A Comparative Study of Learning Achievement in the Database Management System Course Among High Vocational Certificate Students in the Digital Business Technology Program Using Cooperative Learning With the Jigsaw Technique

Tongchai Laboon
Phitsanulok Vocational College
Phitsanulok, Thailand
E-Mail: tongchailaboonplvc@gmail.com
Received 15 January 2025; revised 21 February 2025; accepted 22 February 2025

Abstract

The objective of this research article is to compare the learning achievement in the Database Management Systems course of the Higher Vocational Certificate Program in Digital Business Technology at Phitsanulok Vocational College. The study employs the Jigsaw cooperative learning technique and evaluates students' performance before and after learning. The sample for this study consists of the entire population of students enrolled in the Higher Vocational Certificate Program in Digital Business Technology at Phitsanulok Vocational College during the first semester of the 2023 academic year, totaling 65 students, divided into two groups. The research instruments include the Jigsaw cooperative learning technique, pre-

tests, post-tests, and an achievement test. Statistical methods used for data analysis include arithmetic mean ($\bar{X}$), standard deviation (S.D.), percentage, and t-test. The results indicated that students taught using the Jigsaw cooperative learning technique demonstrated significantly higher learning achievement in the Database Management Systems course compared to those taught using the traditional lecture method, with statistical significance at the 0.05 level.

Keywords: Learning achievement, Database Management Systems, Jigsaw cooperative learning technique

Introduction

In the 21st century, technological advancements have progressed rapidly, leading the global education sector to move beyond traditional teacher-centered models. Education is now rooted in technology, with new knowledge being discovered continuously. Teaching and learning methodologies must therefore evolve to align with these changes, ensuring continuous and effective learning. This shift supports the integration of modern technological media for research and study, promotes self-assessment, encourages interaction, and fosters skill development. Additionally, it emphasizes creating innovative learning materials through electronic media, such as online tutoring, enabling students to engage in self-directed learning. These approaches align with the Ministry of Education's policy to develop youth with technological skills who can collaborate and coexist peacefully in a global society (Ministry of Education, 2008, p. 5).

The National Education Act of 1999 (revised in 2002), Section 22, outlines the principles for educational management, emphasizing that all learners have the potential to learn and develop themselves and that students should be regarded as the most important component. Consequently, educators must shift their role from knowledge transmitters to facilitators who assist, support, and guide students in seeking knowledge from various sources and media. This transformation involves changing teaching methods to enhance the learning process. To thrive in society, individuals must know how to think critically, solve problems, and act appropriately. Therefore, the learning process should integrate technology and information resources effectively. Vicharn Panich (2013, p. 42) highlights that true learning stems from allowing students to learn based on their interests rather than strictly following teacher- or classroom-imposed curricula. Learning through technology or other teacher-assigned media should cater to each student's potential.

Contemporary education frequently integrates technology into various teaching and learning formats, such as Computer-Assisted Instruction (CAI), E-Learning, and Distance Learning. These methods operate under the belief in the current potential of technology to grant students access to abundant learning resources or the "World Knowledge." This approach opens the door to education beyond classroom walls, extending learning to those constrained by time, distance, or location (Chaiyos Ruangsuwan, 2013, p. 19). This aligns with the curriculum of the Office of the Vocational Education Commission for the 2020 Higher Vocational Certificate. The curriculum aims to provide learners with in-depth theoretical and technical knowledge within professional contexts and equip them with information

and communication technology skills for everyday life. It fosters awareness and active participation in addressing the nation's economic challenges, positioning graduates as essential contributors to production and service sectors (Office of the Vocational Education Commission, 2020, p. 2). These attributes are essential for all students to ensure successful performance outcomes.

Database management systems represent a critical skill for learning in this era, often referred to as the "information age." Information literacy is akin to lifelong learning, encompassing components such as information, the internet, and educational reform in a competitive society (Chutima Satchanun, 2007, p. 27-45). This aligns with Vicharn Panich (2012, p. 36), who notes that learning and innovation skills are central to 21st-century life skills. However, these skills must be complemented and supported by three additional competencies: information literacy, media literacy, and digital literacy.

