A Development of COMIDEAP Learning Model to Enhance Numerical Analysis Skills

Kajita Matchima

Applied Statistics, Faculty of Science, Ubon Ratchathani Rajabhat University, Muang, Ubon Ratchathani 34000
Corresponding author. E-Mail address: kajita.m@ubru.ac.th
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Abstract

Higher education institutions instruct graduates in accordance with standardized learning outcomes as stated in Thai Qualifications Framework for Higher Education. This learning model is considered educationally innovative, aiming to develop graduates' skills. To follow the framework, this study focuses on the development of the COMIDEAP learning model (Cooperative learning: Motivation, Information, Discussion, Explain, Application and Progress) to enhance graduates' skills in the academic area of numerical analysis. In the study, numerical analysis skills of students were assessed and compared with their skills through the COMIDEAP learning model. The students' satisfaction with their learning experience was also evaluated. The target group were the first-year students enrolling in the course Introduction to Probability in the academic year 2007. The research instruments were: 1) lesson plans for the subject; 2) pre- and post-learning achievement tests; and 3) a satisfaction questionnaire completed by the students. The findings revealed that:

1. The quality assessment of the COMIDEAP learning model was a highly efficient learning model.
2. At the completion of the subject, the students' post-test scores were higher than their pre-test scores at a significant level, $p > .05$.
3. The students had a high level of satisfaction with their learning experience and numerical analysis skill achievements based on the COMIDEAP learning model.

Keywords: COMIDEAP Learning Model, Cooperative Learning, Numerical Analysis Skill

Introduction

Learning is an important issue that develops human life and wellbeing. Learners and teaching methods are therefore regarded as a significant essence of learning. Previously, learning methods only focused on one-way transfer: from the teacher to learners without establishing networks or two-way interactions. In reality, learning has numerous methods created by learners, for example, friend-to-friend learning interaction, self-study, learning through technology.

The mission of teachers in higher education is to manage studies and create graduates in accordance with National Education Act B.E. 2542 (1999) and Amendment [Second National Education Act B.E. 2545 (2002)] which indicates that learners are the most important factors in developing lifelong learning. To achieve that, the teacher needs to create qualified graduates to meet the Act's objectives by changing his/her role from an instructor to a supporter. In order to help learners acquire learning development effectively, the teacher has to encourage them to have a will to learn, get learning skills, know how to seek for knowledge, synthesize the knowledge, evaluate it and apply it in real life. The teacher should have teaching skills that focus on learner-centeredness by arranging learning environment appropriate to learning processes as an individual or a group, making learners learn systematically and hold personal qualifications.

The Thai Qualifications Framework for Higher Education has grouped graduates' learning outcomes in five Domains of Learning: Ethics and Morals, Knowledge; Cognitive Skills; Interpersonal Skills and Responsibility; and Numerical, Communication and Information Technology Skills. In other words, these domains concentrate on numerical analysis, ability of applying mathematic and statistic techniques, language skills, speaking and

writing skills, and use of information technology (Office of the Higher Education Commission, 2009, p. 7-8). The development of numerical, communicative and IT skills has factors which lead to success through different teaching methods: getting learners practice step by step as planned; giving them information back and forth; and suggesting them to improve important numerical skills with simple calculation; and letting them to apply information and technology. Learners in higher education probably have different capacities of numerical and communicative skills. Some might need a specific instruction by teaching them directly along with practices. The teacher also need to help students develop skills according to learning standards gradually expected.

A learning model is an educational innovation which affects learning success. The learners' achievement can increase and they can remember what they learned longer when teaching methods, materials and learning environment harmonize with their thinking and learning systems. For instance, learners who have thinking systems through graphics better learn when the teacher uses pictures as teaching materials. Leaners who have free associative thinking will learn better though individual studies and self-study activities. Learners who have learning systems as cooperation learn better while doing activities that require participation or teamwork. Choocadee and Akatimagool (2010) developed an effective learning model MIDEAP for the course Microwave Engineering on the topic Waveguides and Application. Likewise, Pimpimool (2010) developed the collaborative learning model 'Online Jigsaw' to improve analytical skills that make learning outcomes more effective.

