

Student perceptions of active learning management in a database systems course: A Thai university comparative study

 Kridsada Budsara¹,  Thanin Ratanaolarn^{2*},  Sirirat Petsangsri³

^{1,2,3}School of Industrial Education and Technology, King Mongkut's Institute of Technology Ladkrabang (KMITL), Bangkok, 10520, Thailand; kridsada.bu@kmitl.ac.th (K.B.) thanin.ra@kmitl.ac.th (T.R.) sirirat.pe@kmitl.ac.th (S.P.).

Abstract: This study investigated undergraduate students' perceptions of learning management in a Database Systems course and compared these perceptions between students with and without prior active learning experience. A questionnaire was administered to undergraduate students from the Faculty of Science at KMITL, selected via simple random sampling. The instrument demonstrated strong validity (IOC = 0.60-1.00) and reliability ($\alpha = 0.81-0.87$). Data were analyzed using descriptive statistics and an independent samples t-test. Overall perception of learning management was moderate. Course content received the highest mean score, followed by the instructor, while assessment and evaluation received the lowest. Students familiar with active learning perceived course content, learning processes, and the overall learning environment significantly more positively than those unfamiliar with active learning. Prior knowledge of active learning positively influences student perceptions, suggesting that readiness and mindset are essential for modern pedagogical approaches. Educators should explicitly introduce active learning principles at the course outset. Curriculum developers should reform assessment strategies to align with active learning principles and ensure practical, real-world examples are embedded in teaching methodology.

Keywords: *Active learning, Database systems course, Higher Education, Learning environment, Student perceptions, Thailand.*

1. Introduction

The Computer Science curriculum at KMITL is compatible with international standards, such as the ACM Computer Science Curricula 2023 [1]. Despite having a strong international-standard course plan, the Computer Science program is confronted with two major empirical issues concerning student quality, due to two national problems.

First, the Thai university admission system (TCAS) utilizes standardized tests, O-NET, GAT/PAT, and A-Levels. According to empirical data, Thai students consistently score relatively low in analytical subjects such as mathematics and science. One example of evidence is the Programme for International Student Assessment (PISA), which demonstrates the lack of higher-order thinking skills (HOTS) in Thai students [2]. According to the revised Bloom's taxonomy, HOTS relates to the analyzing, evaluating, and creating levels [3], which is extremely important in computer science.

Second, internal program management and input from industry partners, which is provided through the co-op education evaluation process, have identified specific skills that graduates require. It is common for employers to comment that new graduates lack analytical and problem-solving skills (PSS) required by the discipline of systems design, are inexperienced in using modern software development tools, and are often challenged to work as effective team members or to function effectively without supervision [4].

In order to overcome these difficulties and increase the competence of the graduates, the curriculum needs to be based on areas such as Artificial Intelligence (AI), Data Management (DM),

and Software Engineering (SE). One introductory course that supports all these areas is the Database Systems course. Knowledge of database system fundamentals is becoming increasingly important in the system development life cycle (SDLC) [5, 6]. Therefore, there is a dire need to improve the way the course is delivered, shifting from traditional lecturing to active learning. Active learning encourages student interaction, self-responsibility, and teamwork, thereby actively fostering the development of higher-order thinking and systematic problem-solving skills [7].

Therefore, to address this inconsistency between reports on Thai students' lack of higher-order thinking skills and the potential of active learning in promoting them [8], this study seeks to systematically explore the learning environment of the introductory *Database Systems Course 1*. The following research objectives (ROs) and research questions (RQs) guide the study:

RO1: Explore undergraduates' perceptions of the learning management of the Database Systems course.

RO2: To compare such perceptions between students with prior insight into active learning methods and those without prior awareness of them.

RQ1: At what level are the student perceptions regarding the content, learning process, assessment, instructor, and learner behavior in the Database Systems course?

RQ2: Is there a statistically significant difference in opinions regarding the learning environment between students who are familiar with active learning and those who are not?

The results of the study are expected to enable university instructors, curriculum developers, and educational administrators to gain evidence-based insights into specific areas of a course that require pedagogical development to enhance the learning experience, to make learning more effective and engaging, in order to improve the analytical and problem-solving skills of Thai computing graduates.

2. Literature Review

This review provides an overview of the existing literature as a theoretical basis for this study. Three key areas are addressed in this section: pedagogical challenges and evolution in the teaching of databases, the theoretical and empirical backgrounds of active learning in STEM (science, technology, engineering, and mathematics), and the roles of student perceptions in educational effectiveness.

