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# Development of Database System Principles and Applications Course based on Task-based Learning and Team-based Learning to Enhance Database Design Abilities of Second Year Students in Fujian University of Technology

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**Abstract**

**Background and Aim:** The undergraduate database system principles and applications course grapples with issues such as the gap between theory and practice, outdated content, and limited teaching methods. Addressing these challenges necessitates a comprehensive reform to enhance students' practical skills and adaptability to technological advancements. This study aimed to: 1) study the background information focusing on course components of Database system principle and application course to enhance students' database design ability, 2) develop a Database system principle and application course based on Task-based learning and Team-based learning to enhance students' database design ability, and 3) determine the effectiveness of implementing the database system principle and application course based on Task-based learning and Team-based learning.

**Materials and Methods:** The sample was second-year students majoring in Internet of Things engineering in the academic year 2023-2024 of Fujian University of Technology, the People's Republic of China was 30 students from 1 classroom derived by cluster random sampling. The experimental design adopted in this study is a group Post-test-only design. The research instruments from each Phase of the study were as follows: Phase I: Interview forms for teachers and students on course-related questions. Phase II: 1) Database system principles and applications course based on Task-based learning and Team-based learning with a very high level of appropriateness. 2) Eight lesson plans based on Task-based learning and Team-based learning with a very high level of appropriateness. 3) An evaluation form of database design ability includes knowledge and skills. 4) a learning achievement test and 5) a student satisfaction questionnaire with a reliability of 0.897. The data were analyzed by using mean, standard deviation, and the one-sample t-test.

**Results:** The results of the study were as follows: 1) The researchers reviewed the literature about the Database System Principles and Applications course and interviewed four teachers and 20 students for problems of the Database System Principles and Applications course, and the information gathered was used to develop the course. The database system principles and applications course in undergraduate education faces problems such as the disconnection between theory and practice, the lag in updating course content, and the single teaching method. These challenges emphasize the urgent need for comprehensive reform of the course content, teaching methods, and assessment system to enhance students' practical skills and their ability to adapt to the rapidly changing technological environment. 2) The Database System Principles and Applications Course based on Task-based Learning and Team-based Learning consisted of the principle, objective, content, instructional strategy, materials, and evaluation. 3) After implementing through Database system principles and applications course based on Task-based learning and Team-based learning, the students' database design ability (Knowledge) was higher than the determined criterion of 70% at a significance level of .05 ($M$ = 31.33, $SD$ = 3.76, $t$ = 4.825, $p$ = .000) and the students' database design ability (Skills) was higher than the determined criterion of 70% at a significance level of .05 ($M$ = 45.12, $SD$ = 2.89, $t$ = 5.913, $p$ = .000). 4) The students' satisfaction was statistically higher than the determined criterion of 70% at a .05 level of statistical significance.

**Conclusion:** To development of a task-based learning and team-based learning database system principles and applications course is significantly effective in enhancing students' database design ability.

**Keywords:** Database system principles and applications course; database design abilities; Task-based Learning and Team-based Learning



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## Introduction

In the current era of rapid development of information technology, database system design and management have become the core skills of computer science and technology majors. With the continuous progress of big data and cloud computing technology, the demand for database systems is also growing, which requires students of related majors not only to master the basic theoretical knowledge of databases but also to have the ability to efficient database design and management. Applied undergraduate education places special emphasis on the cultivation of practical skills, aiming to provide students with teaching content and practical experience closely related to the industry so that they can directly apply the skills they have learned in school to solve real-world problems. Therefore, educational institutions need to continuously update their curriculum content and teaching methods to keep pace with rapidly changing technologies and market demands. Research on database education has shown that a combination of real-life case studies and project-driven learning approaches can significantly improve students' motivation and practical skills. Numerous examples have shown that by simulating project tasks in an enterprise environment, students can experience real-life business processes and data management problems during their studies, leading to a better understanding and mastery of the design and application of database management systems.

Fujian College of Engineering, as a university that trains information technology professionals, faces the challenge of reforming its curriculum teaching model, especially in the core course of Database System Principles and Applications. The current teaching method mainly relies on theoretical lectures and basic laboratory operations, which shows obvious deficiencies in cultivating students' practical design ability and teamwork abilities. To better meet the needs of applied undergraduate education, this study proposes an innovative teaching model that combines Task-Based Learning and Team-Based Learning. This model aims to improve students' practical skills, collaborative skills, and database design abilities through the completion of real-world tasks and teamwork. Through the reformed teaching model, students will be involved in projects that simulate real-world database applications, such as user data management in an e-commerce website and data integration in a hospital information system. This hands-on opportunity helps students understand the practical application of theoretical knowledge and lays a solid foundation for their careers. This study will assess the impact of this model on students' database design skills and teamwork abilities, and explore its potential impact on students' learning attitudes and motivation, which are expected to show high competence in both theoretical and practical exercises.

In addition, the design of the pedagogical model for this study will also reflect the continuous updating and improvement of the course content, taking into account the new demands placed on educational content and methodology by the rapid development of technology. This dynamic approach to curriculum design will help ensure that educational activities are kept up to date with industry standards and emerging technologies, thereby enhancing students' competitiveness in the job market.

