

# Understanding Learning Challenges in Visual Basic.NET Programming Among TVET Students: The Role of ICT Integration

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## Abstract:

The integration of Information and Communication Technology (ICT) tools in education is vital for enhancing learning outcomes, particularly in technical and vocational education and training (TVET) programs. This study rigorously examines the transformative impact of ICT on learning Visual Basic.NET programming among TVET students. Employing a comprehensive census sampling method, the research engaged 79 students and gathered data through a structured questionnaire that investigated the usage of ICT tools, access to vital resources, and various learning challenges. The findings reveal students are effectively leveraging ICT tools, as evidenced by an impressive mean score of 4.41 in ICT resource utilization however findings also found that students encounter significant difficulties with fundamental programming concepts, debugging, and Object-Oriented Programming (OOP). Crucially, the analysis uncovers a moderate negative correlation of -0.5232 between ICT tool usage and learning difficulties, suggesting that increased engagement with ICT tools has the potential to alleviate these challenges significantly. The results of this study underscore the urgent need for equitable access to ICT resources, as well as the implementation of targeted strategies to enhance their effective utilization. In conclusion, this research advocates for the strategic integration of ICT as an essential mechanism to bridge learning gaps, deepen understanding, and elevate programming skills among TVET students.

**Keywords — programming, visual, learning, digital, challenges**

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## I. INTRODUCTION

Courses in programming languages are a cornerstone of education in Information Technology and Computer Science, particularly in polytechnic institutions that aim to equip students with industry-ready skills [1]–[3]. These programs are designed to cultivate proficient graduates who can leverage technology to address real-world challenges. Among the various programming languages taught, Visual Basic Programming (VB.NET) stands out as a popular choice in polytechnic education. Known for its versatility in developing Windows desktop, web, and mobile applications, VB.NET is often selected

due to its structured, accessible nature, making it suitable for students at the onset of their programming education [2]–[4]. The language is especially favoured for its graphical user interface (GUI) capabilities, enabling students to create applications efficiently using drag-and-drop components like buttons, text boxes, and labels. Moreover, VB.NET offers a wide range of pre-built functions and controls that simplify complex tasks, which is crucial for beginner programmers. Despite the language's accessibility, many first-semester students in polytechnic institutions face significant challenges when learning VB.NET programming[2]–[6]. While they may understand

basic programming concepts, such as syntax and semantics, students often struggle to apply these principles in practice, particularly when transitioning from theoretical knowledge to functional code[7]–[10]. Previous research indicates that students frequently encounter difficulties in translating written solutions into operational programs, hindering their ability to develop fully functional applications[5], [11]–[13]. This highlights the importance of integrating Information and Communication Technology (ICT) tools to support their learning.

While ICT tools have been shown to enhance the learning process, it is unclear how effectively these tools are being utilized in the context of VB.NET programming among TVET students[2], [3], [12], [14]–[16]. Additionally, there is a need to examine the specific learning challenges these students face in relation to ICT tool usage. This study aims to investigate the extent to which ICT tools are utilized in the learning process, the challenges students encounter in mastering VB.NET, and the relationship between ICT tool usage and the difficulties faced. By understanding these factors, this research seeks to identify ways in which ICT integration can be optimized to improve learning outcomes in VB.NET programming within TVET education.

## **II. LITERATURE REVIEW**

The integration of Information and Communication Technology (ICT) tools in education, especially in technical and vocational education and training (TVET) programs, has garnered significant attention due to its potential to enhance the learning experience[2], [17]–[20]. Research indicates that ICT tools can significantly improve student engagement, comprehension, and overall learning outcomes, particularly in technical fields such as programming. This literature review focuses on previous studies related to the use of ICT tools in programming education, the challenges students face when learning Visual Basic.NET (VB.NET), and the relationship between ICT tool usage and learning difficulties.

The role of ICT tools in programming education has been extensively studied, with many researchers emphasizing their effectiveness in enhancing learning outcomes[17], [19], [21]. Prior findings have highlighted the positive impact of ICT on programming education, showing that access to resources like online tutorials, development environments, and coding platforms helps students deepen their understanding of programming concepts[5], [22]. Additionally, studies have found that using integrated development environments (IDEs) and online coding platforms increases student engagement and enhances problem-solving abilities. These platforms create an interactive, self-paced learning environment that aids students in better grasping complex programming concepts and techniques[8], [10], [12]. In context of VB.NET, studies have demonstrated that the language's structured architecture, combined with GUI capabilities, improves students' understanding of programming[3], [12], [13].

