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THE EFFECT OF INSUFFICIENT COMPUTER LABORATORY RESOURCES ON TEACHING AND LEARNING OF COMPUTER SCIENCE IN TERTIARY INSTITUTIONS IN DELTA STATE

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ABSTRACT

This study investigates the effect of inadequate computer laboratory resources on the teaching and learning of computer science in tertiary institutions. The paper explores the challenges faced by both instructors/lecturers and students due to insufficient laboratory facilities and provides recommendations for improvements. The population for the study included three (3) tertiary institutions randomly selected in Delta State offering computer science programme. One hundred and fifty (150) questionnaires were administered to instructors/lecturers to extract data. Three (3) research questions were formulated, and means value and charts were used to analyze the collected data. The findings showed through a comprehensive review of existing literature and a case study of the selected institutions, this research highlights the critical role of a well-equipped computer laboratories in fostering effective computer science education. According to the findings, it is suggested that educational authorities and school management should encourage the use of

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available resources by providing the necessary materials to enhance student performance and learning in computer science.

Keywords: insufficient computer laboratory resources, teaching, learning, student performance

Introduction

The dynamics associated with the rapid advancement in technology has underscored the importance of computer science education in today's world. As society becomes increasingly dependent on technology, the need for skilled computer science professionals continues to grow. Consequently, our tertiary institutions play a pivotal role in preparing students for careers in this dynamic field. However, many institutions face significant challenges in providing the necessary resources to support effective computer science education, with one of the most critical resources being the computer laboratory (Guzdial, 2015).

Computer laboratories are essential for hands on learning, allowing students to apply theoretical concepts into practical settings. These laboratories provide the infrastructure needed for programming (coding), software development, networking, and other areas of computer science. Despite their importance, many tertiary institutions, particularly in developing countries, struggle with inadequate computer laboratory resources. This insufficiency can severely hinder the teaching and learning processes, affecting both instructors/lecturers and students.

According to Johnson, Smith, and Brown (2017), a well-equipped computer laboratory enhanced students' learning experiences by providing them with the tools they need to succeed. However, the reality in many institutions is different such as overcrowded laboratory, outdated computer equipment (software and hardware), and limited access to essential software are common issues. These problems not only impede the teaching/learning process but also demotivate students and instructors/lecturers.

Beaubouef and Mason (2005), stated that practical exposure in computer laboratories is vital for retaining students in computer science programmes, as it helps them see the real-world applications of their studies. The disparity in computer laboratory resources can significantly impact the quality of education. Institutions with inadequate laboratory facilities often struggle to keep up with the rapid advancements in technology. As a result, students may miss out on learning the latest programming languages, software development tools, and hardware technologies, putting them at a disadvantage in the job market (Beaubouef & Mason, 2005). Moreover, the lack of adequate computer laboratory resources can affect student motivation and engagement. Studies have shown that students who have access to well-equipped laboratories are more likely to be engaged in their studies and perform better academically (Smith & Doe, 2015).

Instructors/lecturers in institutions with insufficient computer resources may

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find it challenging to deliver effective practical sessions, which are necessary for a comprehensive understanding of computer science concepts (Johnson et al., 2017). This limitation can force instructors/lecturers to rely more heavily on theoretical teaching methods, which may not adequately prepare students for practical challenges in the field. Additionally, the maintenance and upgrading of computer laboratories require significant investment. As technology rapidly evolves, the need for regular updates to hardware and software becomes critical. Institutions must allocate sufficient funds to ensure their laboratories remain up-to-date and capable of providing students with relevant and effective learning experiences (Brown, 2018).

Statement of Problem

Despite the importance of computer laboratories, many tertiary institutions, especially in developing countries, struggle with inadequate resources. This insufficiency not only affects the quality of education but also reduce the ability of students to compete in the global job market (Barker & Aspray, 2006). The gap in resources manifests in various forms, such as insufficient hardware, outdated software, inadequate maintenance, and limited access to laboratory facilities. The above mentioned can lead to overcrowded laboratories, reduced students learning opportunities, and ultimately, a decline in the quality of computer science education.