The teaching and learning of applied statistics focuses on the content with theories of calculation and information analysis. This analysis has complicated processes and theoretical calculations that learners might not notice easily. According to recent studies of teaching applied statistics, it is found that the instruction is mostly pure lectures and that activities depend on the teacher who occasionally uses question-answer sessions without clear instruction. Teaching materials are black board, PowerPoint program or overhead projector. The assessment is mainly subjective test. As the problem lies that there is no enough teaching materials nor interaction between the teacher and learners, the teacher uses materials to explain the content and analyze various information for theory proof and quick calculation.

According to the background and importance of problems mentioned above, it is necessary to develop learning models with cooperative learning that aims to help learners improve numerical analysis skills, including communicative and IT skills. Such models enable learners to acquire knowledge and better understand complicated content in accordance with the Thai Qualifications Framework for Higher Education.

Objectives of the Research

1. To develop COMIDEAP learning model (Cooperative learning: Motivation, Information, Discussion, Explain, Application and Progress) to enhance numerical analysis skills
2. To compare numerical analysis skill of students after using the COMIDEAP learning model
3. To consider the satisfaction of students after treated by the COMIDEAP learning model

Research Hypotheses

The created COMIDEAP learning model can enhance to students' numerical analysis skill, and their satisfaction of learning is higher after treated with the model.

Research Methodology

Research Framework

In this study, the concept of research is described as follows:

1. The research on cooperative learning was first examined by Spencer Kagan (Kagan, 1994), the US educator in research and development in 1985 and published widely in the United States and many countries in Asia. The effective collaborative learning consists of six components as shown in Figure 1.

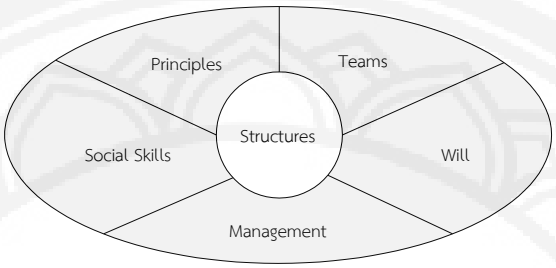

Figure 1 Cooperative Learning

1.1 **Teams** refer to a group of learners who work and learn together effectively.

1.2 **Will** refers to the commitment and ideology of learners to work together. They need to be committed to learn and actively participate in activities.

1.3 **Management** refers to the management to keep the group working efficiently, as well as management of the instructor and students within the group. The instructor must have a good management to achieve group work such as time control, assigning signals to students to stop activities.

1.4 **Social Skills** refers to working together by having good relationship among each other, helping encourage each other and listening to each other's opinions.

1.5 **Four Basic Principles (PIES)** is the basic principle of Cooperative Learning: P=Positive Interdependence, students need to help each other; I = Individual Accountability, everyone accepts that each person in the group are important; E = Equal Participation, everyone in the group must cooperate and participate in the event; and S = Simultaneous Interaction, everyone in the group must interact at all times in the group

1.6 **Structures** refers to the pattern of activity in the work group, depending on the problem or situation studied.

2. The teaching and learning process focuses on learners, principles of classroom activities, roles of teacher and student-centered learning activities. This conceptual framework of teaching innovations pays attention to learners. It consists of six steps as shown in Figure 2.

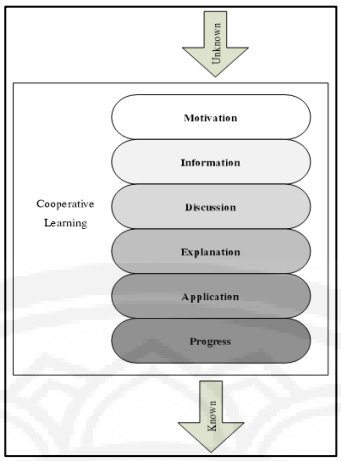

Figure 2 COMIDEAP Learning Model

2.1 **Motivation** is a process that encourages learners to take an interest in the subject of instruction. It is the first step in navigating new learning. Instructors can create motivation by using reference of new research and technology related to subject matters or have teaching materials that make students interested in the content. Teaching may come in different forms such as using video, animated media, computer program or demo.

