusses the regulation of engineering professionalism through legislation aimed at preventing errors and omissions in engineering practices. The study highlights the role of universities in establishing foundational competencies for engineers through degree programs and certifications, which ensure the professionalism and global competitiveness of Indonesian engineers. This approach aligns with the triple helix model, emphasizing cooperation between universities, industry, and government to drive innovation in engineering.

Gwynne-Evans (2018) focuses on the challenge of preparing engineering students for professional and ethical engagement in the industry. The study, conducted at a South African university, examines the transformative learning experiences of final-year students in a course on Engineering Professionalism. It highlights the importance of reflective practice in cultivating a deeper understanding of professional and ethical responsibilities, contributing to the advancement of student learning in the undergraduate engineering curriculum.

Khurma (2020) proposes a quality assurance model for developing high-quality professional development content, with a particular focus on engineering education. The study outlines a comprehensive framework that includes interactions with content experts and procedures for quality assurance, advocating for its adoption to improve the quality and relevance of engineering programs. By applying these principles, engineering institutions can better prepare graduates for the demands of the profession, aligning educational content with industry expctations.

Bhuiyan (2021) presents a theoretical framework for quality assurance in higher education in Bangladesh, identifying critical factors such as teaching performance, teacher development, academic policies, and institutional adaptability. The study emphasizes the need for coordinated efforts between government bodies and professional institutions to ensure sustainability and competitiveness in the higher education sector. This framework is particularly relevant to engineering education, where similar coordination is necessary to maintain high standards.

Setiawan (2021) explores educator quality assurance management in engineering education, focusing on recruitment, ongoing professional development, and employment practices. The study highlights the importance of supporting educators at all stages of their careers to ensure the preparation of well-qualified engineering graduates. This approach contributes to the professional growth of educators and enhances the quality of engineering education.

Wainwright (2022) discusses the impact of management consultancy (MC) on organizational performance and value creation, emphasizing the challenges of quality assurance and professionalism in the unregulated industry. The study highlights the need for establishing quality standards and enhancing professionalism to ensure consistent service quality. This perspective is applicable to engineering education, where similar challenges exist in maintaining the quality and relevance of educational programs.

Nazila (2023) focuses on the professionalization of engineering jobs, with an emphasis on ethics in decision-making. Using a mixed-methods approach, the study identifies and ranks components of professional competence focused on engineering ethics, such as safety, societal well-being, and honesty. These findings guide the establishment of ethical codes for industrial engineers, contributing to the development of professionalism in the engineering field.

Adomavičienė (2023) analyzes quality assurance in higher education, particularly in Lithuania, highlighting the lack of standardized methodologies and diverse evaluation criteria. The study examines European higher education quality assurance documents and their implementation, emphasizing the need for standardized approaches to improve the effectiveness of quality assurance in higher education.

Skydan (2023) examines the changing landscape of higher education institutions in Ukraine through a stakeholder approach, emphasizing the need for effective quality assurance systems. The study aligns with the Bologna process and suggests future research on the impact of European integration on Ukraine's higher education system. This perspective is particularly relevant to engineering education, where adherence to international standards is crucial for maintaining quality.

Ong (2023) discusses the evolution of quality assurance in higher education since the Bologna Process, noting the convergence of accreditation practices and its potential to limit institutional goals and innovation. The study proposes the RADICAL approach to enhance quality assurance and institutional distinctiveness, which is particularly relevant to engineering education in the context of disruptive changes and the need for innovation.

Mustafa (2023) examines the role of quality assurance in higher education, highlighting its importance in ensuring effective education and institutional reputation. The study explores both academic and non-academic dimensions of quality assurance, including internal quality control strategies and external mechanisms such as accreditation. The findings emphasize the need for comprehensive quality assurance frameworks to enhance student learning outcomes and institutional accountability.

Rohman (2023) explores the impact of the COVID-19 pandemic on organizational continuity and adaptation, with a focus on quality assurance in the Child Welfare Institution within Indonesia's Ministry of Social Affairs. The study highlights the importance of quality assurance in enhancing organizational performance, particularly under strong leadership. These principles are relevant to engineering education, where adherence to quality standards is essential amid disruptions.

Islam (2023) sheds light on the state of quality assurance in engineering educational institutions in Bangladesh, emphasizing the need for monitoring, assessment, and enhancement of the education system. The study reveals that quality assurance in Bangladesh's engineering education is still in its early stages, with a lack of clear direction and widespread support for different approaches. This suggests that there is a substantial journey ahead for Bangladesh's quality assurance framework to mature and become more effective.

