Enhancing Database Fundamentals Learning Through Short-Term Face-to-Face Workshops: A Comparative Study

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Abstract: Mastering database fundamentals is crucial for Technical and Vocational Education and Training (TVET) students, yet many constantly struggle with core concepts in Database Fundamentals courses, leading to reduced academic performance and confidence. At Politeknik Sultan Idris Shah (PSIS), there is a notable gap concerning limited empirical evidence on the effectiveness of structured, short-term, face-to-face workshops in improving students' comprehension, self-confidence, and exam readiness for this course. The study aimed to evaluate how effective a short-term face-to-face workshop in improving student understanding and self-confidence in the Database Fundamentals course for polytechnics students. A quantitative approach was employed with 128 students from semesters 2 and 3, incorporating pre-test and post-test assessments and a structured survey. Initial findings indicated that Database Transaction Management, Normalisation/ERD, and SQL were perceived as the most difficult topics, suggesting major struggles by the students. The students reported improved understanding of database concepts and boosted self-confidence, indicating high workshop implementation effectiveness. Importantly, the study demonstrated measurable academic performance improvement across all participating student academic tiers, with the greatest gains observed in the Excellent and Distinction tiers. Overall student satisfaction was high, with strong support for regular workshops. In conclusion, the study provides strong evidence that well-structured, short-term, face-to-face workshops are an effective pedagogical strategy within the PSIS TVET context to improve Database Fundamentals learning outcomes, student confidence, and academic performance across diverse academic tiers.

Keywords: *Database Learning, Face-to-Face Workshops, TVET Education, Academic Performance*

1.0 INTRODUCTION

Databases have become foundational across varied areas such as business, healthcare, education, and manufacturing. For Technical and Vocational Education and Training (TVET), mastering database fundamentals is vital, as these skills provide the backbone for several technical applications in today's workforce. The Database Fundamentals course, particularly in Malaysian polytechnics, covers key concepts and technical skills including database and database management system (DBMS) principles, data models, relational algebra, and normalisation techniques. Students also learn Entity-Relationship Diagrams (ERDs) design, logical-to-physical schema mapping, and transaction management, with a primary focus on relational database systems. Furthermore, the course used Structured Query Language (SQL) for database object creation and data manipulation, making SQL proficiency a crucial skill set for data-centric careers (Radović et al., 2024; Ishaq et al., 2023).

Despite its importance, the learning database concepts present significant challenges for students. Specifically, TVET students undertaking the Diploma of Information Technology (DIT) program at Politeknik Sultan Idris Shah (PSIS) encounter difficulties in understanding and applying key database concepts which has been observed to yield reduced academic performance and lower confidence in this course. These challenges faced by early semesters TVET students in learning Database Fundamentals are often intensified by abstract topics like normalisation and relational algebra due to limited cognitive development and practical exposure (Mahmud et al., 2021). This situation is further complicated by students from non-computer science backgrounds, who may possess limited

mathematical skills and be unfamiliar with computer science principles (Rayapudi & Syedkhamruddin, 2020). These factors collectively result in varying levels of readiness among students.

Educators must therefore adopt flexible, adaptive teaching methods to effectively support all learners. Additionally, reinforcement of hands-on exercises is crucial for bridging the gap between theoretical knowledge and real-world problem solving (Huang, 2019). However, traditional teaching methods like lengthy lectures and basic lab activities, may not be optimally suited for teaching these complicated and abstract issues, highlighting the necessity for innovative and active ways (Knorr, 2020). The goal of this study was to learn more about how this unique way of workshops could help with the issues that were brought up. Short-term workshops, such as one-day sessions, have been suggested as highly effective for final exam preparation. Peer collaboration and hands-on practice in this workshop enhance students' learning and confidence in key concepts.

1.1 Research Problems

Despite the crucial nature of mastering Database Fundamentals for TVET students, early semester students at PSIS face significant difficulties with abstract concepts and practical application, resulting in reduced academic performance and confidence. While short-term workshops are proposed as a solution, there is a lack of sufficient empirical data from PSIS on the efficacy of structured, short-term, in-person workshops in boosting students' understanding, self-confidence, and exam preparation for Database Fundamentals.

