Comparative Effects of Challenge-Based Learning and Place-Based Learning on Academic Performance in Computer Architecture among Computer Engineering Students

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Abstract
This study examined the effects of Challenge-Based Learning and Place-Based Learning on students' academic achievement in Computer Architecture among Computer Engineering students of Waziri Umaru Federal Polytechnic, Birnin Kebbi, Nigeria. The study was motivated by the need to improve students' understanding of Computer Architecture, a core and often challenging course in Computer Engineering programmes. A quasi-experimental research design involving pre-test and post-test control group structure was adopted. The population comprised Computer Engineering students, from which two intact classes totaling 41 students were purposively selected. Group A, consisting of 20 students, was taught using Challenge-Based Learning, while Group B, consisting of 21 students, was taught using Place-Based Learning. The instrument used for data collection was the Computer Architecture Achievement Test (CAAT), a 30-item multiple-choice test validated by experts and with a reliability coefficient of 0.86 established using test-retest method and Pearson Product Moment Correlation. Mean and standard deviation were used to answer the research questions, while paired sample t-test and independent sample t-test were used to test the hypotheses at 0.05 level of significance. The findings revealed that both Challenge-Based Learning and Place-Based Learning significantly improved students' academic achievement in Computer Architecture, as indicated by significant gains from pre-test to post-test in both groups. However, no significant difference was found between the post-test mean scores of students taught using Challenge-Based Learning and those taught using Place-Based Learning, indicating that both instructional strategies were equally effective. The study concluded that learner-centred instructional approaches such as Challenge-Based Learning and Place-Based Learning enhance students' academic performance in Computer Architecture. It was therefore recommended that lecturers should adopt these strategies to improve teaching and learning outcomes in Computer Engineering education.

Keywords: Challenge-Based Learning, Place-Based Learning, Computer Architecture, Academic Achievement.

Introduction

The twenty-first century has witnessed significant transformations in educational practices due to rapid technological advancement, globalization, and the increasing demand for a workforce equipped with critical thinking, creativity, collaboration, communication, and problem-solving skills. Consequently, educational institutions are gradually shifting from traditional teacher-centred approaches to learner-centred pedagogies that actively engage students in the learning process. This shift is particularly important in science, technology, engineering and mathematics (STEM) education, where students are expected not only to acquire theoretical knowledge but also to apply such knowledge to solve real-world problems (Membrillo-Hernández et al., 2021; Beemt, Patricia, et al., 2023). Among the innovative instructional approaches that have gained prominence in contemporary education are Challenge-Based Learning (CBL) and Place-Based Learning (PBL), both of which emphasize active participation, experiential learning, and contextual understanding (Doulougeri et al., 2024; Gallagher & Savage, 2020).

One of the fundamental courses in Computer Engineering education is Computer Architecture. Computer Architecture refers to the conceptual design, functional organization, and operational structure of computer systems, including processors, memory units, input/output systems, storage devices, and communication pathways that enable computers to execute instructions efficiently (Grimes, 2002). The discipline serves as the bridge between hardware and software by explaining how computing systems process, store, and manage information. It encompasses critical concepts such as processor design, instruction execution, memory hierarchy, system performance optimization, and hardware-software interaction. As a core component of Computer Engineering curricula, Computer Architecture provides students with foundational knowledge necessary for understanding computer systems and designing efficient computing solutions.

Globally, Computer Architecture has become increasingly important due to the rapid growth of artificial intelligence, cloud computing, big data analytics, cybersecurity, the Internet of Things (IoT), robotics, and other emerging digital technologies. These technological advancements depend heavily on efficient and innovative computer architectures to achieve improved performance, energy efficiency, security, and scalability (Al-fedaghi, 2021). Consequently, Computer Engineering graduates are expected to possess strong competencies in computer architecture to effectively contribute to technological innovation and digital transformation (Ceze et al., 2016). In developing economies such as Nigeria, knowledge of computer architecture is essential for producing skilled professionals capable of supporting national technological development, industrial automation, digital infrastructure expansion, and sustainable economic growth.