## Objectives

1. To study the background information focusing on course components of Database system principles and applications course to enhance students' database design ability.

2. To develop Database system principles and applications courses based on Task-based learning and Team-based learning to enhance students' database design ability.

3. To determine the effectiveness of implementing the database system principles and applications course based on Task-based learning and Team-based learning

3.1 To compare students' database design ability after implementing Database system principles and applications course based on Task-based learning and Team-based learning with a criterion set at 70%

3.2 To compare the students' satisfaction after implementing Database system principles and applications courses based on Task-based learning and Team-based learning with a criterion set at 70%.

## Literature review

### Course development theory

The reform of the curriculum is based on the fundamental goal of cultivating students' "vocational competence", emphasizing the combination of work process and learning knowledge, and demonstrating the vocational and practical nature of skills. After a lot of practice, it has achieved remarkable results and has played a great role in the society. (Sha, 2023).



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In Tang Baizhi's book "Vocational Education Curriculum and Teaching Theory", it is pointed out that vocational education curriculum is the entire educational content that is beneficial to the physical and mental development of the educated person by the occupation's certain educational purpose, under the educator's organized and planned guidance, and the educated person's interaction with the educational situation (Tang, 2015)

The course development process usually includes six stages: requirements analysis, design, development, implementation, evaluation and feedback, and continuous improvement. The goal of the requirements analysis stage is to determine the objectives and learning needs of the course, as well as the educational goals, student learning needs, and background. In the design stage, educators design the course based on the results of the requirements analysis. Teachers need to determine the structure, content, learning objectives, teaching strategies, assessment methods, and learning resources of the course. The design stage includes developing a syllabus, writing textbooks, and designing course plans. In the development stage, educators begin to create course content and learning resources.

As early as 1978, Shao Ruizen translated Bruna's curriculum design and teaching ideas with "basic discipline structure" as the core of the domestic academic circle. Later, in 1985, Liao Zhexun translated the article "Five Curriculum Concepts -- Their Ideological Roots and Thoughts on Curriculum Design" jointly written by the American curriculum scholars Elliert W. Eisner and Elizabeth Elizabeth Vallance. In detail, it shows five representative course design orientations of the United States to the domestic academic circle (Liao, 1985). Then, Wang compiled the fourth chapter of An Introduction to Curriculum Research co-authored by British scholars Philip H. Taylor and Colin Richards, and published it in the second issue of Foreign Education Research in 1986 under the title of "Three Models of Curriculum Design". The three curriculum design modes are objective mode, process mode, and environment mode. These research results give us an overall understanding of the representative theories of the curriculum development model in foreign countries at that time.

A curriculum is a plan for ordering and directing the teaching-learning experiences that students encounter in an educational institution. The process of providing the plan and keeping it running smoothly is known as curriculum development. Curriculum development is the more comprehensive term, which includes planning (determination of aims and goals), design, implementation, and evaluation. Since curriculum development implies change and betterment, curriculum improvement is often used synonymous with curriculum development, though in some cases improvement is viewed as the result of development (Oliva, 1999).

**Task-based learning**

Task-based Learning emerged in the 1980s as the latest development in communicative language teaching. It is a teaching method that focuses on tasks as the core of teaching and design, integrating teaching objectives into one or more specific activity tasks. Learners complete tasks through activities such as expressing, communicating, explaining, asking, and cooperating, to master the learning objectives.

The basic feature of The Task-based learning is that "the teacher should change his role from the traditional authoritative role of transferring knowledge to students to the teaching task of the whole process." "Pedagogical methods require teachers to shift their role from the traditional authoritative role of transferring knowledge to students to the role of mentors for student learning. Task-driven teaching methods help achieve student primacy. (Wang, 2018)

Büyükkarcı (2009), Title of the article: A critical analysis of Task-based learning.1) Pre-task: The teacher begins the topic by giving students clear directions as to what they need to do during the task phase and may help students recall some language that may be useful for the task. 2) Task: Students complete a task in pairs or small groups using language resources as a way for the teacher to monitor and provide support. 3) Planning: Students set up a short oral or written report to explain what happened in the class. short oral or written report to explain to the class what happened during their task. They then practice what they are going to say in their groups. 4) Report. Students report orally to the class or read a written report. The teacher chooses the order in which students submit their reports and can give students some quick feedback on the content. 5) Analysis: The teacher highlights relevant parts of the recorded text for students to analyze. 6) Practice: The teacher selects language areas to practice based the teacher selects language areas to practice based upon the needs of teacher selects language areas to practice based upon the needs of the students and what emerged from the task and report phases.

Willis (1996) considered the process of task implementation as a pedagogical activity and based on this, he proposed a three-phase model of Task-based pedagogy, i.e., pre-task, on-task, and post-task. Based



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on the foundation of Willis's (1996) theoretical research, the classroom teaching model was divided into pre-task, in-task, and post-task phases, and design instruction and research were conducted.