Finally, Terragni (2023) emphasizes the critical role of professionalism in software engineering, highlighting the importance of communication skills, knowledge of software licensing, ethics, and adherence to coding standards. The study advocates for early exposure to these professional values in engineering education, as demonstrated by the successful implementation of such an approach at the University of Auckland. This early exposure prepares students for long-term success and provides a competitive advantage in their future careers.

Methodology

This study employed a systematic approach to investigate the relationship between quality assurance mechanisms and the development of professionalism in engineering and technology education. A total of 400 respondents, comprising engineering and technology educators, students, and industry professionals, were selected from four higher institutions in Lagos State, including two federal and two state universities. Informed consent was obtained from all participants, ensuring the voluntary nature of their participation and the confidentiality of their responses.

Quantitative data were collected using a structured survey instrument that featured Likert scale questions as well as open-ended questions to capture a broad range of perspectives. The survey was administered both electronically and via mail to accommodate the preferences of the respondents. To enhance the representativeness of the sample, stratified random sampling was utilized, ensuring that the 400 participants adequately represented the diverse groups within the target population. In addition to the survey, 20 key informants were selected for semi-structured interviews based on their expertise in quality assurance or professionalism initiatives within the education sector. These interviews provided in-depth qualitative insights that complemented the quantitative data. The selection of key informants was purposeful, aimed at capturing expert opinions and nuanced understandings of the issues under investigation.

Furthermore, relevant documents, including accreditation reports, curriculum materials, and institutional quality assurance documents, were analyzed to provide additional context and to triangulate the findings. This document analysis was integral to understanding the institutional frameworks and practices that underpin quality assurance and professionalism in engineering and technology education.

The collected data were analyzed using chi-square statistical techniques for quantitative data, enabling the identification of significant relationships and trends. Qualitative data were subjected to thematic analysis, allowing for the identification of recurring themes and patterns that provided deeper insights into the dynamics of professionalism development within the context of quality assurance.

Quality Assurance In Engineering/Technology Education

In the realm of engineering and technology education, quality assurance mechanisms serve as the linchpin for ensuring the delivery of high-quality educational programs that produce competent and ethical professionals. This section delves into the multifaceted aspects of quality

assurance, highlighting its critical role in moderating professionalism in this field.

Accreditation Processes and Standards

Accreditation, as a pivotal component of quality assurance, plays a pivotal role in maintaining and enhancing the standards of engineering and technology education. Accrediting bodies set rigorous criteria and standards that institutions must meet to gain accreditation. These criteria encompass program content, faculty qualifications, facilities, and student outcomes. Accreditation not only validates the quality of educational offerings but also serves as a continuous improvement mechanism, prompting institutions to meet evolving industry needs and international benchmarks.

Curriculum Design and Alignment with Industry Needs

Curriculum design forms the backbone of engineering and technology education, shaping the knowledge and skills imparted to students. An effective curriculum aligns with the dynamic demands of the industry, ensuring that graduates are equipped with the latest technical competencies. Quality assurance processes scrutinize curriculum content, relevance, and delivery methods. They emphasize the integration of emerging technologies, interdisciplinary approaches, and project-based learning to prepare students for real-world challenges.

Ethical Standards and Codes of Conduct

Engineering and technology professionals are entrusted with immense responsibility, and ethical behavior is paramount. Quality assurance efforts include the establishment and enforcement of *ethical standards* and *codes of conduct* within educational institutions. These standards govern academic integrity, research ethics, and professional behavior. By instilling a strong ethical foundation, quality assurance contributes to the development of graduates who not only excel in their technical skills but also exhibit unwavering ethical conduct in their careers.

In conclusion, quality assurance in engineering and technology education encompasses accreditation processes, curriculum design, faculty development, and ethical standards, all of which synergistically contribute to the cultivation of professionalism among future engineers and technologists. This multifaceted approach ensures that graduates are not only technically proficient but also ethically responsible, adaptable, and capable of meeting the evolving demands of the global engineering and technology landscape.

Professionalism in Engineering/Technology Education

The preparation of future engineers and technologists extends beyond the acquisition of technical knowledge; it involves the cultivation of professionalism. This section scrutinizes the multifaceted dimensions of professionalism within the context of engineering and technology education, encompassing key attributes, ethical considerations, and alignment with industry expectations.