In traditional classrooms, most teachers encourage students to engage in group learning. However, not all groups effectively support learning or enhance students' quality of life. Johnson et al. (1 9 9 8) categorized student learning groups into four types as follows:

1. Pseudo Learning Group: Students in this type of group are uninterested in group work and prefer to learn individually to outperform others. Their primary goal is to secure higher grades than their peers.

2. Traditional Classroom Learning Group: In this group, teachers assign students to work together on specific tasks. However, the collaboration is minimal, as most tasks are individually performed, and

assessments are conducted on an individual basis. Students in these groups are often unmotivated to assist one another in the learning process.

3. Cooperative Learning Group: This type involves students engaging in activities with clear learning goals. Each student takes responsibility for two key aspects: maximizing their own learning and ensuring that all group members achieve their learning objectives. Members recognize that their success depends on the success of the entire group, fostering full cooperation to enhance collective learning.

4. High-Performance Cooperative Learning Group: This group meets all criteria for effective cooperative learning and exceeds expectations. The primary distinction between cooperative learning groups and high-performance groups lies in the level of commitment among members. In high-performance groups, members demonstrate strong care and support for one another, resulting in improved learning outcomes, increased enjoyment, and overall academic success. Teachers should incorporate cooperative learning into their teaching practices and continuously refine methods to develop high-performance learning groups.

Research has shown that implementing cooperative learning methods, such as the Jigsaw technique, significantly improves student learning outcomes. This approach involves dividing students into groups with diverse abilities and gender representation. Teachers begin by presenting the lesson and assigning group tasks. Once all groups have a clear understanding of the lesson, a formative assessment is conducted individually without discussion. Individual scores are compared with baseline scores, and the group's average score is calculated. Groups with the highest scores receive certificates or rewards. This process is cyclical, encompassing lesson

presentations, worksheets, exercises, and formative assessments. Within this framework, group members must collaborate, complete tasks together, and resolve challenges collectively. The success of a group depends on the abilities of its members, with collaboration being the central element of learning. This teaching method fosters motivation, encouraging students to engage more actively in their studies.

In the first semester of the 2020 academic year, students enrolled in this course were at the Higher Vocational Certificate (HVC) level. The instructor developed assessments emphasizing both knowledge and comprehension. Each academic year, various teaching methods were employed to ensure that students understood the course content and met the required passing criteria. These methods included remedial teaching and peer-assisted learning groups. The goal was to adapt the instructional approach to suit the needs of students effectively. However, challenges arose with these methods:

1. Remedial Teaching: When students failed assessments for specific lessons, scheduling remedial sessions became problematic, especially as the instructor taught multiple classes with differing schedules. Additionally, students often showed reduced enthusiasm for hands-on practice, knowing they would have another chance to complete the tasks.

2. Peer-Assisted Learning Groups: Students were allowed to form their own groups, with the stipulation that each group include high-performing, average, and low-performing students. However, the grouping process was often imbalanced, leading to a lack of diversity in abilities.

The instructor clarified that the objective of group learning was to encourage stronger students to support weaker ones, fostering knowledge

sharing and unity within the group. Students were required to sit and work within their assigned groups. Despite these efforts, issues persisted, such as students forming groups with peers who shared similar attitudes or academic tendencies. For example, groups often consisted of students who were disengaged, habitually late, or academically weak. Consequently, weaker groups lacked academic support and struggled with tasks, while stronger groups worked quickly, leaving weaker students feeling demotivated and bored.