Ellis (2016), Title of the article: The methodology of Task-based teaching. A. Pre-mission includes the framing of activities (e.g., defining the outcome of the mission), planning time, and performing similar tasks. B. On-task Includes time pressure and number of participants. C. Post-task Includes learner reports, awareness raising, and repetition of the task.

The synthesized teaching steps of Task-based learning：

Step 1: Introduce the task refers to introducing a task so that students understand the background and objectives of the task they will be completing. The task can be introduced through pictures, videos, stories, etc., and stimulate students' interest.

Step 2: Task Preparation refers to before students complete the task, some preparatory work is carried out, such as vocabulary learning, grammar explanation, language modeling training, and so on. This helps students understand and complete the task better.

Step 3: Task execution refers to students doing practical work according to the task requirements, such as carrying out dialogues, writing, discussions, speeches, etc. Teachers can provide necessary support and guidance. Teachers can provide necessary support, guidance, and feedback to help students complete the tasks.

Step 4: Task reflection refers to students reflecting on the task after completing it, reviewing their performance, the difficulties they encountered, and what they have learned from the task. They can share their experiences and feelings and learn from them.

Step 5: Language summary refers to teachers conducting a language summary after the task is completed to help students extract and summarize the language knowledge and skills they have learned in the task. This can include vocabulary, sentence patterns, grammar rules, etc.

Step 6: Feedback Review refers to teachers providing feedback, pointing out students' strengths and areas for improvement, and helping them to correct their mistakes. At the same time, relevant revision is carried out to consolidate what students have learned in the task.

**Team-based learning**

The basic characteristics of Team-based learning are: emphasizing students' cooperation in learning and problem-solving in small groups. 1) The team must be permanent, appropriately formed, and managed; 2) Students must be responsible for their individual and collective work; 3) Students must have frequent and timely performance feedback; and 4) Group assignments must promote learning through application. (Harde, 2015).

Matalonga, et al (2017), Title of the article: Deploying Team-based Learning at undergraduate software engineering courses. 1) Individual study. Each Thematic unit starts with an assigned reading that students must complete outside the class.2) Individual test. The individual test or Readiness Assessment Test (RAT) consists of true/false or multiple-choice questions that evaluate the student's understanding of the readings. 3) Team test. The team test or Group Readiness Assessment Test (GRAT) consists of the same questions as the IRAT but is applied to groups (this time, students must take the questions with their groups. 4) Written appeals. Teams can submit written appeals to refute the answer to a question. Appeals must be evidence-based and students should fundament their argument with information extracted from the assigned reading. From a course design perspective, the feedback the instructor receives from appeals enables the continuous improvement of the assessment tests. 5) Instructor feedback. Instructor feedback should come immediately after the appeals and should focus only on challenging or weak aspects detected in the tests of the assigned readings. The instructor should tailor the feedback according to the evidence of team test results. 6) Application-oriented activities. These are team exercises that groups must complete to apply the acquired knowledge and guide them to higher levels of comprehension about the topics of the unit.

Burgess et al (2020), Title of the article: Team-based learning: design, facilitation, and participation.

Gomez, et al, (2010), Title of the article: Computer-supported Team-based learning: The impact of motivation, enjoyment and team contributions on learning outcomes. There is little to no lecturing with the instructor taking the role of a facilitator of teams that are formed at the start of the semester. In Team-based learning, a semester-long course is divided into 4–8 content-specific modules of 1–3 weeks in duration per module. Each module follows an iterative learning process that repeats a sequence of activities consisting of (1) individual preparation through out-of-class reading of the learning materials, (2) readiness assessments through individual and team tests, (3) application of course concepts through multiple team activities, and (4) an (optional) end of module test.



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The synthesized teaching steps of Team-based learning:

Step 1: Team Formation refers to Students being divided into teams, each team usually consisting of 4-6 students. Teams can be formed according to students' interests, backgrounds, or abilities, or grouped by the teacher.

Step 2: Pre-lesson Preparation refers to Students preparing for the lesson and preparing relevant learning materials and tasks before the lesson. Teachers can provide reading materials, videos, case studies, etc. to help students master basic concepts and knowledge.

Step 3: Team Discussion refers to Students discussing the materials prepared before class in small groups and sharing their understanding and opinions. They can ask questions, debate and explain to each other to promote deeper understanding.

Step 4: Team Exam refers to After the team discussion, students take a team exam, solving problems that require cooperation and application of knowledge. Team members rely on each other to complete the task.

Step 5: Teacher Feedback refers to the teacher providing timely feedback to assess students' team performance and individual performance, pointing out their strengths and areas for improvement. This helps students identify their problems and improve teamwork and learning skills.

Step 6: Concept Summarization refers to the teacher conducting a conceptual summary to help students sort out and summarize the core concepts and knowledge they have learned in the team discussions and team tests. They also answer students' questions and confusion. At the end of the lesson, a summary and assessment are conducted to allow students to review their gains and growth in collaborative team learning. The teacher can provide feedback and suggestions to help students improve.

Step 7: Application Exercises refer to Students engaging in application exercises that reinforce the knowledge and skills they have learned. This can be in the form of problem-solving, completing projects, and presenting demonstrations.