Existing research on workshop-based learning in TVET often focuses on online interventions or addresses broader computing topics, not specifically fundamental database concepts. Furthermore, the differential benefits across various academic performance tiers in PSIS remain unclear. This study was necessary because there was a lack of specific evidence from PSIS about how effective short, face-to-face workshops are for teaching Database Fundamentals. This study aims to fill these gaps by specifically evaluating face-to-face workshop effectiveness and its varied impact on PSIS students, guiding the best possible pedagogical implementation strategies.

1.2 Research Objectives

The objectives that this research aims to achieve are:

i. To evaluate the effectiveness of a short-term face-to-face workshop in improving student understanding and self-confidence in the Database Fundamentals course.
ii. To compare the academic performance improvements among students of different academic tiers after attending the intervention workshop.
iii. To assess students' satisfaction with the overall workshop implementation.

1.3 Research Questions

Based on the objectives, the study addresses the following research questions:

i. How effective is a short-term face-to-face workshop in enhancing the student's understanding and self-confidence in the Database Fundamentals course?
ii. Is there a measurable difference in academic performance improvements among students from different academic tiers following the workshops?
iii. What is the level of student satisfaction with the implementation of the short-term workshop?

2.0 LITERATURE REVIEWS

2.1 Challenges in Database Fundamentals Learning in TVET education

Database Fundamentals are essential in information technology studies, particularly in Technical and Vocational Education and Training (TVET) institutions, where the students are expected to understand data modelling, Structured Query Language (SQL), and DBMS. However, many students struggle with abstract concepts like normalisation and relational algebra, especially in the early semesters (Semesters 2 and 3), when cognitive maturity and applied experience are still developing (Mahmud et al., 2021). Study by Knorr (2020) found that beginners in database topics often struggle to integrate knowledge for sophisticated problem-solving due to cognitive strain. Traditional database learning methods like long lectures and basic lab activities are unsuitable for teaching complex and abstract topics, but project-based learning incorporating practical tasks enhances knowledge and problem-solving skills (Dominguez & Jamie, 2010).

2.2 Effective Pedagogical Strategies in Database Fundamentals Learning

Technology integration in teaching strategically uses digital tools and platforms to improve student engagement and learning outcomes (Lim & Ahmad, 2022). Database Fundamentals learning incorporates tools like DBMS, SQL simulators, collaborative platforms (Cheong & Mokhtar, 2022), query builders, ERD software (Mahmud et al., 2021), and even gamified web systems designed for SQL practices (Morales-Trujillo and Garciá-Mireles, 2020) to reinforce student understanding, improve motivation, and encourage active participation and student engagement.

Study by Azman et al. (2021) show improved students' capacity to model, query, and manage relational databases through hands-on DBMS tools during face-to-face workshops. Integrating hands-on technology tools for normalising database designs bridges theoretical instruction and practical application in database learning (Yusof and Hashim, 2019). Additionally, digital tools in structured learning settings boost collaboration and critical thinking, preparing students academically in a database course (Rahman et al., 2020). Studies have reported positive outcomes from such approaches.

2.3 The role and advantage of short-term workshops in technical skill development

Short-term, face-to-face workshops serve as a strategic intervention in TVET to tackle student issues related to low comprehension, poor academic performance and high course repetition rates (Kamisan et al., 2024). They provide focused learning modules, fostering practical skills development and motivation through real-world scenarios (Yusof and Hashim, 2019). In database learning, workshops enable quick hands-on practice of concepts, revisiting challenging concepts and preparing for assessments (Lim and Ahmad, 2022). Comparative studies confirm workshop-based activities effectiveness over traditional lectures enhanced students' grasp and recall of complex database concepts and students' confidence in utilizing DBMS, especially among those in the initial semesters of their studies (Azman et al., 2021; Cheong and Mokhtar, 2022). These comparative findings accentuates the value of interactive and time-efficient pedagogical methods tailored to the students' cognitive abilities and learning preferences and needs, directly supporting the aim of this study.

2.4 The advantages of collaborative learning in technical education

Collaborative learning in face-to-face workshops offers significant advantages for database fundamentals, rooted in Social Constructivist Learning Theory by Vygotsky (1978), where knowledge is actively constructed in social interaction and collaboration with both peers and teachers, which form learning process components. From a technical education perspective, this environment fosters concept retention as students actively participate in discussions, problem-solving, and group activities, with instructors facilitating engagement. Such active teaching strategies and cooperative learning significantly improve academic performance, critical thinking, and problem-solving skills across various disciplines (Carstensen et al., 2020; Lorente et al., 2021; Alali and Wardat, 2024).