2.1. Pedagogical Challenges and Evolution in Database Teaching

The database systems course strengthens the computer science curriculum as a key subject that develops the skills used to model, design, and manipulate data in a database [9, 10]. The importance of the subject has been highlighted with its central role in the System Development Life Cycle (SDLC) and contemporary areas such as Data Management (DM) and Artificial Intelligence (AI). Kumar et al. [1] in the ACM/IEEE Computer Science Curricula 2023, effective teaching of this subject continues to present challenges yet to be overcome.

One of the main difficulties is that key database concepts, such as relational theory, normalization, and transaction management, are abstract, and students find it difficult to see their connection to real-life applications [11, 12]. The situation may worsen when passive, lecture-based teaching is adopted. Consequently, students might acquire a superficial understanding of a concept or a technique and thus become unable to put their knowledge into practical use [13]. Another important factor is the misalignment of teaching and assessment. For example, though practical ideas may be introduced during classes, students are often expected to have grasped them through theoretical exams. Real competency is not assessed [14, 15].

To respond, the pedagogy of database education has come a long way. Studies have shown that traditional education methods can give way to effective alternatives. For example, project-based learning (PjBL), where students design and implement a complete database for a realistic application scenario, increases engagement and practical design capabilities by a significant amount [12]. Moreover, problem-based learning (PBL) presents learners with a complex, open-ended problem, helping them develop critical thinking and self-directed learning skills, which are central to database

design [12, 16]. Furthermore, the presentation of information also plays an important role in the effectiveness of pedagogy; Leitheiser and March [17] showed early on that the graphical representation of database structures has a substantial impact on the efficiency of learning using the classical Entity-Relationship model and the usability of the final graphical user interface. These active learning approaches, where students take center stage, move away from the traditional focus on knowledge transmission. Instead, they aim to develop competent graduates who can thrive in a work environment that demands more than just knowledge, creativity, and problem-solving ability [15].

2.2. Active Learning as a Paradigm for Modern STEM Education

The pedagogical evolution in database education rests within a broader push in STEM education toward active learning. While often treated as a monolith, active learning is best understood as a broad umbrella category of instructional techniques "that engage students in the process of learning through activities and/or discussion in class, as opposed to passively listening to an expert" [18]. These include approaches ranging from the simple (think-pair-share, peer instruction) to the complex (PBL, PjBL).

The evidence supporting active learning is substantial. A seminal meta-analysis [19] showed that average examination scores increased and achievement gaps shrank for underrepresented students in undergraduate STEM. Thus, active learning has powerful, equitable benefits. One of the underlying mechanisms reflects basal differences due to levels of cognitive and metacognitive engagement in learning. However, constructing a more detailed picture of the basis of the effectiveness of active learning requires a more nuanced understanding [20]. Active learning works not necessarily because it encourages physical activity, but because students authentically process information and engage in metacognitive practices that promote learning (e.g., knowledge construction, critical evaluation, etc.).

The theoretical bases for active learning are grounded in constructivism. Scaffolding is an important principle, characterized initially by Wood et al. [21] as the support from a tutor that enables students to achieve a given goal they could not achieve alone. Active learning provides guided tasks, formative feedback, and structured resources that are removed as the learner gains knowledge and confidence [22]. This is compatible with a competency-based approach, in that the emphasis is placed on ensuring the student can apply their learning within meaningful contexts: a common theme in contemporary curriculum design [1, 15].

2.3. Students' Perceptions, Readiness, and the Thai Context

The success or failure of any pedagogical innovation depends not only on what is being designed but also on how well it is received by students [23]. Students' perceptions of the learning environment, including content, pedagogy, assessment, and instructor quality, are important because they affect motivation, engagement, and learning outcomes [24]. A greater sense of ownership of learning and satisfaction with the learning process is often associated with a positive perception.

An important but sometimes neglected issue is student preparedness for pedagogical transformation. Students who are used to traditional, teacher-centered pedagogy can initially perceive active learning pedagogies as unstructured or overly demanding, which can lead to resistance to these pedagogies [25]. This is a salient issue in contexts where reforms are taking place to move to active learning pedagogies. In Thailand, national standardized testing such as PISA has revealed problems Thai students have with higher-order thinking skills [8]. Hence, a national agenda has introduced more student-centered approaches to school education. Fortunately, existing research suggests the potential of active learning pedagogies for meaningful learning [26].

2.4. Research Gap

This leaves an important research gap. While it is established that active learning methods benefit database education and that students' perceptions of active learning are important [27], no research investigates how students' prior knowledge and understanding of general principles of active learning

influence their perception of the learning environment for a particular course. Does a student with prior knowledge make them more likely to appreciate the content and processes involved in a course, even if the course implementation is only partial? This work hypothesizes that prior knowledge is a form of cognitive scaffolding, i.e., it scaffolds a student to be better prepared to engage in active-learning elements and thus appreciate such a course, as evidenced by a more positive perception of the learning environment for the course.