**Database design ability**

The general definition of database design refers to the construction (design) of an optimized database logic model and physical structure for a given application environment, and the establishment of a database and its application system based on this, so that it can effectively store and manage data and meet various requirements. Various user application requirements, including information management requirements and data operation requirements. In a broad sense, database design is the design of the database and its application system, that is, designing the entire database application system; in a narrow sense, it is the design of the database itself, that is, designing the schema of the database at all levels and establishing the database, which is part of the design of the database application system. The narrow definition of database design is that designing a good database is inseparable from designing a good database application system. A good database structure is the basis of the application system, especially in actual system development projects. The two are closely related. in parallel (Wang & Sa, 2023).

Information management requirements refer to what data objects should be stored and managed in the database; data operation requirements refer to what operations need to be performed on the data objects, such as querying, adding, deleting, changing, statistics, and other operations. The goal of database design is to provide users and various application systems with an information infrastructure and an efficient operating environment. An efficient operating environment means that the access efficiency of database data, the utilization rate of database storage space, and the efficiency of database system operation and management are all high (Wang & Sa, 2023).

## Conceptual Framework

In this study, the independent variables were Database system principles and applications courses based on Task-based learning and Team-based learning and the dependent variables were Students' database design ability and students' satisfaction. Figure 1 illustrates the conceptual framework of this study. Independent Variable Dependent Variables.



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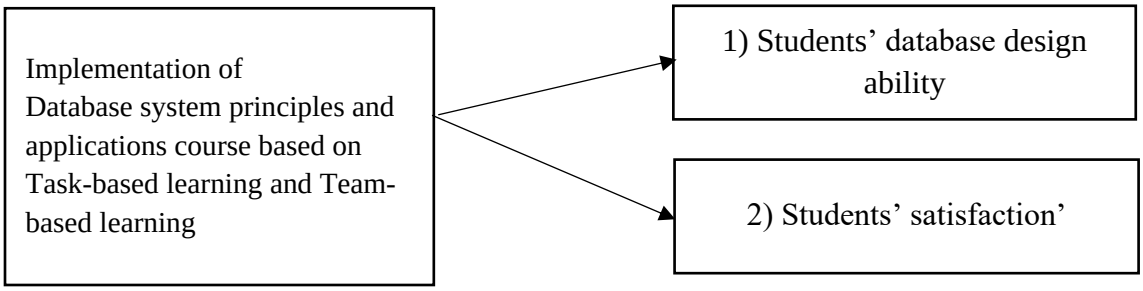


**Figure 1:** The figure of Research conceptual Framework

**Methodology**

**Phase 1: Study the background information focusing on current course components of Database system principles and applications course to enhance students' database design ability.**

Study-related literature on database system principles and applied courses and interview the teachers and students of related majors of the Fujian University of Technology.

**1. Target group**

1) 8 teachers teaching Database system principles and applications course at Fujian University of Technology. In this study, 4 teachers were derived by purposive sampling.

2) 90 students have learned the Database System Principles and Applications course. In this study, 20 students were derived by purposive sampling.

**2. Research instrument**

1) Interview form for teacher about course components and the problems existing in Database system principles and applications course. The interview form mainly includes 4 aspects: 1) Teaching objectives, 2) Teaching contents, 3) Teaching methods, and 4) Evaluation.

2) Interview form for students about course components and the problems existing in the database System Principles and Applications course. The interview form mainly includes 3 aspects: 1) Teaching methods, 2) Media and resources, and 3) Evaluation.

**3. Data analysis**

1) Interpret information from literature data through three methods: reading comprehension of data, data visualization, and content analysis.

2) Using a voice recorder and interview notes for data collection and analysis, summarizing the interview content. Using content analysis method to analyze and summarize the interview data.

**Phase 2 Developing Database system principles and applications course based on Task-based learning and Team-based learning to enhance students' database design ability.**

The task of this stage is to develop a Database system principles and applications course using Task-based learning and Team-based learning.

1. Developing Database system principles and applications courses based on Task-based learning and Team-based learning. This step aimed to develop the draft Courses according to the result from the first phase. The components of the draft curriculum consisted of 1）Principles 2）Objectives3）Contents, 4）Instructional strategy, 5) Media and Resources, and 6) Evaluation.

2. Determining the quality of developing database system principles and application courses based on Task-based learning and Team-based learning. This step aimed to determine the quality of the draft curriculum document before its implementation. The draft curriculum document was evaluated by five experts regarding the appropriateness and consistency of each component of the draft curriculum. Firstly, an appropriateness evaluation involves the appropriateness of each component of the draft course document. Secondly, consistency evaluation involves the internal consistency among the components of the draft curriculum document. Experts' recommendations were used to revise the curriculum document.

3. Constructing 8 lesson plans. Consider the overall structure and format of each lesson. Refer to the 6 Steps of Instructional Strategies in Chapter 1. 1) Team Formation, 2) Pre-lesson Preparation, 3) Team Discussion, 4) Team Exam, 5) Teacher Feedback, 6) Concept Summarization, 7) Application Exercises.