A study on cooperative learning by Natthapoom Jaratham (2015) explored the learning outcomes of first-year vocational students enrolled in Practical Skills *1* in the Automotive Department at Metro Technology College, Chiang Mai. The study employed the Jigsaw cooperative learning technique with 28 students. Findings indicated that the learning outcomes were significantly improved compared to before the instruction, supporting the hypothesis that the Jigsaw technique enhances academic performance. Building on this, the researcher expressed interest in applying the Jigsaw cooperative learning technique to improve students' academic performance. This method involves grouping students with varying intellectual and academic abilities into small groups, allowing them to collaborate, exchange ideas, and learn from one another's experiences and perspectives. This approach encourages students to understand the emotions, thoughts, and reasoning of their peers, ultimately fostering skills beneficial to their future careers. By emphasizing group success and shared benefits, the researcher aims to develop a teaching module based on the Jigsaw cooperative learning technique for the Database Management Systems course in the Digital Business Technology program at the HVC level during the first semester of

the 2023 academic year. The goal is to enhance students' academic performance significantly.

Research Objectives

The objectives of this research are as follows:

1. To enhance the academic performance of students in the Database Management Systems course, as part of the Higher Vocational Certificate program in Digital Business Technology at Phitsanulok Vocational College, through the implementation of the Jigsaw cooperative learning technique.

2. To compare the academic performance of students in the Database Management Systems course within the Higher Vocational Certificate program in Digital Business Technology at Phitsanulok Vocational College taught using the Jigsaw cooperative learning technique.

3. To compare the pre-learning and post-learning academic performance of students in the Database Management Systems course within the Higher Vocational Certificate program in Digital Business Technology at Phitsanulok Vocational College taught using the Jigsaw cooperative learning technique.

Research Scope

This research focuses on comparing learning outcomes using the cooperative learning method through the Jigsaw technique. The researcher reviewed documents, concepts, theories, and related studies on cooperative learning and the Jigsaw technique. The Jigsaw method, initially introduced by Aronson (1978, pp. 22-25), is based on the concept of assembling parts

into a complete picture. Each student studies only a specific part or subtopic of the overall content through materials or activities provided by the teacher. While studying their assigned subtopics, students work in groups with peers who are tasked with the same subtopic. They then prepare to return to their original group to explain or teach their part to other group members. The Jigsaw technique consists of three key components:

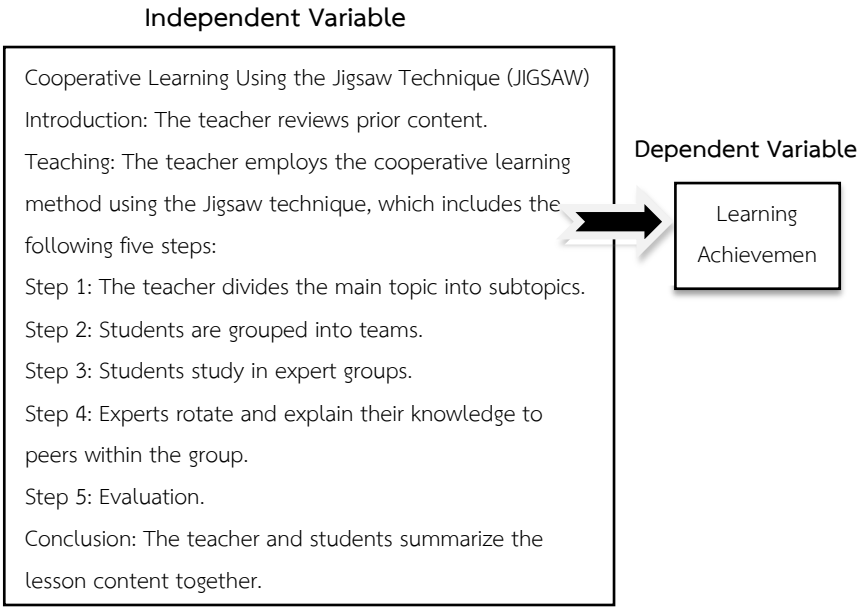
1. Preparation of Learning Materials: The teacher prepares worksheets for each group expert and develops formative assessments for each learning unit.

