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ADInstruments Power Lab Integration in Physiology Practical: A Cross-sectional survey Study of Perception, Competence, and Skills Among Undergraduate Health Science Students in a Nigerian Tertiary Institution

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ABSTRACT
In recent years, health science education has increasingly adopted interactive, technology-enhanced tools such as ADInstruments PowerLab. These systems promote student engagement, deeper understanding of physiological concepts, and the development of critical thinking and clinical competence through real-time experimentation and data analysis. This study evaluated undergraduate health science students' perceptions, competence, and skills in using the ADInstruments PowerLab system during physiology laboratory sessions. A cross-sectional survey was conducted from May to July 2024 among students in Medicine and Surgery, Nursing, and Medical Laboratory Science. A total of 122 students were selected through random sampling. Data were collected using a semi-structured, self-administered questionnaire. Statistical analyses included descriptive statistics, chi-square tests, and univariate linear regression, with significance set at $p<0.05$. Age, gender, and type of secondary school attended were not significantly associated with perception, competence, or skills scores. Significant associations were found with academic level ($p=0.003$), ICT competency ($p=0.006$), and course of study ($p=0.019$). Students in 300 level showed lower skill scores than 200 level ($B = -1.78$, $p = 0.01$), and those with advanced ICT skills had lower scores than beginners ($B = -2.85$, $p = 0.01$). Medicine and Surgery students had significantly higher competence scores than Nursing and Medical Laboratory Science students ($p = 0.02$). Students exhibited positive perceptions, moderate competence, and varied skills, with performance influenced by academic level, ICT competency, and course of study.

Keywords:
Clinical Competence,
Perceptions,
Education,
Teaching/methods

INTRODUCTION

Over the past few decades, the delivery of medical and allied health science education has undergone significant transformation with the integration of advanced instructional technologies (Altintas & Sahiner, 2024). In response to the growing complexity of healthcare systems and the shift towards competency-based curricula, traditional lecture-based methods have increasingly been replaced by interactive, learner-centred pedagogies that foster critical thinking, skill acquisition, and clinical preparedness (Moran et al., 2018; Imrana et al., 2025).

PowerLab, developed by ADInstruments, is a widely utilized computer-based platform for data collection and analysis in biomedical science education and research (Khan & Abbas, 2018). It enables students to conduct real-time physiological experiments, such as cardiovascular assessments, respiratory monitoring, electrocardiography, and electromyography (Ketabchi et al., 2024). With its intuitive interface and modular design, ADInstruments PowerLab facilitates the visualization, acquisition, analysis, and interpretation of physiological data within a simulated yet authentic learning environment. This approach aligns with principles of adult learning theory by promoting active student engagement, encouraging hypothesis generation, collaborative experimentation, and critical interpretation of findings.

Multiple studies evaluating the application of ADInstruments PowerLab in pre-clinical education have demonstrated positive outcomes when students engaged

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with the system under guided supervision (Noor et al., 2023). The use also fostered the development of critical thinking skills during practical sessions, promoting active participation and motivating further self-directed learning (Quinche & Quinche, 2020). To enhance the training of well-rounded healthcare professionals, academic institutions are establishing clinical skills laboratories, supported by evidence that faculty-led, interactive sessions improve pre-clinical learning and competency development (Motsaanaka et al., 2024).

The integration of technology in health science education plays a pivotal role in enhancing students' clinical competence and practical understanding, particularly in foundational disciplines such as physiology (Moro et al., 2020). ADInstruments PowerLab, despite its growing adoption, there remains a limited body of empirical research assessing its impact on student competency, skill acquisition, and perceptions across various undergraduate health science programs. This study is therefore justified in its objective to examine the perceptions, competence, and skills of undergraduate health science students regarding the use of the ADInstruments PowerLab system in physiology practical sessions.

MATERIALS AND METHODS

Study design

This cross-sectional survey was conducted among undergraduate students at the College of Medical Sciences, Edo State University Iyamho, Nigeria, who were enrolled in programs in medicine and surgery, nursing, and medical laboratory science, between May and July of 2024. Before any data was collected, each participant gave their informed consent. The Google Forms platform was used to administer a semi-structured questionnaire electronically.

