Investigating Practical Content Delivery Perspectives among Engineering Students: Insights from Tertiary Institutions in South-West Nigeria

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Abstract: - The lack of enthusiasm among students for practical classes is alarming. This prompted the need for an investigation into the issues of engineering education, with a focus on practical content delivery perspectives. An online questionnaire was completed by 325 respondents from tertiary institutions in southwest Nigeria, resulting in responses. This ensured diversity in age, gender, field of study, and academic level, providing detailed insights into the composition of the respondent pool. Notably, the majority of participants (295) are male, with only 30 females, highlighting a gender disparity that is common in most tertiary institutions. The distribution across fields and academic levels illustrates the diversity of engineering disciplines and academic advancement. For instance, electrical/electronics engineering received 153 responses, with ND 1 students being the most represented. A comprehensive evaluation of practical session challenges revealed widespread consensus on issues such as time constraints, insufficient equipment, and overcrowded classes. The mean values revealed the relative importance of each criterion, providing a more comprehensive understanding of respondents' viewpoints. The study concludes with innovative strategies for improving hands-on education while addressing identified shortcomings. The recommendations include improved access to resources, increased industry participation, modernization of equipment, standardized content delivery, technology-enabled learning, faculty development, structured coaching, adaptive assessments, and regular curriculum evaluations. These programs aim to promote continuous improvement and create a positive and productive learning environment for engineering students. This study provides valuable insights and practical solutions for enhancing the delivery of content, bridging gaps, and improving the quality of engineering education.

Key-Words: - Challenges, engineering students, laboratory, practical content delivery, student attitudes, strategic initiatives.

Received: August 5, 2023. Revised: December 7, 2023. Accepted: February 11, 2024. Published: April 5, 2024.

1 Introduction

Globally, the educational environment has evolved significantly, transitioning from a traditional teacher-centric paradigm to one that emphasizes student-centred approaches. This development, influenced by the works of scholars such as [1], [2], aims to foster independence, practical skills, and self-reliance in students. Teaching engineering involves hands-on tasks and technology, which help students understand and use what they learn, [3]. Using technology makes learning easier for students. The quality of practical classes is crucial for students in engineering, [4], [5], [6]. [7]. This approach, which supports practical laboratory experience to improve theoretical comprehension, corresponds with the most recent advancements in education. According to [8], [9], [10], [11], practical experiments not only help with theoretical comprehension but also promote the development of crucial abilities such as teamwork, efficient communication, and the application of theory in everyday circumstances.

Delivering practical knowledge is critical in engineering education because it improves comprehension of theoretical ideas and their practical application, [12], [13]. Practical experiments are essential not only for obtaining technical information but also for establishing core abilities that will prepare students for the ever-changing demands of future employment, [14], [15], [16]. This study investigates how engineering students in the South-Western part of Nigeria discern practical classes. By focusing on this area, we can add to what we know about teaching practical subjects in this independent education system.

The practical knowledge gained in the laboratories, will not only build their comprehensive understanding of technology education but will also give them insights into various teaching approaches. According to reference [17], the major function of the engineering profession is to examine data and resources to serve humanity. This needs a deeper knowledge than just theory learned in the classrooms. Having practical experience is important, showing the need for a mix of book smarts and practice in engineering education, [18], [19].

Students nowadays have better access to useful and informative resources via social media platforms, which makes the process of learning and understanding techniques much easier and more interactive. This reinforces the importance of technical and vocational education in preparing engineering students for a better understanding of the lessons learned and help in their career path after graduation, [20]. Technical and Vocational Education (TVE) plays a key role in filling the technical and economic gap by giving students the right skills, knowledge, and values for their jobs, [21], [22]. Practical work is crucial because it improves lab skills, and knowledge, and helps students grasp scientific theories better, [23], [24], [25], [26], [27]. This enhances students' learning performance, promotes better understanding, and facilitates quicker adaptation to the working environment during their industrial attachment, [28], [29]. However, there are reasons for concern because students' attitudes toward practical classes are unsatisfactory. This emphasizes the importance of studying engineering students' perspectives on laboratory experiments to enhance the theoretical knowledge provided in class.

