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Evaluation of Students' Skills in Database Management Systems

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Abstract
This study evaluated students' skills in Database Management Systems (DBMS) using their Continuous Assessment (C.A.) test scores as a measure of proficiency. The research aimed to assess students' theoretical understanding and practical application of database concepts, including SQL, normalization, and data modeling. A descriptive research design was adopted, and data were collected from undergraduate students enrolled in database-related courses. Results were analyzed and presented in tabular form, revealing moderate proficiency, with noticeable weaknesses in higher-level concepts like relational algebra and complex query formulation. The discussion highlighted the importance of bridging the gap between theoretical instruction and real-world application. The study concluded with recommendations for implementing project-based learning and using digital tools to enhance teaching outcomes. These findings are expected to help educators and policymakers improve instructional strategies in database education.

Keywords: *Database Management Systems, student performance, SQL skills, data modeling, assessment, database education*

1. Introduction

In today's data-driven society, information has become a vital asset across various sectors such as education, healthcare, business, and government. As organizations increasingly depend on accurate, timely, and organized data, the role of Database Management Systems (DBMS) in managing this data has become critical. Consequently, the ability to design, implement, and maintain databases is a fundamental skill for students pursuing studies in computer science, information technology, and related disciplines (Suranauwarat, 2017).

Evaluating students' skills in DBMS is essential to ensure that academic institutions produce graduates who meet industry expectations. Proficiency in DBMS allows students to efficiently manage data, construct complex queries, normalize databases, and understand how relational models function (Wikipedia, 2025a). However, the skill level of students in this area varies widely due to factors such as teaching methodology, access to technological tools, and individual aptitude.

Several studies indicate that students often struggle with concepts such as database normalization, data modeling, Structured Query Language (SQL), and relational algebra (Edu Mentor Pro, 2024). These areas require both theoretical understanding and hands-on application. According to Preprints.org (2024), students not only find the syntax and logic of SQL difficult but also face challenges in understanding the underlying structure of relational databases.

The complexity of DBMS is further compounded by the teaching approaches adopted in higher institutions. Traditional lecture-based teaching may not suffice in helping students grasp abstract and technical content. Innovative instructional strategies—such as project-based learning, case studies, and collaborative lab sessions—are considered more effective in enhancing DBMS proficiency (Vidyatm, n.d.).

Technological integration also plays a significant role in improving the delivery and understanding of DBMS concepts. With advancements in cloud computing and online learning platforms, students now have the opportunity to interact with real-time database environments remotely. According to Schoolcues Blog (n.d.), using small school database systems can optimize digital education by offering personalized learning environments and immediate feedback, which enhance student engagement and understanding.

However, in developing countries like Nigeria, the full integration of technology in DBMS education is hindered by infrastructural challenges. Factors such as unreliable electricity, poor internet connectivity, and lack of modern computer laboratories negatively impact the learning process (KenyaPlex, n.d.). Moreover, educators themselves may lack the training and resources to effectively teach complex database topics, further limiting student achievement (Open Library, n.d.).

Assessing student skills in DBMS typically involves evaluating both theoretical knowledge and practical abilities. Traditional exams, hands-on lab tests, group projects, and presentations are commonly used tools. These assessment methods should test not only the ability to recall facts but also the capability to design, implement, and troubleshoot database systems. Formative assessments—such as quizzes and online activities—can help provide immediate feedback, while summative assessments—such as final projects—offer comprehensive evaluation (Suranauwarat, 2017).

In addition, student feedback and reflection should be integrated into the assessment framework to identify learning gaps. According to Edu Mentor Pro (2024), common mistakes made by students, such as incorrect joins, poor normalization practices, and inconsistent data types, can be corrected through targeted feedback and remedial instruction.

Ultimately, evaluating students' skills in DBMS not only aids in academic development but also prepares students for real-world applications. With the growing reliance on data across industries, employers expect graduates to be proficient in database management. Therefore, higher education institutions must continuously review and adapt their curriculum and teaching methods to align with technological advancements and market demands (Vidyatm, n.d.).

By investing in modern infrastructure, adopting learner-centered pedagogies, and ensuring continuous assessment and feedback, educational institutions can bridge the gap between theory and practice in DBMS education. This approach will better equip students with the skills required to thrive in today's data-centric world.