Selection criteria

Eligibility for inclusion in this study was limited to undergraduate students enrolled in the Medicine and Surgery, Nursing, and Medical Laboratory Science programs at Edo State University Iyamho, Nigeria, during the 2024 academic session. Participants were required to be in good academic standing and to provide voluntary informed consent. Only students who were currently studying physiology and had either completed or were actively engaged in practical sessions involving the use of ADInstruments PowerLab were considered eligible. Individuals with prior experience using ADInstruments PowerLab outside the context of the study or those unable to provide informed consent were excluded.

Sampling

The sample size for this study was determined based on a presumed response rate of 50%, a 95% confidence level, and a 5% margin of error. The initial sample size estimate, assuming an infinite population, was 384 participants; however, a finite population correction was applied due to the relatively small total population of eligible students (approximately 205). Using OpenEpi version 3.03, the adjusted minimum required sample size was calculated to be 130 participants (Dean et al., 2010). Ultimately, 122 respondents provided informed consent, with the shortfall in sample size primarily attributed to non-responsiveness and scheduling challenges despite multiple follow-up attempts. Participants were selected through random sampling, with assistance from the college administration in contacting students via phone and email.

Ethical approval

Ethical clearance for this study was granted by the Institutional Review Board of the College of Medical Sciences, Edo State University Iyamho (approval number: CMSIRB-4717/ESUI/2024/763). All procedures involving human participants adhered to the ethical guidelines of the institution and conformed to the principles outlined in the Declaration of Helsinki (1975), as revised in 2008. Participation was voluntary and anonymized, with rigorous measures implemented to safeguard the privacy and confidentiality of all respondents. Informed consent was obtained from each participant prior to data collection, either through direct interaction or electronically via Google Forms.

Data collection

Data collection was carried out using a self-administered proforma, distributed to medical and allied health students. A pilot study involving 25 students was conducted prior to survey distribution to evaluate the validity and reliability of the questionnaire. This pretest facilitated the identification and revision of unclear or ambiguous items, resulting in refinements to the proforma. The Cronbach's alpha for the dataset was 0.74, reflecting an acceptable level of internal consistency. The semi-structured questionnaire included four sections: demographic information (5 questions), Perception (15 questions), Competence (7 questions), and Skills (7 questions) related to ADInstruments PowerLab usage. The questionnaire consisted of closed-ended questions with predefined response options. Two lecturers from the Faculty of Basic Medical Sciences, Edo State University Iyamho, assisted the research team in reviewing the questionnaire for clarity and simplicity. Once the target sample size was achieved, the Google Forms link was disabled to prevent further submissions. Data were subsequently entered and analyzed using Microsoft Excel.

Scoring technique

The Perception, Competence, and Skills sections each employed a standardized three-point Likert scale to assess students' responses, with options categorized as 'agree', 'neutral', and 'disagree'. Responses were scored accordingly: a favourable response was assigned a score of 3, a neutral response a score of 2, and an unfavourable response a score of 1. For the Perception domain, cumulative scores between 1–22 indicated a negative perception, 23–28 reflected a neutral perception, and 29 or higher signified a positive perception towards ADInstruments PowerLab utilization. In the Competence section, scores from 1–11 denoted poor skills, 12–14 average skills, and 15 and above indicated excellent practical skills related to ADInstruments PowerLab application. Similarly, for the Skills section, scores within the same ranges were interpreted as low, moderate, and high levels of perceived competence, respectively.

Data analysis

After being extracted into a Microsoft Excel file, the data were analyzed using Statistical Package for Social Sciences (SPSS) version 27 software. The number (percentage) and mean (standardized deviation) were used to report categorical and numeric variables, respectively. Chi-square tests were used to determine association between categorical variables. Data normality was evaluated using the Shapiro–Wilk test (p-value > 0.05 indicating normally distributed continuous variables). The Wilcoxon rank-sum test and the Kruskal–Wallis rank-sum test/the Dunn test for multiple comparisons were employed to compare the perception, competence and skills scores between two groups and among three groups or more, respectively. Factors associated with students' perception, competence and skills scores were identified via univariate linear regression models. Statistically significant differences were considered when the p-value < 0.05.