2. Group and Expert Group Formation: The teacher divides students into groups, ensuring each group has experts for different subtopics based on the worksheets. Each expert studies their assigned worksheet before joining the expert group to complete tasks based on the material. When students are ready for activities, tasks in expert groups may vary. The teacher encourages students to study their subtopics and prepare short presentations to share their knowledge with their original groups.

3. Reporting and Formative Testing: Once expert groups complete their tasks, each expert returns to their original group to explain their subtopic. The teacher encourages diverse presentation methods and facilitates discussions and problem-solving. Formative assessments are then conducted (Chaiwat Suthirat, 2009, p. 185).

These two cooperative learning methods help enhance various skills, including knowledge acquisition, social skills, and teamwork. They foster students' collaborative behaviors and increase motivation to achieve group success. This competitive yet cooperative environment encourages students to improve their learning, leading to higher academic

achievement.Based on these concepts, the researcher adapted the Jigsaw cooperative learning method to improve students' learning outcomes. The adapted teaching process consists of five steps: 1. Introduction. 2. Teaching 2.1. The teacher defines the learning objectives 2.2. The teacher organizes students into groups. 2.3. Students study in expert groups 2.4. Experts rotate and explain their knowledge to peers in their original groups 2.5. The teacher conducts evaluations. 3. Conclusion: The teacher and students summarize the lesson content collaboratively. The results from this cooperative learning approach are compared with those from the traditional lecture-based teaching method, which emphasizes content explanation. The traditional method follows a similar sequence of activities: 1.Introduction: Introducing the lesson. 2. Teaching: Delivering content explanations. 3. Conclusion: Summarizing the content.



Research Methodology

1. Population and Sample

Population: The population consists of Higher Vocational Certificate students in the Digital Business Technology program at Phitsanulok Vocational College, located in Mueang District, Phitsanulok Province. Each classroom includes students of mixed abilities, with a total of 65 students across three classrooms in the first semester of the 2023 academic year.

2. Research Design

This study employs a quasi-experimental design, involving a control group and an experimental group, with pre-test and post-test measurements.

X_1 Pretest	T Treatment	X_2 Posttest
Experimental Group (X_{a1})	Cooperative Learning Method: Jigsaw Technique (JIGSAW)	Experimental Group (X_{a2})

3. Research Instruments

The research instruments used in this study are divided into two categories: instruments for the experiment and instruments for data collection.

3.1 Instruments for the Experiment consists of the lesson plans

3.1.1 The lesson plans were developed for the course Database Management Systems and consist of nine plans. The content covered in these lesson plans is as follows:

3.1.2 Components of the Lesson Plans

1. Lesson topic
2. Key concepts

3. Learning content

4. Learning objectives

5. Teaching and learning activities

6. Instructional materials

7. Assessment and evaluation

8. Additional learning resources

9. Suggested activities

10. Post-lesson reflections

3.1.3 The lesson plans for the experimental group are designed based on the cooperative learning method using the Jigsaw technique (JIGSAW). The learning activities are organized as follows:

Step 1: The teacher divides the content into subtopics.

Step 2: Students are organized into mixed-ability groups called “Home Groups”.

Step 3: Students form "Expert Groups," where members from different Home Groups studying the same subtopic come together to review assigned materials.

Step 4: Each student returns to their Home Group and takes turns explaining their subtopic to the group. Discussions, clarifications, and reviews are conducted to ensure clear understanding.

Step 5: Knowledge testing. Each student takes an individual test, and the scores of all group members are combined to form the group’s score. The group with the highest score receives a reward.

3.1.4 Development of Lesson Plans Using the Cooperative Learning Method with the Jigsaw Technique (JIGSAW)

1. Review the 2020 Higher Vocational Certificate (HVC) curriculum issued by the Office of Vocational Education Commission to understand its concepts, principles, goals, and overall framework.

2. Research theories and concepts related to integrated learning and cooperative learning, specifically focusing on the Jigsaw technique.

3. Analyze the course description, standards, and objectives of the Database Management Systems course to integrate its content into the lesson plans effectively.