3. Methods

3.1. Research Design and Population

This study employed a survey research design, whose population consisted of 550 third- and fourth-year undergraduate students from the Departments of Computer Science, Applied Statistics, and Applied Mathematics in the Faculty of Science at KMITL, who had previously taken the Database Systems course in the 2024 academic year.

3.2. Sample Size and Sampling Technique

Yamane's formula [28] was used to determine sample size, resulting in 277 students. Simple random sampling was used to select participants from the list of students, stratified by academic year and department. Data collection yielded 226 complete responses, representing an 82% response rate. The distribution of the population and the actual sample is detailed in Table 1.

Table 1.
Population and Sample Distribution by Department and Academic Year.

Department	Class	Population	Target Sample	Actual Sample	Response Rate
Computer Science	3	118	36	34	95%
	4	140	43	33	77%
Subtotal		258	79	67	85%
Applied Statistics	3	243	74	68	92%
	4	182	55	38	69%
Subtotal		425	129	106	82%
Applied Mathematics	3	113	34	28	81%
	4	113	34	25	73%
Subtotal		226	68	53	77%
Total	3	474	144	130	90%
	4	435	133	96	72%
Grand Total		909	277	226	82%

3.3. Research Instrument

The research instrument was a questionnaire on students' perceptions of the learning management in the Database Systems course. It covered five aspects: 1) Content, 2) Learning Process or Teaching Methods, 3) Assessment and Evaluation, 4) Instructor, and 5) Learner and Learning Behavior. The questionnaire comprised 49 items using a 5-point rating scale (5 = Highest, 4 = High, 3 = Moderate, 2 = Low, 1 = Lowest).

The experts evaluated the developed model's quality using a five-point Likert scale. The interpretation of mean scores was based on the following predetermined range of scores: a mean score from 4.50 to 5.00 indicated the highest level of quality; 3.50 to 4.49 signified a high level; 2.50 to 3.49 signified a moderate level; 1.50 to 2.49 signified a low level; and a mean score from 1.00 to 1.49 indicated the lowest level [29].

The instrument was validated by a panel of experts, yielding an Index of Item-Objective Congruence (IOC) between 0.60 and 1.00 for all items. A pilot test demonstrated high reliability, with Cronbach's alpha coefficients ranging from 0.81 to 0.87 for each aspect.

3.4. Data Collection and Analysis

Data were collected during January and February 2025 using online (Google Form) and onsite (paper-based) methods. Data analysis was performed using descriptive statistics (frequency, mean, and standard deviation) and an independent samples t-test to compare the perceptions of students familiar with active learning against those not.

4. Results

4.1. Respondents' Characteristics

The majority of the 226 respondents were male (50.88%). Most had a GPA between 2.50 and 3.00 (42.48%). A slight majority (55.31%) reported no prior knowledge of 21st-century learning skills and innovation, while 55.31% reported prior knowledge of active learning methods (Table 2).

Table 2.
General Characteristics of the Student Respondents.

Characteristic	Category	Frequency	%
Gender	Male	115	50.88%
	Female	111	49.12%
GPA	< 2.50	55	24.34%
	2.50 - 3.00	96	42.48%
	> 3.00	75	33.19%
21st-century skill awareness	Yes	101	44.69%
	No	125	55.31%
Active learning awareness	Yes	125	55.31%
	No	101	44.69%

4.2. Overall Perceptions of the Learning Environment

As shown in Table 3, the overall perception of active learning management in the Database Systems course was moderate ($M=3.36$, $SD=0.52$). Among the five aspects, *content* received the highest mean score ($M=3.49$, $SD=0.62$), followed by *instructor* ($M=3.45$, $SD=0.76$). *Assessment and evaluation* ($M=3.04$, $SD=0.68$) had the lowest mean score.

Table 3.
Student Perceptions of the ALM Environment.

Aspect	M	SD	Int.	Rank
Course Content	3.49	0.62	Mod.	1
Learning Process / Teaching Methods	3.40	0.62	Mod.	4
Assessment and Evaluation	3.04	0.68	Mod.	5
Instructor	3.45	0.76	Mod.	2
Learner and Learning Behavior	3.41	0.58	Mod.	3
Overall	3.36	0.52	Mod.	

Note: M = mean, SD = standard deviation, INT. = interpretation.