RESULTS AND DISCUSSION

Table 1: Bio-information of Undergraduate Health Science Students

Question	**Factor**	**Variable**	**Participants = 122 n(%)**
1	Age (years)	< 20	80 (66%)
		20–25	42 (34%)
2	Gender	Male	37 (30%)
		Female	85 (70%)
3	Secondary School	Private	95 (78%)
		Public	24 (20%)
4	Current Level	200	77 (63%)
		300	45 (37%)
5	ICT Competency	Beginner	29 (23%)
		Intermediate	79 (64%)
		Advanced	14 (11%)
6	Program	Medicine & Surgery	57 (47%)
		Nursing & MLS	65 (53%)

Table 1 outlines the bio-information of 122 undergraduate health science students. The majority of participants (66%) were under 20 years of age, while 34% were between 20 and 25 years old. A greater proportion of females (70%) participated in the study compared to males (30%). Most students (78%) attended private secondary schools, with 20% having attended public schools. In terms of academic level, 63% of students were in their 200-level, and 37% were in their 300-level. Regarding ICT competency, 64% identified as having intermediate skills, 23% were beginners, and 11% reported advanced skills. The participants were almost evenly distributed between the Medicine & Surgery program (47%) and the Nursing & Medical Laboratory Science program (53%). This demographic composition offers a broad representation across various factors, enhancing the depth of analysis on ADInstruments PowerLab usage in health science education.

Table 2: Perception of students of Undergraduate Health Science Students on the use of ADInstruments PowerLab

S/N	**Variable**	**Agreed n (%)**	**Disagreed n (%)**	**Neutral n (%)**
1	ADInstruments PowerLab system gadgets are useful for students	117 (96%)	5 (4%)	0 (0%)
2	Edo State University medical students know nothing about	28 (23%)	85 (70%)	9 (7%)

	ADInstruments PowerLab system gadgets			
3	ADInstruments PowerLab system gadgets aid effective teaching	109 (89%)	8 (7%)	4 (3%)
4	ADInstruments PowerLab system gadgets aid effective learning	109 (88%)	10 (8%)	3 (2%)
5	ADInstruments PowerLab system gadgets can improve teaching and learning processes	116 (96%)	4 (3%)	2 (2%)
6	ADInstruments PowerLab system gadgets can enhance students' critical thinking skills	108 (88%)	10 (8%)	5 (4%)
7	ADInstruments PowerLab system gadgets can enhance students' participation and feedback to teachers	105 (86%)	12 (10%)	5 (4%)
8	ADInstruments PowerLab system gadgets can enhance collaboration among students	107 (87%)	11 (9%)	5 (4%)
9	ADInstruments PowerLab system gadgets can enhance teacher-student interaction	108 (84%)	19 (15%)	4 (3%)
10	ADInstruments PowerLab system gadgets offer opportunities for educational resources for practicals	119 (94%)	9 (7%)	4 (3%)
11	ADInstruments PowerLab system gadgets tend to increase students' learning motivation	96 (81%)	18 (15%)	10 (8%)
12	ADInstruments PowerLab system gadgets can enhance students' learning outcomes	103 (85%)	10 (8%)	7 (6%)
13	Students' negative attitude towards ADInstruments PowerLab gadgets can reduce learning outcomes	88 (72%)	29 (24%)	6 (5%)
14	ADInstruments PowerLab system gadgets are useful for students	111 (90%)	9 (7%)	3 (2%)
15	Edo State University medical students know nothing about ADInstruments PowerLab gadgets	114 (94%)	7 (6%)	2 (2%)

Table 3 highlights the positive perception of 122 undergraduate health science students regarding the use of ADInstruments PowerLab gadgets. A significant majority (96%) of students agreed that the ADInstruments PowerLab system is useful, and 94% recognized its value in providing educational resources for practical sessions. Most respondents (89%) believed it aids effective teaching, and 88% felt it supports learning. Additionally, 96% agreed that ADInstruments PowerLab enhances teaching and learning processes, while 88% noted its impact on improving critical thinking skills. While 86% agreed it fosters student participation and feedback, 81% felt it increased learning motivation, and 85% believed it improved learning outcomes. However, 72% acknowledged that negative attitudes towards ADInstruments PowerLab could reduce learning outcomes.