Despite the importance of Computer Architecture in Computer Engineering education, many students continue to experience difficulties in understanding its abstract concepts and complex processes. Traditional lecture-based teaching methods often emphasize the transmission of theoretical knowledge with limited opportunities for active engagement, practical application, and contextual learning. As a result, students may struggle to comprehend critical concepts such as processor operations, memory management, instruction execution, and system organization, leading to poor academic performance. Although various innovative pedagogical approaches have been introduced to address these challenges, there remains limited empirical evidence regarding the effectiveness of Challenge-Based Learning and Place-Based Learning in improving students' academic performance in Computer Architecture, particularly within Nigerian polytechnic institutions.

The significance of this study lies in its potential contribution to educational practice, policy, and research. The findings may provide Computer Engineering lecturers with empirical evidence on innovative instructional approaches capable of enhancing students' academic performance in Computer Architecture. The study may also assist curriculum planners and educational administrators in making informed decisions regarding the adoption of learner-centred teaching strategies within engineering programmes. Furthermore, the findings could contribute to the growing body of literature on active learning pedagogies in STEM education and serve as a reference for future researchers interested in improving teaching effectiveness and student learning outcomes in technical and engineering disciplines. Ultimately, the study may support efforts aimed at producing competent Computer Engineering graduates equipped with the knowledge and skills required to meet contemporary technological and societal demands.

Objectives of the Study

The main objective of this study was to determine the influence of Challenge-Based Learning and Place-Based Learning on the academic performance of Computer Engineering students in learning Computer Architecture at Waziri Umaru Federal Polytechnic, Birnin Kebbi. Specifically, the study sought to:

1. determine the mean score difference between the pre-test and post-test academic performance of Computer Engineering students taught Computer Architecture using Challenge-Based Learning;
2. determine the mean score difference between the pre-test and post-test academic performance of Computer Engineering students taught Computer Architecture using Place-Based Learning; and
3. determine the mean score difference between the post-test academic performance of students taught Computer Architecture using Challenge-Based Learning and those taught using Place-Based Learning.

Research Questions

The following research questions guided the study:

1. What is the mean score difference between the pre-test and post-test academic performance of Computer Engineering students taught Computer Architecture using Challenge-Based Learning?
2. What is the mean score difference between the pre-test and post-test academic performance of Computer Engineering students taught Computer Architecture using Place-Based Learning?
3. What is the mean score difference between the post-test academic performance of students taught Computer Architecture using Challenge-Based Learning and those taught using Place-Based Learning?

Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance:

HO1: There is no significant difference between the mean pre-test and post-test academic performance of students taught Computer Architecture using Challenge-Based Learning.

HO2: There is no significant difference between the mean pre-test and post-test academic performance of students taught Computer Architecture using Place-Based Learning.

HO3: There is no significant difference between the mean post-test academic performance of students taught Computer Architecture using Challenge-Based Learning and those taught using Place-Based Learning.

Literature Review

Conceptual Review

Concept of Challenge-Based Learning

Challenge-Based Learning is a collaborative and inquiry-driven instructional approach that engages learners in identifying, investigating, and solving authentic challenges within real-world contexts. Rooted in constructivist learning theory, CBL encourages students to move beyond passive reception of knowledge and actively participate in the learning process through investigation, critical analysis, teamwork, and solution development (Bohm et al., 2020). CBL also rooted from experimental learning which poses key fundamentals that students academically achieve better when they are actively engage or participate open learning (Membrillo-Hernández et al., 2021). The approach typically follows three major phases of Engage, Investigate, and Act. This allowing learners to explore meaningful challenges, gather and analyse relevant information, and implement practical solutions (Martin & Bombaerts, 2025). Through this process, students develop deeper conceptual understanding, critical thinking abilities, communication skills, and problem-solving competencies that are essential in contemporary professional environments (Apple Inc, 2026). Within engineering education, CBL has been recognized as an effective strategy for connecting theoretical concepts with practical applications and preparing students to address complex technological challenges (Félix-herrán et al., 2022; Gallagher & Savage, 2020; Beemt, Watering, et al., 2023).