The study by [30], investigates learner agency in engineering students' problem-solving and project-based learning (PBL). In Qatar, 39 students utilize the Q approach to uncover diverse perceptions, emphasizing intrapersonal, behavioral, and environmental factors. The findings emphasize the importance of teacher responsibilities and underscore the need for more opportunities for learner agency in PBL. The paper by [31], discusses the increasing challenges associated with heterogeneous student groups in higher education. It is recommended to implement block teaching in engineering education to improve flexibility, inclusivity, and enjoyment. A poll has found positive student responses, indicating that block teaching is an effective technique for meeting the needs of diverse students. Recognizing the evolving landscape of educational approaches, the study conducted by [32], examines the effectiveness of virtual experiments in enhancing students' academic performance, practical skills, and perspectives in a typical physics laboratory. Even though hands-on experience enhances students' learning outcomes, attitudes toward practical classes among engineering students are worrisome. To tackle this challenge, it is crucial to comprehend the attitudes of engineering students towards laboratory practicals and experiments. This study aims to contribute to the understanding by examining the practical content delivery perspectives of engineering students at tertiary institutions in the southwest region of Nigeria. By examining these perspectives, the study aims to offer insights that can guide instructional practices, enhance the learning experience, and connect theoretical knowledge with practical application in engineering.

2 Methodology

This study examines the challenges of engineering education, focusing on practical content delivery perspectives among engineering students using an exploratory approach. A diverse sample of 325 participants from tertiary institutions in South-West Nigeria was randomly selected to ensure representation across various demographics, including age, gender, field of study, and academic level. Demographic variables were collected and analyzed to gain insight into the composition of the respondent pool, as well as the distribution of participants across different fields of study and academic levels. During practical sessions, participants were asked to provide feedback on the following challenges:

- ❖ Time constraints
- ❖ Inadequate availability of equipment for experiments
- ❖ Setting up of apparatus by the lecturer or technologist, rather than by students
- ❖ Overcrowded practical sessions
- ❖ Insufficient time for submitting reports
- ❖ Issues with the malfunction of equipment/apparatus during practical sessions
- ❖ Intermittent electricity supply
- ❖ Outdated equipment and facilities

This feedback was collected using a 5-point Likert scale, ranging from "strongly agree" to "strongly disagree." The gathered data was qualitatively analyzed to identify significant challenges, providing insights for understanding and addressing real-world learning situations in engineering education. Throughout the research process, strict ethical considerations were adhered to, ensuring participant anonymity and informed consent.

3 Results and Discussion

Table 1. Demographic Distribution of Respondents

Variable		Frequency (n = 325)
Age	Below 20	112
	20 - 25	165
	25 - 30	39
	Above 30	9
Gender	Male	295
	Female	30

Table 1 presents the demographic profile of 325 respondents, highlighting the distribution of age and gender. The majority, 295, are male, while 30 are female. In terms of age, 165 respondents are between the ages of 20 and 25, while 112 are under 20 years old. A smaller number, 39, falls within the 25-30 range, with only 9 exceeding 30 years of age.

Table 2. Distribution of Respondents by Field of Study and Academic Level

Variable		Frequency (n = 325)
Field of Study	Agric & Bioenvironmental Engineering	19
	Civil Engineering	9
	Computer Engineering	79
	Electrical/Electronics Engineering	153
	Mechanical Engineering	47
	Mechatronics Engineering	11
	Welding and Fabrication	7
Level	ND 1	134
	ND 2	123
	HND 1	49
	HND 2	19

Table 2 summarises the distribution of the 325 respondents according to their field of study and academic level. Electrical/electronics engineering accounts for the majority of respondents (153), with computer engineering coming in second with 79. Among the different academic levels, ND 1 has the highest representation with 134 respondents, followed by ND 2 with 123 respondents, HND 1 with 49 respondents, and HND 2 with 19 respondents. This demonstrates the diversity of engineering disciplines and educational progression.