4.3. Comparison of Perceptions Based on Awareness of Active Learning Management (ALM)

An independent samples t-test was conducted to compare the perceptions of students who were aware of active learning ($n=125$) and those who were not aware of active learning ($n=101$). Table 4's results show statistically significant differences in three areas: content ($t=3.70$, $p<.01$), learning process ($t=1.82$, $p<.05$), and perception ($t=1.89$, $p<.05$). In all these areas, students familiar with active learning reported significantly more positive perceptions.

Table 4.
T-test Results Comparing Perceptions by Active Learning Awareness.

Aspect	Student perception of ALM				t-value	Sig.
	Not aware (n=101)		aware (n=125)			
	Mean	SD	Mean	SD		
Course Content	3.62	0.57	3.33	0.64	3.70**	0.00**
Learning Process / Teaching Methods	3.47	0.62	3.32	0.62	1.82*	0.04*
Assessment and Evaluation	3.05	0.68	3.03	0.69	.20	0.42
Instructor	3.49	0.76	3.40	0.76	.87	0.20
Learner and Learning Behavior	3.47	0.59	3.34	0.56	1.61	0.06
Overall	3.42	0.52	3.29	0.52	1.89*	0.03*

Note: ** $p < 0.01$, * $p < 0.05$, SD = standard deviation, Sig. = significance.

5. Discussion

This study aimed to explore students' evaluation of the learning environment in a database systems course and whether awareness of active learning before the class affected their evaluation of the learning environment. The study results supported the hypotheses and provided an actionable understanding of the course's strengths and weaknesses. The remainder of the section is organized around the five aspects of the learning environment and interprets the overall results with the help of the item-level results.

5.1. Course Content

Among the five learning environment aspects (Table 5), the aspect of Course Content received the highest mean rating ($M=3.49$). An examination of the item-level results provides a clear account of the observations: students strongly perceived the course content as highly relevant to them and beneficial for their future career plans. The means for items C1, C2, and C3 were in the range of "High": consistency with current teaching and the current ICT labor market ($M=3.67$), relevance to SDLC ($M=3.65$), and relevance to students' interests ($M=3.51$).

Table 5.
Student Perceptions of Course Content.

Item	M	SD	Int.
Appropriateness and alignment with the course description	3.50	0.77	High
Appropriateness and alignment with Active Learning methodologies	3.25	0.79	Mod.
Modernity, alignment with current technological and innovation advancements	3.41	0.91	Mod.
Alignment with the demands of the current ICT labor market	3.67	0.90	High
Matches the interests of the learners	3.51	0.90	High
Appropriateness for the students' level of knowledge and ability	3.43	0.82	Mod.
Demonstrates the importance and relation to the Software Development Life Cycle (SDLC)	3.65	0.92	High

Note: M = mean, SD = standard deviation, INT. = interpretation.

These results clearly validate the effectiveness of the current curriculum design. The delivered realignment between industry alignment and foundational basics, such as SDLC [5, 30], also has meaning to the students who clearly see the significance of this knowledge in the profession and roles they intend to pursue. However, an important caveat must be raised. The item "Appropriateness for Active Learning methodologies" only scores a modest response ($M=3.25$). This recasts how the result is understood, while what is in favor with students, the how (i.e., active learning implementation), is not as much. Students appear engaged with relevant material, but the level of active participation remains below its potential.

5.2. Learning Processes and Teaching Methods

The data on *Learning Processes* and Teaching Methods presents a picture of a course that successfully encourages higher-order thinking but may lack in providing concrete, practical scaffolding

(Table 6). Items related to cognitive engagement, such as "Stimulates systematic thinking" ($M=3.62$) and "Stimulates analytical thinking" ($M=3.59$), were rated highly. This is a positive sign, indicating that the instructional strategies are, to some degree, targeting the development of critical thinking skills often lacking in Thai graduates.

However, several items crucial for implementing active learning effectively scored in the moderate range, pointing to areas for improvement. The use of "group activities for collaborative learning" ($M=3.31$), "providing feedback to learners" ($M=3.27$), and most strikingly, "using real-world, practical examples and case studies" ($M=2.64$) were not perceived as strong points. The very low score on practical examples is particularly telling. While students are being asked to think, they may not be given enough authentic, hands-on problems to anchor that thinking, a core principle of PBL [12, 31]. This gap between being asked to think critically and being equipped with the practical tools and contexts to do so effectively can lead to student frustration and a moderate overall rating for this aspect.

Table 6.

Student Perceptions of ALM Processes and Teaching Methods.