Concept of Placed-Based Learning

Place-Based Learning represents an active student-centred and innovative pedagogical approach that utilizes the local environment, community, culture, and societal realities as the context for teaching and learning (Elfer, 2011; Kokotsaki et al., 2016). The approach is founded on experiential and constructivist learning principles, emphasizing that meaningful learning occurs when students can relate academic content to familiar and relevant contexts (Miller & Twum, 2017). It is also characterised Place-Based Learning encourages learners to explore issues and opportunities within their immediate surroundings, thereby enhancing engagement, motivation, and knowledge application (Elfer, 2011). Rather than treating knowledge as abstract and detached from everyday life, PBL enables students to connect classroom learning with real-world experiences and community needs (Gnyawali et al., 2024). The approach has been shown to improve students' understanding of concepts while simultaneously promoting civic responsibility, collaboration, and contextual problem-solving skills (Johnson et al., 2023). In technological and engineering disciplines, place-based learning provides opportunities for students to examine local technological challenges and develop solutions that are relevant to their communities.

Concept of Academic Performance

Academic performance remains one of the most widely used indicators for evaluating the effectiveness of teaching and learning processes in educational institutions. Academic performance refers to the extent to which students achieve intended learning outcomes as measured through examinations, tests, assignments, projects, and other forms of assessment (Bello et al., 2024). In engineering education, academic performance is particularly important because it reflects students' mastery of technical concepts, analytical skills, and problem-solving abilities required for professional practice. Several factors influence students' academic performance, including instructional methods, learning environment, motivation, prior knowledge, and engagement in the learning process (Abdurrahman et al., 2023). Consequently, identifying instructional strategies that enhance students' academic achievement remains a major concern for educators and researchers.

The integration of Challenge-Based Learning and Place-Based Learning aligns with contemporary educational reforms that advocate for authentic, contextualized, and student-centered learning experiences. While Challenge-Based Learning focuses on solving real-life problems through inquiry and innovation, Place-Based Learning situates learning within the realities of the learners' immediate environment. Together, these approaches create opportunities for students to engage actively with content, develop higher-order thinking skills, and appreciate the practical relevance of their learning experiences. Their adoption in engineering education may therefore contribute significantly to improving students' understanding and application of complex technical concepts (Taconis & Bekker, 2023).

Empirical Review

A number of empirical studies have examined the effectiveness of Challenge-Based Learning in engineering education. Doulougeri et al. (2024), in a systematic review of CBL implementation, reported that the approach promotes knowledge acquisition, knowledge application, student engagement and the development of higher-order thinking skills through authentic real-world challenges. Similarly, in a related study, Huesca et al. (2024) found that Challenge-Based Learning significantly improved competency development and learning outcomes among engineering students, while Félix-Herrán et al. (2022) reported that CBL enhanced engineering students' learning experiences and competency acquisition through active participation and engagement with authentic engineering challenges.

With respect to Place-Based Learning, Johnson et al. (2020) found that participation in a place-based learning community improved academic performance and persistence among first-year STEM students, while Johnson et al. (2023) reported that students who participated in place-based STEM learning programmes demonstrated improved academic achievement and stronger educational outcomes in subsequent years. Furthermore, Freeman et al. (2014) found that active-learning approaches in general produce significantly better academic outcomes than traditional lecture methods, although differences among individual active-learning strategies are often small and statistically insignificant. These studies collectively suggest that both Challenge-Based Learning and Place-Based Learning are capable of enhancing students' academic achievement, which this present study sought to verify within the specific context of Computer Architecture instruction.

Theoretical Framework

This study is anchored on Constructivist Learning Theory, Experiential Learning Theory, and Situated Cognition Theory.

Constructivist Learning Theory holds that learners actively construct knowledge and meaning from their experiences rather than passively receiving information from lecturers (Batten & Ross, 2021). Challenge-Based Learning was rooted in this theory as it encourages students to move beyond passive recipient of knowledge and to active participates in the learning process through investigation, teamwork, critical analysis and solution development (Bohm et al., 2020). Similarly, Place-Based Learning is also founded on constructivist principles, emphasizing that meaningful learning occurs when students relate academic content to contexts that are familiar and relevant to them (Miller & Twum, 2017).

Experiential Learning Theory posits that learning is most effective when it arises from direct, active engagement and reflection on experience rather than from the passive transmission of theory (Kolb et al., 2000; Miettinen, 2010). Challenge-Based Learning was derive on this theory as students academically achieve better when they are actively engaged in an open and participatory learning (Hernández et al., 2021). Place-Based Learning is likewise grounded in experiential principles, since it engages learners in exploring issues within their immediate surroundings as a basis for constructing knowledge (Elfer, 2011).