The lack of adequate computer laboratory resources is particularly pronounced in developing countries, where budget constraints and infrastructural challenges are the problem. As a result, students from these institutions often find themselves at a disadvantage compared to their peers in better-equipped institutions. This disparity not only affects their academic performance but also their future career prospects.

Aim/Objectives of the study

The aim of this research is to investigate the effect of insufficient computer laboratory resources on the teaching and learning of computer science in tertiary institutions in Delta state. The specifically, the study determined:

1. To analyze the impact of insufficient computer laboratory resources on the teaching and learning of computer science.
2. To identify the challenges faced by students and instructors/lecturers due to inadequate lab facilities.
3. To propose recommendations for improving computer laboratory resources in tertiary institutions to enhance the quality of computer science education.

Research Questions

In this study, the following research questions were answered

1. How do insufficient computer laboratory resources affect student learning outcomes in computer science?
2. What challenges do instructors/lecturers face in teaching

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computer science due to inadequate laboratory facilities?

3. What measures can be implemented to improve computer laboratory resources in tertiary institutions?

Literature Review

The Role of Computer Laboratories in Education

Computer laboratories are integral to the practical application of theoretical knowledge in computer science. They enable students to experiment with coding, software development, networking, and other essential skills in a controlled environment. Johnson, Smith, and Brown (2017) emphasize that well-equipped laboratories enhance student learning experiences and outcomes by providing access to modern technologies and resources. This access is important for developing the hands-on skills necessary for success in the field.

Guzdial (2015) highlights that practical engagement is essential for effective learning in computer science. He argues that without adequate laboratory resources, students miss out on crucial hands-on experience, which can lead to a superficial understanding of concepts. This is supported by Beaubouef and Mason (2005), who state that practical exposure in computer laboratory is vital for retaining students in computer science programme, as it helps them see the real-world applications of their studies.

Challenges of Insufficient Resources

Barker and Aspray (2006) highlight the challenges associated with insufficient computer laboratory resources. These include overcrowded laboratories, where too many students share limited resources, leading to reduced individual practice time. Outdated equipment and software further exacerbate the problem, as students are unable to work with current technologies, which are critical for their future careers.

Furthermore, limited access to necessary software can hinder students' ability to complete assignments and projects effectively. This lack of resources can result in decreased student engagement and lower academic performance. Smith and Doe (2015) note that students in under-resourced institutions often feel demotivated and less confident in their abilities.

Similarly, a study by Mahapatra and Panda (2016) reveals that insufficient computer lab resources lead to decreased student satisfaction and engagement. Students often express frustration with having to share outdated equipment and deal with frequent technical issues. This frustration can result in a lack of interest in the subject matter and lower academic performance.

Case Studies and Statistical Analysis

Several studies have demonstrated the impact of well-equipped computer laboratories on student performance and satisfaction. For example, Smith and Doe (2015) conducted a case study on resource allocation in tertiary institutions and found

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that those with better-equipped laboratories reported higher student satisfaction and better learning outcomes.

Similarly, Brown (2018) showed that institutions with modern laboratories facilities saw improved student performance in computer science courses. The research indicated that students in well-resourced institutions had higher grades, better retention rates, and more positive attitudes towards their studies. These findings highlight the importance of adequate laboratories resources for academic success.

Moreover, a study by Hu, Zhang, and Wang (2019) utilized statistical analysis to examine the relationship between laboratories resources and student performance in Chinese universities. The results showed a significant positive correlation between the quality of laboratories facilities and student grades, suggesting that investment in laboratories infrastructure is a key factor in educational success.

Implications of Insufficient Resources

The implications of inadequate computer laboratory resources are far-reaching. For instructors/lecturers, the lack of resources can limit their ability to deliver effective practical sessions, forcing them to rely more on theoretical teaching methods. This shift can reduce the overall effectiveness of the educational experience (Johnson et al., 2017).