4. Create nine lesson plans using the Jigsaw cooperative learning technique.

5. The instructional plan utilizing the Jigsaw cooperative learning technique was completed and presented to five experts for evaluation. These experts specialized in different fields relevant to the study. Mrs. Anchaleeporn Laboon provided expertise in print media design, while Mr. Phumipat Wanphipatphong contributed knowledge in educational technology. Ms. Kornchanok Thapyotha, affiliated with Phitsanulok Vocational College, specialized in instructional design within educational institutions. Additionally, Ms. Wirunporn Kaewkla and Mr. Danucha Mueang-oon, both from Bueng Phra Commercial College, were experts in database management systems, with Mr. Danucha also specializing in computer networks.The experts' assessments were analyzed to determine the average satisfaction score, following the interpretation criteria based on John W. Best's conceptual framework.

6. Based on the experts' feedback, the evaluation results indicated that the lesson plans were rated at a "very good" level.

7. Implement the lesson plans with first-year HVC students in the Digital Business Technology program at Phitsanulok Vocational College during the first semester of the 2021 academic year. The pilot test aimed to verify the appropriateness of content, instructional time, and evaluation methods. Adjustments were made, including revisions to the end-of-lesson exercises to reinforce learning, adjustments to the duration of each unit to align with the content, and the development of parallel pre-test and post-test assessments.

8. Apply the revised lesson plans to HVC students during the 2022 academic year as the experimental group.

3.2 Instruments for Data Collection

The instruments for data collection include the following:

1. Pre-Test is a multiple-choice test with five options, covering nine units with a total of 90 questions, worth 90 points. This test is designed to evaluate students' prior knowledge before instruction.

2. Post-Test is a multiple-choice test with five options, covering nine units with a total of 90 questions, worth 90 points. This test assesses students' knowledge after instruction.

3. Achievement Test Includes both subjective tests and practical tests. There are four sets of tests, each worth 20 points, with a total score of 80 points. These tests are designed to measure students' academic achievement.

4. Development and Validation of Research Instruments

The development of research instruments for this study was conducted as follows:

4.1 Pre-test and Post-test

The pre-test and post-test were designed to assess students' knowledge before and after instruction. The development process included the following steps:

1. Studying documents, concepts, theories, and methods for creating pre-tests and post-tests.

2. Analyzing behavioral objectives and learning content.

3. Developing multiple-choice tests with five options.

4. Presenting the tests to five experts to ensure alignment with behavioral objectives.

5. Determining the consistency between the tests and behavioral objectives using the Index of Item-Objective Congruence (IOC), which yielded values ranging from 0.80 to 1.00 for all items.

6. Revising the tests based on expert feedback and finalizing them as five-option multiple-choice tests.

4.2 Achievement Test

The achievement test was developed to evaluate students' learning outcomes according to the course objectives. The process involved the following steps:

1. Studying documents, concepts, and theories on assessment and evaluation methods for developing achievement tests.

2. Analyzing the curriculum, determining learning content, and specifying behavioral objectives for each unit.

3. Designing the test as a combination of subjective questions and practical tests suitable for Higher Vocational Certificate (HVC) students.

4. Developing tests aligned with behavioral objectives for nine learning units, divided into four sets, with a total score of 80 points.

5. Presenting the tests to five experts to verify content validity and alignment with the curriculum and behavioral objectives.

6. Calculating the IOC based on expert evaluations, with all items achieving a value of 1.00.

7. Preparing the final test, including answer keys and scoring criteria for each item.

8. Pilot testing the achievement test with first-year HVC students in the Business Computer program at Phitsanulok Vocational College during the first semester of the 2021 academic year.

9. Analyzing students' scores to determine the difficulty index (p) for subjective and practical tests using C.A. Drake's method. A suitable difficulty index ranges from 0.20 to 0.80.