Situated Cognition Theory posits that knowledge learned within authentic, meaningful contexts is more readily understood and retained by students than knowledge acquired through decontextualized instruction (Wilson & Myers, 2000; Sweller, 2019). This theory underpins the expectation that connecting Computer Architecture concepts to authentic challenges (as in Challenge-Based Learning) and to local technological and societal realities (as in Place-Based Learning) would enable students to construct stronger conceptual understanding than conventional lecture-based instruction. Together, these three theories provided the conceptual lens through which the design of the instructional treatments and the interpretation of the study's findings were undertaken.

Methodology

This study adopts a quasi-experimental research design. The study involves two instructional groups: (i) Challenge-Based Learning group (Group A) and (ii) Place-Based Learning group (Group B). Both groups were exposed to Computer Architecture instruction using their respective teaching strategies. The population of the study consists of 41 Computer Engineering students enrolled in Waziri Umaru Federal Polytechnic, Birnin Kebbi.

Table 1: Samples for the study

S/N	Group	Samples Selected
1.	Group A: Challenge-Based Learning group	20
2.	Group B: Place-Based Learning group	21
	Total number of students	41

A pre-test was administered to both groups in the first week to determine their baseline knowledge in Computer Architecture. Thereafter, the experimental treatments were conducted over a period of six (6) weeks. At the end of the treatment period and a post-test was administered to both groups using the same instrument, but with reshuffled items to minimize recall bias and ensure validity of measurement.

Instrumentation

The instrument used for data collection was the Computer Architecture Achievement Test (CAAT), designed to measure students' academic performance in Computer Architecture. The instrument consisted of thirty (30) multiple-choice items with four options (A–D), with only one correct answer per item. The test items were developed based on the course curriculum and validated by subject matter experts to ensure content relevance, clarity, and alignment with instructional objectives.

The instrument was further subjected to a pilot study to determine its reliability. The reliability coefficient was established using Pearson's Product Moment Correlation Coefficient (test-retest method), yielding a reliability index of 0.86, which indicates high internal consistency.

Data collected for the study were analysed using both descriptive and inferential statistics. Mean and standard deviation were used to answer the research questions. Paired sample t-test was used to determine the significance of differences between pre-test and post-test scores within each group, while independent sample t-test was used to determine the difference between the post-test scores of the two groups. All hypotheses were tested at 0.05 level of significance.

Result of the Findings

Table 2: Students Mean Scores of Pre-test and Post-test score in Group-A

S/N	Test	N	Mean Score	Standard Deviation	Mean Difference
1.	Pre-test	20	4.70	2.79	32.55
2.	Post-test	20	37.25	9.80	

Table 2 shows the mean scores of students in Group A before and after exposure to the challenged-based learning. The result revealed that the students had a pre-test mean score of 4.70 (SD=2.79) and a post-test mean score of 37.25 (SD=9.80), resulting in a mean gain score of 32.55. This indicates a substantial improvement in students' achievement in Computer Architecture following exposure to the challenged-based strategy.

Table 3:

Paired Sample t-Test Analysis of Mean Scores on Pre-test and Post-Test in Group-A

Test	N	Mean	SD	Mean Difference	95% CI of Difference	t	df	p-value
Pre-Test	20	4.7	2.79	32.55	27.83 – 37.27	-14.44	19	< .000*
Post-Test	20	37.25	9.8					

**Significant at $p < .05$.*

Table 3 shows the paired samples t-test analysis comparing students' pre-test and post-test scores. The result revealed that the mean post-test score (M = 37.25, SD = 9.80) was considerably higher than the mean pre-test score (M = 4.70, SD = 2.79). The mean gain score was 32.55. Furthermore, the paired samples t-test indicated that the difference between the pre-test and post-test scores was statistically significant, $t(19) = 14.44$, $p < .000$. This finding suggests that the instructional treatment of challenge-based learning strategy significantly improved students' performance.

Table 4: Students Mean Scores of Pre-test and Post-test in Group-B

S/N	Test	N	Mean Score	Standard Deviation	Mean Difference
1.	Pre-test	21	3.95	1.88	32.72
2.	Post-test	21	36.67	6.86	

Table 4 presents the mean scores of students in Group B before and after exposure to the instructional treatment. The findings revealed that the students obtained a pre-test mean score of 3.95 (SD = 1.88) and a post-test mean score of 36.67 (SD = 6.86), yielding a mean gain score of 32.72. This suggests that students' achievement in Computer Architecture improved considerably after exposure to the place-based learning strategy.