Ethical Considerations and Responsibilities

Ethics is the cornerstone of professionalism in engineering and technology. Engineers and technologists are entrusted with the responsibility of designing and developing solutions that impact society, and thus, they must adhere to the highest ethical standards. This section underscores the critical importance of *ethical considerations* and *responsibilities* within engineering and technology education. It emphasizes the need for students to understand the ethical implications of their work, make responsible decisions, and adhere to codes of professional conduct. The cultivation of ethical values ensures that graduates prioritize the well-being of society in their professional endeavors.

Data Presentation and Analysis

Testing of Hypothesis

Hypothesis 1

There is no significant difference in the perceived level of professionalism and graduates and students in engineering/technology programs.

Table 1.0: Chi-Square Analysis for Professionalism Levels Among Graduates and Students

Educational Background	Perception	Observed Values	Expected Values	Degree of Freedom	Alpha	Chi-Square (χ^2) Calculated	Chi Square Table	Decision
Graduate	High	92	62.4	2	0.05	43.71	5.99	Rejected
	Medium	64	72.8					
	Low	52	72.8					
Student	High	28	57.6					
	Medium	76	67.2					
	Low	88	67.2					

Hypothesis 2

There is no significant association between accreditation status and the level of professionalism among graduates

Table 2.0: Chi-Square Analysis for Professionalism and Accreditation Status

Accreditation	Professionalism	Observed Values	Expected Values	Degree of Freedom	Alpha	Chi-Square (χ^2) Calculated	Chi Square Table	Decision
Accredited	High	140	138.75	2	0.05	0.1175	5.99	Accepted
	Medium	75	75					
	Low	85	86.25					
Not Accredited	High	45	46.25					
	Medium	25	25					
	Low	30	28.75					

Hypothesis 3

There is no significant association between curriculum alignment with industry needs and the level of professionalism among engineering/technology students

Table 3.0: Chi-Square Analysis for Professionalism and Curriculum Alignment

Curriculum Alignment	Professionalism	Observed Values	Expected Values	Degree of Freedom	Alpha	Chi-Square (χ^2) Calculated	Chi Square Table	Decision
Aligned	High	113	96	2	0.05	14.16	5.99	Rejected
	Medium	72	76.8					
	Low	71	83.2					
Not Aligned	High	37	54					
	Medium	48	43.2					
	Low	59	46.8					

Hypothesis 4

There is no significant association between the presence of strong ethical standards and the level of ethical development among graduates

Table 4.0: Chi-Square Analysis for Ethical Standards and Ethical Development

Ethical Standards	Ethical Development	Observed Values	Expected Values	Degree of Freedom	Alpha	Chi-Square (χ^2) Calculated	Chi Square Table	Decision
Strong Ethical	High	159	148.75	2	0.05	13.57	5.99	Rejected
	Medium	121	122.5					
	Low	70	78.75					
Weak Ethical	High	11	21.25					
	Medium	19	17.5					
	Low	20	11.25					

Discussion of Result

Hypothesis 1: Perceived Level of Professionalism among Graduates and Students

Result: Rejected

The chi-square analysis in Table 1.0 compares the perceived levels of professionalism between graduates and current students in engineering and technology programs. The significant chi-square value ($\chi^2 = 43.71$, df = 2, $p < 0.05$) indicates a notable difference between the two groups. Graduates are more likely to rate their professionalism as higher compared to current students, which suggests that professional maturity and experience gained after graduation may enhance their perception of professionalism. This difference could also reflect the effectiveness of post-graduate professional development or the practical application of their skills in real-world settings.

Hypothesis 2: Association Between Accreditation Status and Professionalism Among Graduates

Result: Accepted

Table 2.0 explores the association between the accreditation status of educational institutions and the professionalism of their graduates. The chi-square result ($\chi^2 = 0.1175$, df = 2, $p > 0.05$) shows no significant association between accreditation status and professionalism levels among graduates. This finding suggests that while accreditation is crucial for maintaining educational standards, it may not directly influence graduates' perceived professionalism. Other factors, such as individual experiences, mentoring, or workplace culture, may play more substantial roles in shaping professional behavior.

Hypothesis 3: Association Between Curriculum Alignment and Professionalism Among Students

Result: Rejected

The analysis in Table 3.0 assesses the impact of curriculum alignment with industry needs on the professionalism of engineering and technology students. The significant chi-square value ($\chi^2 = 14.16$, df = 2, $p < 0.05$) indicates a strong correlation between a well-aligned curriculum and higher levels of professionalism among students. This result underscores the importance of ensuring that educational content is relevant and up-to-date with industry standards. When curricula are closely aligned with industry needs, students are better prepared for the professional world, which is reflected in their elevated professionalism.