Table 3: Competence of Undergraduate Health Science Students on the use of ADInstruments PowerLab

S/N	**Variable**	**Agreed n (%)**	**Disagreed n (%)**	**Neutral n (%)**
1	Most students frequently operate ADInstruments PowerLab system gadgets	75 (61%)	40 (33%)	7 (6%)

2	Most students do not know how to operate ADInstruments PowerLab system gadgets	62 (51%)	52 (43%)	10 (7%)
3	Most students operate ADInstruments PowerLab system gadgets once in a month	41 (34%)	72 (59%)	10 (8%)
4	Skills and knowledge affect your use of ADInstruments PowerLab system gadgets during practicals	89 (73%)	27 (22%)	3 (2%)
5	The environment affects your use of ADInstruments PowerLab system gadgets during practicals	56 (46%)	52 (43%)	12 (10%)
6	Most students can measure physiological indices using ADInstruments PowerLab system gadgets	72 (59%)	34 (28%)	15 (12%)
7	ADInstruments PowerLab system gadgets is self-explanatory	66 (54%)	51 (42%)	5 (4%)

The data presented in Table 3 demonstrates varying levels of competence in the use of ADInstruments PowerLab gadgets among 122 undergraduate health science students. A majority of participants (61%) indicated frequent use of the ADInstruments PowerLab system gadgets, while 33% disagreed, and 6% were neutral. In contrast, there was a mixed response regarding familiarity with the system, with 51% acknowledging that most students are unfamiliar with its operation, and 43% disagreed with this statement. Additionally, 34% of students reported using the ADInstruments PowerLab system gadgets once a month, though the majority (59%) disagreed, indicating less frequent usage. The role of skills and knowledge in effectively using ADInstruments PowerLab during practical sessions was broadly recognized, with 73% agreeing that these factors influence their ability to operate the system. Environmental factors also played a role, with 46% agreeing and 43% disagreeing that the environment affects usage. In terms of measuring physiological indices, 59% of students expressed confidence in using the system, while 28% disagreed. Lastly, while 54% of participants agreed that the ADInstruments PowerLab system is self-explanatory, 42% disagreed, suggesting that a notable proportion of students encounter challenges with the system's usability.

Table 4: Skills of Undergraduate Health Science Students on the use of ADInstruments PowerLab

S/N	**Variable**	**Agreed n (%)**	**Disagreed n (%)**	**Neutral n (%)**
1	Can operate a ADInstruments PowerLab system gadget	86 (71%)	26 (21%)	7 (6%)
2	Can set up a ADInstruments PowerLab system gadget	77 (63%)	33 (27%)	7 (6%)
3	Can fix all the accessories in a ADInstruments PowerLab system gadget	52 (43%)	54 (44%)	12 (10%)
4	ADInstruments PowerLab system gadget requires internet to work	87 (71%)	17 (14%)	15 (12%)
5	Can report findings using a ADInstruments PowerLab system gadget	88 (72%)	23 (19%)	8 (7%)
6	Can analyze report findings using a ADInstruments PowerLab system gadget	82 (67%)	29 (24%)	6 (5%)
7	ADInstruments PowerLab system gadget does not require internet to work	29 (24%)	73 (60%)	16 (13%)

Table 4 presents the skills of 122 undergraduate health science students in utilizing ADInstruments PowerLab gadgets. The majority of participants (71%) reported being able to operate the system, although 21% disagreed and 6% were neutral. A smaller proportion (63%) felt confident in setting up the system, with 27% disagreeing and 6% neutral. Fewer students (43%) were able to fix all the accessories in the ADInstruments PowerLab system, and 44% disagreed, indicating a gap in technical maintenance skills. Regarding internet connectivity, 71% of students accurately recognized that ADInstruments PowerLab requires the internet for operation, while 14% disagreed, and 12% were uncertain. A significant proportion (72%) expressed the ability to report findings using the system, though 19% disagreed and 7% were neutral. A slightly lower number (67%) reported being able to analyze the findings, with 24% disagreeing. Lastly, 60% of students erroneously believed that the ADInstruments PowerLab system does not require an internet connection, revealing some misunderstandings about its technical requirements.

