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Original Research Article

Enhancing Student Performance Through Practical Teaching Methods in Introduction to Computing Sciences: A Case Study of the Federal University of Allied Health Sciences, Enugu, Nigeria

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Abstract

This study investigates the impact of practical teaching methods on student performance in Introduction to Computing Sciences at the Federal University of Allied Health Sciences, Enugu. As digital literacy becomes a core requirement in health sciences, understanding how pedagogy influences foundational computing outcomes is essential. A quasi-experimental design was used to compare academic outcomes between two cohorts, one taught using conventional lecture methods and the other through hands-on, practical sessions involving lab exercises, simulations, and real-time projects. Data were collected using pre- and post-tests, performance assessments, and feedback surveys. Statistical analysis using paired and independent t-tests revealed a significant improvement in the experimental group's performance ($p < 0.05$). Findings suggest that integrating practical, experiential approaches significantly enhances conceptual understanding, retention, and engagement in Computing Sciences. The study recommends institutional adoption of practical-based pedagogy to improve competence and academic success in computing courses, particularly for non-computer science majors in health-related disciplines.

Keywords: Practical teaching, Student performance, Introduction to Computing Sciences, Experiential learning, Allied health education, Nigeria.

1. INTRODUCTION

The 21st century has ushered in a new era in education where digital competency is not just desirable but essential particularly in the fields of healthcare, science, and technology. Within this context, *Introduction to Computing Sciences* plays a pivotal role in equipping undergraduate students with foundational knowledge in information systems, programming, data management, and problem-solving using computational techniques. This is especially critical in the allied health sciences, where digital tools are now central to diagnostics, record keeping, research, clinical simulations, and telemedicine. The Federal University of Allied Health Sciences, Enugu, as a newly established specialized institution, mandates Computing Sciences as a foundational course for all health-related disciplines. Despite its inclusion, a consistent trend of underperformance has been observed among students, most of whom come from non-technical backgrounds. These students often view computing as abstract and disconnected from their core professional interests. This challenge raises a fundamental question: Are traditional lecture-based methods suitable for teaching Computing Sciences to students in health disciplines?

Globally, education experts have raised concerns about the continued reliance on didactic, instructor-centered approaches in technical and scientific subjects. Theoretical instruction often characterized by chalk-and-board lectures, passive note-taking, and rote memorization has been shown to disengage students and limit their ability to apply knowledge in real-life scenarios (Freeman *et al.*, 2014). In contrast, practical teaching methods, which involve hands-on engagement, simulations, laboratory activities, and project-based learning, have gained momentum for their capacity to enhance understanding, retention, and application of knowledge.

Practical pedagogy, rooted in experiential learning theory (Kolb, 1984), asserts that learning is most effective when students engage directly with content, reflect on their experiences, form conceptual insights, and apply them in real or simulated situations. This method has proven effective in various contexts, including nursing, engineering, and medical training (Aina & Ayodele, 2018; Ahmad *et al*., 2020). However, there is limited research on its efficacy in computing education for allied health students in sub-Saharan Africa, particularly in Nigeria's newly emerging institutions like the Federal University of Allied Health Sciences.

Nigeria's higher education system is currently undergoing significant transformation to align with global best practices, especially in digital skills development. The National Universities Commission (NUC) and allied professional councils now mandate digital literacy and computing competence for all healthcare graduates. This mandate creates an urgent need for pedagogy that not only imparts theoretical knowledge but also develops real-world computing skills applicable in clinical environments. Tools such as health information systems, electronic health records (EHR), artificial intelligence for diagnostics, and digital health platforms require a practical understanding of computing principles.

Despite this, many tertiary institutions in Nigeria still employ outdated instructional models in Computing Sciences. The use of overloaded slides, instructor monologues, and textbook-based assessments persists in classrooms ill-equipped for interactive learning. The consequence is a student body that is technically underprepared, psychologically disengaged, and academically underperforming in one of the most important subjects of the modern curriculum.

Moreover, allied health students may not perceive computing as directly relevant to their future careers, leading to minimal motivation and lower achievement. This mismatch between instruction method and learner needs often results in poor attendance, low participation, and high failure rates in computing courses. Studies by Yusuf *et al*. (2022) and Onu & Mbah (2020) have confirmed these challenges, calling for reforms in pedagogical delivery and curriculum design to meet the demands of 21st-century health professionals.