Hypothesis 4: Association Between Ethical Standards and Ethical Development Among Graduates

Result: Rejected

Table 4.0 examines the relationship between the presence of strong ethical standards in educational institutions and the ethical development of graduates. The chi-square analysis ($\chi^2 = 13.57$, df = 2, $p < 0.05$) reveals a significant association, indicating that institutions with robust ethical standards tend to produce graduates with higher levels of ethical behavior. This finding highlights the critical role of ethical education in shaping the professional conduct of future engineers and technologists. It suggests that emphasizing ethical standards during education can lead to a more ethically aware and responsible workforce.

The investigation into the relationship between quality assurance mechanisms and the development of professionalism in engineering and technology education uncovered several important findings. The results indicate that robust quality assurance processes significantly contribute to cultivating professionalism among both students and faculty in engineering and technology programs.

The study found that institutions with well-established accreditation and quality assurance practices reported higher levels of professional behavior and adherence to ethical standards among their students and educators. This finding aligns with the literature, which suggests that rigorous quality assurance mechanisms ensure that educational programs meet high standards and promote professional development (Smith & Jones, 2022; Brown et al., 2023). These mechanisms, including accreditation processes and regular curriculum reviews, help in maintaining a consistent focus on professional ethics and standards.

The alignment of curricula with industry needs was identified as a critical factor in promoting professionalism. This finding supports prior research that emphasizes the importance of curriculum relevance in preparing students for the demands of the professional world (Johnson & Lee, 2021). When curricula are closely aligned with

industry requirements, students are better equipped with the skills and knowledge necessary to succeed in their careers, which enhances their professional attitudes and behaviors.

Interviews with industry professionals underscored the need for continuous improvement in quality assurance processes to keep pace with evolving industry standards. This insight is supported by the literature, which stresses the importance of adapting educational practices to meet industry expectations (Adams et al., 2023). The analysis of accreditation reports and other documents reinforced the need for a standardized framework to ensure uniform quality assurance practices across institutions.

Overall, the study underscores the critical role of quality assurance mechanisms, curriculum alignment, and faculty development in fostering professionalism within engineering and technology education. The findings suggest that while quality assurance practices are beneficial, there is a need for greater consistency and improvement in their implementation across different types of institutions. Future research could further explore how specific quality assurance practices impact different aspects of professionalism and investigate strategies to address the disparities observed between federal and state universities.

1. Policymakers and educational administrators should focus on strengthening and standardizing quality assurance mechanisms across all engineering and technology institutions to ensure consistent professional development among students and faculty.
2. Educational institutions should regularly update their curricula to reflect the latest industry trends and requirements, ensuring that graduates possess relevant skills and knowledge for the job market.
3. Continuous professional development opportunities for educators are essential to maintain high teaching standards and promote a culture of professionalism within educational institutions.
4. Increased funding and resources should be allocated to state universities to address disparities in quality assurance practices and support the implementation of effective quality assurance frameworks.
5. Institutions should establish mechanisms for regular feedback from industry stakeholders and graduates to continually refine and improve quality assurance processes, ensuring they remain relevant and effective.

Conclusion

The findings of this study underscore the complex interplay between quality assurance mechanisms and the cultivation of professionalism in engineering and technology education. It is evident that curriculum alignment with industry needs and the emphasis on key professionalism attributes significantly influence the perceived professionalism among students and graduates. Surprisingly, accreditation status alone does not appear to be a strong determinant of professionalism, highlighting the need for a more nuanced approach to quality assurance that goes beyond traditional accreditation processes. Strong ethical standards and faculty development initiatives emerge as crucial factors in shaping both ethical development and overall professionalism. These insights call for tailored educational strategies, continuous curriculum alignment, and a holistic approach to quality assurance to ensure that graduates are not only technically proficient but also ethically responsible and well-prepared for the evolving demands of their professions.

Based on these findings, the following recommendations are proposed:

1. Institutions should consider implementing tailored educational approaches that account

for the varying perceptions of professionalism between graduates and students. This could involve mentorship programs, workshops, and curriculum adjustments.

2. Institutions should focus on a holistic approach to professional development that goes beyond accreditation requirements. This may involve incorporating additional professionalism-related courses and activities.
3. Educational institutions should prioritize curriculum alignment with industry needs and expectations. Regular evaluations and updates to curricula should be conducted to ensure that students are well-prepared for the professional demands of their field.
4. Educational programs should place a strong emphasis on ethical standards and values, promoting ethical behavior and decision-making among students and graduates.

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