10. Analyzing the discrimination index (r) for subjective and practical tests using C.A. Drake's method. A suitable discrimination index ranges from 0.20 to 1.00. If the r-value is negative or less than 0, the test item needs revision or removal.

11. Calculating the reliability of the subjective and practical tests using Cronbach's alpha coefficient.

12. Implementing the validated achievement test with first-year HVC students in the Digital Business Technology program at Phitsanulok Vocational College.

5. Data Collection

Data collection for this research focused on comparing learning outcomes in the Database Management Systems course (Course Code

30204-2002) using the cooperative learning method with the Jigsaw technique versus the lecture-based learning method.

6. Data Analysis

6.1 Quality Analysis of Pre-Test, Post-Test, and Achievement Test consists of the following:

1. Index of Consistency (IOC):

The consistency of test items was analyzed using the IOC.

2. Difficulty and Discrimination Indices:

Test scores were analyzed for difficulty and discrimination indices using the method by C.A. Drake.

3. Reliability Analysis:

Test reliability was calculated using Cronbach's alpha coefficient, which is suitable for subjective tests. The formula used was the Alpha Coefficient (α) (Phannee Leekijwattana, 2011, p. 110).

6.2 Analysis of Learning Achievement

1. Mean ($\bar{X}$) and Standard Deviation (S.D.)
2. t-test

Research Results

The results of this research are as follow:

The study on the development of learning achievement in the Database Management Systems course for Higher Vocational Certificate students in the Digital Business Technology program at Phitsanulok Vocational College, using the Jigsaw cooperative learning technique, showed significant improvements in student performance.

The results revealed that students in Group 1, who underwent four assessments, achieved an overall learning achievement score of 81.25%. Their average scores increased progressively, starting from 14.00 in the first assessment and rising to 17.87 in the final test. Similarly, Group 2 attained an overall learning achievement score of 80.94%, with their scores improving from 13.25 to 18.50 over the four assessments. Group 3 recorded a total learning achievement score of 77.34%, with their average scores increasing from 12.25 in the first assessment to 17.75 in the last. These results indicate that all groups successfully met the required assessment criteria.

Furthermore, a comparison of pre-learning and post-learning achievement scores demonstrated a significant improvement after implementing the Jigsaw cooperative learning technique. The average pre-learning score was 3.72, while the post-learning score increased to 9.10. This improvement was found to be statistically significant at the 0.05 level, confirming the effectiveness of the learning approach in enhancing students' academic performance.

Discussion of Results

Based on the research results, the results can be discussed as follows :

1. Comparison of Learning Achievement in the Database Management Systems Course Using the Jigsaw Technique:

1. 1 The learning achievement of students taught using the cooperative learning method with the Jigsaw technique showed an increase in post-test scores across four assessments. The average scores were as follows: Test 1: 12.50, Test 2: 14.70, Test 3: 17.50, Test 4: 18.07.

These scores were out of a total of 20 points. The analysis revealed that post-test scores were significantly higher than pre-test scores at the 0.05 statistical significance level.

1.2 The students' post-test scores were consistently higher than their pre-test scores at the 0.05 statistical significance level, affirming the effectiveness of the Jigsaw technique in improving learning outcomes.

The cooperative learning approach emphasizes collaboration, interaction, and mutual assistance among students. Higher-performing students help their peers, fostering responsibility for the group's collective success. This aligns with the concept that the success of each member contributes to the overall success of the group (Sombat Kanjanarakphong, 2002, pp. 24–25).

This study also found that the cooperative learning method using the Jigsaw technique led to significantly higher post-test scores compared to pre-test scores, supporting the research hypothesis. The method incorporates engaging, appropriate media that enhances self-directed, flexible, and enjoyable learning. Students develop a sense of accomplishment, pride, and happiness, which positively impacts their learning experience. This finding is consistent with Kantarithai Chonlawit (2010, p. 76), who analyzed teaching strategies for happiness and learning skills in lower secondary students using the Jigsaw technique. The study reported high levels of happiness in learning.