Group projects where students work in small teams (Fittipaldi, 2020), enhance cooperation between team members, communication, and the ability to solve complex problems by leveraging diverse viewpoints (Ainsworth, 2021; Farshadfar, 2024; McKay & Sridharan, 2024), despite potential challenges with unequal participation (McKay & Sridharan, 2024) and students' struggles in groups (Claude et al., 2024) exists. Ultimately, the shift from traditional lectures to student-centered, collaborative models in technical education, including Database Fundamentals, consistently demonstrates improved learning outcomes (Rahman et al., 2020).

2.5 Research Gaps and Context

Despite a growing corpus of research on workshop-based learning and TVET teaching approaches, polytechnic students' utilization of short-term, face-to-face Database Fundamentals workshops is lacking. Many studies focus on online learning interventions or general computing education topics, neglecting tailored, in-person workshop database interventions (Rahman et al., 2020). This research is situated within the evolving landscape of TVET which is heavily influenced by

government policies and initiatives and demands of Industry 4.0 that require a workforce equipped with advanced technical and soft skills. Nonetheless, there is a notable discrepancy between the skills taught in conventional higher education and those sought by industries (Agarwal, 2006).

Higher Education 4.0 emphasizes competency-based learning to ensure graduates possess the skills to meet the Industry 4.0 needs, requiring integration of cutting-edge technologies, data-driven tools, and student-centered learning approaches (Schwab, 2016). Significant obstacles include lack of instructors qualified to integrate Industry 4.0 technologies (Kassim et al., 2025) and a poorly defined concept of generic skills suited for TVET graduates (Mohd Kamaruzaman et al., 2019), hindering TVET graduates' job market success (Muschalla, 2021). Addressing these gaps requires targeted training for instructors and systematic identification of future generic skills to tailor curricula and pedagogical approaches (Kassim et al., 2025; Mohd Kamaruzaman et al., 2019).

3.0 METHODOLOGY

This study research design was based on a quantitative survey and academic performance test approach, which included structured pre-test and post-test assessments. The participants were DIT students from semester 2 and semester 3 of the Department of Information and Communications Technology (JTMK), PSIS who enrolled in the Database Fundamentals course. Participation was inclusive of all students who attended the workshops. Only students who attended the workshop sessions were included in the final analysis. The face-to-face workshop was ran in one day session and consisted of the following activities as shown in Figure 1, comprises concept revision, peer-to-peer collaborative discussions, and guided explanation of past examination questions.

***Figure 1**: Short-term face-to-face workshop activities*

The survey instruments were structured questionnaires divided into four sections namely Section A, B, C, and D, and were provided to the students via online survey link after the workshop to ease the data collection process (Thangiah, 2018). Section A gathered demographic and critical topics information; Section B assessed the effectiveness of the workshop implementation method; Section C evaluated the workshop's effectiveness on improving students' understanding and self-confidence on exam readiness; and Section D measured the overall satisfaction of workshop implementation.

Validated instruments by Kamisan et al. (2024) and Mohd Noor (2022) were adapted and modified to fit post-workshop evaluation tool effectiveness in TVET-based final exam preparation interventions.

The questionnaire used a 4-point Likert scale with options ranging from "Strongly Disagree" to "Strongly Agree.". A 4-point Likert scale without a neutral midpoint was used to encourage respondents to choose a clear stance rather than allowing for neutrality or hesitation (Brown, 2000; Krosnick & Presser, 2010). While this design can prompt decisive feedback, it is acknowledged that it may not fully capture nuances of neutrality or hesitation, potentially leading to a slight skew in perceived results towards either agreement or disagreement. This scale format is described as a common practice, often depending on the researcher's preference (Croasmun, 2011).

Students' academic performance across tiers was assessed using structured pre-test and post-test that contained ten questions covering five course topics. These assessments addressed the same learning objective and were given both before and after the intervention. The data were analysed using SPSS software. Descriptive statistics evaluated survey responses and structured pre-tests and post-tests scores for academic performance. Table 1 summarises the overall data analysis.