2.2 **Information** is a step that requires knowledge and theoretical principles for learners. The students are interested in the subject. At this stage, the instructor delivers the lesson directly to the learner. Teachers should have the tools and media which make students better understand the content such as presentations, transparencies, leaflets, etc.

2.3 **Discussion** is a process designed to allow learners to exchange learning experiences in groups. The content should involve issues and new sources of information about the subject to encourage students to participate in activities. At this stage, learners will develop their own learning methods. It is the understanding of the exchange of ideas by the instructor who is guiding and controlling time.

2.4 **Explanation** is a process designed to help learners understand principles and prove theories through tools or instructional media such as simulators, demonstration series, etc. This includes the summary of issues, additional concepts and principles related to learners.

2.5 **Application of knowledge** is the process of modifying experiences which allow students to apply knowledge to a situation. The knowledge comes from the learning process and application.

2.6 **Progress** is the process of evaluating learners' learning by using tests after passing the learning process based on behavioral objectives of the generated learning model.

3. Numerical Analysis Skills in Communication and Information Technology is the ability to study and understand problems. It can be selected and applied to statistical and mathematical techniques. Here, students can use information technology to collect, process, interpret, and present information. They can also communicate effectively in speaking and writing, including choosing the format of presentation appropriate for different groups.

The results of numerical analysis skills in communication and Information Technology include the ability to use tools that are currently available to work on computers. The teacher can introduce problem solving by using mathematical information or statistics. Then students can communicate effectively through oral and written

presentation. The format of the media presentation should be appropriate by using Information Technology properly (Office of the Higher Education Commission, 2009, p. 7-8). The research framework is shown in Figure 3.

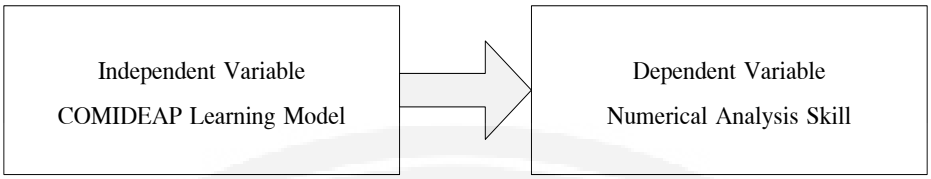

Figure 3 Research Framework

Research Design

This research used One-Group Pretest-Posttest Design.

Pretest	Independent Variable	Posttest
T_1	X	T_2

Figure 4 Experimental design

The Target Group

The target group were 25 first-year students who enrolled in the course Introduction to Probability in the first semester of the academic year 2017.

Research Instruments

1. The instruments in the study were a lesson plan, knowledge handouts and teaching materials as follows.

1.1 The lesson plan was based on the analysis of learning activities applied to the COMIDEAP Learning Model. Its key elements included learning objectives, content, activities, media, resources and assessments. The content was composed of five integrated lessons: Factorial Numbers, Sets, Set Algebra and Laws of the Algebra of Sets; Permutation and Combination; Theory of Probability; Application of Probability; and Probability Distribution of Discrete and Continuous Random Variables. The teaching period was three hours per week (48 hours for 16 weeks in total).

1.2 The knowledge handouts covered the five topics in the lesson plan.

1.3 The teaching media was a presentation in PowerPoint program as shown in Figure 5 below.

Figure 5 A sample presentation of the lesson plan

2. The data collection instruments consisted of the achievement test, the student satisfaction questionnaire and the questionnaire on quality assessment checked by specialists. The details were as follows.

2.1 The achievement test consisted of 25 multiple-choice questions together with five essay questions to be finished in two hours 30 minutes. It covered Knowledge, Comprehension, Application, Analysis, Synthesis and Evaluation in accordance with the learning plan. The pretest and posttest were designed by using the COMIDEAP learning model.

2.2 The survey of student satisfaction was conducted through the five-rating scale questionnaire.

2.3 The COMIDEAP learning model's assessment was a five-rating scale questionnaire and evaluated by three specialist who were experts in statistics and educational research.

Data Collection

The research procedures were as follows.