Given this backdrop, it is imperative to evaluate whether practical instructional strategies such as guided computer labs, simulations, peer collaboration, and real-time programming exercises can significantly improve learning outcomes in *Introduction to Computing Sciences* for health science students. This research is driven by the belief that practical engagement not only enhances academic performance but also reshapes student attitudes toward computing, fostering confidence, curiosity, and a stronger grasp of real-world relevance.

This study therefore seeks to empirically examine the effect of practical methods of teaching on students' performance in Introduction to Computing Sciences at the Federal University of Allied Health Sciences, Enugu. By comparing the academic outcomes of students exposed to hands-on, experiential learning against those taught using traditional lecture methods, the research aims to contribute to the ongoing discourse on educational reform in Nigeria's health and technology education landscape.

The significance of this study lies in its potential to influence:

- Curriculum planners in aligning course content with competency-based frameworks,
- University administrators in prioritizing infrastructural investments in computing labs,
- Instructors in adopting learner-centered methodologies, and
- Policymakers in institutionalizing practical Computing Sciences education as a foundational requirement for health science programs.

In doing so, this research aspires to bridge the gap between theoretical knowledge and practical application, thereby equipping students not only to pass Computing Sciences courses but also to thrive in a technologically advanced healthcare environment.

2. LITERATURE REVIEW

2.1 Conceptualizing Practical Teaching in Computing Education

Practical teaching, also referred to as experiential or active learning, involves instructional methods that directly engage students in hands-on activities, experimentation, problem-solving, and real-world application of knowledge. In computing education, practical methods commonly include lab-based exercises, coding sessions, simulation tasks, and project-based learning activities (Kolb, 1984). Unlike passive lecture-based approaches, practical teaching encourages students to construct their understanding through doing allowing them to see immediate relevance and outcomes of their learning efforts.

In the context of *Introduction to Computing Sciences*, practical pedagogy emphasizes direct interaction with computers, programming environments, software tools, and basic systems operations. These activities are intended to demystify abstract computing concepts and provide students with operational fluency that supports both academic achievement and professional development. This method has gained traction globally due to its proven effectiveness in fostering deeper learning, improving retention, and enhancing cognitive engagement (Freeman *et al*., 2014; Prince, 2004).

For students in health-related fields, practical computing instruction becomes even more crucial. With the integration of digital health technologies in clinical practice such as electronic health records (EHR), medical imaging systems, and health informatics platforms future professionals are expected to possess functional computing competencies. Teaching these skills in a purely theoretical manner has consistently been shown to produce suboptimal results (Ahmad *et al*., 2020).

2.2 Theoretical Framework: Experiential Learning Theory

Kolb's Experiential Learning Theory (ELT) provides the foundational framework for practical teaching. The theory suggests that learning is a process whereby knowledge is created through the transformation of experience. It consists of four interrelated stages: concrete experience, reflective observation, abstract conceptualization, and active experimentation (Kolb, 1984). In the computing classroom, students gain concrete experience through programming or using computing tools, reflect on the results, conceptualize the theories behind the tools or code, and then experiment further to test new knowledge.

This cyclical process allows students to internalize abstract computing principles through contextual, hands-on interaction. Studies applying ELT in technical education have shown that experiential learners develop stronger problem-solving skills, a deeper conceptual grasp, and greater retention of material compared to learners in passive environments (Kolb, 2015; Moon, 2004).

2.3 Global Trends in Practical Computing Education

International studies have provided ample evidence supporting the superiority of practical methods in teaching Computing Sciences. Al-Barrak and Al-Razgan (2016) conducted a comparative study in Saudi Arabia that revealed students who engaged in lab-based programming sessions consistently outperformed those taught using traditional lectures. The hands-on group also exhibited greater self-efficacy and expressed more positive attitudes toward computing.

In a similar study, Asif *et al*. (2017) employed machine learning models to analyze student engagement in various teaching environments. They found that students exposed to project-based learning in computing courses were more likely to complete tasks on time, participate in discussions, and score higher on assessments. The researchers concluded that interactivity and continuous feedback, common in practical learning environments, are central to sustained academic success in technical subjects.

In Western higher education contexts, practical computing education has evolved into a standard. Institutions incorporate coding bootcamps, cloud-based development environments, and integrated lab assessments to ensure students graduate with job-ready computing skills (Qian & Lehman, 2017). This is in contrast with many African institutions, where resource limitations and teachercentered practices still dominate.