**1. Target group**



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5 experts. The informants consisted of 2 specialists in the curriculum field, 2 specialists in instruction relevant to specific content, and 1 specialist in the measurement and evaluation field.

**2. Research instrument**

1) Evaluation form of Database system principles and applications course based on Task-based learning and Team-based learning

2) Evaluation form of the appropriateness of lesson plans

**3. Data analysis**

The collected data were analyzed for the appropriateness of the curriculum document and lessons.

**Phase 3 Determine the effectiveness of implementing the Database system principles and applications course based on Task-based learning and Team-based learning to enhance students' database design ability**.

**1. Population and sample**

The population: Second-year students majoring in the Internet of Things Engineering in the academic year 2023-2024 of Fujian University of Technology, People's Republic of China was 90 students.

The sample: Second-year students majoring in Internet of Things Engineering in the academic year 2023-2024 at Fujian University of Technology, People's Republic of China, consisted of 30 students from one classroom, derived through cluster random sampling.

**2. Research Instruments**

Research instruments were the tools for collecting data. The research instruments which were used in This study aimed to:

2.1 Database system principles and applications course based on Task-based learning and Team-based learning from phase 2.

2.2 8 lesson plans from phase 2.

2.3 Test for assessing knowledge of database is used to assess students' theoretical knowledge of database system principles. The test consists of multiple sections covering all levels from the basics to advanced concepts: multiple choice questions test students' understanding and application of basic database concepts, data models, database management systems, data structures, and query languages. These test questions are rigorously tested for content validity to ensure that each question is closely related to the learning objectives. The index of Item Objective Congruence (IOC) value of the knowledge test was 0.80 at the lowest and 1.00 at the highest. The result of analyzing the IOC value showed that all test items were appropriate and could be used in the test. The knowledge test difficulty (p) was between 0.24-0.79, and item discriminability (r) should range from 0.24-0.95 and more than 0.20. The test paper reliability is 0.708 and more than 0.7 (Richardson & Kuder, 1939).

2.4 Evaluation for assessing skills of the database is designed specifically to assess students' technical competence in practical database design projects. The assessment focuses on the conceptual, logical, and physical design phases: Conceptual design assessment: assesses the student's understanding of the project requirements and initial design skills, including the definition of project objectives and requirements and the construction of a preliminary data model. Logical Design Assessment: Tests students' logical application of the database structuring process, involving database normalization, data integrity, and security measures. Physical design assessment: tests students on the technical details of implementing a database design, including performance optimization, scalability, and maintainability assessments. Each design phase measures student skills through specific marking criteria to ensure the objectivity and accuracy of the assessment results. These test questions are rigorously tested for content validity to ensure that each question is closely related to the learning objectives. The index of Item Objective Congruence (IOC) value of the skill test was 0.80 at the lowest and 1.00 at the highest. The result of analyzing the IOC value showed that all test items were appropriate and could be used in the test. The test paper reliability is 0.708 and more than 0.7.

2.5 Satisfaction questionnaire A questionnaire was developed to collect students' opinions on teaching methods, course content, learning activities, and materials. The questionnaire consisted of quantitative rating items and open-ended questions that were used to gain insight into student satisfaction and feedback. The questionnaire is provided to 5 experts for content validity check and suggestions. The quality of the questionnaire is considered according to the Index of Item Objective Congruence (IOC) obtained from the achievement test evaluation form. The IOC of each item of the satisfaction questionnaire was between 0.80-1.00. The Cronbach's Alpha coefficient of the reliability of the student satisfaction



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questionnaire is 0.897, which is greater than 0.70 (Cronbach, 1951). This showed that the internal consistency of the student satisfaction questionnaire met the requirements.

**3. Data collection**

The curriculum was implemented to the samples in the semester of the 2023-2024 academic year. The procedures of data collection during the curriculum implementation process were as follows:

3.1 The samples that were assigned as experimental groups were taught by using Database system principles and applications courses based on Task-based learning and Team-based learning. This group was taught through 8 Lesson plans.

During instruction through the curriculum implementation process, the researcher observed and recorded data including the teaching process, learning process, classroom atmosphere, students' behavior, and teacher's behavior that occurred in the classroom.

3.2 The samples were given the Evaluation form of database design ability and Learning achievement test, collecting score

3.3 The samples were given the students' satisfaction questionnaire to express their opinions toward the course.

**4. Data analysis**

In this study, quantitative data were analyzed by using the statistical program in line with the research objectives

4.1 Statistics used to determine the different significance at .05 level of scores on the student's database design ability after implementing through Database system principles and applications course based on Task-based learning and Team-based learning by using one sample t-test.

4.2 Statistics used to assess the student's satisfaction toward Database system principles and applications course based on Task-based learning and Team-based learning by using arithmetic mean and standard deviation and one sample t-test.

Moreover, qualitative data were analyzed and interpreted by content analysis and interpretation through the inductive method.