Moreover, the accessibility of VB.NET enables students to create functional applications early in their learning process, which can boost their motivation and confidence in their programming skills. Despite the advantages of ICT tools, prior research also highlights significant challenges that students encounter when learning programming, especially at the beginner level. Findings suggest that while students may have a basic understanding of programming concepts such as syntax and semantics, they often struggle to apply these concepts in practice[3], [10], [23]. A primary barrier is the difficulty in transitioning from theoretical knowledge to the actual process of coding. This issue is particularly evident in the context of VB.NET when students attempt to integrate different components into a cohesive and functioning program[5], [7]. Additionally, the challenge of debugging and error handling remains a significant obstacle for students learning VB.NET. The difficulty in debugging, combined with the challenges of understanding more complex programming concepts such as Object-Oriented Programming (OOP), often leads to frustration and

disengagement among students. Several studies have explored the relationship between the use of ICT tools and the learning difficulties that students face in programming education[8], [23], [24]. Findings indicate that students who regularly utilize ICT tools, such as online tutorials, coding exercises, and collaborative platforms, report fewer difficulties in mastering core programming concepts. This aligns with previous studies that found a positive relationship between increased use of ICT tools and improved student performance in programming courses[19], [25].

Prior studies also examined the impact of using ICT tools on learning outcomes where the findings showed students who frequently engaged with online resources and integrated development environments (IDEs) performed significantly better in VB.NET programming tasks[22], [26]–[28]. However, the relationship between ICT usage and learning difficulties deemed as complex, as individual learning preferences and access to technology can greatly influence students' experiences[18], [20], [25]. Prior research indicated that while ICT tools are beneficial for many students, they tend to be less effective for those who prefer traditional learning methods or who lack sufficient ICT literacy[17], [20], [23], [29]. Therefore, this study aimed to investigate the extent to which ICT tools are utilized in the learning process, the challenges students face while mastering VB.NET, and the relationship between ICT tool usage and the difficulties encountered.

### III. METHODOLOGY

This study utilized a quantitative research methodology to collect and analyse data from participants. A census sampling approach was used to distribute the survey to 79 students, ensuring that all individuals within the target group were included in the study. This sampling technique aimed to provide a comprehensive overview of the students' experiences and perspectives, allowing for a deeper understanding of the role of ICT in their educational process [30]. The data collected from the

questionnaire served as the primary source of information for this research.

The questionnaire utilized in this study consisted of 20 items, serving as the primary tool to assess the use of ICT tools in learning Visual Basic.NET programming and the educational challenges faced by students. Participants were instructed to carefully read each statement and select their responses on a 5-point Likert scale, ranging from "Strongly Disagree" to "Strongly Agree." The questionnaire was adapted from previous studies on ICT integration in programming education and learning challenges. It was tailored and modified to better align with the specific objectives of this research. The modified questionnaire was divided into three sections. Section

A collected demographic information, such as age and gender, to provide context for the data. Section B included 10 items that focused on evaluating the use of ICT tools among students, while Section C contained 10 items specifically related to the learning challenges encountered by students while studying Visual Basic.NET. To ensure the instrument's validity, it was reviewed and validated by two experts in programming education. Their feedback helped refine the questionnaire to ensure it accurately captured the intended data. A pilot study was conducted with 10% of the total respondents to test the clarity and reliability of the survey items. The data collected from the survey were analysed using the Statistical Package for the Social Sciences (SPSS) version 29.0 to derive meaningful insights and address the research questions.

### IV. RESULT ANALYSIS

TABLE I  
MEAN AND STANDARD DEVIATION OF ICT TOOL USAGE FOR LEARNING  
VISUAL BASIC.NET PROGRAMMING

Question	Mean	Standard Deviation
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ICT Resource Utilization	4.41	0.65
Online Learning Resources	4.01	0.77
Access to ICT Tools	3.99	0.83
Use of Development Environments	3.67	0.85
Internet Access and Reliability	3.97	0.81

Table 1 shows the significant insights into using ICT tools for learning Visual Basic.NET among TVET students. The elevated mean score of 4.41 for ICT resource utilization indicates that students effectively utilize the available ICT tools, reinforcing that technology is seamlessly integrated into their learning processes[15], [31], [32]. There is modest utilization of online learning resources, with a mean of 4.01, suggesting that although several students depend on online tutorials and materials, usage differs among individuals, highlighting varying learning preferences and access levels[27], [33]–[37]. Access to ICT tools received a score of 3.99, indicating that most students possess sufficient access to essential resources; nonetheless, certain discrepancies imply that not all students may enjoy equal chances[15], [37].

The utilization of development environments (mean of 3.67) exhibits significant variability, suggesting that while students consistently employ tools such as Visual Studio, others may not fully leverage these resources due to unfamiliarity or limited access. Moreover, although internet access seems predominantly reliable (mean of 3.97), the variability in replies indicates that students may encounter difficulties with connectivity, thus impeding their educational experience[8], [38]–[40]. These findings correspond with the study's objective to comprehend the impact of ICT tool utilization on learning outcomes in Visual Basic.NET programming. Although ICT tools are essential for improving learning, disparities in access and utilization indicate potential obstacles to entirely using these resources, which may exacerbate

students' difficulties in grasping programming principles [5], [6], [15], [18], [41].