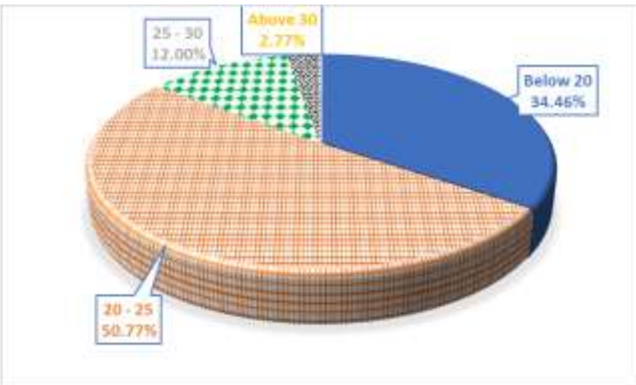

Fig. 1: Age Distribution of Participants

Figure 1 illustrates the age distribution of participants in the study. Approximately 34.46% of the sample population is below 20 years old, indicating a significant representation of younger individuals. The largest segment, comprising approximately 50.77% of participants, falls within the 20–25 age bracket, highlighting the significant presence of individuals in early adulthood. Participants aged between 25 and 30 constitute about 12.00% of the total sample, while those above 30 years old represent approximately 2.77% of the participants, indicating a smaller but still notable demographic. This distribution highlights the significant presence of individuals aged 20 to 25, followed by those below 20, with relatively smaller proportions in the older age groups.

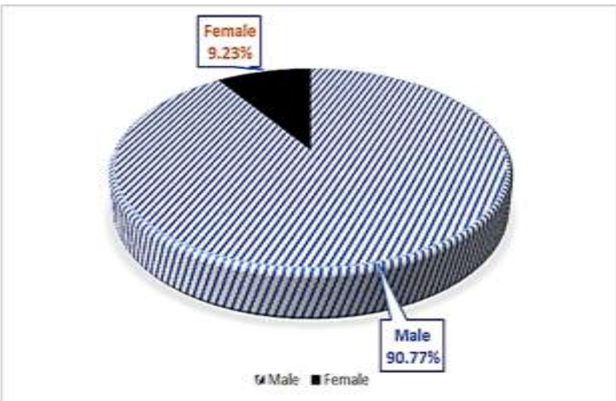

Fig. 2: Gender Percentage of Respondents

Figure 2 displays the gender distribution of the 325 respondents. A substantial majority of 295 are male, accounting for approximately 90.77% of the total. Females constitute a smaller proportion, representing approximately 9.23% of all respondents. The figure illustrates a gender imbalance in the surveyed population, likely stemming from the low representation of female engineering students.

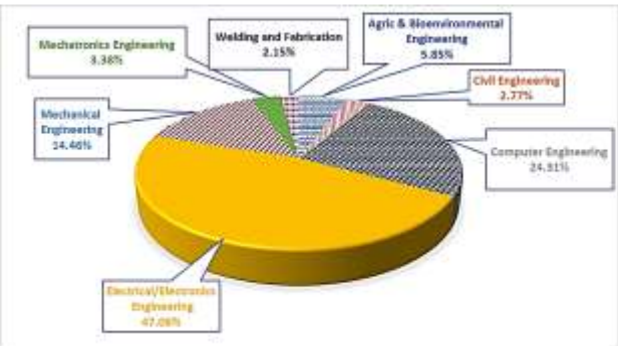

Fig. 3: Percentage of Respondents Based on Field of Study

Figure 3 visually illustrates the diversity in respondents' fields of study. Electrical/Electronics Engineering has the highest representation, comprising 47.08%, followed by Computer Engineering with 24.31%. Conversely, fields such as agric & bioenvironmental engineering and civil engineering show lower percentages. This figure depicts the distribution of respondents across various engineering disciplines.