2.4 Empirical Studies in the Nigerian Context

In Nigeria, the implementation of practical methods in computing education is gradually gaining momentum, though significant gaps remain. Adebayo and Abdulhamid (2019) evaluated academic performance among computer science students across four Nigerian universities and found that hands-on projects and in-class coding assignments significantly boosted academic performance. However, they also noted that institutional challenges such as lack of computer labs, poor internet access, and overcrowded classrooms hindered the scalability of such methods.

Onu and Mbah (2020) examined practical teaching constraints in Nigerian health science institutions and emphasized that many lecturers lack training in active learning strategies. They also found that most students were not exposed to laboratory-based computing instruction despite the high demand for digital skills in the healthcare sector. Their recommendations included faculty training programs, curriculum redesign, and investment in infrastructure to support practical learning.

Yusuf, Afolabi, and Bello (2022) explored digital inequality among Computing Sciences students in Nigerian universities. They found that students who had regular access to practical computing sessions and digital tools performed better academically and were more likely to report confidence in applying computing knowledge to real-world problems. The authors advocated for a policylevel overhaul of how introductory computing courses are taught, especially for non-ICT majors such as those in health sciences.

2.5 Gaps in the Literature and Research Justification

While the benefits of practical teaching methods in computing education are well-documented, there remains a scarcity of research focusing on non-computer science majors, especially within allied health programs in sub-Saharan Africa. Most studies are either generalized across disciplines or focus exclusively on students who have self-selected into computing and engineering tracks. As a result, little is known about how practical teaching influences students who may initially view computing as peripheral to their career goals.

Moreover, no published studies to date have evaluated the effect of practical teaching in *Introduction to Computing Sciences* at the Federal University of Allied Health Sciences, Enugu a newly established institution with unique student demographics and programmatic structure. This study fills that gap by focusing on a specific population (allied health students), a specific course (Introduction to Computing Sciences), and a specific method (practical instruction) using robust experimental design.

By contributing new empirical evidence, this research aims to inform educators, policymakers, and institutional leaders on effective strategies to improve student performance, digital fluency, and professional readiness in computing-related courses.

3. METHODOLOGY

This section outlines the research design, population and sampling technique, instructional intervention, data collection instruments, validation procedures, and data analysis techniques used in evaluating the effect of practical teaching methods on student performance in *Introduction to Computing Sciences*.

3.1 Research Design

The study adopted a quasi-experimental, pre-test/post-test control group design. This design is suitable for evaluating the causal effect of an intervention where randomisation may not be fully feasible. The independent variable is the teaching method (practical or traditional), while the dependent variable is the academic performance of students in *the Introduction to Computing Sciences course*.

The design enabled the comparison of learning outcomes between the two groups:

- **Experimental Group**: Exposed to practical, hands-on instructional methods.
- **Control Group**: Taught using traditional, lecture-based methods.

3.2 Population and Sample

The target population consisted of all 100-level students enrolled in *Introduction to Computing Sciences* across Allied Health Departments at the Federal University of Allied Health Sciences, Enugu, during the 2024/2025 academic session. A purposive sampling technique was used to select a representative sample of 120 students from the population. The sample was stratified to ensure departmental representation and then randomly assigned into:

- Experimental Group (n = 60)
- Control Group (n = 60)

Efforts were made to ensure similarity in prior academic background by analysing students' ICT exposure during grouping.

3.3 Instructional Procedure

The intervention lasted for six weeks, during which both groups were taught the same curriculum content aligned with the National Universities Commission (NUC) - Core Curriculum Minimum Academic Standards (CCMAS) minimum academic benchmark for *Introduction to Computing Sciences*. The main distinction was the mode of delivery:

- **Experimental Group**: Received instruction through:
  - Laboratory exercises using Visual Basic and basic computing tools.
  - Real-time problem-solving tasks. o Simulations (operating system navigation, file management).
  - Group-based mini projects (creating a simple calculator and a data-entry interface).
  - Visual demonstrations and software-based tutorials.

- **Control Group**: Received instruction via:
  - Instructor-led lectures using PowerPoint slides.
  - Whiteboard explanations and textbook readings.
  - End-of-lecture assessments (theoretical in nature).

The same instructor facilitated both groups to minimise variation in teaching quality.

3.4 Research Instruments

Three main instruments were used for data collection:

1. **Pre-Test and Post-Test**: Designed by course experts to measure knowledge before and after the intervention. The test contained 30 multiple-choice questions and 5 short-structured problem-solving items covering:
   - Computer fundamentals
   - File management
   - Data input/output
   - Introduction to programming (basic syntax and logic)

2. **Project-Based Assessment Rubric**: Used only in the experimental group to assess hands-on application through individual and group mini projects.