Table 1
Summary of research data analysis

No.	Research Questions	Research Instruments	Analysis Methods
1	How effective is a short-term face-to-face workshop in enhancing the student's understanding and self-confidence in the Database Fundamentals course?	Questionnaires	Descriptive Statistics
2	Is there a measurable difference in academic performance improvements among students from different academic tiers following the workshops?	Pre-Test and Post-Test Scores	Descriptive Statistics
3	What is the level of student satisfaction with the implementation of the short-term workshop?	Questionnaires	Descriptive Statistics

To compare academic performance improvements across academic tiers, the students' continuous assessment test results were categorised by the official Polytechnic Grading System (*Examination Instructions and Assessment Methods (Diploma (6th Ed.)*, 2019). Table 2 shows the details of academic tiers.

Table 2
Academic Tiers based on Polytechnic Grading System

No.	Percentage	Grade	Academic Tiers
1	90 -100	A+	Exceptional
2	80 - 89	A	Excellent
3	79 - 65	A-, B+, B, B-	Distinction
4	64 - 40	C+, C, C-, D+, D	Pass
5	39 - 0	E, E-, F	Fail

4.0 DATA ANALYSIS AND FINDINGS

4.1 Demographic analysis of respondents

The study included 128 students in Semester 2 and 3 from the JTMK, PSIS who took part in the Database Fundamentals workshops. Among them, 52% (n=67) were female and 48% (n=61) were male. In terms of academic performance, 52% (n=66) were high achievers (Exceptional and Excellent), 38% (n=49) were average performance (Distinction), and 10% (n=13) were low performers (Pass) based on their test marks in continuous assessment. Most students belong in the Distinction range. All participants completed the workshop and online survey, yielding a reliable data sample. In addition, participants were asked to identify which topics they found most difficult to understand, results are presented in Figure 2.

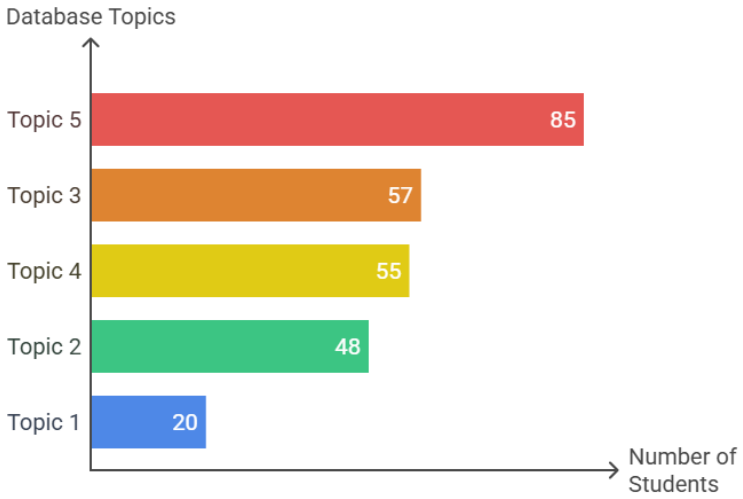

***Figure 2**: Students perceptions of most difficult topics*

The results indicate that Topic 5 (Database Transaction Management), emerged as the most difficult topic, with 85 students identifying it as a major struggle. This was followed by Topic 3 (Normalisation and Entity Relationship Diagram) with 57 students, and Topic 4 (SQL) with 55 students, each chosen by over half of the respondents. Topic 2 (Relational Data Model) was considered moderately difficult gaining 48 students' responses, while Topic 1 (Fundamentals of Database Management System) was perceived as the least difficult, gaining 20 students' responses. These results highlight specific topics where learners may need extra support or instructional focus.

4.2 Analysis of workshop implementation efficacy

This section presents the analysis of student responses in Section B of the questionnaire regarding the implementation methods used during the workshop. Overall, participants gave positive

feedback on how the workshop was conducted.