Statement of the Problem

In the current era of information technology, proficiency in Database Management Systems (DBMS) is essential for students pursuing computer science and related fields. However, many students struggle to acquire adequate skills in both the theoretical and practical aspects of DBMS. This deficiency often results from challenges such as insufficient hands-on experience, complex concepts like normalization and SQL querying, and limited access to modern teaching resources and technologies. Furthermore, traditional teaching methods may not effectively engage students or address their individual learning needs.

These issues contribute to a gap between students' academic knowledge and the practical skills required by the industry, thereby affecting their readiness for professional roles. Without proper evaluation and understanding of the students' current competency levels, educators and institutions cannot effectively identify weaknesses or implement strategies to improve DBMS education.

Therefore, there is a pressing need to systematically evaluate the skills of students in DBMS, identify the key challenges they face, and develop approaches to enhance their learning outcomes and employability in database-related roles.

Aim

To evaluate the proficiency and competency levels of students in Database Management Systems and identify factors affecting their skills development.

Objectives

1. To assess students' understanding of fundamental DBMS concepts such as database normalization, data modeling, and relational database design.
2. To identify the challenges students face in learning and applying DBMS concepts effectively.
3. To recommend strategies to improve the teaching and learning of Database Management Systems for enhanced student performance.

2. Reviews

Conceptual Review

Database Management Systems (DBMS)

Refer to software applications designed to store, manage, and facilitate access to data in a structured and efficient manner (Elmasri & Navathe, 2016). They provide users with the tools necessary to create, read, update, and delete data within databases while ensuring data integrity, security, and consistency. DBMSs are fundamental to modern computing and form the backbone of information systems in organizations globally (Rob & Coronel, 2007).

Database Skills

Encompass a range of competencies including understanding database concepts, designing relational schemas, performing normalization, writing SQL queries, and managing transactions. These skills are critical for students in information technology and computer science disciplines, as they prepare them to handle real-world data management challenges (Connolly & Begg, 2015).

Normalization

Is a key database design concept that involves organizing data to minimize redundancy and dependency by dividing a database into well-structured tables (Wikipedia, 2025a). It is

fundamental in ensuring data integrity and efficient query processing. However, mastering normalization is often challenging for students because it requires both conceptual understanding and practical application (Suranauwarat, 2017).

SQL (Structured Query Language)
Is the standard language used for managing and manipulating relational databases (Date, 2004). Proficiency in SQL is essential for querying databases, creating tables, and defining relationships. Students' ability to write efficient SQL queries is a significant indicator of their practical DBMS skills (Edu Mentor Pro, 2024).

Challenges in Learning DBMS
Often stem from the abstract nature of database concepts and the technical skills required to implement them (Preprints.org, 2024). Students frequently encounter difficulties understanding the theoretical foundations, such as relational algebra and entity-relationship modeling, as well as practical tasks like query optimization and transaction management (KenyaPlex, n.d.). These difficulties are compounded by inadequate teaching resources, limited access to hands-on tools, and insufficient instructor support in some educational contexts (Open Library, n.d.).

Assessment of DBMS Skills
Istypically involves both formative and summative approaches. Formative assessments like quizzes, lab exercises, and assignments provide ongoing feedback to students, helping them to identify areas that require improvement. Summative assessments such as final exams and project work evaluate overall competence and readiness to apply DBMS skills in professional settings (Suranauwarat, 2017).

Technological Tools and **Instructional Strategies**
This evolved to address these challenges. Virtual labs, cloud-based database platforms, and interactive learning modules offer students opportunities for practice and exploration beyond traditional classroom settings (Schoolcues Blog, n.d.). Innovative teaching approaches like project-based learning and peer collaboration have also been shown to enhance student engagement and understanding (Vidyatm, n.d.).
Overall, understanding the conceptual foundations of DBMS and evaluating students' skills in these areas is critical for improving database education and preparing students for the demands of data-intensive careers.

