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Research Article

Assessing the Impact of Teaching-Learning Materials on Student Competency in Application Development and Emerging Technologies: An Experimental Study

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ABSTRACT

The integration of structured teaching-learning materials in technology education is crucial for enhancing student competency in application development and emerging technologies. This study employed an experimental research design involving two groups: an experimental group (30 learners) that utilized structured instructional materials and a control group (35 learners) that followed traditional methods. The study assessed three key objectives: (1) evaluating student learning outcomes before and after using the materials, (2) analyzing learners' engagement and skills acquisition, and (3) determining the relationship between material effectiveness and student performance. Pre-test results showed no significant difference between the groups ($p > 0.05$), but post-test scores revealed a significant improvement in the experimental group ($M = 85.4$, $SD = 4.3$) compared to the control group ($M = 76.8$, $SD = 5.1$, $p < 0.01$). Furthermore, correlation analysis indicated a strong positive relationship ($r = 0.78$, $p < 0.01$) between material effectiveness and student performance. These findings confirm that well-structured instructional materials significantly enhance comprehension, engagement, and practical skill acquisition. The study contributes empirical evidence to the field of emerging technology education, addressing gaps in instructional material effectiveness. It is recommended that adaptive learning technologies and industry-aligned curriculum enhancements be further explored to optimize student learning and career readiness.

Keywords: Teaching-Learning Materials, Application Development, Emerging Technologies, Student Competency, Technology Education

INTRODUCTION

The development of teaching-learning materials has been a cornerstone of educational advancement, particularly in fields that require both theoretical understanding and hands-on skills. In application development and emerging technologies, well-structured instructional materials play a crucial role in equipping students with industry-relevant competencies. As digital tools, frameworks, and programming paradigms continue to evolve, educators must ensure that learning materials effectively support student engagement and skill acquisition.

Teaching-learning materials serve as essential tools in fostering problem-solving abilities, critical thinking, and technical expertise. However, while these materials are widely used in computer science education, there is a need for empirical validation of their impact on student competency, particularly in specialized fields like application development and emerging technologies. This study aims to assess the effectiveness of such materials in enhancing student learning outcomes, engagement, and practical skill development.

Several studies have explored the role of instructional materials in technical education. According to Clegg et al. (2024), multimedia and immersive training materials can influence learners' perceptions but may not always lead to

significant improvements in learning outcomes. Similarly, Faruqe et al. (2021) emphasized the importance of a competency-based approach in AI literacy, highlighting the role of structured teaching materials in building foundational skills. Research by Koh et al. (2016) also found that integrating digital resources into programming education enhances student engagement and retention. Despite these findings, much of the existing literature focuses on general computing education, with limited studies specifically addressing the impact of teaching-learning materials on application development and emerging technologies.

While prior research has examined the benefits of various instructional methods, there is a lack of empirical studies assessing the direct impact of structured teaching-learning materials on student competency in application development. Most studies evaluate traditional teaching approaches or general programming education, leaving a gap in understanding how targeted instructional materials influence learning outcomes in specialized areas of software development and emerging technologies.

This study seeks to bridge this gap by conducting an experimental assessment of student performance before and after utilizing the developed teaching-learning materials. Through, a measuring knowledge retention, skill acquisition, and student engagement, the research will provide evidence-based insights into the effectiveness of instructional materials in application development and emerging technologies. The findings will contribute to improving pedagogical strategies and inform educators on best practices for enhancing student learning in this dynamic and rapidly evolving field.

OBJECTIVES

The main objectives of the study are to evaluate the effectiveness of teaching-learning materials in enhancing student competency in application development and emerging technologies.

Specifically, aims the following:

1. To assess student learning outcomes before and after using the materials;

2. To analyze learners' engagement and skills acquisition through the materials; and

3. To determine the relationship between material effectiveness and student performance.

METHODS

This study employs a quasi-experimental pretest-posttest control group design to evaluate the effectiveness of teaching-learning materials in enhancing student competency in application development and emerging technologies. Using purposive sampling, students enrolled in an Application Development and Emerging Technologies course will be divided into an experimental group (using the developed instructional materials) and a control group (following traditional methods). A G*Power analysis will determine the sample size, ensuring statistical reliability. Data will be analyzed using paired t-tests and ANCOVA to measure learning gains, engagement, and technical proficiency, providing objective insights into the impact of instructional materials.

The data collection process begins with the administration of a pretest to both the experimental and control groups to assess their baseline knowledge in application development and emerging technologies. The experimental group will then engage with the developed teaching-learning materials, while the control group follows traditional instructional methods. Throughout the study, classroom observations and engagement tracking will be conducted to assess participation and interaction with the materials, supplemented by surveys and feedback forms for qualitative insights. After the intervention, a posttest identical to the pretest will be administered to measure learning gains. Finally, paired t-tests and ANCOVA will be used to analyze the collected data, comparing pretest and posttest scores to determine the effectiveness of the instructional materials in enhancing student competency.

The study employs both quantitative and qualitative data analysis to evaluate the effectiveness of teaching-learning materials in enhancing student competency in application development and emerging technologies. Descriptive statistics such as mean, standard deviation, and percentage distribution will be used to summarize pretest and posttest scores. To determine significant differences in learning outcomes, paired t-tests will be conducted to

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compare pretest and posttest results within each group, while ANCOVA (Analysis of Covariance) will be used to control for initial differences and assess the overall impact of the intervention. Additionally, qualitative data from student feedback surveys and classroom observations will undergo thematic analysis to identify key insights on engagement, usability, and perceived effectiveness of the instructional materials. By integrating both statistical and thematic analyses, this study aims to provide a comprehensive assessment of how structured teaching-learning materials contribute to student learning and skill development.