Similarly, Sasivimon Suthisuwan (2018, p. 229) found that students using web-based lessons with guided graphic organizers and the Jigsaw technique had significantly higher post-test scores than pre-test scores at the 0.05 statistical significance level. The Jigsaw technique focuses

on student-centered activities, enabling learners to actively engage, take responsibility for assigned tasks, and exchange knowledge effectively within their groups. These activities include brainstorming, organizing ideas, and guided problem-solving, which develop critical thinking and content comprehension, ultimately improving post-test scores.

This result aligns with Hirunsub Piasena (2019, p. 159), who demonstrated that the Jigsaw technique promotes group collaboration, self-directed research, problem analysis, discipline in group work, and knowledge synthesis for group sharing. The structured teaching process ensured effective learning outcomes. Similarly, Manaswee Uttarapath (2017, p. 29) found that students taught using the Jigsaw technique achieved significantly higher learning outcomes than the 60% benchmark at the 0.05 statistical significance level. The method enhanced analytical thinking and problem-solving skills, contributing to improved academic performance. This aligns with the research by Manaswee Uttarapath (2017, p. 29), who studied the impact of the cooperative learning method using the Jigsaw technique on learning achievement. The results revealed that students taught using the Jigsaw technique achieved learning outcomes significantly higher than the 60% benchmark at the 0.05 statistical significance level. This improvement was attributed to the Jigsaw technique's ability to enhance students' analytical thinking skills and problem-solving abilities.

2. Comparison of Learning Achievement

The research results indicated differences in learning achievement between the cooperative learning method using the Jigsaw technique and the lecture-based learning method.

The analysis of pre-test and post-test scores between the experimental and control groups revealed that in the pre-test, both the experimental and control groups were tested on 9 units and in the post-test, the experimental group had a higher average score than the control group across all 9 units. This demonstrates that the learning achievement of the experimental group was significantly higher than that of the control group. These findings align with the research of Somyot Sitlawarang (2013), who studied the comparison of learning achievement in the course Computer Applications for Careers among first-year vocational students in the Business Computer program at Sukhothai Vocational College during the 2012 academic year. The study involved 64 students, comparing the Jigsaw cooperative learning method with the traditional teaching method. The results showed that students in the experimental group, who were taught using the Jigsaw technique, had higher post-test scores compared to the control group. Further analysis of the learning outcomes in the Database Management Systems course for students in the Digital Business Technology program during the first semester of the 2020 academic year involved grading students on an 8-level scale: 4, 3.5, 3, 2.5, 2, 1.5, 1, and 0. In the experimental group, which consisted of 84 students, 79 students (94.04%) achieved grades of 2 or higher. In comparison, the control group, with 65 students, had 54 students (83.07%) scoring 2 or above. These results clearly indicate that the experimental group, which was taught using the cooperative learning method with the Jigsaw technique, demonstrated significantly better learning outcomes than the control group.

The study concludes that the cooperative learning method using the Jigsaw technique is an effective instructional activity where the teacher

assigns group members to study specific portions of the content individually. Each group member is tasked with a distinct section of the material, working with members from other groups assigned to the same section. Once the material is thoroughly understood, they return to their original group to explain their section to the others in a structured sequence. One member of the group then summarizes all sections into a cohesive understanding. This classroom activity encourages collaborative success, where students are divided into groups and assigned parts of a topic to collectively assemble into a comprehensive body of knowledge, akin to completing a jigsaw puzzle. At the end of the learning process, teachers prepare tests to assess students' understanding of the lesson content.

Recommendations

1. Suggestions Based on This Research

1.1 Learning groups should be organized with the purpose of having higher-performing students assist their peers who may require additional support. This approach fosters knowledge sharing, unity within the classroom, and helps all students meet the required passing criteria.

1.2 The cooperative learning method using the Jigsaw technique not only improves academic achievement but also promotes social skills, leadership abilities, and a sense of mutual assistance among students.