Table 5: Association of demographic characteristic with Perception, Competence and Skills

Factor	Variable	Perception			Competence			Skills		
		Mean ± SD	χ^2	p	Mean ± SD	χ^2	p	Mean ± SD	χ^2	p
Age (years)	< 20	32.8 ± 2.9	5.68	0.06	15.3 ± 2.7	2.31	0.32	15.7 ± 2.9	3.97	0.14
	20–25	31.9 ± 3.9			15.0 ± 2.8			15.1 ± 2.2		
Gender	Male	32.3 ± 3.4	2.23	0.33	15.9 ± 2.6	1.65	0.44	15.8 ± 2.2	3.59	0.17
	Female	32.5 ± 3.4			14.92 ± 2.7			15.4 ± 2.8		
Secondary School	Private	32.3 ± 3.5	1.14	0.56	15.3 ± 2.8	1.31	0.52	15.3 ± 2.7	0.33	0.85
	Public	33.1 ± 2.4			15.0 ± 2.3			16.0 ± 2.4		
Current Level	200	32.6 ± 3.2	1.27	0.53	14.9 ± 2.8	3.24	0.20	16.1 ± 2.2	11.33	0.001*
	300	32.2 ± 3.7			15.7 ± 2.5			14.3 ± 3.0		
ICT Competency	Beginner	32.4 ± 3.7	1.75	0.78	14.7 ± 2.7	2.50	0.64	13.1 ± 2.0	14.34	0.01*
	Intermediate	32.3 ± 3.4			15.4 ± 2.6			15.6 ± 2.6		
	Advanced	33.3 ± 1.2			15.3 ± 3.4			15.9 ± 3.5		
Program	Medicine & Surgery	32.5 ± 3.0	0.15	0.92	15.6 ± 2.8	7.93	0.02*	15.4 ± 2.8	0.13	0.94
	Nursing & MLS	32.4 ± 3.6			14.9 ± 2.7			15.5 ± 2.6		

*significance of p-value less than 0.05

Table 5 examines the relationship between demographic characteristics and students' perceptions, competence, and skills in utilizing ADInstruments PowerLab. The results indicate that no significant differences were found in perception, competence, or skills based on age, gender, secondary school type, or ICT competency. However, a statistically significant ($p = 0.003$) difference was identified in the skills domain based on academic level (200-level vs. 300-level), suggesting that 300-level students exhibited greater proficiency in using ADInstruments PowerLab than their 200-level counterparts. Additionally, ICT competency was significantly linked to skills ($p = 0.006$), with students possessing advanced ICT skills showing higher levels of competence with the ADInstruments PowerLab system. Moreover, students enrolled in the Medicine & Surgery program demonstrated significantly higher competence ($p = 0.019$) compared to those in the Nursing and Medical Laboratory Science (MLS) programs.

Table 6 Factors associated with the ADInstruments PowerLab Perception, Competence and Skills scores of Undergraduate Health Science Students