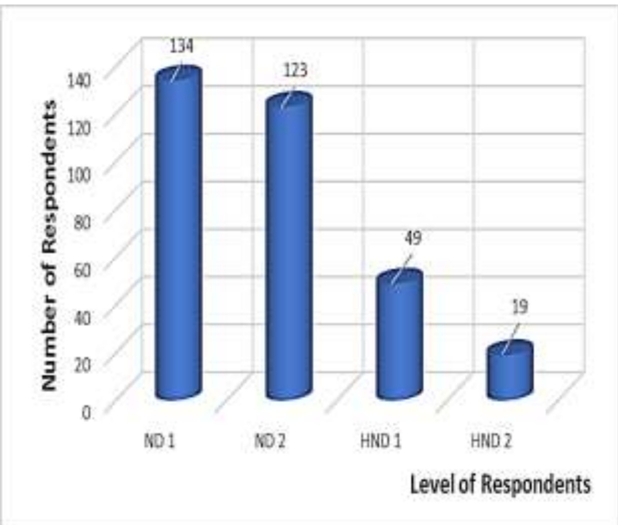

Fig. 4: Chart showing the level of respondents

Figure 4 displays the distribution of respondents across different academic levels. Notably, ND 1 has the highest presence, with over 134 respondents, followed by ND 2 with approximately 123. HND 1 has approximately 49 respondents, while HND 2 has the lowest representation with around 19 responses. The illustration depicts the distribution of respondents across different academic levels.

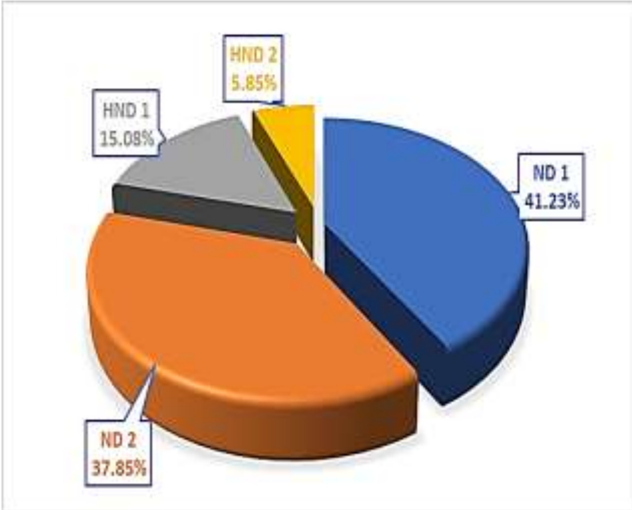

Fig. 5: Percentage level of Respondents

Figure 5 shows the distribution of respondents across academic levels. Notably, ND 1 is the largest segment, accounting for 41.23%, followed by ND 2, which accounts for approximately 37.85%. HND 1 accounts for the largest portion at 15.08%, while HND 2 accounts for the smallest portion, approximately 5.85%. The pie chart effectively illustrates the distribution of respondents across different academic levels.

Table 3 presents a comprehensive review of challenges encountered during practical sessions, using a 5-point Likert scale (ranging from strongly agree to strongly disagree). Key findings reveal significant agreement on issues such as time constraints, limited equipment availability, and overcrowded sessions. Average scores demonstrate a widespread acknowledgment of these challenges, highlighting the necessity for enhancements in practical learning environments. This data-driven insight is consistent with the input from respondents, emphasizing the need to address resource availability, infrastructure challenges, and instructional techniques to enhance the practical learning experience for greater success.

Table 3. Evaluation of Practical Session Challenges

S/N	Challenges/Scale	SA	A	U	D	SD
		Agree			Disagree	
1.	Time constraints	150	173	2	0	0
2.	Inadequate availability of equipment for experiments	128	180	0	17	0
3.	Setting up of apparatus by the lecturer or technologist, rather than by students	132	159	0	27	7
4.	Overcrowded practical sessions	87	45	0	10	183
5.	Insufficient time for submitting reports	162	141	0	0	22
6.	Issues with the malfunction of equipment/apparatus during practical sessions	35	120	0	92	78
7.	Intermittent electricity supply	191	125	0	9	0
8.	Outdated equipment and facilities	119	125	0	48	33
	Average	**125.5**	**133.5**	**0.25**	**25.38**	**40.38**