1. The target group did the achievement test as the pretest.

2. The instructor taught the students by following the lesson plan. Each lesson was based on the 6-step activities:

2.1 **Motivation**: The instructor used the PowerPoint presentation to explain the purpose of each topic. The learners were motivated and challenged to participate in analyzing the content in every activity. In this first step, the learners needed to search for resources of problems by communicating through the chat group, the webboard and the face-to-face group to exchange knowledge.

2.2 **Information**: The instructor delivered the knowledge from the lessons directly to the learners. Various teaching materials were used to make learners interested and better understand the content of the lessons such as PowerPoint presentation, transparencies and knowledge handouts, including activities as a group/online discussion with Computer Assisted Instruction through Network.

2.3 **Discussion**: This step allowed learners to exchange learning experiences and encouraged them to participate in activities. The instructor instructed and supervised the teaching activities. The lessons consisted of the following activities:

2.3.1 Group activities: This activity gave learners the content to find answers or search for common conclusions from different groups. The learners were asked to study and analyze problems by seeking for

information to test their collective ideas and solve problems together in groups. Then they needed to bring back the knowledge or discovery to the group members and share the same understanding.

2.3.2 Basic group activities: This activity allowed each expert in every group to get back to their group and discussed the acquired knowledge together.

2.3.3 Communication: The instructor provided an exchange of learning among learners themselves or with the instructor such as Q & A board, discussion room, teacher consultation, etc.

2.4 **Explanation**: This step helped learners to prove theoretical principles by themselves. The instructor summarized important issues, additional concepts and learning scenarios to motivate the learners to search for knowledge as a group. The learners were encouraged to link new knowledge to traditional one by using decision-making or the reasoning methods, including oral presentations.

2.5 **Application of Knowledge**: This allowed the learners to apply knowledge to the situation. The knowledge was derived from the learning process which made them gather, analyze and synthesize information from different sources to get a concept leading to collective learning.

2.6 **Progressive Evaluation**: All members in the group had a test at the end of each lesson, based on the activity schedule taught by the instructor. The scores from individual tests were the average scores of each group. The learning activities were conducted with the Teams Games Tournament (TGT) technique, together with bonus rewards in the form of bonus points to make the learners active and collaborative.

3. After completing the learning activities as planned, the learners had the achievement test as the posttest.

4. The target group responded to the student satisfaction questionnaire on the COMIDEAP learning model in the course Introduction to Probability.

5. The Pretest and Posttest scores were analyzed statistically, including the data from the student satisfaction survey.

Results

Part 1: The results of the assessment of the quality of the COMIDEAP learning model by specialist were shown in Table 1.

Table 1 The results of the assessment of the quality of the COMIDEAP learning model by the specialists

	Mean	S.D.	Interpret
1. Design of Learning Model	4.67	0.58	Very Suitable
2. Learning Activities	4.67	0.58	Very Suitable
3. The support of Teaching	4.67	0.58	Very Suitable
4. Measurement and Evaluation of Learning	4.33	0.58	Suitable
Overall	**4.58**	**0.51**	**Very suitable**

In Table 1, it was found that the respondents perceived the appropriateness of the COMIDEAP learning model by an average of 4.58. When considering each aspect, the mean of Design of Learning Model, Learning Activities and the Support of Teaching was 4.67, followed by the Measurement and Evaluation of Learning with the average score 4.33. In overall, the COMIDEAP learning model was able to enhance numerical analysis skills at the highest level.

Part 2: The results of the experiment using the COMIDEAP learning model for learners were shown in Table 2.

Table 2 The comparisons numerical analysis skill of learners after using COMIDEAP learning model

Score	n	Mean	Mean differences	S.D.	t	P-value
Pretest	25	21.80	17.08	5.99	14.27*	.00
Posttest	25	38.88				

* P-Value < .05

According to Table 2, it was revealed that the mean scores of post-learning achievement of students after using the COMIDEAP learning model was higher than the mean score before learning with the COMIDEAP learning model at the .05 significant level. This showed that the COMIDEAP learning model could increase the learners' achievement.

Part 3: The Student Satisfaction Assessment for the COMIDEAP learning model was shown in Table 3.