## Results

**Phase 1: Study the background information focusing on current course components of Database system principles and applications course to enhance students' database design ability.**

The researcher reviewed the literature about the Database System Principles and Applications course and interviewed 4 teachers and 20 students for problems of the Database System Principles and Applications course, and the information gathered was used to develop the course. The database system principles and applications course in undergraduate education faces problems such as the disconnection between theory and practice, the lag in updating course content, and the single teaching method. These challenges emphasize the urgent need for a comprehensive reform of the course content, teaching methods, and assessment system to enhance students' practical skills and their ability to adapt to the rapidly changing technological environment.

**Phase 2 Developing Database system principles and applications course based on Task-based learning and Team-based learning to enhance students' database design ability.**

The draft course document consists of six components: 1) Principles 2) Objectives 3) Contents, 4) Instructional strategy, 5) Media and Resources, and 6) Evaluation. The summary of each component was as follows:

1) Principles

Identify the instructional objectives and learning outcomes of the course, which should be clear and consistent with the course objectives. Review the basic concepts and principles of database systems, including data models, database management systems, data structures, and query languages. Examine the basic principles of database design and normalization, as well as database security and integrity

The use of Task-based learning and Team-based learning allows students to work independently, form teams for discussion, and provide timely and accurate help to each other when learners encounter difficulties so that they can complete learning tasks more efficiently and practically.

2) Objectives



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Refine the course objectives and clarify their relevance. To develop students' database design and management skills and improve their practical application skills in the database field.

3) Contents

Organizes course content in a modular fashion to ensure that it follows a logical sequence and gradually introduces more complex and advanced concepts and techniques. It Covers database design principles, relational database management system concepts and applications, SQL query language, storage and indexing techniques, data security, and data warehousing. Lectures are accompanied by relevant case studies.

4) Instructional Strategy

A variety of teaching methods, including classroom lectures, Task-based learning, and Team-based learning.

Step 1: Team Formation refers to students being divided into small groups, each consisting of 5 people.

Step 2: Task Preparation refers to students' preview and preparation of relevant learning materials and tasks according to the assigned task book.

Step 3: Task Execution refers to students carrying out practical operations according to the task requirements.

Step 4: Team Discussion and reflection refers to the process of performing the task and after the task is completed, members discuss and communicate with each other, reflecting on the problems encountered in the process of completing the task and the shortcomings in dealing with the problems and results of completing the task.

Step 5: Summary and Feedback refers to student's knowledge, students' completion of the task, and a summary, at the same time the teacher gives some feedback on the completion of the situation to students.

Step 6: Evaluation refers to Teachers evaluating the results of the task, determining whether students complete the task, through the assessment method, and at the same time teacher helps students refine and summarize their knowledge and skills.

5) Media and Resources

Teaching materials, courseware, lab instructions and case studies, multimedia resources, online learning platforms, and lab resources are available.

6) Evaluation.

Design diverse learning assessment methods, assignments, project evaluations, and paper tests to assess students' understanding and mastery. Provide timely feedback and guidance to help students identify and correct errors and explore and consolidate the application of database systems.

The findings of the course document evaluation by experts. This step aimed to determine the quality of the draft course document before its implementation. The draft course document was evaluated by experts regarding the appropriateness and consistency of each component of the draft course. The findings of the course evaluation which were collected and analyzed were presented in Table 1 as follows:

**Table 1**: The findings of the course evaluation by experts

| No | Items | *M* | *SD* | Level |
|---|---|---|---|---|
| 1 | **Principle**<br>The principle of the course is appropriate for implement | 5.00 | 0.00 | Very high level |
| 2 | **Objective**<br>Improvement of database design capabilities | 4.80 | 0.45 | Very high level |
| 3 | **Content**<br>The course contents are appropriate for the goal of the course | 5.00 | 0.00 | Very high level |
| | The scope and sequence of course contents are appropriate for students' learning | 4.80 | 0.45 | Very high level |
| | Time allocation in each content topic is appropriate for students' learning | 4.80 | 0.45 | Very high level |
| 4 | **Instructional strategy**<br>Step1: Team Formation | 4.80 | 0.45 | Very high level |
| | Step2: Task Preparation | 5.00 | 0.00 | Very high level |



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| No | Items | *M* | *SD* | Level |
|---|---|---|---|---|
| | Step3: Task Execution | 5.00 | 0.00 | Very high level |
| | Step4: Team Discussion and reflection | 5.00 | 0.00 | Very high level |
| | Step5: Summary and Feedback | 5.00 | 0.00 | Very high level |
| | Step6: Evaluation refers to Teachers evaluating the | 4.60 | 0.55 | Very high level |
| 5 | **Media and resources**<br>The learning materials are appropriate for the teaching-learning processes | 5.00 | 0.00 | Very high level |
| 6 | **Assessment**<br>The Evaluation form of database design ability | 4.80 | 0.45 | Very high level |
| | Learning achievement test | 4.60 | 0.55 | Very high level |
| | **Total/Overall** | 4.87 | 0.24 | Very high level |

As presented in Table 1, it was revealed that the experts evaluated course development overall at a very high level with an *M* of 4.87, and *SD* of 0.24, which is statistically significant and allows for the use of the draft curriculum. If the mean scores of the appropriateness evaluated by a group of experts were higher than 3.51, the draft curriculum document was appropriate.