Table 5: Paired Sample t-test Analysis of Mean scores on Pre-test and Post-test in Group-B

Test	N	Mean	SD	Mean Difference	95% CI of Difference	t	df	p-value
Pre-Test	21	3.95	1.88	32.71	29.32 – 36.11	20.09	20	< .001*
Post-Test	21	36.67	6.86					

**Significant at p < .05.*

Table 3 presents the paired samples t-test analysis comparing students' pre-test and post-test scores. The results revealed that the students had a mean score of 3.95 (SD = 1.88) in the pre-test and 36.67 (SD = 6.86) in the post-test. The mean gain score was 32.71. The paired samples t-test further indicated that the difference between the pre-test and post-test scores was statistically significant, $t(20) = 20.09$, $p < .001$. This finding implies that the instructional strategy of placed-based learning strategy had a significant positive effect on students' achievement in Computer Architecture.

Table 6: Mean Difference of Students' Post-test Scores of Group-A and B

S/N	Test	N	Mean	Standard Deviation	Mean Difference
1.	Post-Test: Group A	20	37.25	9.80	0.58
2.	Post-Test: Group B	21	36.67	6.86	

Table 6 shows the post-test mean scores of students in Groups A and B. The result revealed that students in Group A obtained a mean score of 37.25 (SD = 9.80), while those in Group B obtained a mean score of 36.67 (SD = 6.86). The mean difference between the two groups was 0.58 in favour of Group A. This indicates that students in both groups achieved comparable levels of performance in Computer Architecture after the instructional treatments.

Table 7:
Independent Sample t-test Analysis on Pre-Test and Post-test Mean Scores of Group A and B

Test	Group	N	Mean	SD	Mean Difference	95% CI of Difference	t	df	p-value
Pre-Test	Place-Based Learning	21	3.95	1.88	-0.75	-2.27 – 0.77	-1.00	33.12	0.325
	Challenge-Based Learning	20	4.7	2.79					
Post-Test	Place-Based Learning	21	36.67	6.86	-0.58	-5.98 – 4.81	-0.22	33.87	0.827
	Challenge-Based Learning	20	37.25	9.8					

**Not significant at $p < .05$.*

Table 7 presents the independent samples t-test analysis comparing the pre-test and post-test scores of students taught Computer Architecture using Challenge-Based Learning and Place-Based Learning. The result revealed no significant difference in the pre-test scores of students in the Place-Based Learning group (M = 3.95, SD = 1.88) and those in the Challenge-Based Learning group (M = 4.70, SD = 2.79), $t(33.12) = -1.00$, $p = .325$. This indicates that both groups were comparable before the commencement of the treatment. Similarly, no significant difference was found between the post-test scores of students taught using Place-Based Learning (M = 36.67, SD = 6.86) and those taught using Challenge-Based Learning (M = 37.25, SD = 9.80), $t(33.87) = -0.22$, $p = .827$. This finding suggests that both instructional strategies were equally effective in improving students' achievement in Computer Architecture.

Discussion of Findings

The findings of this study revealed that students exposed to Challenge-Based Learning demonstrated a significant improvement in achievement in Computer Architecture. The result showed that the mean score increased from 4.70 in the pre-test to 37.25 in the post-test, and the difference was found to be statistically significant, $t(19) = 14.44$, $p < .001$. This finding indicates that Challenge-Based Learning effectively enhanced students' understanding and mastery of Computer Architecture concepts.

The finding agrees with Doulougeri, Vermunt, Bombaerts, and Bots (2024), who conducted a systematic review of Challenge-Based Learning implementation in engineering education and reported that Challenge-Based Learning promotes knowledge acquisition, knowledge application, student engagement, and the development of higher-order thinking skills through authentic real-world challenges. The authors observed that students exposed to challenge-oriented activities demonstrated improved learning outcomes because they actively connected theoretical knowledge with practical problem-solving experiences (Doulougeri et al., 2024).

The finding is also consistent with Huesca et al. (2024), who reported that Challenge-Based Learning significantly improved competency development and learning outcomes among engineering students. Their study concluded that learners exposed to challenge-oriented instructional activities developed deeper conceptual understanding and performed better academically than students exposed to conventional instructional approaches.