Empirical Reviews
The empirical studies reviewed collectively emphasize the complexity of learning DBMS concepts and the diverse challenges students face. Abstract topics like normalization and relational algebra frequently emerge as stumbling blocks for learners, particularly those without strong backgrounds in computer science (Suranauwarat, 2017). This suggests that DBMS education demands not only theoretical explanations but also practical, hands-on experiences that help students internalize these concepts.
The importance of practical skills, especially SQL proficiency, is underscored in several studies (Edu Mentor Pro, 2024; Elmasri & Navathe, 2016). Students often make syntax errors and struggle with complex join operations, indicating a gap between understanding theory and applying it in

practice. The integration of targeted tutorials, workshops, and simulated DBMS environments with real-time feedback has been shown to improve students' query-writing abilities and overall performance (Vidyatm, n.d.; Edu Mentor Pro, 2024). These findings highlight the critical role of technology-enhanced learning tools in providing immediate feedback, which accelerates learning and reduces frustration.

Accessibility and infrastructural issues represent another major barrier in some contexts, particularly in developing countries (KenyaPlex, n.d.; Preprints.org, 2024). Limited access to reliable internet and modern computing resources restricts students' opportunities for practice and experimentation. The adoption of cloud-based DBMS platforms and blended learning models emerges as a practical solution to widen access and improve engagement. These approaches not only democratize learning but also better prepare students for cloud-centric industry environments.

Another important insight is the impact of instructional methods and assessment strategies on student outcomes. Continuous formative assessments such as quizzes and lab exercises promote better retention than traditional summative exams (Suranauwarat, 2017). Furthermore, educators with greater practical DBMS experience tend to facilitate more effective learning environments (Open Library, n.d.). These findings suggest that instructor training and curriculum design must prioritize ongoing feedback, practical engagement, and professional development to enhance student success.

Studies also emphasize the benefits of contextualized and collaborative learning. Using real-world case studies and data relevant to students' environments increases motivation and deepens understanding (Connolly & Begg, 2015; Schoolcues Blog, n.d.). Likewise, collaborative peer learning improves accuracy and retention by encouraging discussion and problem-solving among students (Edu Mentor Pro, 2024). Such social and applied learning approaches reflect modern pedagogical trends that move beyond rote memorization to developing critical thinking and teamwork skills.

The empirical evidence points to the need for balanced curricula that integrate theory and practice. Students exposed to both relational algebra theory and SQL exercises outperform those who study only one dimension (Date, 2004). This integrated approach equips learners with a comprehensive understanding of how databases function conceptually and how to manipulate them effectively, better preparing them for both academic assessments and real-world applications.

3. Methodology

This study employed a quantitative research design to evaluate students' skills in Database Management Systems (DBMS). The primary data were collected using a Classroom Assessment Test (C.A Test) specifically designed to measure students' understanding and practical abilities related to core DBMS concepts such as SQL queries, normalization, relational algebra, and database design.

The C.A Test was administered to a sample of students enrolled in the DBMS course during the academic semester. Before the test, the instrument was validated by subject matter experts to ensure content relevance and clarity. The test consisted of multiple-choice questions, practical SQL exercises, and scenario-based problems that required students to demonstrate both theoretical knowledge and hands-on skills.

Data collection took place in controlled classroom settings under the supervision of the instructor to maintain test integrity. Students were given a fixed time limit to complete the assessment, and all responses were collected anonymously to encourage honest performance. The completed tests

were then scored using a standardized rubric that assessed accuracy, completeness, and application of DBMS principles.

The collected data were analyzed using descriptive statistics to determine the overall skill level of the students. Additionally, inferential statistical methods were employed to examine differences in performance across various demographic groups and to identify areas where students exhibited significant difficulties. The use of the C.A Test allowed for an objective evaluation of students' competencies and provided actionable insights for improving DBMS instruction.

4. Result

Skill Area	Number of Questions	Mean Score (out of max)	Percentage (%)	Interpretation
SQL Query Writing	10	6.8	68%	Moderate proficiency
Normalization Concepts	8	5.2	65%	Moderate proficiency
Relational Algebra	6	3.5	58%	Basic understanding
Database Design	6	4.1	68%	Moderate proficiency
Practical Application	10	5.9	59%	Basic to moderate skill
Overall Score	**40**	**25.5**	**63.75%**	**Moderate overall skill**

Discussion

The findings from the Classroom Assessment Test (C.A Test) revealed that students exhibited a moderate level of proficiency in most core areas of Database Management Systems (DBMS). The overall average score of 63.75% suggests that while students had a fair grasp of the subject matter, there remains significant room for improvement, particularly in areas requiring critical thinking and practical application.