The findings of lesson plans according to Database system principles and applications course based on Task-based learning and Team-based learning which were collected and analyzed by arithmetic means and standard deviation were presented in the table below. This procedure aimed to determine the quality of the lesson plans before their implementation.

**Table 2**: The findings of lesson plan evaluation by experts

| No | Items | *M* | *SD* | Level |
|---|---|---|---|---|
| 1 | Lesson plan 1 | 4.89 | 0.21 | Very high level |
| 2 | Lesson plan 2 | 4.87 | 0.23 | Very high level |
| 3 | Lesson plan 3 | 4.90 | 0.20 | Very high level |
| 4 | Lesson plan 4 | 4.87 | 0.26 | Very high level |
| 5 | Lesson plan 5 | 4.83 | 0.28 | Very high level |
| 6 | Lesson plan 6 | 4.89 | 0.23 | Very high level |
| 7 | Lesson plan 7 | 4.89 | 0.26 | Very high level |
| 8 | Lesson plan 8 | 4.90 | 0.17 | Very high level |

As presented in Table 2, it was revealed that the experts evaluated lesson plans overall at a very high level, which was statistically significant, therefore, the quality of lesson plans was very high level and the lesson plans can be used. If the mean scores of the appropriateness evaluated by a group of experts were higher than 3.51, the mean of the draft curriculum document was appropriate.

**Phase 3 Determine the effectiveness of implementing the Database system principles and applications course based on Task-based learning and Team-based learning to enhance students' database design ability**.

The findings of the comparison of students' database design ability by using arithmetic mean and standard deviation and one sample t-test were presented in the below table. This table aimed to answer the research objective about whether Database system principles and applications courses based on Task-based Learning and Team-based Learning were able to enhance database design abilities. Database design ability refers to the knowledge and skills.



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**Table 3 The** finding comparing the different scores of Students' database design ability (Knowledge) by using learning achievement tests implemented through Database system principles and applications course based on Task-based learning and Team-based learning

| Group | n | Full score | Criteria score | *M* | *SD* | *t* | *p* |
|---|---|---|---|---|---|---|---|
| Experimental group | 30 | 40 | 28 | 31.33 | 3.763 | 4.85** | 0.000 |

** $p<0.01$

As presented in Table 7 after implementing through Database system principles and applications course based on Task-based learning and Team-based learning, the students' database design ability (Knowledge) was higher than the determined criterion of 70% at a significance level of .05 ($M$ = 31.33, $SD$ = 3.76, $t$ = 4.825, $p$ = .000).

**Table 4:** The finding comparing the different scores of Students' database design ability (Skills) after implementing Database system principles and applications course based on Task-based learning and Team-based learning with the criteria set at 70%

| Group | n | Full score | Criteria score | *M* | *SD* | *t* | *p* |
|---|---|---|---|---|---|---|---|
| Experimental group | 30 | 60 | 42 | 45.120 | 2.890 | 5.91** | 0.000 |

** $p<0.01$

As presented in Table 8, after implementing through Database system principles and applications course based on Task-based learning and Team-based learning, the students' database design ability (Skills) was higher than the determined criterion of 70% at a significance level of .05 ($M$ = 45.12 out of 60, $SD$ = 2.89, $t$ = 5.913, $p$ = .000).

The findings of a comparison of students' satisfaction after learning through the database System Principles and Applications course based on Task-based Learning and Team-based Learning with the criteria set at 3.51 scores which were analyzed by using a t-test for one sample were presented in the below table. This table aimed to answer the research objective about whether students are satisfied after learning through Database system principles and applications courses based on Task-based Learning and Team-based Learning.

**Table 5 The** finding comparing the different scores of students' satisfaction after learning through the Database system Principles and applications course based on Task-based Learning and Team-based Learning with the criteria set at 3.51 score

| Group | n | Full score | Criteria score | *M* | *SD* | *t* | *p* |
|---|---|---|---|---|---|---|---|
| Experimental group | 30 | 5 | 3.51 | 4.482 | 0.322 | 16.52** | 0.000 |

** $p<0.01$

As presented in Table 9, the mean scores of students' satisfaction after learning through database System principles and applications course based on Task-based Learning and Team-based Learning was 4.482 from a possible full mark of 5 and the standard deviation was 0.322 which was statistically higher than the criterion of 70% at .05 level of statistical significance ($t$ = 16.527, $p$ = .000).

## Discussion

This study aims to improve the database design skills of information technology students at Fujian Engineering College by implementing Task-based learning and Team-based learning teaching models. The results of the study showed that students showed significant improvement in both theoretical knowledge and practical skills, which is consistent with the positive impact of Task-based learning and Team-based



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learning on improving students' professional skills in other studies. In addition, the successful implementation of the team project also shows that students' teamwork and problem-solving abilities can be effectively enhanced by collaborating on specific tasks. Some of the challenges of reform in the teaching and learning model are also indicated in the study, including how to effectively organize and manage team projects and how to ensure that all students are actively involved in team activities. In addition, the study should also assess students' acceptance and satisfaction with the new teaching model, as this has a direct impact on the continued implementation and improvement of the teaching model.