For students, insufficient resources can lead to a lack of hands-on practice, which is essential for mastering computer science skills. A study by Tsai and Tsai (2018) found that students with more practical experience in computer laboratories were more confident and better prepared for technical job roles. The lack of computer laboratory resources can also impact student motivation and engagement. Mahapatra and Panda (2016) found that students who experienced frequent technical difficulties and limited access to necessary resources were less motivated to engage with their studies. This lack of engagement can lead to higher dropout rates and lower overall academic performance.

Research Method

This study employs a survey type approach, using descriptive method. The research focuses on a sample of tertiary institutions with varying levels of computer laboratories resources. The population of this study consists of computer science instructors/lecturers/lecturers and students in tertiary institution in Delta state, Nigeria. Delta State has nine (9) tertiary institution comprises of colleges, polytechnics and university. Three (3) institutions were randomly sampled for the study. The total numbers of respondents were one hundred and fifty (150) computer science instructors/lecturers/lecturers and students

The main instrument for this study was a designed questionnaire use for data collection on the effect of insufficient computer laboratories resources in teaching and learning computer science in tertiary institutions. The instrument is a close ended questionnaire. A four (4) point Likert type scale ranging from strongly agree (SA),

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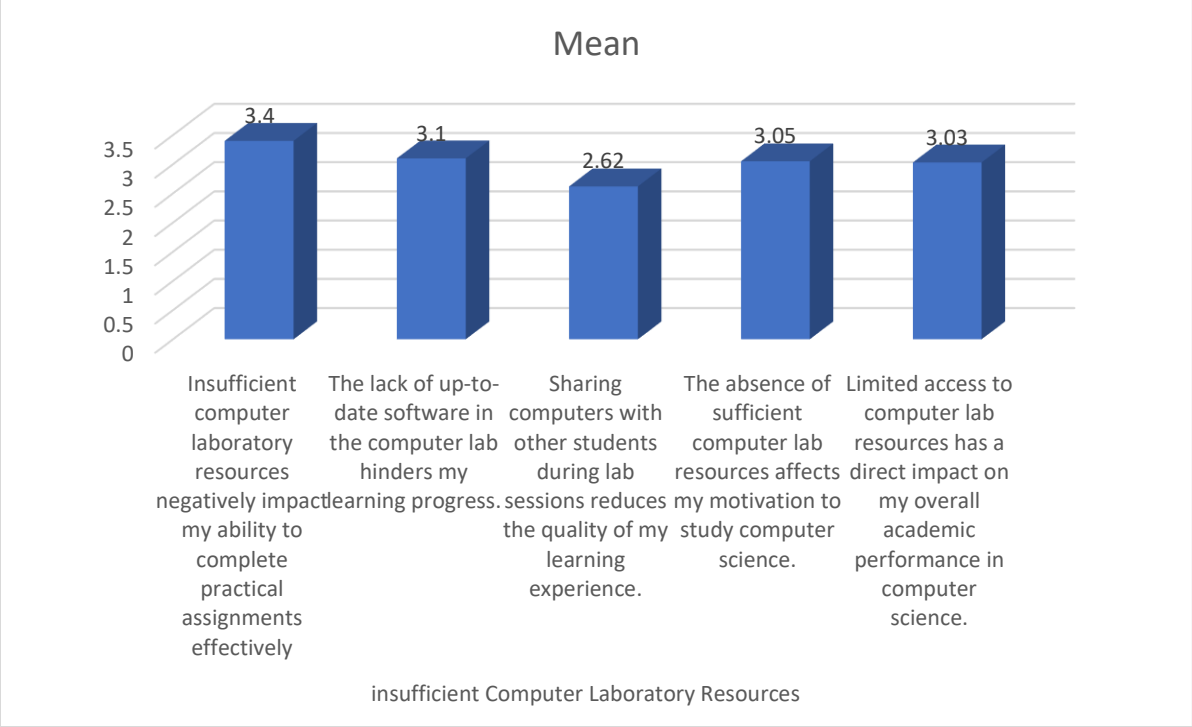
Agree (A), Disagree (D), and strongly disagree (SD). The instrument was validated by an expert lecturer of measurement and evaluation in FCE(T), Asaba. The reliability of the instrument was tested. The instruments were administered to the respondents and they were encouraged to fill the questionnaire immediately. The questionnaire was collected immediately after response for analysis. The research questions were answered using mean statistics of 2.5 and above as a significant level