Table 3
Effectiveness of Workshop Implementation Methods

	Items	Mean	Standard Deviation	Level
a.	The workshop content was relevant and useful for student preparation for the final exam.	3.80	0.40	High
b.	Workshop activities and media are used effectively to convey information.	3.75	0.47	High
c.	Printed materials are arranged neatly.	3.74	0.49	High
d.	The explanations given during the workshop were clear and easy to understand.	3.73	0.44	High
e.	The instructor demonstrates an appropriate level of knowledge in the topic being presented.	3.77	0.42	High
f.	The facilitator helped strengthen students' understanding of database concepts.	3.71	0.58	High
g.	The structure and duration of the workshop were adequate and suited students' learning needs.	3.75	0.45	High

Results in Table 3 shows the overall mean score for this section was 3.75, indicating a high level of agreement among participants regarding the effectiveness of the workshop's implementation. The responses also showed relatively low standard deviations ranging from 0.40 to 0.58, suggesting consistent perceptions across participants. The highest rated item was (a) with a mean score of 3.80 indicating that students found the subject matter directly beneficial to their exam readiness. Items (b) and (e) also received strong agreement, highlighting the effectiveness of the media and activities used and the instructor's knowledge. The item with the lowest mean score compared to others was (f) with a mean of 3.71. This may suggest that while overall understanding was improved, some students may have needed more targeted guidance on specific technical aspects and improvement in facilitator support. Lastly, the data indicates that the workshop was well executed with clear delivery, relevant content and effective use of resources all contributing to a productive learning experience.

4.3 Analysis of academic understanding and self-confidence

This section analyses the effectiveness of the workshop in enhancing student's understanding of database related concepts and boosting their confidence in preparing for the final exam.

Table 4
Effectiveness of Workshop in Improving Students Understanding and Self-Confidence

	Items	Mean	Standard Deviation	Level
a.	Understanding of basic database concepts has increased compared to before.	3.70	0.46	High
b.	I mastered the concept of Entity-Relationship Diagram (ERD) and its use in data modelling.	3.66	0.52	High
c.	I clearly understand how to perform normalisation in a database.	3.59	0.54	High
d.	I am skilled in using SQL commands correctly in solving problems.	3.61	0.60	High
e.	I better understand the need for the questions given.	3.59	0.55	High
f.	I am able to meet the scoring criteria.	3.62	0.52	High
g.	I am more confident in answering all the final exam questions well.	3.58	0.54	High
h.	I am more prepared for the final exam after attending the workshop.	3.60	0.54	High
i.	I am confident that I will achieve better results after participating in the workshop.	3.63	0.50	High

Based on the results presented in Table 4, the overall mean score for this section is 3.62 with standard deviations ranging from 0.46 to 0.60 indicating a high level of agreement and consistency in responses. Among nine items, the highest mean score was recorded for item (a) with a mean of 3.70 reflecting strong perceived gains in fundamental knowledge. This was closely followed by item (b) on mastery of the ERD with a mean of 3.66 and item (i) with a mean of 3.63, indicating a positive outlook on academic performance post-workshop. Items such as (g) and (c) received slightly lower but still high mean scores 3.58 and 3.59 respectively suggesting these areas may require further reinforcement or follow-up sessions. In summary, the analysis shows that the workshop was effective in not only strengthening conceptual understanding in key database topics but also in boosting student's confidence and perceived readiness for final examinations.

4.4 Analysis of academic performance improvement across academic tiers

This section analyses the improvement of students' academic performance across all academic tiers. The results are presented in Table 5.

Table 5
Comparison of Academic Performance (Pre-Test and Post-Test) Across All Academic Tiers

Academic Tiers	Mean Pre-Test	Mean Post-Test	Improvement
a. Exceptional	6.50	8.22	1.72
b. Excellent	5.83	8.47	2.64
c. Distinction	5.67	8.16	2.49
d. Pass	5.08	7.15	2.07

The overall mean pre-test score was 5.88, which increased to 8.15 in the post-test, reflecting an overall improvement of 2.27 scores after the workshop intervention. This indicates a positive impact of the workshop on students' academic performance across all tiers. The highest improvement with 2.64 scores difference, was observed among Excellent students, and followed closely by the Distinction students with 2.49 scores gained. Pass students also benefited significantly with 2.07 scores increased showing that the workshop does support low-performing students.

The smallest improvement shown by the Exceptional students with 1.72 scores probably due to their high baseline performance. In summary, the results indicate that the workshop contributed to academic performance improvement for students at all levels, with the greatest relative gains observed among students in the Excellent and Distinction students. This suggests that mid to high achieving students responded particularly well to the structured intervention, while even lower-achieving students showed meaningful progress.