Item	M	SD	Int.
The teaching plan emphasizes learning through problem-solving or system development tasks in class.	3.50	0.94	High
Stimulates analytical thinking through appropriate questions aligned with learning goals and course description.	3.59	0.94	High
Stimulates systematic thinking through appropriate questions aligned with learning goals and course description.	3.62	0.93	High
Teaching methods that stimulate by starting with problem identification (user needs), data collection, and problem assessment to enable self-learning of complex topics.	3.50	0.87	High
Teaching methods that encourage students to initiate problem-solving approaches, individually and in groups.	3.54	0.92	Mod.
Practice using ICT tools to solve problems	3.46	0.86	Mod.
Teaching through activities that allow students to practice analytical thinking and problem-solving skills.	3.22	0.99	Mod.
Teaching through group activities that allow students to study and learn collaboratively during class.	3.31	0.86	Mod.
Providing feedback to learners, e.g., checking homework, announcing exam results	3.27	0.85	Mod.
Using examples or case studies relevant to the course content that can be practically applied	2.64	1.20	Mod.
Interaction between the instructor and students in the classroom	3.47	0.92	High
Interaction among students during learning	3.55	1.03	High

Note: M = mean, SD = standard deviation, INT. = interpretation.

5.3. Assessment and Evaluation

In keeping with the broader results, the domain of assessment and evaluation was the most poorly rated aspect. At the same time, the breakdown reveals a system that students see as traditional and largely deficient in formative and participative dimensions (Table 7). The lowest-rated item on the entire instrument was pre-testing of underpinning knowledge ($M=2.62$), which suggests that diagnostic assessment to inform teaching is not well embedded in practice. Items on student involvement in establishing assessment criteria ($M=2.82$) and appropriate timing of assessment throughout the course ($M=2.97$) also scored poorly.

Table 7.
Student Perceptions of Assessment and Evaluation.

Item	M	SD	Int.
Testing of students' foundational knowledge before instruction	2.62	0.99	Mod.
Fair assessment and evaluation, e.g., announcing grading criteria before exams	3.07	1.06	Mod.
Appropriate timing of assessment during the learning process, not focused only on midterm/final exams.	2.97	0.93	Mod.
Student involvement in setting assessment criteria	2.82	1.02	Mod.
Assessment that covers knowledge and application ability	3.07	0.83	Mod.
Assessment that covers analysis and synthesis of problems	3.21	0.85	Mod.
Assessment that covers creative project work	3.20	0.92	Mod.
Assessment that emphasizes individual or group student development	3.21	0.90	Mod.
An assessment that covers responsibility in the assigned group work	3.22	0.89	Mod.

Note. M = mean, SD = standard deviation, INT. = interpretation.

This pattern suggests that assessment is predominantly driven by high-stakes, summative exams (midterms and finals), with criteria set exclusively by the instructor. These traditional models of assessment oppose active learning principles, which stipulate frequent, formative feedback and shared ownership of the learning process among instructors and students [18]. Although items related to assessing analytical skills and creative projects scored slightly higher (low-moderate range), the overall picture suggests that assessment practices have not changed to reflect the intention to promote competency-based learning [1].

5.4. Instructor's Role

The instructor's role was perceived positively, specifically in interaction within the classroom. For instance, opportunities for students to ask questions in class ($M=3.81$), soliciting questions in class ($M=3.81$), and stimulating self-learning rather than spoon-feeding ($M=3.72$) were items rated highly. This indicates that the respective instructors are trying to move away from "chalk and talk" and have primarily created a positive interactive environment.

Nevertheless, there is a notable weakness in "*Availability for consultation outside of class*" ($M=3.11$). The instructor is a pivotal facilitator and mentor in an SCL approach, and a substantial amount of this must be done outside of stipulated class times [22]. A moderate score might imply an instructor resource limitation or a practice entrenched in historic times. It may not have evolved with the dynamics of an active learning setup.

Table 8.
Student Instructor Perceptions.

Item	M	SD	Int.
Teaching that considers students' prior knowledge	3.07	0.98	Mod.
Encouraging self-learning rather than being a direct knowledge transmitter	3.72	0.99	High
Providing opportunities for students to ask questions in class	3.81	1.00	High
Availability for consultation outside of class hours	3.11	1.19	Mod.
Creating motivation and positive attitudes toward learning	3.48	1.03	Mod.
Stimulating learning through appropriate questioning to encourage thinking, analysis, and conclusion	3.52	0.98	High

Note: M = mean, SD = standard deviation, INT. = interpretation.

5.5. Learner and Learning Behavior

These data describe a responsible student population, conscious of the career value of the course, albeit with room for inculcating certain self-regulating learning behaviors (Table 9). Responsibility-related items, such as "*Completing assigned work before class*" ($M=3.69$) and "*Responsibility in individual and group work*" ($M=3.70$, $M=3.72$), were strong, with students comprehending the significant importance of "*Understanding the benefits of the course for their future career*" ($M=3.73$).