Database education is essential for national computer exams and effective data management across sectors, but non-computer majors face challenges like low motivation and weak skills. Reforms in teaching methods, content, and curriculum are necessary to improve the quality of database courses in undergraduate institutions. These reforms aim to stimulate student interest, enhance critical thinking, and align education with evolving technology. Scholars advocate for a holistic approach to teaching, combining practical experience, mentorship, and research integration. (Qiu, 2011; Qian, 2012; Huang & Fang, 2014)

Applied undergraduate education serves as a pivotal response to the evolving demands of modern economic and social development, emphasizing the cultivation of application-oriented professionals to address industry needs. Liu and Wang (2020) highlight its role in meeting talent demands and advancing higher education accessibility. Embracing pedagogical frameworks such as Task-Based Learning and Team-Based Learning, educators aim to bridge the gap between classroom learning and real-world application. Willis (1996) underscores the effectiveness of such approaches in enabling learners to apply knowledge and skills in authentic contexts. Tao Xingzhi's advocacy for the unity of teaching and practice accentuates the importance of practical skill development in education, aligning with constructivist learning principles that emphasize learners' active construction of knowledge. In this learner-centric paradigm, educators act as facilitators, guiding learners in tasks and group activities to foster independent thinking and engagement, as posited by Doyle (2023). This learner-centric approach aims to nurture intrinsic motivation and effective learning habits among students.

The implementation of Task-Based Learning and Team-Based Learning in database education presents a paradigm shift toward student-centered pedagogy, emphasizing collaboration, active participation, and problem-solving. Wang (2018) highlights Team-Based Learning's focus on shifting the teacher's role from knowledge transfer to mentorship, enhancing learning efficiency and database design skills. Similarly, Harde (2015) underscores the student-centered design of Team-Based Learning, promoting collaboration and providing opportunities for critical thinking and skill development. By integrating theoretical knowledge with practical tasks, Task-Based Learning and Team-Based Learning foster a deeper understanding of database concepts and enhance mastery through hands-on experience.

Furthermore, course reform anchored in innovative teaching modes like Task-Based Learning and Team-Based Learning not only enhances student interest but also cultivates essential skills such as communication, teamwork, and problem-solving. Students become active participants in their learning journey, engaging in practical database design tasks that stimulate motivation and improve learning outcomes. This practice-oriented approach not only hones technical skills but also nurtures vital soft skills crucial for effective database design. Thus, the integration of Task-Based Learning and Team-Based Learning facilitates a holistic approach to education, bridging the gap between theory and practice while fostering comprehensive skill development among students.

## Conclusion

This study confirms the effectiveness of the teaching model based on task-oriented learning and team-oriented learning in enhancing students' database design skills. The enhancement of performance through theoretical tests and practical projects confirms that this teaching mode can effectively combine theoretical knowledge and practical operations to enhance students' vocational skills. Meanwhile, the successful implementation of the teamwork project strengthened students' communication and collaboration skills. Future research could further explore how different teaching methods and tools affect student learning outcomes and the applicability of these methods in other disciplines and settings. Consideration should also be given to how technological tools and platforms, such as online collaboration tools and virtual reality (VR) technology, can be utilized to further enhance the interactivity and practicability of the teaching and learning model. Through continuous improvement of teaching strategies and tools, we can



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better prepare students for the rapidly changing technological environment and enable them to succeed in their future careers. This not only helps to improve the quality of education but also provides a useful reference for higher education in the development of applied technology talents.

## Recommendation

### Recommendation for implication

1) It provides a basis for the innovation and reform of the education mode of the course and adopts different methods to construct more novel and effective teaching methods, which is of great significance to the reform of the curriculum of applied undergraduate education.

2) Teachers use task learning as the main teaching mode, supplemented by team learning, to stimulate students' enthusiasm for learning, improve learning efficiency, and improve the learning effect, which is of great practical significance to improve the learning effect and practical ability of college students. Utilizing the teaching models and methods in this paper can better assist educators in transitioning to a new teaching model better suited to the educational requirements and training program of applied undergraduate education.

3) Along with the study, I distributed anonymous questionnaires to investigate students' attitudes towards learning. The results showed that. The novel teaching mode stimulates students' interest in independent learning, improves students' initiative, innovation, and practical ability, and improves students' comprehensive quality, which not only effectively improves the learning effect, but also lays a good foundation for future practical work.

### Recommendation for further research

1) Analyze existing literature on database-based instruction, task-based learning, and team-based learning, focusing on successful case studies and their effects on student learning outcomes. Develop a theoretical framework based on constructivist and collaborative learning theories to guide research methodology and course design.

2) Utilize modern technologies like big data, VR, and online collaboration tools to enhance instructional design. Create task-based and team-based learning activities integrating key database design concepts. Explore how virtualized database environments can support these activities. For example, a large number of real data cases obtained from big data technologies can be added to the teaching case base for real use and design results comparison.

3) Design an empirical study to assess the impact of the instructional approach on student learning outcomes. Integrate research findings with case studies and best practices to offer practical guidance to educators. Establish feedback mechanisms for ongoing improvement of instructional design.

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