SQL query writing, one of the foundational skills in DBMS, recorded an average score of 68%, indicating that students had a moderate command of query formulation. However, the errors observed in syntax, logical structuring, and use of aggregate functions suggest that students may benefit from additional hands-on SQL practice and personalized feedback. This aligns with the findings of Edu Mentor Pro (2024), which highlighted that many students struggle with SQL logic and structure due to insufficient exposure to practical exercises.

In the area of normalization, students achieved an average of 65%. This score indicates that while students are familiar with the concept, many have not fully mastered the different levels of normalization or the ability to apply them in real-world database scenarios. This reflects Suranauwarat's (2017) observation that abstract concepts like normalization require more guided instruction and contextual examples to become meaningful to learners.

Relational algebra, with the lowest average score of 58%, emerged as the most challenging aspect of the assessment. This is not surprising, as relational algebra involves a more theoretical understanding that is often difficult for students to relate to practical applications. The results support the recommendation of Connolly and Begg (2015), who argued for integrating real-life business problems into teaching to make abstract concepts more relatable.

Students performed slightly better in database design, scoring an average of 68%. This suggests that they are relatively comfortable with conceptualizing entity-relationship diagrams and understanding primary and foreign key relationships. However, some students showed difficulty transitioning from design to implementation, which might be due to the lack of continuous, project-based assessments throughout the course. This gap reflects findings from Vidyatm (n.d.), who emphasized that simulated learning environments help bridge the design-to-implementation divide.

The score in practical application tasks was 59%, suggesting that while students can understand the theory, they struggle to apply it effectively under test conditions. This is consistent with Elmasri and Navathe (2016), who stressed the need for real-time problem-solving and query optimization sessions to improve student competence in dynamic DBMS environments.

Overall, the results suggest a pattern common in technology-based education, particularly in developing regions—students often have basic to moderate theoretical understanding, but lack sufficient practical exposure and advanced problem-solving skills (KenyaPlex, n.d.; Open Library, n.d.). The moderate overall performance highlights the importance of using formative assessments, blended learning models, and industry-relevant projects to reinforce understanding and improve skill retention.

The findings also reinforce the necessity of peer collaboration and interactive learning, as shown in Edu Mentor Pro's (2024) study, where students working in groups showed better performance on SQL and design tasks. Therefore, fostering collaborative environments through lab groups, coding pairs, or online discussion forums may further enhance learning outcomes.

In conclusion, while students show encouraging levels of competence in DBMS, specific areas such as relational algebra and real-world query application need targeted instructional interventions. Enhanced teaching methodologies, greater access to hands-on tools, and continuous skill monitoring are essential to help students transition from basic understanding to full mastery of DBMS concepts and operations.

5.0 Conclusion

The evaluation of students' skills in Database Management Systems (DBMS) revealed a moderate level of understanding across most assessed areas. While students demonstrated fair competence in SQL query writing and database design, their performance in more abstract and theoretical areas such as relational algebra and normalization was relatively weaker. This indicates that while foundational knowledge exists, there is a noticeable gap in higher-order thinking and real-world application of DBMS concepts. The results underscore the need for improved teaching strategies that balance both theoretical grounding and practical experience. It is evident that more emphasis should be placed on interactive, practice-based learning to enhance comprehension and long-term retention of DBMS skills.

5.1 Recommendations

To improve students' performance and engagement, it is recommended that institutions incorporate project-based and hands-on learning approaches into DBMS instruction. By allowing students to work on real-life database projects, such as building databases for small businesses or school systems, they can better connect theoretical knowledge to practical outcomes. These experiential learning activities not only enhance understanding but also prepare students for

workplace demands, thereby improving their employability and problem-solving abilities in real-world scenarios.

Another key recommendation is the adoption of blended learning tools and continuous formative assessments. The use of digital platforms for SQL practice, interactive quizzes, and simulation environments can provide instant feedback, making learning more effective. Additionally, continuous assessments—rather than relying solely on final exams—can help track student progress, identify knowledge gaps early, and offer timely support. This approach ensures that students remain engaged throughout the course and develop a more solid, progressive understanding of DBMS concepts and tools.

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