4.5 Analysis of overall workshop satisfaction

This section analyses the students' responses on their overall satisfaction with the workshop. The results are presented in Table 6. The overall mean satisfaction score was 3.73, indicating a high level of student satisfaction with the workshop. All four items achieved the same mean score, reflecting consistent and positive perceptions across different aspects of the workshop experience. All items received the same mean score of 3.73 and the low standard deviations values ranging from 0.44 to 0.47 suggest strong agreement and minimal variation in responses. This uniformity confirms that the workshop was well-received by participants in all key areas of delivery and organization.

Table 6
Overall Workshop Satisfaction

Items	Mean	Standard Deviation	Level
a. Overall, this workshop successfully achieved its objectives and was beneficial.	3.73	0.44	High
b. I am satisfied with the overall organization of the workshop.	3.73	0.47	High
c. This workshop met my expectations.	3.73	0.45	High
d. Workshops like this need to be held regularly before the final exams.	3.73	0.44	High

5.0 DISCUSSIONS

This study's results showed that short-term face-to-face workshops significantly improved student learning outcomes in database fundamentals including understanding, confidence, satisfaction and academic performance. Students reported increased understanding of complex database topics which are database transaction management, normalisation and SQL. The mean scores for perceived learning improvements (M = 3.70 for basic concepts, M = 3.66 for ERD and M = 3.59 for normalisation). This conceptual clarity stemmed from the workshop's structured approach, incorporating concept revision, collaborative peer discussion and guided examination questions practices.

These findings are consistent with Prince (2004), who argued that active learning methods such as workshops and collaborative tasks are more effective than passive lectures for developing technical knowledge. Furthermore, post-workshop data revealed increased students' confidence (M = 3.63 for projected performance improvement and M = 3.60 for exam preparedness), demonstrating the psychological benefits of instructor-led interactive sessions. This is consistent with Freeman et al. (2014), who stated that active learning enhances academic achievement, confidence and engagement.

The effectiveness of the workshop fits well with Social Constructivist Learning Theory by Vygotsky (1978). This theory suggests that knowledge is actively built through social interaction and collaboration with peers and teachers, which is integral to the learning process (Kassim et al., 2025). Furthermore, face-to-face intervention also helped by providing immediate feedback and collaborative problem-solving, useful for hands-on practices like illustrating ERD and constructing SQL. Analysis of pre-test and post-test scores across different academic tiers revealed notable improvements in all groups. The results (see Table 5) show that the workshop successfully aided students at all academic tiers, with

particularly significant gains among mid to high-performing students, consistent with the benefits of guided peer and instructor-led activities over traditional methods (Chi and Wylie, 2014).

Feedback on workshop implementation methods was overwhelmingly positive. Students rated content relevance (M = 3.80), instructor knowledge (M = 3.77) and the effectiveness of media and materials (M = 3.75). These results reinforce the importance of multimodal instruction and structured delivery in promoting student learning outcomes through Universal Design for Learning (UDL) principles by Mayer (2009) and CAST (2018). The high satisfaction ratings (M = 3.73 for all items) indicate that students believed their expectations were met in workshop experience and the pedagogical approach was well-received. According to Levinsson, et al., (2024), student happiness is frequently influenced by how effectively course design, delivery and assessment meet their needs.

Brief, focused workshops offer an effective and scalable strategy for improving Database Fundamentals learning within the TVET context. For polytechnics like PSIS, these targeted interventions are a practical approach to boost academic performance across all student levels. The high student satisfaction and positive feedback on implementation further support the feasibility and student acceptance of this approach for regular implementation.

6.0 Conclusions and future works

This study confirmed a short-term, face-to-face workshop significantly enhanced PSIS students' understanding, and self-confidence in Database Fundamentals, particularly for challenging topics like transaction management, normalisation, and SQL. The intervention showed measurable academic performance gains were observed across all academic tiers, with the most substantial improvements in the Excellent and Distinction categories. High student satisfaction ratings consistently affirmed the workshop's relevance, instructor expertise, and overall organization. These findings align with existing literature supporting active, workshop-based learning over traditional lecture formats for technical education, addressing a notable research gap concerning targeted, face-to-face polytechnic database interventions and offering valuable comparative insights into academic performance improvements across tiers. Despite limitations in self-reported data and intervention duration, this study provides strong evidence that well-structured, short-term workshops are a scalable and adaptable strategy for reinforcing core competencies in database education. Future research should explore longitudinal designs, performance-based assessments, and innovative enhancements like gamification or AI-driven adaptive learning to further validate these findings.

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