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Distance Online Learning and Evaluation  
Framework (DOLE)

จัดทำโดย

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ภาควิชาวิทยาการคอมพิวเตอร์และเทคโนโลยีสารสนเทศ คณะ  
วิทยาศาสตร์ มหาวิทยาลัยนเรศวร

## ความสำคัญและที่มาของปัญหาการทำวิจัย

Lessons in the teaching-learning process for distance learning [1] are typically designed to help students to find essential information or to carry out desired tasks, e. g. as assignments. As information related instruction conveys information about the domain of instruction there is no specific skill to be learned during that process; for example, in this part of the course the appearance of an object can be described. The lessons for performance-based instruction on the other hand, aim at resulting in improved procedural skills, which the student are expected to train or work out during the teaching-learning process [2].

To find out how much and how well students have learned the material a number of formal and informal tools and methods are used. For example, to formally evaluate student learning, most teachers use quizzes, tests, examinations, and homework, which help to assess the student's level of knowledge and to assign marks and grades.

A number of different techniques are used to assess learning informally, such as teachers listening to students' remarks and questions, teachers posing questions, and observing body language and facial expressions. With these informal assessments the teachers are able to adjust their teaching better to the students' needs. Slowing down the pace of instruction or reviewing specific material of the teaching-learning process as a response to students' demands can increase the learners' motivation and learning outcome.

The distance learning-teaching process is somewhat different to classroom teaching-learning process [3]; there are no

- traditional, familiar classrooms
- more or less homogeneous groups of students
- students' questions, comments, signs of body language, and facial expressions, which the teacher can observe face-to-face
- ways to control the distance delivery system completely
- spontaneous ways to talk to students individually.

For these reasons, distance instructors may find it appropriate to extend the formal evaluation process of the students by testing and homework through using a more informal approach in collecting data to determine

- student comfort with the method used to deliver the distant instruction
- appropriateness of assignments
- clarity of course content
- how well class time is being spent
- teaching effectiveness
- the ways to improve a course
- other types of evaluation

Evaluation can be either formative, summative, or a combination of both [4]. Relevant data are collected for quantitative and qualitative analysis.

#### The formative evaluation

- is an on-going process to be considered at all stages of instruction
- enables instructors to improve the course as they proceed
- facilitates the adjustment of course management and materials
- identifies gaps in the instructional plan or the need for more adjustments

Among the strategies used by instructors to collect formative data from their distant students are e-mail, online chat, and phone calls.

E-mail (electronic mail) is an asynchronous way of communication and can be very effective for instructors and students to communicate. Instructors can elicit and extend material covered in the online course, and students can ask questions or giving comments.

Online chat is a synchronous communication method and can also be very effective in gathering informal data about students' learning achievement and motivation. As we observe that almost all students use online chat for communication, this method can be seen as a non-interrupting way to communicate with students.

Teachers should call students often and ask them open ended questions to let students voice their concerns. Follow with probes (e.g., "Then, will you need more information sources?"). Set phone-in office hours but be sure to welcome calls at other times.

#### The summative evaluation

- helps to evaluate the overall effectiveness of the finished course and instructional material
- can be a basis for developing a revision plan
- can be a baseline of information for designing a new plan, program, or course
- does not help current students since can attend only after having completed the course

Quantitative evaluation uses statistical methods and can evaluate data about large groups of people; under some circumstances, a considerable number of data is needed to come to statistically relevant results. Unfortunately, most of the classes in distance learning courses are small, so that they defy statistical analysis.

By definition and design, forced choice surveys offer respondents a limited number of possible response options. Therefore, new insights and novel perspectives that are not inside the provided response set will not be reported.

The often tedious nature of quantitative data collection can discourage formative evaluation, and leads to an over-reliance on summative evaluation.

Qualitative evaluation uses a wider range of information, which can be very specific und inhomogeneous, so the categorization of the data can be cumbersome. Qualitative evaluation does not depend so much on the size of the classes; small classes are generally not problematic for getting useful results [5].

For qualitative evaluation there are many different methods of data collection available, such as open ended questioning (e. g. respondents are asked to specify strengths and weaknesses of a course and suggest modifications), participant observation and non-participant observation (with the instructor

participating or not participating in class and observing group dynamics and behavior), content analysis (the evaluator using predetermined criteria to review course documents including the syllabus and instructional materials as well as student assignments and course-related planning documents), and interviews (with a facilitator or specially trained person gathering data through one-on-one and small-group interviews with students).