However, proactive and self-directed learning behaviors were moderate. In particular, “*Reading or seeking knowledge before class*” ($M = 2.90$) received a low score. This reflects a common challenge in transitioning from passive to active learning models: students accustomed to teacher-centered classrooms are generally used to receiving information rather than discovering it independently, and therefore may not develop consistent habits of preparatory study that make active learning sessions more effective [25]. Similarly, moderate scores on items such as “*Ability to create a project*” ($M = 3.38$) and “*Comparing one’s own problem-solving methods with others*” ($M = 3.38$) suggest that, while students are engaged, they are still developing deeper metacognitive skills related to self-evaluation and knowledge construction.

Table 9.
Student Perceptions of Learners and Learning Behavior.

Item	M	SD	Int.
Knowledge and understanding of the context of assigned tasks	3.29	0.89	Mod.
Reading or seeking knowledge about upcoming topics before class	2.90	1.08	Mod.
Completing assigned work (homework) before class	3.69	0.97	High
Understanding the benefits of the Database Systems course for a future career	3.73	0.91	High
Responsibility for individually assigned work	3.70	0.92	High
Responsibility for group-assigned work	3.72	0.86	High
Systematic thinking processes to achieve goals	3.44	0.80	High
Regularly researching new knowledge about information technology	3.23	0.95	Mod.
Ability to compare one's problem-solving methods with the instructor's or peers'	3.38	0.92	Mod.
Ability to use mistakes to improve work	3.55	0.89	High
Ability to systematically analyze problems with multiple solution approaches	3.40	0.81	Mod.
Ability to synthesize overall work from sub-components	3.32	0.76	Mod.
Ability to create projects	3.38	0.81	Mod.
Participation in answering questions or expressing opinions during class	3.16	0.95	Mod.
Ability to explain or answer peers' questions about lessons	3.29	0.88	Mod.

Note: M = mean, SD = standard deviation, INT. = interpretation.

5.6. Synthesis Integration: Active Learning Effect Comprehension

This detailed information enriched the comparative analysis: the result that those students with active learning experience had more favorable impressions of the content, the process, and the overall environment than those without is now more precise. In short, students with active learning dispositions are more likely to accept the course's efforts at interactive teaching and critical thinking exercises, thanks to having a conceptual framework for them. They are more capable of understanding why they are expected to work in groups or do problem-solving, even if the effort is imperfect; thus, the content and ways of learning are more appreciated. Without knowledge of active learning, even the duplicate content is perceived as disorganized or unnecessarily challenging for students, resulting in a relatively negative impression. This emphasizes the importance of active learning, explicitly "selling" the idea of active learning to students, explaining its pedagogical logic and strengths.

The results are consistent with Thailand's higher education reform roadmap, particularly within the *National Education Plan (2023–2037)*, which prioritizes learner-centered pedagogy, critical thinking, and digital-age competencies [32]. These policy directions mirror the global framework of *Sustainable Development Goal 4 (SDG4)*, which calls for inclusive and quality education and the promotion of lifelong learning opportunities [33]. Our findings highlight that achieving these policy goals requires structural changes in teaching methods and systematic development of student readiness for new learning paradigms. Integrating active learning awareness into first-year orientation, teaching preparation programs, and curriculum policy would help bridge the gap between policy aspirations and classroom realities, contributing to Thailand's educational transformation and international benchmarks for quality and equity in STEM education.

6. Conclusion and Suggestions

This study concluded the following results:

- Students' perceptions of the learning management of the Database Systems course were moderate.
- Content aspect was the most positively perceived aspect by students, while assessment and evaluation were the most negatively perceived aspects needing improvement.
- Students with previous exposure to active learning techniques indicated much more positive perceptions of the course content, learning processes, and overall learning atmosphere than their peers who reported no such knowledge.

Based on those conclusions, the following recommendations are offered:

- For Instructors: Actively introduce the concept and benefits of active learning at the beginning of the course to shape students' expectations and promote a more positive attitude towards active learning among students.
- For Curriculum Development: The evaluation and assessment procedures adopted in the Database Systems course need immediate transformation, moving towards project-based assessments, portfolios, and practical assignments that reflect real work tasks. These methods are more suitable for the course's objectives, helping to reduce the mismatch and promote more positive student' perceptions.
- For institutional policy: More institutional strengthening of faculty development programs to train instructors in designing and implementing active learning, mainly focused on reconciling teaching to assessment alignment.