Results and Findings

This data analysis and results is presented here. The purpose of this is to present and analyze the data collected during the survey and to reflect on the findings of the data collected. The details are listed in the tables and presented in chart to verify their authenticity or otherwise. A total of one hundred and fifty (150) copies of the questionnaire were distributed to the respondents in the study area.

Figure one

The mean value chart for each component on insufficient computer laboratory resources

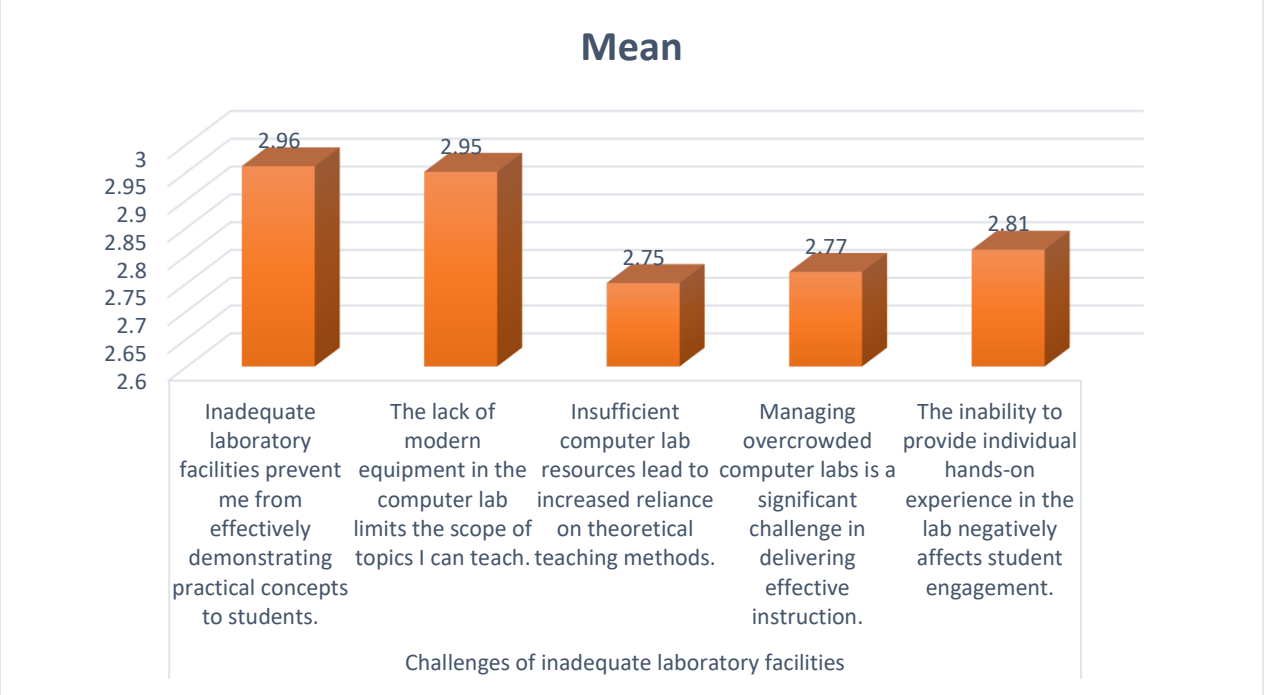


From figure one, the mean score of all the items with the mean value of 3.40, 3.10, 2.62, 3.05 and 3.03 were agreed by respondent that insufficient computer laboratory resources affect student learning outcomes in computer science. However, computer laboratories should be well-equipped and up-to-date is essential for providing students with practical

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skills and knowledge they need to succeed in the ever-evolving field of computer science.