Similarly, Félix-Herrán et al. (2022) found that Challenge-Based Learning enhanced engineering students' learning experiences and competency acquisition through active participation, collaborative problem-solving, and engagement with authentic engineering challenges. The researchers concluded that challenge-based instructional environments improve students' academic achievement by encouraging meaningful learning rather than rote memorization.

The findings further revealed that students taught Computer Architecture using Place-Based Learning achieved significantly higher post-test scores than their pre-test scores. The students' mean score increased from 3.95 in the pre-test to 36.67 in the post-test, and the difference was statistically significant, $t(20) = 20.09$, $p < .001$. This result suggests that Place-Based Learning significantly improved students' achievement in Computer Architecture.

This finding is supported by Johnson, Sprowles, Goldenberg, and Margell (2020), who found that participation in a place-based learning community improved academic performance and persistence among STEM students. The researchers argued that when learning is connected to meaningful local contexts and authentic experiences, students are better able to understand and apply concepts, leading to improved academic outcomes.

The finding is also consistent with Johnson et al. (2023), who reported that students who participated in place-based STEM learning programmes demonstrated improved academic achievement and stronger educational outcomes in subsequent years. According to the authors, contextualized learning experiences enhance understanding by connecting classroom instruction with real-world situations that are meaningful to learners.

The improvement observed in this study can further be explained by situated cognition theory, which posits that knowledge learned within authentic contexts is more meaningful and easier to understand than knowledge acquired through decontextualized instruction (Sweller, 2019). Through connecting Computer Architecture concepts to local technological and societal realities, Place-Based Learning may have enabled students to construct stronger conceptual understanding, resulting in improved achievement.

The study also found that there was no significant difference between the post-test achievement scores of students taught using Challenge-Based Learning and those taught using Place-Based Learning, $t(33.87) = -0.22$, $p = .827$. Although the Challenge-Based Learning group recorded a slightly higher mean score (37.25) than the Place-Based Learning group (36.67), the difference was negligible and statistically insignificant. This finding indicates that both instructional strategies were equally effective in improving students' achievement in Computer Architecture.

This finding supports the broader active-learning literature, which suggests that various learner-centred instructional approaches often produce comparable positive academic outcomes because they share common pedagogical features such as active participation, collaboration, inquiry, reflection, and authentic learning experiences. Freeman et al. (2014) found that active learning approaches generally produce significantly better academic outcomes than traditional lecture methods, although differences among active-learning strategies themselves are frequently small and statistically insignificant. Similarly, Doulougeri et al. (2024) observed that Challenge-Based Learning shares several characteristics with other experiential and contextual learning approaches, including authentic learning tasks, collaboration, and real-world application, all of which contribute positively to student achievement.

Therefore, the findings of this study demonstrate that both Challenge-Based Learning and Place-Based Learning are effective learner-centred instructional strategies capable of improving students' achievement in Computer Architecture. Their emphasis on active engagement, authentic learning experiences, collaboration, inquiry, and real-world application appears to have contributed substantially to students' improved academic performance.

Conclusion

Based on the findings of this study, it is concluded that both Challenge-Based Learning and Place-Based Learning are effective instructional strategies for improving students' academic achievement in Computer Architecture among Computer Engineering students. The results revealed that students in both instructional groups recorded substantial improvements between pre-test and post-test scores, indicating that the two approaches significantly enhanced students' understanding of Computer Architecture concepts. Furthermore, the absence of a significant difference between the post-test performance of students taught using Challenge-Based Learning and those taught using Place-Based Learning suggests that both strategies are comparably effective in facilitating academic achievement. Therefore, the study establishes that learner-centred and contextually driven instructional approaches are superior alternatives to conventional teaching methods in Computer Architecture instruction.

Recommendations

Based on the findings of the study, the following recommendations are made:

1. Computer Engineering lecturers should adopt both Challenge-Based Learning and Place-Based Learning strategies in teaching Computer Architecture, as both approaches have been shown to significantly improve students' academic achievement.
2. Curriculum planners and educational administrators should integrate learner-centred and context-based instructional approaches into Computer Engineering curricula to promote active learning, critical thinking, and practical application of Computer Architecture concepts.
3. Institutions should organise regular professional development programmes, workshops, and training sessions for lecturers to enhance their competence in implementing Challenge-

Based Learning and Place-Based Learning effectively in technical and engineering education.

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