Table 3 The Average, Standard Deviation and Level of Student Satisfaction after using the COMIDEAP learning model

	Mean	S.D.	Interpret
1. Learning model	4.68	0.48	Very Satisfied
2. Content	4.60	0.50	Very Satisfied
3. Instructional media	4.64	0.49	Very Satisfied
4. Examination	4.50	0.51	Very Satisfied
Overall	**4.61**	**0.49**	**Very Satisfied**

Table 3 showed that student satisfaction after using the COMIDEAP learning model was 4.61 at the highest level. When considering each aspect, it was found that the Learning model had 4.68 average score, followed by the mean of 4.64, 4.60 and 4.50 for the instructional media, the content and the examination, respectively.

Data Summary

1. By evaluating the quality of the COMIDEAP learning model in teaching and learning to enhance the numerical analysis skills, it was found that the panelists had an opinion on the suitability of the COMIDEAP learning model. As a whole, the design of the learning model, learning activities and the support of teaching were very appropriate, as well as the measurement and evaluation of learning. In general, the COMIDEAP learning model to enhance numerical analysis skills was satisfactory at the highest level.

2. By comparing student achievement scores, the average score of post-learning achievement of learners using the COMIDEAP learning model to enhance numerical analysis skills was higher than that of the pretest scores. The COMIDEAP learning model could increase the student achievement.

3. The study of student satisfaction after using the COMIDEAP learning model showed that the average score of satisfaction was 4.61 at the highest level. When considering each aspect, it showed that the Learning Model had 4.68 average score, followed by the mean of 4.64, 4.60 and 4.50 for the instructional media, the content and the examination, respectively.

Discussion

The effects of learning management using the COMIDEAP learning model to enhance the numerical analysis skills were described as follows.

According to the results, the quality of the COMIDEAP learning model developed to enhance numerical analysis skills was at the highest level. This might be that the model corresponded to the theories and learning principles of student-centeredness, based on the combination of Cooperative Learning and the MIDEAP learning model to enhance students' numerical analysis skills. The model's content also involved learning processes that developed individual learning styles. The instructor could use these styles as a role model to create other learning activities. This is in accordance with Choocadee and Akatimagool (2010) who conducted a study on the development of a microwave circuit model in a rectangular waveguide with the aim to develop a microwave circuit model in a rectangular waveguide and a learning pattern. The results of the research showed that the learning achievement based on the MIDEAP model was effective at 71.75 / 70.26, higher than the standard set of 70/70. Their research corresponded to that of Santawamet (2004) who studied the development of English reading comprehension of six Prathomsuksa students. The study showed that the students' participation in learning English through the technique of the lesson was satisfactory as they cooperated with each other and joined the learning activities very well.

Regarding this study's COMIDEAP Learning Model for enhancing numerical analytical skills, the results were also high in student achievement. The model focused on learners, making the class as a collaborative learning and encouraging them to exchange knowledge through various activities such as an activity between the instructor and learners, an explanation of theories through lectures, group discussions, or sharing class comments and doing self-study activities. The activities encouraged the learners to analyze problems properly in a systematic, accurate and procedural way to enhance student analysis skills. According to Sirirojanamai (2005), the results of using the cooperative learning with social engineering students were higher than those of using the ordinary method.

Based on the Student Satisfaction Assessment after applying the COMIDEAP learning model, the overall satisfaction score was at the highest level. This might be that the model provided activities focusing on the learners' ability to work in small groups with talented group members. Therefore, there were some interrelation and shared responsibility to enhance each learner's learning capacity. As Chanakitjanukit (2007) pointed out, the effect of web-based learning based on cooperative learning styles gave different effects on learning achievement. The students' participation in learning through Web Quests and wiki on a large scale all aspects was at satisfactory level.

Suggestions

General Suggestions

1. In the case that a researcher does not conduct the self-teaching, it is necessary to write the lesson plan with the course instructor to achieve a clear understanding of activities and contents.

2. Teaching activities should create a friendly atmosphere between learners and the instructor by talking, asking questions and applying thinking processes to get learners' attention through teaching materials and diverse activities.

Suggestions for Further Research

1. It should investigate how long it takes to organize activities during teaching sessions.

2. It should examine the COMIDEAP learning model in combination with other learning models that enhance students' skills.

3. The COMIDEAP learning model should be applied to enhance numerical analysis skills in other subjects.

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