1.3 Students should be involved in the group formation process. If the teacher assigns fixed groups, students may only work together for a limited number of sessions before reverting to their usual friend groups. During exams, they may study individually, which undermines the objectives

of the Jigsaw technique. Allowing students some freedom in forming their groups can enhance the effectiveness of this cooperative learning method.

The Jigsaw technique is particularly suitable for teaching the Database Management Systems course. It leads to higher learning achievement, helps students meet the academic standards set for the course, and ensures that all students successfully complete the curriculum.

2. Recommendations for Future Research

2.1 Instructors implementing any learning method must clearly explain the objectives and steps of the instructional process. This ensures that students understand the procedures and engage in the learning activities effectively.

2.2 Future research should develop instructional modules for the Database Management Systems course using the Jigsaw cooperative learning technique and compare its effectiveness with other teaching methods to identify the most effective practices.

References

Aronson, E. (1978*). The Jigsaw Classroom*. Sage.

Chonlawit, K. (2010). *An analysis of textbooks, learning happiness, and study skills for junior high school students* [Master's thesis, Chulalongkorn University]. Chulalongkorn University Intellectual Repository.

Jaratham, N. (2015). *A study of learning achievement in the Handicraft Work 1 course for vocational certificate students in the automotive mechanics department at Metro Technology College, Chiang Mai* [Unpublished research, Metro Technology Colleg].

Johnson, D. W., Johnson, R. T., & Holubec, E. J. (1998). *Advanced cooperative learning* (3rd ed.). Interaction Book Co.

Kanjanarakphong, S**.** (2002). *Teaching techniques for developing students' thinking skills.* Thanakorn Press.

Leekijwattana, P. (2011). *Educational research methods* (7th ed.). Mean Service Supply.

Ministry of Education. (2008). *The Basic Education Core Curriculum B.E. 2551 (A.D. 2008).* Kurusapa Ladphrao.

Office of the Vocational Education Commission. (2020). *Higher vocational certificate curriculum (HVC).* Retrieved May 30, 2023, from https://bsq.vec.go.th/หลักสูตร/ประกาศนียบัตรวิชาชีพชั้นสูง(ปวส)/หลักสูตรพศ2563.aspx

Panich, V. (2013). *Creating learning for the 21st century.* Siam Commercial Foundation Printing.

Piasena, H. (2019). *Development of Training Packages for Computer Skills Using Problem-Based Learning and Jigsaw Technique: Effects on Problem-Solving Ability, Self-Discipline, and Learning Achievement of Matthayom Suksa 2 Students* [Master's thesis, Sakon Nakhon Rajabhat University]. Sakon Nakhon Rajabhat University Electronic Thesis Database (E-Thesis).

Ruangsuwan, C. (1990). *Educational technology: Theory and research.* Odean Store.

Satchanun, C. (2007). Information literacy: Teaching and research. *Library Journal, 51*(2), 27–45.

Sitlawarang, S. (2013). *Cooperative learning using the Jigsaw technique versus traditional learning management for first-year vocational*

certificate students in the business computer program, academic year 2012, at Sukhothai Vocational College [Unpublished research, Sukhothai Vocational College].

Suthirat, C. (2009). *80 innovations in learner-centered learning management.* Danex Intercorporation.

Suthisuwan, S**.** (2018). *Development of web-based instruction using guided learning, graphic organizers, and Jigsaw technique to enhance analytical thinking skills, learning achievement, and learning happiness in the career and technology learning area for Grade 4 students* [Master's thesis, Sakon Nakhon Rajabhat University]. Sakon Nakhon Rajabhat University Electronic Thesis Database (E-Thesis).

Uttarapath, M. (2017). *The effects of cooperative learning using the Jigsaw technique on analytic geometry learning at Thachang Witthayakarn School, Tha Chang District, Surat Thani Province* [Unpublished research, Southern Technology College].

Name : Tongchai Laboon
Highest Education: M.Ed. in Technology and Educational Communications
Affiliation: Phitsanulok Vocational College