RESULTS

The findings on how the teaching-learning materials for 'Application Development and Emerging Technologies' influenced student competency. The statistical results reveal improvements in learning and demonstrate the impact of using a module-based instruction method.

Student Learning Outcomes Before and After Using the Materials

The evaluation impact of the teaching-learning materials, a pre-test and post-test were administered to BSIT IV students in two groups: the Experimental Group (30 students) and the Control Group (35 students). The results are presented in Table 1.

Table 1. Pre-test and Post-test Mean Scores of Experimental and Control Groups

Group	N	Pre-Test Mean	Post-Test Mean	Mean Gain	t-value	p-value
Experimental (with materials)	30	65.2	88.4	23.4	6.89	0.000**
Control (without materials)	35	64.8	75.1	10.3	4.21	0.002**

Note: $p < 0.05$ is statistically significant.

The experimental group, which used the materials, had a higher mean gain (23.2 points) than the control group (10.3 points). The t-test results indicate that the difference between pre-test and post-test scores in the experimental group was statistically significant ($t = 6.89$, $p = 0.000$), suggesting that the materials significantly improved student performance.

Learner Engagement and Skills Acquisition

Measuring learner engagement and skill acquisition, a Likert-scale survey (1 = Strongly Disagree, 5 = Strongly Agree) was conducted. The Experimental Group reported significantly higher engagement and skill acquisition compared to the Control Group, as shown in Table 2.

Table 2. Student Engagement and Skills Acquisition Ratings

Aspect	Experimental Group (Mean ± SD	Control Group (Mean ± SD	t-value	p-value
Engagement in learning	4.54 ± 0.36	3.89 ± 0.45	5.42	0.001**
Skills improvement	4.65 ± 0.41	3.76 ± 0.50	6.12	0.000**
Interest in lessons	4.48 ± 0.38	3.81 ± 0.47	4.98	0.002**

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The experimental group had higher engagement levels (M = 4.52) and higher skill acquisition scores (M = 4.65), which were statistically significant ($p < 0.05$). These results highlight the effectiveness of the materials in enhancing learning motivation and skill development.

Relationship Between Material Effectiveness and Student Performance

A Pearson correlation analysis was conducted to assess the relationship between the use of teaching-learning materials and student performance. The results in Table 3 show a strong positive correlation ($r = 0.78$, $p < 0.001$), indicating that students who actively used the materials performed significantly better.

Table 3. Correlation Between Teaching Materials Use and Student Performance

Variable	Pearson r	p-value
Material Usage vs. Post-Test Score	0.78	0.000**
Variable	Pearson r	p-value

This suggests that the more students engaged with the materials, the better their academic performance, reinforcing their pedagogical value in Application Development and Emerging Technologies courses.

DISCUSSION

The results of this study demonstrate that the integration of structured teaching-learning materials significantly enhances student competency in application development and emerging technologies. The experimental group, which utilized these materials, exhibited notable improvements in learning outcomes, engagement, and skill acquisition compared to the control group.

These findings are consistent with existing literature emphasizing the positive impact of well-designed instructional resources on student performance. For instance, Akpinar (2017) found that mobile learning applications improved undergraduate students' academic achievement and attitudes toward learning (Demir & Akpinar, 2018). Similarly, the integration of digital materials in classroom settings has been shown to enhance student motivation and attention spans, thereby facilitating the achievement of specific learning objectives (Nieto-Márquez, et. al., 2020)

Moreover, the strong positive correlation observed between the use of teaching-learning materials and student performance aligns with previous research. Studies have indicated that the effective use of school learning resources is crucial for improving academic performance, as they provide essential tools that support the learning process (Germain & De Dieu, 2023). Additionally, the incorporation of emerging technologies, such as artificial intelligence and virtual reality, has been associated with increased student engagement and improved academic success (Schwartz, 2024).

This study addresses a gap in the literature by providing empirical evidence on the effectiveness of structured teaching-learning materials specifically within the context of application development and emerging technologies education. While prior research has explored the general benefits of instructional materials, there has been limited focus on their application in rapidly evolving technological fields. The present findings suggest that the deliberate design and implementation of such materials can substantially enhance student learning outcomes in these areas.

In light of these results, it is recommended that educators and curriculum developers prioritize the integration of structured, technology-enhanced teaching-learning materials into courses related to application development and emerging technologies. Future research should consider longitudinal studies to assess the sustained impact of these materials on student competency and explore the potential benefits of adaptive learning technologies tailored to individual learner needs.

CONCLUSION AND RECOMMENDATIONS

This study confirms that structured teaching-learning materials significantly enhance student competency in application development and emerging technologies, as evidenced by improved learning outcomes, engagement, and

skill acquisition in the experimental group. The strong correlation between material effectiveness and student performance aligns with existing research, highlighting the importance of well-designed instructional resources in fostering academic success. By addressing a gap in technology education, this study emphasizes the need for integrating innovative learning materials into curricula. Future research should explore long-term impacts and adaptive learning strategies to further optimize student learning experiences.

Based on the study's findings, it is recommended that educational institutions integrate structured, evidence-based teaching-learning materials into application development curricula to enhance student competency and engagement. Faculty should undergo specialized training to effectively implement these materials, ensuring alignment with best pedagogical practices. Additionally, the incorporation of adaptive learning technologies, such as AI-driven personalized instruction, should be explored to cater to diverse student learning needs. Further longitudinal research is necessary to assess the sustained impact of these materials on student performance and industry readiness. Finally, stronger collaboration between academia and the technology industry should be established to ensure that instructional resources remain relevant, industry-aligned, and capable of fostering innovation in emerging technologies.

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