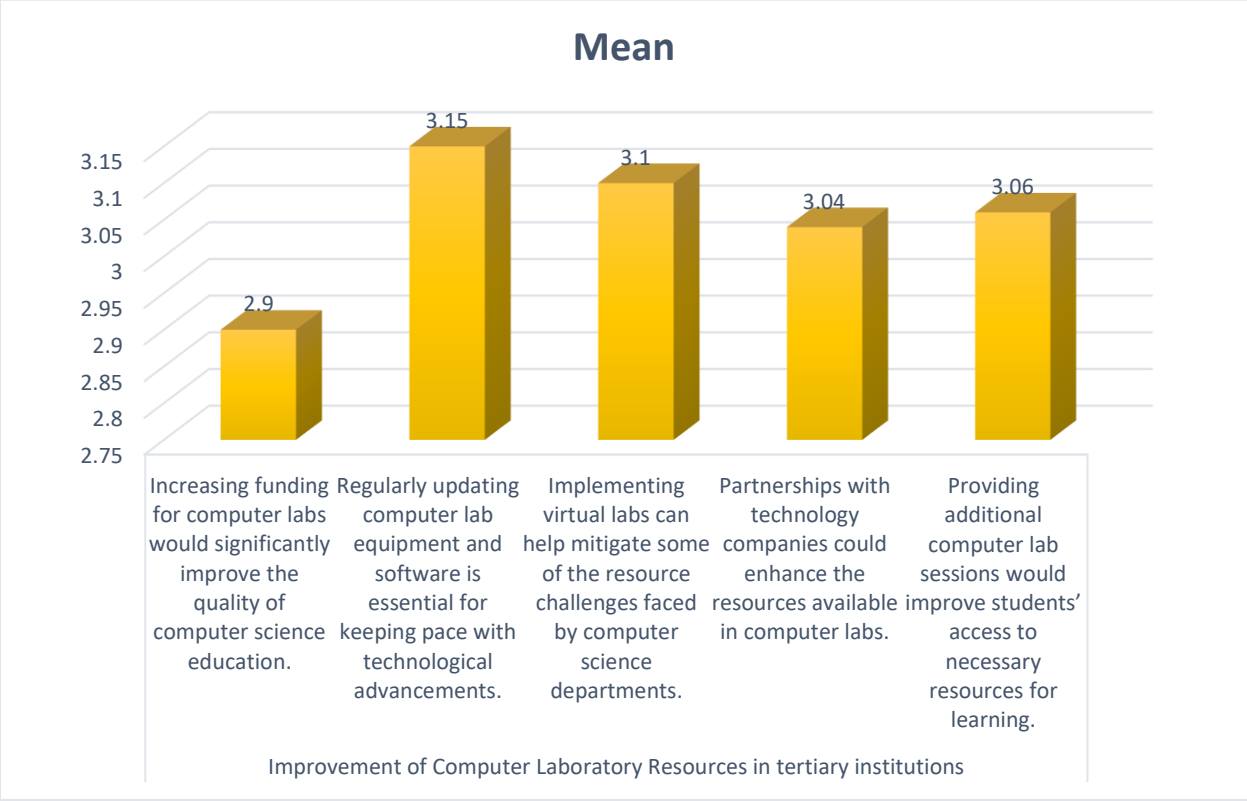
Figure two
The mean value chart for each component on challenges to inadequate laboratory facilities



From figure two, the mean score of 1,2,3,4 and 5 items with the mean value of 2.96, 2.95, 2.75, 2.77 and 2.81 were agreed by respondent that challenges instructors/lecturers faced in teaching computer science are due to inadequate laboratory facilities. The challenges faced by institutions in maintaining and upgrading their laboratories underscore the need for increased investment and strategic planning.