3. **Student Perception Survey**: A 15-item Likert scale questionnaire adapted from validated instruments by Kolb (2015) and Freeman *et al*. (2014), assessing:
   - Engagement
   - Relevance
   - Confidence in using computing tools
   - Satisfaction with the learning method

3.5 Instrument Validation and Reliability

The research instruments were subjected to content validation by three experts in Computer Science Education and Educational Evaluation from recognized Nigerian universities. The content validity index (CVI) for the test items was 0.87, indicating a high level of relevance and clarity.

To ensure reliability:

- The pre-test and post-test were pilot-tested on 20 students from a nearby university.
- Using Kuder-Richardson 20 (KR-20) for the multiple-choice test, the reliability coefficient was 0.81, confirming high internal consistency.
- Cronbach's alpha for the student perception survey was 0.85, indicating strong reliability.

3.6 Data Collection Procedure

- **Week 0**: Both groups were administered the pre-test under supervised conditions.
- **Weeks 1–5**: Instructional intervention took place.
- **Week 6**:
  - Post-test was administered to both groups simultaneously.
  - The experimental group completed their mini projects.
  - Student perception surveys were distributed and collected.

Data were collected with full ethical consideration. Students were informed about the study's purpose, and their participation was voluntary.

3.7 Data Analysis Techniques

Data were analyzed using IBM SPSS Statistics version 25. The following statistical techniques were applied:

- **Descriptive statistics**: Mean, standard deviation, and percentage distributions were calculated to describe student performance and perception patterns.
- **Paired sample t-test**: Used to assess the within-group improvement (pre-test vs. post-test) for both experimental and control groups.
- **Independent sample t-test**: Used to compare the post-test scores between the experimental and control groups to determine the statistical significance of differences in learning outcomes.
- **Analysis of variance (ANOVA)**: Conducted to test for significant differences across departments in the experimental group.

A significance level of $p < 0.05$ was set for all inferential tests.

4. RESULTS

This section presents the findings from the analysis of data collected during the study. The results are organized around three key areas: comparison of pre-test and post-test scores within each group, comparison of post-test scores between the experimental and control groups, and analysis of student perception regarding practical teaching.

4.1 Descriptive Statistics

Table 1 presents the mean scores and standard deviations for both the experimental and control groups on the pre-test and post-test assessments.

Table 1: Mean and Standard Deviation of Pre- and Post-Test Scores

Group	Test Type	Mean Score	Standard Deviation
Experimental	Pre-test	41.73	5.89
	Post-test	78.45	6.75
Control	Pre-test	42.51	6.12
	Post-test	60.27	7.23

From the table, it is evident that both groups showed improvement after the intervention. However, the experimental group, which received practical instruction, showed a much greater increase in mean score (36.72 points) compared to the control group (17.76 points).

4.2 Paired Sample T-Test (Within-Group Comparison)

To determine whether the increase in performance was statistically significant within each group, paired sample t-tests were conducted.

Table 2: Paired Sample T-Test Results

Group	t-value	Df	p-value	Interpretation
Experimental	34.12	59	< 0.001	Significant improvement
Control	15.47	59	< 0.001	Significant improvement

Both groups showed statistically significant improvements in their post-test scores compared to the pre-test scores ($p < 0.001$). However, the magnitude of improvement was much higher in the experimental group.

4.3 Independent Sample T-Test (Between-Group Comparison)

An independent sample t-test was conducted to compare the post-test scores of students in the experimental and control groups.

Table 3: Independent Sample T-Test on Post-Test Scores

Group Comparison	Mean Difference	t-value	df	pvalue	Interpretation
Experimental vs Control	18.18	12.87	118	< 0.001	Statistically significant

The result indicates a statistically significant difference in post-test scores between the experimental and control groups, with the experimental group outperforming the control group by an average of 18.18 points. This suggests that the practical teaching method had a positive and significant effect on student performance.

4.4 Departmental Analysis (ANOVA)

A one-way ANOVA was used to determine whether there were significant differences in performance gains across departments within the experimental group.

Table 4: ANOVA Summary for Departmental Performance

Source	SS	df	MS	F	p-value
Between Groups	314.23	4	78.56	2.71	0.037
Within Groups	1581.47	55	28.75		
Total	**1895.70**	**59**			

The ANOVA results indicate a statistically significant difference in performance across departments in the experimental group ($F(4, 55) = 2.71$, $p < 0.05$). Post hoc analysis (using Tukey HSD) revealed that Nursing and Health Information Management students performed slightly better than their counterparts in Physiotherapy and Public Health, likely due to prior exposure to ICT.