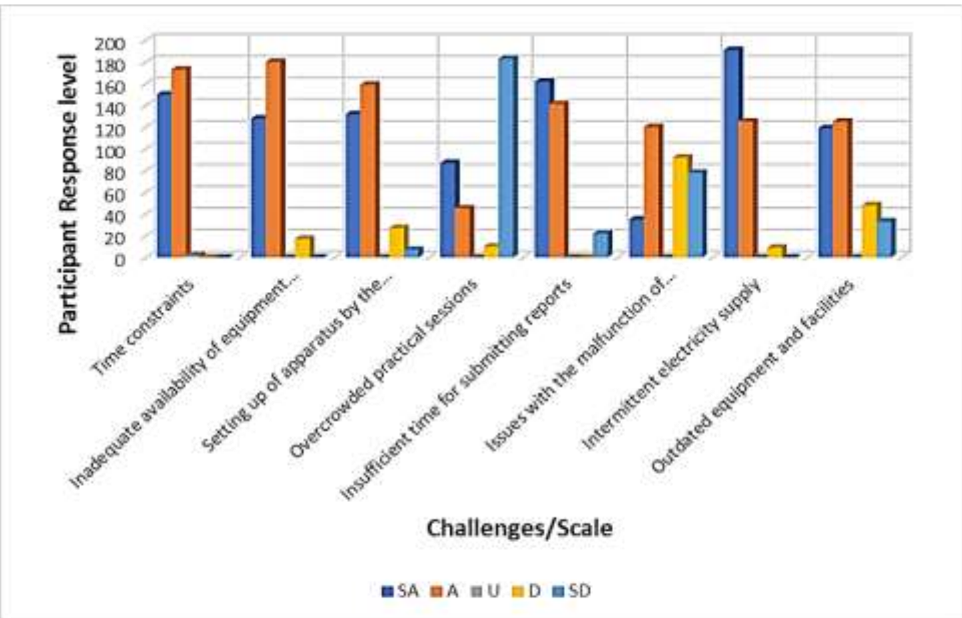

Fig. 6: Mean Value of Respondents According to the Evaluation Criteria

Figure 6 shows the average values of respondents based on the evaluation criteria. Notably, key figures show that 150 respondents agree on time limitations, 128 on inadequate equipment, and 132 on lecturer-led apparatus setup. Surprisingly, 183 respondents oppose overloaded sessions. In addition, 162 respondents agree that there is inadequate time for report submission, and 191 believe that erratic power supply is a challenge. The image effectively portrays group perceptions, highlighting the significance of each factor in evaluating challenges during practical sessions.

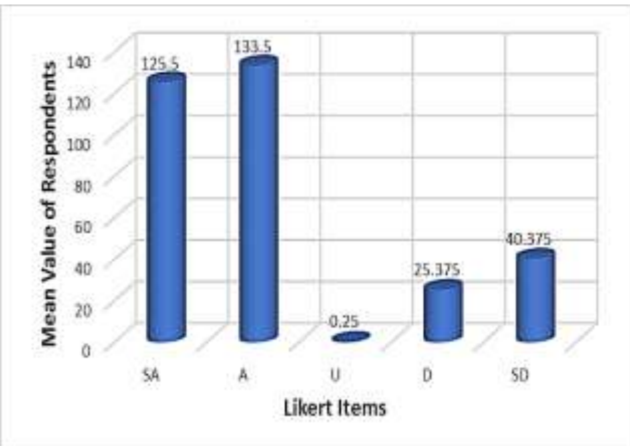

Fig. 7: Mean Value of Respondents According to Likert Item

Figure 7 depicts respondents' perspectives on practical session challenges, highlighting the computed mean values of 125.5 for "strongly agree," 133.5 for "agree," 0.25 for "undecided," 25.375 for "disagree," and 40.375 for "strongly disagree." These values capture the collective perspective, indicating varied attitudes among respondents when addressing the challenges encountered during practical sessions, thus offering a comprehensive summary of the general stance on the examined areas.