Figure three
The mean value chart for each component on improvement of computer laboratory resources in tertiary institutions

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From figure three, the mean score of 1,2,3,4 and 5 items with the mean value of 2.90, 3.15, 3.10, 3.04, and 3.06 were agreed by respondent that computer laboratory in tertiary institutions should be improved. However, increased in funding from both government and private sectors is essential to address the resource gap.

Discussion

The discussion interprets the findings, it's highlighted that insufficient computer laboratory resources reduce the overall quality of computer science education. For instance, the lack of adequate lab resources can lead to reduced hands-on practice, which is critical for mastering computer science skills (Barker & Aspray, 2006).

Implications for Teaching: Instructors/lecturers face significant challenges in delivering practical components of their courses. This often results in a reliance on theoretical teaching methods, which may not adequately prepare students for real-world applications (Johnson et al., 2017).

Implications for Learning: Students in tertiary institutions with insufficient computer laboratory resources are at a disadvantage compared to their peers in better-equipped institutions. This disparity

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can affect their academic performance and future career prospects (Smith & Doe, 2015).

Funding and Investment: Increased funding from both government and private sectors is essential to address the computer laboratory resource gap. Tertiary institutions management should prioritize investments in modernizing their computer laboratory (Brown, 2018).

Regular Updates: Regular updates of equipment and software are necessary to keep pace with technological advancements. This ensures that students have access to the latest tools and technologies (Johnson et al., 2017).

Virtual Laboratory: The integration of virtual laboratory can complement physical resources, providing students with additional opportunities for hands-on learning. Virtual laboratory can also serve as a cost-effective solution to some of the resource challenges (Barker & Aspray, 2006).

Recommendations for Improvement

Based on the findings from the literature, several measures can be implemented to address the resource gap in computer laboratories. Increased funding from both government and private sectors is essential to modernize lab facilities. Regular updates of equipment and software ensure that students have access to the latest tools and technologies. Additionally, the integration of virtual laboratory can provide supplementary resources that enhance the learning experience (Brown, 2018).

Virtual laboratories, as suggested by Gartner and Brooks (2016), can offer a cost-effective solution to some of the resource challenges. They provide students with access to virtualized environments where they can practice coding, networking, and other skills. These laboratories can be accessed remotely, increasing flexibility and accessibility for students.

Conclusion

The study highlights the critical importance of adequate computer laboratory resources in the teaching and learning of computer science in tertiary institutions. Insufficient laboratory facilities hinder the practical application of theoretical concepts, negatively impacting both students and instructors/lecturers. This inadequacy leads to reduced hands-on practice, lower student engagement, and diminished educational outcomes. To address these challenges, increased funding by government and stakeholders, regular updates to laboratory equipment and software, and the integration of virtual laboratory are essential. By implementing these measures, tertiary institutions can significantly enhance the quality of computer science education, better by preparing students for the demands of the modern technological workforce.

Recommendations

Based on the findings, the following recommendations are proposed to improve computer laboratory resources and enhance the quality of computer science education in tertiary institutions:

1. **Increase Funding**: Government and private sectors should increase

financial support to modernize and maintain computer laboratories. Adequate funding will ensure that laboratory is equipped with the latest technology and resources.

2. **Regular Updates**: Institutions should prioritize regular updates of both hardware and software in computer laboratory. Keeping equipment current with technological advancements will ensure that students have access to modern tools necessary for their education and future careers.
3. **Integration of Virtual Laboratory**: To supplement physical resources, institutions should integrate virtual laboratories. Virtual laboratory provides a cost-effective way to offer additional hands-on learning opportunities and can be accessed remotely, increasing flexibility and accessibility for students.
4. **Partnerships with Technology Companies**: Establishing partnerships with technology companies can provide access to cutting-edge software and hardware. These collaborations can also offer students exposure to industry-standard tools and practices.
5. **Strategic Planning and Management**: Institutions should implement strategic planning and efficient management practices to ensure the optimal use and maintenance of computer laboratory resources. This includes regular assessments of laboratory conditions and resource allocation to meet the needs of students and instructors/lecturers effectively.

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