Factor	Variable	Perception		Competence		Skills	
		B (95%CI)	p	B (95%CI)	p	B (95%CI)	p
Age (years)	< 20 (ref)	-	-	-	-	-	-
	20–25	-0.88 (0.34 to -2.11)	0.16	-0.33 (0.67 to -1.33)	0.52	-0.66 (0.31 to -1.62)	0.18
Gender	Female (ref)	-	-	-	-	-	-
	Male	-0.21 (1.11 to -1.54)	0.75	0.94 (2.00 to -0.12)	0.08	0.53 (1.47 to -0.61)	0.42
Secondary School	Private (ref)	-	-	-	-	-	-
	Public	0.81 (2.36 to -0.73)	0.30	-0.30 (0.96 to -1.55)	0.64	0.70 (1.91 to -0.51)	0.26
Current Level	200 (ref)	-	-	-	-	-	-
	300	-0.35 (0.91 to -1.61)	0.59	0.79 (1.81 to -0.22)	0.12	-1.78 (-0.84 to -2.71)	0.01*
ICT Competency	Beginner (ref)	-	-	-	-	-	-
	Intermediate	-0.08 (1.28 to -1.45)	0.90	0.74 (1.84 to -0.37)	0.19	-0.34 (0.70 to -1.37)	0.52
	Advanced	0.87 (3.19 to -1.44)	0.46	0.59 (2.45 to -1.28)	0.53	-2.85 (-1.11 to -4.60)	0.01*
Program	Medicine & Surgery (ref)	-	-	-	-	-	-
	Nursing & MLS	-0.10 (1.12 to -1.32)	0.87	0.74 (1.72 to -0.23)	0.14	-0.16 (0.80 to -1.11)	0.75

*significance of p-value less than 0.05 when compared to reference (ref)

Table 6 presents the results of linear regression analyses examining factors associated with undergraduate health science students' ADInstruments PowerLab perception, competence, and skills scores. Overall, most variables showed no statistically significant associations; however, notable findings emerged. Students at the 300 level had significantly lower skills scores compared to 200-level students (B = -1.78, 95% CI: -2.71 to -0.84, p = 0.01), suggesting a decline in hands-on engagement or confidence with increased academic progression. Similarly, students with advanced ICT competency demonstrated significantly lower skills scores than beginners (B = -2.85, 95% CI: -4.60 to -1.11, p = 0.01), possibly reflecting a gap between digital proficiency and laboratory application. No statistically significant associations were observed for age, gender, secondary school type, or programme of study across any of the three outcome variables. Although competence scores appeared higher among males (p = 0.08) and Nursing/MLS students (p = 0.14), these trends did not reach significance.

The findings of this study provide valuable insights into undergraduate health science students' perceptions, competence, and skills in using ADInstruments PowerLab system gadgets, highlighting both strengths and areas for improvement in the integration of educational technology in health science curricula. A key finding is the overwhelmingly positive perception of ADInstruments PowerLab gadgets among students, with 96% agreeing that the system is useful for teaching and learning. This aligns with existing literature reporting that students generally view educational technologies positively due to their perceived ability to enhance engagement and learning outcomes (Bhattacharya Srabani et al., 2017). Similarly, 96% of students in this study stated that ADInstruments PowerLab enhances teaching and learning, consistent with findings by Stewart, Lund and McQuillen (2023) and Rakhmatullaev et al. (2025) who found that such technologies promote better educational delivery and interactive learning. Furthermore, 88% perceived ADInstruments PowerLab as effective in improving critical thinking skills, corroborating Kim, Yi & Hong (2020), who highlighted educational technology's role in fostering higher-order cognitive skills.

Despite these positive perceptions, the study revealed a gap between students' perceptions and their actual competence in using ADInstruments PowerLab. While 61% of students reported frequent usage, only 43% felt confident in fixing all accessories. This suggests familiarity may be limited to basic operations. These results are in line with Christopoulos & Sprangers (2021), who found that students are often comfortable with basic tasks but struggle with more technical aspects. Niiranen (2021) similarly noted that perceived competence does not always reflect actual performance, as technical skills require hands-on experience. Moreover, although 59% of students expressed confidence in measuring physiological indices using ADInstruments PowerLab, 28% disagreed, suggesting insufficient training for advanced tasks. Orji & Perumal (2024) echoed that theoretical understanding often does not translate into practical skill without adequate hands-on exposure. Chen et al. (2020) also found that hands-on training significantly boosts students' technical competence.