Quantitative and qualitative evaluation can be used in various areas of the teaching-learning process and learning environment. Examples are

- course content (relevancy, organization of the materials, adequate body of knowledge)
- class formats (effectiveness of the lectures, appropriateness of the lab assignments),
- use of technology (attitudes towards technology, familiarity with technology)
- class atmosphere (conduciveness to student learning)
- assignments (adequate level of difficulty, usefulness, timeliness of feedback, time required for finishing)
- Tests (frequency, relevancy, sufficient review, difficulty, feedback)
- Support services (facilitator, technology, library services, instructor availability)
- Student achievement (adequacy, appropriateness, timeliness, student involvement)
- Student attitude (attendance, assignments submitted, class participation)
- Instructor (contribution as discussion leader, effectiveness, organization, preparation, enthusiasm, openness to student views)

There are also approaches, which can be seen as mixed methods circumventing some of the drawbacks of the pure quantitative and pure qualitative approach. These approaches are mainly used outside the educational environment, such as evaluating socio-economic programs and universities [6].

Much effort has been spent for the technical reuse of electronically-based distance teaching materials and in particular creating or re-using Learning Objects [7]. Learning objects (LO) are teaching units that are properly indexed (tagged) with keywords, and maybe more metadata. LOs are often stored in as XML files, which enable better indexing and organizing structures. Creating a course requires putting together a sequence of LOs [8].

A common standard format for e-learning content is SCORM [9] whilst other specifications allow for the transporting of "learning objects" (Schools Interoperability Framework) or categorizing meta-data (LOM, [10]).

In this research, we develop a framework for a distance learning and evaluation framework in Thai language.

## กรอบแนวคิดหรือทฤษฎี และงานวิจัยที่เกี่ยวข้อง

### Distance learning and e-assessment

While distance learning primarily refers to remote computer-enhanced education it is currently extending to emerging technologies, such as mobile computing (M-learning) and Personal Digital Assistants (PDAs). Distance learning may include the use of web-based technologies, including blogs, polls (electronic voting systems), simulations, games, and wikis. The differentiation to blended learning is floating.

E-learning systems are mostly used together with face-to-face learning, but they may be applied to distance learning after some adaptation. For a differentiation between face-to-face and E-learning, see Figure 1, which shows the portion of e-learning in each of the teaching-learning models [11].

Distance learning has proven to be useful in tertiary education, e.g. universities, and in environments which need their learners to be lifelong learners. Contents of distance E-learning range from technical and medical knowledge to soft skills, such as social behavior. Even the instruction of hands-on practical work can be assisted by distance learning units.

Distance E-learning has to serve very different learner groups. There are novice learners, intermediate and advanced up to experienced students. Furthermore distance E-learning courses can be attended by dependent or independent learners who study full-time or part-time. Distance E-learning is based on prerequisites, such as management, culture, and IT [12]. Distance E-learning can be presented in many forms (see Table 1).

All of these forms can be enhanced by multimedia content, which is designed to suit for various types of learners. Such multimedia materials can consist of

- e-books,
- e-libraries, where we can borrow books online and check availability of books.
- streaming videos or audio files, where details and information are kept in multimedia files or sound and can be accessed via the Internet,

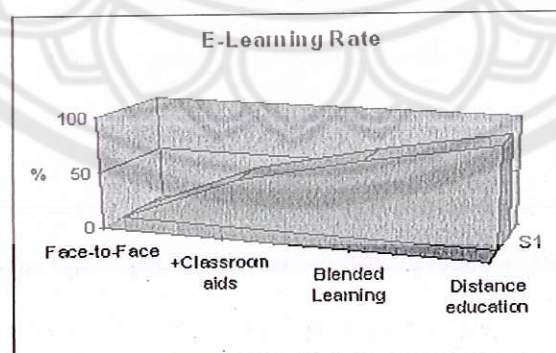


Fig 1: E-Learning rate in different learning environments



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Table 1 Forms of distance E-learning

Computer Based Training (CBT)	students learn by executing special training programs on a computer
Web Based Training (WBT)	students learn by executing special training programs on a computer via the Internet
Blended Learning	provision or use of resources which combine e-learning (electronic) or m-learning (mobile) with other educational resources
Virtual Classroom, Lab	Students study at home and use Voice over IP and webcams in a virtual class, e.g. performing experiments
Digital Learning Games	Computer games with an educational background

Distance E-learning can meet diverse user needs and requirements and can be consumed just in time at home, on travel or at the working place. It can be designed for the user's context in small parts of the learning content. The content can be made available to a large number of participants. Participants can work out the material self-paced. So maximum information retention is more likely. As learners study in their natural environments travel costs and associated expenses are considerably reduced.