This study was limited because it focused on one university, so it may not be generalizable. Future research should sample students from multiple institutions and consider adopting mixed methods. Qualitative interviews exploring the reasons for students' perceptions should be conducted to better understand their perception scores.

Institutional Review Board Statement:

This research did not engage with vulnerable groups, collect identifiable personal information, or implement any intervention. Consequently, according to Thailand's *Guidelines for Conducting Human Subjects Research in Behavioral Science, Social Sciences, and Humanities* [34], the study was exempt from formal ethics review requirements.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

Acknowledgments:

The authors would like to thank Ajarn Charlie for his Thai-to-English translation and English language editing support of the manuscripts.

Copyright:

© 2025 by the authors. This article is an open-access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

References

- [1] A. N. Kumar *et al.*, *Computer science curricula 2023*. New York: ACM Press; IEEE Computer Society Press; AAAI Press, 2023.

- [2] S. Thomson, L. De Bortoli, C. Underwood, and M. Schmid, *PISA 2018: Reporting Australia's results, Volume I: Student performance*. Melbourne, Australia: Australian Council for Educational Research (ACER), 2019.
- [3] N. Zhao and Q. Fu, "Under the framework of deep learning cognitive theory and Bloom's Taxonomy: Investigating the role of artificial intelligence in fostering higher-order thinking in engineering education," in *2025 7th International Conference on Computer Science and Technologies in Education (CSTE)* (pp. 892-896). IEEE, 2025.
- [4] A. Mahmood, X. Huang, and N. Rehman, "STEM education as a catalyst for career aspirations and 21st-century competences: Insights from teachers' perspectives," *School Science and Mathematics*, 2025. <https://doi.org/10.1111/ssm.18381>
- [5] A. Naguib, H. K. Aslan, and K. M. Fouad, "Effective integration of database security tools into SDLC phases: A structured framework," *Journal of Cybersecurity & Information Management*, vol. 16, no. 1, pp. 176-207, 2025. <https://doi.org/10.54216/JCIM.160114>
- [6] E. Foster and J. B. Towle, *Software engineering: A methodical approach*. Boca Raton, FL, USA: Auerbach Publications, 2021.
- [7] D. Asok, A. Abirami, N. Angeline, and R. Lavanya, "Active learning environment for achieving higher-order thinking skills in engineering education," in *2016 IEEE 4th International Conference on MOOCs, Innovation and Technology in Education (MITE)* (pp. 47-53). IEEE, 2016.
- [8] P. Kwangmuang, S. Jarutkamolpong, W. Sangboonraung, and S. Daungtod, "The development of learning innovation to enhance higher order thinking skills for students in Thailand junior high schools," *Heliyon*, vol. 7, no. 6, p. e07309, 2021. <https://doi.org/10.1016/j.heliyon.2021.e07309>
- [9] R. Elmasri and S. B. Navathe, *Fundamentals of database systems*, 7th ed. London, U.K: Pearson, 2015.
- [10] A. Silberschatz, H. F. Korth, and S. Sudarshan, *Database system concepts*, 7th ed. New York, USA: McGraw-Hill Education, 2020.
- [11] C. J. Date, *An introduction to database systems*, 8th ed. Boston, MA, USA: Pearson/Addison Wesley, 2004.
- [12] P. Pimdee, A. Sukkamart, C. Nanth, T. Kantathanawat, and P. Leekitchwatana, "Enhancing Thai student-teacher problem-solving skills and academic achievement through a blended problem-based learning approach in online flipped classrooms," *Heliyon*, vol. 10, no. 7, p. e29172, 2024. <https://doi.org/10.1016/j.heliyon.2024.e29172>
- [13] A. Uzun, A. Onur, and S. Alabay, "Students' views on database management systems course designed according to problem-based learning," *International Journal of Evaluation and Research in Education*, vol. 9, no. 1, pp. 177-187, 2020. <http://doi.org/10.11591/ijere.v9i1.20501>
- [14] S. J. Doniyor o'g'li, "Problems and solutions to increase the efficiency of database teaching," *European Journal of Research and Reflection in Educational Sciences*, vol. 10, no. 2, pp. 9-15, 2022.
- [15] J. Saidov, A. Qudratov, S. Islikov, M. Normatova, and R. Monasipova, "Problems of competency approach in developing students' creativity qualities for creating a database," *Journal of Higher Education Theory & Practice*, vol. 23, no. 1, 2023. <https://doi.org/10.33423/jhetp.v23i1.5786>
- [16] J. H. Moust, H. V. Berkel, and H. G. Schmidt, "Signs of erosion: Reflections on three decades of problem-based learning at Maastricht University," *Higher Education*, vol. 50, pp. 665-683, 2005. <https://doi.org/10.1007/s10734-004-6371-z>
- [17] R. L. Leitheiser and S. T. March, "The influence of database structure representation on database system learning and use," *Journal of Management Information Systems*, vol. 12, no. 4, pp. 187-213, 1996. <https://doi.org/10.1080/07421222.1996.11518106>
- [18] E. J. Theobald *et al.*, "Active learning narrows achievement gaps for underrepresented students in undergraduate science, technology, engineering, and math," *Proceedings of the National Academy of Sciences*, vol. 117, no. 12, pp. 6476-6483, 2020. <https://doi.org/10.1073/pnas.1916903117>
- [19] J. Ishiyama, "What is the impact of in-class active learning techniques? A meta-analysis of the existing literature, APSA 2010 Annual Meeting Paper," 2020. https://papers.ssrn.com/Sol3/papers.cfm?abstract_id=1644146
- [20] D. Lombardi, T. F. Shipley, B. T. Astronomy Team, Chemistry Team, Engineering Team, Geography Team, Geoscience Team,, and P. Team, "The curious construct of active learning," *Psychological Science in the Public Interest*, vol. 22, no. 1, pp. 8-43, 2021. <https://doi.org/10.1177/1529100620973974>
- [21] D. Wood, J. S. Bruner, and G. Ross, "The role of tutoring in problem solving," *Journal of Child Psychology and Psychiatry*, vol. 17, no. 2, pp. 89-100, 1976. <https://doi.org/10.1111/j.1469-7610.1976.tb00381.x>
- [22] J. Van de Pol, M. Volman, and J. Beishuizen, "Scaffolding in teacher-student interaction: A decade of research," *Educational Psychology Review*, vol. 22, pp. 271-296, 2010. <https://doi.org/10.1007/s10648-010-9127-6>
- [23] T. Promsiri, "AI and the psychology of educational disruption: Historical patterns and cognitive implications," *Acta Psychologica*, vol. 260, p. 105637, 2025. <https://doi.org/10.1016/j.actpsy.2025.105637>
- [24] S. P. Fraser, "Pedagogical content knowledge (PCK): Exploring its usefulness for science lecturers in higher education," *Research in Science Education*, vol. 46, pp. 141-161, 2016. <https://doi.org/10.1007/s11165-014-9459-1>
- [25] J. Miller-Young, "Book review of teaching and learning STEM: A practical guide 2nd edition," *College Teaching*, vol. 73, no. 3, pp. 201-202, 2025. <https://doi.org/10.1080/87567555.2024.2386006>
- [26] L. Lu, S. S. Mustakim, and M. M. Muhamad, "The effectiveness of problem-based learning on students'creative thinking: A meta-analysis study," *Journal of Institutional Research South East Asia*, vol. 22, no. 3, p. 47, 2024.