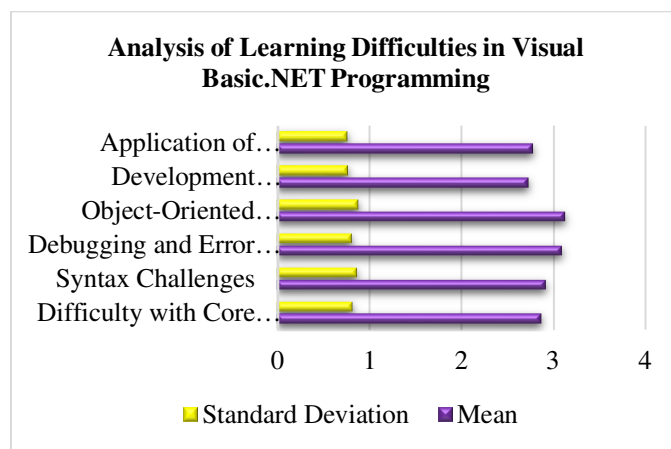


Fig. 1 Analysis of Learning Difficulties in Visual Basic.NET Programming

Fig. 2 shows an analysis of learning difficulties in Visual Basic.NET Programming. The results of the study reveal several important insights into the learning difficulties faced by TVET students in learning Visual Basic.NET programming. The moderate difficulty (mean of 2.87) with core programming concepts and syntax challenges (mean of 2.92) suggests that students find it moderately challenging to grasp fundamental programming principles and syntax. Debugging and error handling (mean of 3.09) and Object-Oriented Programming (OOP) (mean of 3.13) are particularly difficult for students, with a significant number of students reporting considerable challenges in these areas. This indicates that while students may understand the basics, more complex concepts like OOP and debugging remain barriers[12], [18], [42], [43]. Proficiency in development environments (mean of 2.73) also presents a challenge, indicating that students may struggle with navigating and using tools like Visual Studio effectively. Finally, the application of programming skills (mean of 2.78) reveals that students find it moderately difficult to transfer their theoretical knowledge into practical coding tasks. These findings align with the study's aim to understand the learning difficulties faced by TVET students in Visual Basic.NET programming.

The results suggest that while students generally make use of ICT tools, these learning challenges are significant, especially in more advanced topics such as debugging and OOP.

TABLE 2  
CORRELATION BETWEEN ICT TOOL USAGE AND LEARNING DIFFICULTIES

Variable	Average Mean	Correlation
ICT Tool Usage	4.01	-0.5232
Learning Difficulties	2.92	

Table 2 illustrates a moderate negative connection (-0.5232) between using ICT tools and learning difficulties. This aligns with the study's objective to examine the correlation between ICT tool usage and the learning obstacles TVET students face in Visual Basic.NET programming. The inverse correlation suggests that students often encounter fewer learning challenges as they enhance their use of ICT tools. Enhanced student involvement with accessible ICT resources may promote a more profound comprehension of Visual Basic.NET programming ideas. This indicates that ICT tools substantially mitigate some challenges students have in programming, especially in debugging, object-oriented programming (OOP), and syntax problems[15], [19], [31], [37], [44]. Prior research has demonstrated that using ICT tools is essential in mitigating the learning difficulties encountered by students, particularly in technical disciplines such as programming. Furthermore, the results of this study align with research in the realm of TVET education, demonstrating that incorporating ICT tools enhances practical learning. TVET programs primarily emphasize cultivating technical and vocational skills, with experiential learning being an essential curriculum element[3], [12], [25], [37]. Prior research has indicated that students enrolled in TVET programs derive advantages from utilizing ICT tools, as these instruments facilitate interactive engagement with the subject matter. This discovery is especially pertinent in TVET education, where access to current materials and technology is essential for equipping students for the contemporary labour market. This study support that

equipping students with sufficient ICT resources helps equalize opportunities, particularly in contexts where conventional teaching approaches may inadequately meet the requirements of diverse learners[31], [45], [46]. This study demonstrates that ICT tools can effectively close learning gaps by providing students with a more adaptable and pragmatic method for acquiring programming abilities. This study reveals a mild negative connection, indicating that ICT integration might effectively support TVET students by alleviating challenges in complex disciplines like Visual Basic.NET programming.

## V. CONCLUSION

This study highlights the significant role of Information and Communication Technology (ICT) tools in enhancing the learning experience of TVET students in Visual Basic.NET programming. The findings indicate that while ICT tools are widely used and generally beneficial for student learning, challenges related to access and utilization remain. A high level of ICT resource utilization, combined with modest engagement with online resources, suggests that students benefit from technology; however, access limitations and varying levels of usage hinder the full potential of these tools. Moreover, students encounter moderate to significant difficulties in understanding fundamental programming concepts, with challenges in debugging, object-oriented programming (OOP), and using development environments like Visual Studio. The inverse correlation between ICT tool usage and learning difficulties further emphasizes the value of these resources in helping students overcome programming challenges. As students engage more effectively with ICT tools, they encounter fewer obstacles in mastering complex topics such as OOP and debugging. This aligns with previous research that shows ICT tools enhance learning outcomes, particularly in technical fields like programming, by offering interactive, self-paced, and accessible learning opportunities.

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