ICT competency was strongly associated with ADInstruments PowerLab skills. Students with stronger ICT backgrounds tended to perform better with the system, aligning with Dunn & Kennedy (2019) who found ICT literacy enhances academic and practical performance in technology-enhanced settings. However, students with advanced ICT skills showed significantly lower ADInstruments PowerLab skill scores in the regression analysis (B = -2.85, p = 0.01), contrary to findings by Almerich et al. (2020) who reported a positive relationship between ICT proficiency and practical problem-solving. This disconnect is supported by the work of Alsarayreh (2023) who found that while students with advanced ICT skills were adept at using general-purpose software and digital tools, they often struggled with specialized technical systems, possibly due to the lack of targeted, hands-on training. Furthermore, Chukwuedo & Ogbuanya (2020) argue that proficiency in basic digital tools does not necessarily equate to the technical skills required for more specialized equipment, emphasizing the need for domain-specific training to bridge this gap. This is echoed by Saubern et al. (2020) who noted that despite the broad digital literacy of university students, the absence of focused training on specialized equipment in their curricula led to poor technical troubleshooting skills. Still, the association between ICT competency and skills was statistically significant in Table 5 (p = 0.01), affirming its role in shaping students' practical engagement with ADInstruments PowerLab.

Academic level was also significantly associated with students' skill scores (p = 0.001). Interestingly, students in the 200-level demonstrated higher skill scores compared to their 300-level counterparts. This pattern was further confirmed by the regression analysis (B = -1.78, p = 0.01), indicating a significant decline in ADInstruments PowerLab skills as students' progress in their academic journey. This finding contradicts previous studies such as Noor, Khan & Nizami (2023) who observed that experience over time generally enhances competence in the use of ADInstruments PowerLab. A possible explanation, as proposed by Oyeniran & Chıa (2020) is that institutional shifts toward theory-heavy curricula at higher levels may limit students' exposure to practical applications, leading to skill atrophy.

Regarding demographics, no significant associations were found between age, gender, or secondary school type and students' competence or skills. This lack of significant findings contrasts with several studies that identified demographic variables as influential. and Maon et al (2021) reported that gender and secondary school background significantly predicted students' technological competence. For instance, Jiménez-Hernández et al. (2020) found that male students typically exhibit higher confidence and proficiency in using technical tools compared to their female counterparts. However, this study aligns with Alieto et al. (2024) who found narrowing gender and background gaps due to widespread integration of digital technologies. This suggests that ICT access in both public and private schools may now be more equitable, leading to more uniform digital competence. Notably, students in the Medicine & Surgery program demonstrated significantly higher competence scores than those in Nursing and Medical Laboratory Science (p = 0.02). This finding aligns with Pit & Bailey (2018) who observed that students enrolled in clinical programs often have greater exposure to specialized equipment, leading to enhanced proficiency in handling such technologies. Similarly, Kay, Goulding & Li (2018) reported that medical students generally receive more structured and frequent hands-on laboratory training than their peers in allied health disciplines, contributing to their higher competence levels. Furthermore, Ibe and Sawaya et al. (2021) noted that curriculum design plays a crucial role in shaping students' exposure to practical tools, with clinical medicine programs typically embedding more simulation-based and laboratory-intensive learning activities. This is echoed in the findings of Donkin, Askew & Stevenson (2019) who emphasized the need for field-specific training protocols to ensure equitable competence development across different health science disciplines. It also underscores the influence of curriculum design on practical skill development, highlighting the need for more balanced and inclusive training opportunities across all health science programs to ensure equitable competence in using tools like ADInstruments PowerLab.

CONCLUSION

The findings revealed that undergraduate students largely perceived the ADInstruments PowerLab system as beneficial for enhancing teaching, learning, and classroom engagement. Although most participants exhibited a moderate level of competence and possessed fundamental operational skills. Importantly, significant relationships emerged between students' academic levels, ICT proficiency, and skill acquisition, indicating that hands-on experience and digital literacy play a critical role in shaping practical laboratory performance. This study therefore advocates for the integration of continuous hands-on training, the development of program-specific instructional modules, efforts to bridge the gap between ICT literacy, improvements in curriculum design, and the routine assessment of training effectiveness.

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