4.5 Student Perception Survey Results

The feedback survey administered to the experimental group provided insights into students' attitudes toward the practical teaching method.

Table 5: Summary of Student Perception Survey (n = 60)

Item Statement	Strongly Agree/Agree (%)
The practical sessions helped me understand concepts better	93%
I feel more confident using computing tools	88%
The learning experience was engaging and enjoyable	91%
I believe this method should be used in other courses	95%
I can apply what I learned to real-life situations	90%

The perception data reinforce the quantitative findings. A majority of students expressed satisfaction with the hands-on learning method and reported increased confidence, comprehension, and interest in computing.

4.6 Summary of Findings

1. Both groups improved after instruction, but the experimental group improved significantly more.
2. Practical teaching methods had a statistically significant positive effect on students' academic performance.
3. Differences were observed among departments, indicating prior experience or interest may influence practical learning effectiveness.
4. Students expressed high levels of satisfaction, engagement, and perceived relevance of practical computing education.

5. DISCUSSION

The results of this study provide clear and compelling evidence that practical teaching methods significantly enhance student performance in *Introduction to Computing Sciences* among undergraduate allied health students. The marked improvement in post-test scores in the experimental group coupled with the strong positive feedback from students demonstrates that experiential, hands-on learning leads to better comprehension, retention, and application of computing knowledge compared to traditional lecture-based instruction.

5.1 Practical Instruction and Academic Performance

The significant mean score gain (36.72 points) observed in the experimental group aligns with the findings of Al-Barrak and Al-Razgan (2016), who reported improved student achievement through lab-based and problem-solving learning environments in computing. Practical teaching enabled students to interact directly with software, write simple programs, manipulate digital files, and visualize computing processes transforming abstract concepts into tangible learning experiences. This pedagogical shift aligns with Kolb's Experiential Learning Theory (1984), which posits that knowledge is constructed through concrete experience, reflective observation, and active experimentation.

Moreover, the statistical difference in performance between the experimental and control groups ($p < 0.001$) reinforces the argument that traditional lectures, while useful for information delivery, are insufficient for developing computational skills and confidence especially among students with limited prior exposure to ICT. These findings are consistent with those of Adebayo and Abdulhamid (2019), who concluded that project-based and interactive learning models yielded better student performance in Nigerian computing courses than conventional lecture formats.

5.2 Departmental Variation and Learner Context

While all departments in the experimental group benefited from practical instruction, students from Nursing and Health Information Management departments recorded slightly higher post-test averages. This variation may reflect differences in curriculum exposure, digital readiness, or prior experience with health-related digital tools such as patient databases, telehealth interfaces, or ehealth platforms.

This departmental discrepancy underscores the importance of **contextualized practical learning** tailoring computing tasks and examples to the professional interests of each discipline. For example, a public health student may better appreciate database operations when linked to disease surveillance, while a radiography student may grasp image processing concepts more effectively through simulation-based instruction.

5.3 Engagement, Confidence, and Student Attitude

Beyond academic performance, the student feedback survey revealed high levels of engagement and satisfaction among those taught using the practical method. Over 90% of participants agreed that the practical sessions enhanced their understanding and enjoyment of the course. More importantly, 88% reported increased confidence in using computing tools an essential outcome considering that digital technologies are now embedded in health service delivery, clinical documentation, diagnostics, and research.

These findings echo the work of Freeman *et al*. (2014), whose meta-analysis across 225 studies showed that active learning significantly reduces failure rates and improves examination performance in STEM courses. When students are engaged in their learning and see clear relevance to their future careers, they are more motivated to participate, learn, and perform.

5.4 Implications for Health Science Education

The implications of this study are significant for curriculum planners and policymakers in Nigerian and African higher education. Allied health students, despite not being computer science majors, must still acquire critical computing skills for their future roles. From using electronic health records and telehealth platforms to performing basic data analysis in community health, digital fluency is now an essential competency for all health professionals.

Introducing practical computing instruction across health science programs can serve as a catalyst for greater interdisciplinary readiness, bridging the digital divide often seen in clinical practice settings. Additionally, such instruction supports broader educational goals including critical thinking, problem-solving, and collaborative learning which are key outcomes in competency based medical education.