Application in distance learning is a developing area and can often be seen in first language education, and mostly English as a foreign/second language (EFL/ESL) situation. For instance, in the research into computer assisted language learning (CALL), the effectiveness of teaching vocabulary has been reported [13]. The importance of vocabulary knowledge is prominent in understanding any language (e.g. Wilkins, 1972). In the EFL (English as a foreign language) environment in particular, learning is generally more challenging. This is because there is little mental lexicon readily available to the learners at the early stage of learning. For instance, when learners are learning objects (such as fruits, vegetables) it is hard for learners to relate them with their meaning and their existing knowledge if they had not encountered them in their real life. Moreover, in teaching young learners in general, motivation is one of the important factors to consider since they tend to be less intrinsically driven compared to adult learners.

The framework for the learning process is considered by suggesting three steps: presentation, practice and performance. Having the available systems which are targeted to learners, however, they seem to lack the attention to the evaluation stage. In the case of evaluating learners, it is often neglected or the concept of 'assessing' learners being avoided for such reasons as the result could discourage learners, in case of them receiving negative results. However, it is important to consider the way to evaluate and check the understanding of the learners in any learning. It is necessary to have an evaluation stage, after any teachings and techniques used, so that it enables educators to monitor the learners' understanding as well as the effectiveness of the techniques and approaches, which in the end, also serve as a follow-up and feed into a revision phase. The points raised above (i.e. the motivation and learning environment factors) should be fed into the design of the interface for the assessment, which will be discussed in the next section.

## วัตถุประสงค์

- เพื่อออกแบบระบบการเรียนรู้วัตถุ (Learning Object) แบบมัลติมีเดีย และระบบการประเมินจากการเรียนรู้แบบทางไกลสำหรับผู้เรียนวัยเยาว์ผ่านเครือข่ายอินเทอร์เน็ต
- เพื่อนำแนวคิดและ หลักการ evaluation มาปรับปรุงและพัฒนาขึ้นใหม่เพื่อเป็นแนวทางใหม่ที่ใช้ในระบบการประเมินโดยการตอบคำถามของผู้เรียนวัยเยาว์หลังจากได้ทำการเรียนรู้ผ่านระบบเครือข่ายอินเทอร์เน็ตแล้ว
- เพื่อการวิจัยที่มุ่งสร้างฐานความรู้เกี่ยวกับการประเมินและกระบวนการเรียนรู้ผ่านระบบมัลติมีเดียเพื่อให้ได้ข้อมูลในการนำไปศึกษาค้นคว้าและนำผลงานไปประยุกต์ใช้ต่อไป

## ขอบเขตการวิจัย

- วิเคราะห์และออกแบบระบบการเรียนรู้วัตถุ (Learning Object) แบบมัลติมีเดีย และระบบการประเมินจากการเรียนรู้แบบทางไกลสำหรับผู้เรียนวัยเยาว์ผ่านเครือข่ายอินเทอร์เน็ต รวมทั้งออกแบบรูปแบบการทำงานของระบบโดยรวมและออกแบบหน้าจอของระบบมาพัฒนาระบบ และเขียนโปรแกรมการเรียนรู้โดยใช้หลักการมัลติมีเดียและระบบการประเมินด้วยภาษา PHP
- ทดสอบ แก้ไข แล้วดูผลของระบบว่าให้ผล ตามที่ต้องการหรือไม่หรือมีส่วนใดที่ผิดพลาดหรือไม่ และสามารถเพิ่มส่วนที่ทำให้ ระบบสมบูรณ์มากยิ่งขึ้น

## วิธีการทดลอง

### System Concept

Nowadays, user interfaces can be designed and implemented with a wealth of technical opportunities, which may lead to overshadow the important points. For distance learners, the user interface must be playful and more attractive than that for adult learners, without distracting the users from the intended conversation [14], [15].

The learning design strategy has to take into account the learners' specific behavior and cultural background. In case of Thai students, for instance, there is a great demand of multimedia content, which has to add some fun to the learning materials. From our teaching experience Thai students tend to be social learners studying in groups and comprehend through visual stimuli as well as examples and case studies.

Numerous qualitative and quantitative studies are available that analyze the usefulness of applying computer games for instruction purposes. They are mainly driven by the question as to how acquire and improve the necessary skills that people will face in the 21st century: managing information, being adaptive to changing roles and environments. Recent interest in games and learning stems from some complex debates about the very role and practices of education in a new century, rather than just from a simple belief that young people find games motivating and fun and, therefore, that they should be exploited in educational contexts. These debates suggest, among other things, that computer games are designed 'to be learned' and

therefore provide models of good learning practices, and that by playing games young people are developing practical competencies and learning skills.