- [27] B. Shebaro, "Using active learning strategies in teaching introductory database courses," *Journal of Computing Sciences in Colleges*, vol. 33, no. 4, pp. 28-36, 2018.
- [28] P. Pimdee, "Causal relationship model of Thai student energy conservation behaviour," *Journal of Sustainability Science and Management*, vol. 12, no. 2, pp. 218-227, 2017.
- [29] A. Sukkamart, P. Pimdee, P. Leekitchwatana, W. Kongpiboon, and T. Kantathanawat, "Predicting student-teacher self-directed learning using intrinsic and extrinsic factors: A Theory of Planned Behavior adoption," *Frontiers in Psychology*, vol. 14, p. 1211594, 2023. <https://doi.org/10.3389/fpsyg.2023.1211594>
- [30] I. Sommerville, *Software engineering*, 10th ed. Harlow, U.K: Pearson Education, 2015.
- [31] D. F. Wood, "Problem based learning," *Bmj*, vol. 326, no. 7384, pp. 328-330, 2003. <https://doi.org/10.1136/bmj.326.7384.328>
- [32] EC/OECD, "STIP compass Thailand overview," 2025. <https://stip.oecd.org/stip/interactive-dashboards/countries/Thailand>
- [33] M. Ortiz-Gómez, R. Melero-Bolaños, Y. Muñoz-Ocaña, and A. de los Ríos-Berjillos, "What does sustainable development goals knowledge contribute to? A longitudinal study of values and sustainable behaviour in university students," *International Journal of Sustainability in Higher Education*, 2025. <https://doi.org/10.1108/IJSHE-12-2023-0587>
- [34] P. Phuangsuwan, P. Limna, and S. Siripipatthanakul, "Ethics in the social sciences research," *Advance Knowledge for Executives*, vol. 3, no. 4, pp. 1-11, 2024.