A practical example could be the formation of collaborative relationships between engineering institutions and industrial stakeholders. This teamwork can help students get newer tools and spaces for learning, giving them more chances for hands-on practice. Also, adding tech-based learning like electronic simulations to engineering courses can offer more interactive learning. Guiding courses and advice can help bridge the gap between theory and practice, improving students' academic and job growth. This plan will get engineering graduates ready for future challenges. The research results can combine with artificial or computational intelligence to create AI systems that make learning more practical, change how students learn, and give quick feedback to engineering students, making their overall performance better.

4 Strategic Initiatives for Advancing Practical Education in Engineering

1. **Modernization of Facilities and Equipment**: This helps technological advances by eliminating the requirements for textbooks and giving students innovative learner-centered tools for hands-on learning, engineering laboratories, equipment, and facilities.
2. **Standardise Information Delivery Methods**: This precisely enumerates a set of guidelines for technologists and lecturers to strictly obey whenever they are imparting practical sessions to the students of engineering and still keep it understandable.
3. **Consistent Curriculum Review and Adaptation**: organizing strategies for running program tips that would as well motivate the curriculum revision up to every season or even once a two-year period using trend, technology, and industry overhaul. As a result of their overall view of existence, they feel confident in unfamiliar settings, and their competency increases as well.
4. **Improved Access to Useful Resources:** Therefore, the design should certainly enable the students to have easy access to the kind of laboratories, techniques, and learning equipment needed for hands-on training.
5. **Technology-Enabled Learning Implementation:** To achieve thorough on-the-spot learning, especially in a place devoid of real physical resources, such as simulations, virtual laboratories, and modern technologies.
6. **Increased Industry Collaboration:** To synergize with industry partners by providing industry-required projects, internships, and practical training.
7. **Adaptive Assessment Strategies:** Make use of assessment tools to give students insightful feedback on a range of real-world problems so they can identify their strong and weak points and keep getting better.
8. **Faculty Development Programmes:** To train and qualify faculty members effectively, equipped with new methods and techniques to instruct students.
9. **Integrated Curriculum Development:** **i**ncorporating alternating or concurrent knowledge of students with the practical and theoretical parts of a curriculum is a solution.
10. **Organised Guidance and Mentoring Programs:** The mentorship programs shall be put in place to lead all students to have the necessary expertise and the ability to grasp good engineering principles during practical classes

5 Conclusion

The study used an exploratory method to investigate engineering students' perceptions of practical content delivery at tertiary institutions in southwest Nigeria. The findings highlight concerns regarding the practical learning conditions in engineering education. The demographic profile indicates that the respondents vary in terms of age, gender, field of study, and academic level, with 90.77% male and 9.23% female participants, contributing to a more comprehensive understanding of the population. The comprehensive analysis of practical session challenges revealed unanimous agreement on issues such as time constraints, insufficient equipment availability, and overcrowded sessions, with 80% indicating time constraints as a major challenge. Mean values capture the collective perspective, emphasizing various emotions regarding practical session challenges. The study identified strategic approaches to enhance practical engineering education. Recommendations include improved access to resources, increased collaboration with industry, modernized equipment and facilities, standardized content delivery, technology-enabled learning, faculty development, structured guidance, mentorship programs, adaptive assessments, and regular curriculum reviews. Despite several drawbacks, such as gender imbalance, it provides a solid foundation for future research. These findings can help educators, institutions, and legislators make changes that promote a more favorable and impactful learning environment for engineering students. Additionally, the practical applications of these findings extend to improving overall educational outcomes, fostering innovation, and equipping engineering graduates with the skills needed to address real-world challenges in the field.

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Contribution of Individual Authors to the Creation of a Scientific Article (Ghostwriting Policy)

The authors equally contributed in the present research, at all stages from the formulation of the problem to the final findings and solution.

Sources of Funding for Research Presented in a Scientific Article or Scientific Article Itself

No funding was received for conducting this study.

Conflict of Interest

The authors have no conflicts of interest to declare.