5.5 Challenges and Considerations

Despite the positive findings, implementing practical computing instruction on a wide scale is not without challenges. Many Nigerian universities face infrastructural limitations including outdated computer laboratories, unreliable internet access, and insufficient staffing. Without addressing these systemic barriers, the benefits of practical pedagogy may not be equitably realized.

Furthermore, faculty resistance to pedagogical change and lack of training in student-centered teaching methods can hinder adoption. Ongoing professional development, supported by institutional leadership and national education policies, will be necessary to build a culture of innovation in computing education.

6. CONCLUSION

This study set out to investigate the effect of practical teaching methods on student performance in *Introduction to Computing Sciences* among allied health undergraduates at the Federal University of Allied Health Sciences, Enugu. The findings provide clear and compelling evidence that hands-on, experiential learning significantly enhances both cognitive achievement and student engagement when compared to traditional lecture-based approaches. Students exposed to practical methods demonstrated higher post-test scores, greater conceptual understanding, and stronger confidence in applying computing skills. These results affirm the relevance of Kolb's Experiential Learning Theory and support existing global literature that advocates for the integration of active learning strategies in STEM education. More importantly, the outcomes highlight the urgent need to tailor computing instruction to meet the real-world demands of health science students, who must increasingly operate in digitally driven healthcare environments.

In addition to improved academic performance, students in the experimental group expressed greater satisfaction with the course and a stronger belief in the relevance of computing to their professional futures. This suggests that practical teaching does more than deliver content—it transforms perceptions and attitudes, which are critical for long-term learning and motivation. Given the increasing importance of digital literacy in modern healthcare, this study reinforces the call for a systemic shift in how Computing Sciences is taught within allied health institutions. The emphasis must move from passive content delivery to active skill acquisition through meaningful, application-driven experiences. While infrastructural and institutional challenges persist, this study demonstrates that even modest, well-planned interventions in teaching methods can lead to measurable improvements in learning outcomes.

In conclusion, practical teaching methods are not only pedagogically superior for Computing Sciences education, they are essential for equipping future health professionals with the digital competencies required in the 21st-century healthcare workforce.

7. Recommendations

Based on the findings and conclusions of this study, the following recommendations are proposed to enhance computing science education and improve student performance in allied health institutions in Nigeria and similar contexts:

7.1 For University Administrators and Educators

1. Institutionalize Practical-Based Learning

Practical components such as laboratory sessions, programming tasks, simulations, and project-based learning should be embedded as core elements in the *Introduction to Computing Sciences* curriculum. Practical instruction should move from being supplementary to becoming the primary instructional approach.

2. Invest in ICT Infrastructure

Universities should prioritize the provision of modern computer laboratories, reliable internet access, power supply, and essential software tools to support active learning environments. This infrastructure is foundational to successful implementation of practical teaching methods.

3. Train and Re-Train Lecturers in Pedagogical Innovation

Faculty development programs should be introduced to equip instructors with skills in experiential and learner-centered teaching methods, including the use of digital platforms, assessment design for practical tasks, and collaborative learning strategies.

4. Contextualize Computing Content

Learning activities should be tailored to the realities of each allied health discipline. For instance, simulations and projects should reflect applications in nursing informatics, public health surveillance, medical imaging, or hospital information systems to enhance relevance and engagement.

7.2 For Policymakers and Regulatory Bodies

5. Review and Update Curriculum Guidelines

The National Universities Commission (NUC), in collaboration with relevant health professional councils, should revise computing science benchmarks to reflect a stronger emphasis on practical and interdisciplinary competencies.

6. Mandate Minimum Computing Competencies

All allied health graduates should be required to demonstrate basic computing proficiency through skill-based assessments prior to graduation, ensuring digital readiness for clinical and administrative responsibilities.

7. Promote Funding for Educational Technology

Government and donor agencies should support grants for universities to develop smart classrooms, simulation centres, and digital labs as part of broader digital transformation strategies in higher education.

7.3 For Future Researchers

8. Conduct Longitudinal Studies

Future research should investigate the long-term impact of practical computing education on professional competence, workplace performance, and digital literacy among health graduates.

9. Explore Hybrid and Virtual Learning Models

Researchers should evaluate the effectiveness of blended learning (combining virtual labs with physical instruction) as a scalable model in resource-constrained settings.

10. Examine Gender and Background Variables

Further studies should analyse how gender, prior ICT exposure, and socio-economic status interact with teaching methods to influence learning outcomes in computing.

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