Interesting application areas for computer games are the development of strategic and logical thinking as well as language. That means, students are expected to develop their hard skills as well as their soft skills. Even the assessment of students can be made within the gaming environment as long as the boundary conditions are the same for every participant Prensky [16] suggests that today's learners have changed, and that video (and computer) game players are developing skills and competencies that others are not learning, such as decision making, data handling, multi-tasking, and information processing.

Characteristics of good instructional computer games include challenge and adaptability, a more practice-based rather than a didactic approach with authentic tasks, letting the students experience consequences of interactions and choices they make. Games situate players in particular literacy practices associated with the identities being played, immersing them in peculiar vocabularies and social customs; often these literacy practices are associated with real-world professional domains, or are consistent within the fantasy. Games prepare players to deal with complex electronic environments, to negotiate and handle data in multiple formats simultaneously, to interact with images, sounds and actions, and to interact with others through electronic channels [17].

DOLE is a system concept, which can be implemented as a web based online game where users log onto the website and play/learn against an artificial intelligence (A.I.) engine. For example, players think of an animal, vegetable, mineral, or other object and DOLE has to guess which term (word) the player is thinking and vice versa. The resulting system can be used anywhere and anytime. It is fun harnessing with edutainment and game learning style. It can practice the way of learner thinking and can assess skills, knowledge, and thinking of learners.

The software development of the user interface can be carried out using rapid prototyping (for an overview of the various rapid prototyping paradigms for the implementation of user interfaces see [18]).

The system is separated into 2 parts of object learning: 1) the user thinks of an object and the system poses questions, which the user has to answer correctly; 2) the system chooses an object and lets the user ask questions about it, which the system will answer correctly. Framework 1 is described in the following.

### **Use Case and Basic System Requirements of SOCKS**

The elicitation of requirements for a Web-based counseling system is a rather complicated process, since many heterogeneous aspects have to be considered, such as test psychology, the difficulty of questions and topics of the learning domain, ergonomics of the user interface and data security as well as authorization and authentication aspects.

Let us consider a simple use case for SOCKS, which is outlined in the following. Student W is attending an online course on Software Engineering, which is almost finished regarding the last day the final test can be taken. The online course comprises 15 learning units overall and the time students are expected to spend in each unit varies from three to five hours. W has been studying all units and has taken all quizzes including the mid term test with varying results. The mid term test consisted of 25 questions and has been offered online.



The questions covered all units of the first half of the online course and were designed with varying levels of difficulty. W has got more points than she expected before taking the test. Nevertheless, she is not sure whether she will pass the final and comprehensive test with a good grade. In this case, W can ask SOCKS for a consultation based on her time spent in every unit of the Software Engineering online course and on her points in the related quizzes plus the mid term test. SOCKS takes into account her individual data and calculates a predicted grade for the final grade as is. Furthermore, SOCKS will advise W on units that cover the spectrum of questions that W has answered with fewer points than average. With this advice W can then improve her studies by going back into specific learning units, and hopefully she will get a good grade in the final test.

In the following, the authors outline the four basic processes involved in SOCKS together with information security requirements. The basic processes are

- the process monitoring the students' learning behavior,
- the prediction process for the student's learning outcome
- the resulting counseling process, and
- the evaluation of the counseling process.

Table 1 Example of the learning record of a student

LU	TST	TSG	TSV	TSO
1	65	10	12	87
2	75	7	9	91
3	58	16	21	95
4	77	18	10	105

As participants of an online course have to work through the learning materials, such as texts, graphical representations and instructional videos, their learning behavior regarding the time they spend on the materials can be measured and stored in an individual learning record. Table 1 shows an example learning record related to the time spent on different materials in the first four learning units (LU). TST, TSG and TSV refer to the time spent on texts, graphics and videos, respectively. TSO is the overall time, i.e. TST+TSG+TSV. All data are given in minutes.

The participants are expected to take quizzes and tests regularly. The corresponding results are individually stored in the students' learning records. An example of this part of the learning record is shown in Table 2, which is enriched by the individual results of each quiz and test taken by the participant.

The prediction process uses the enhanced learning records and takes into account the actual time spent in each learning unit against the average time spent and the learning results as has been gathered by the quiz and test results.

In all areas that deal with data records of individuals there are comprehensible concerns about the integrity and the security of data and information monitored, transferred, stored and retrieved. Primary issues within information security are the protection of data against unauthorized use as well as the authorization and the authentication process. The related system components have to be Web-based and should be based on standard interfaces and software.

Table 2 Enhanced learning record of student

LU	TSO	Q1	Q2	T1	T2
1	87	76	69	72	74
2	91	79	72	77	77
3	95	60	62	68	67
4	105	59	67	73	79

#### System Framework of SOCKS

In Figure 3 the system framework of the Student Online Counseling Kernel System (SOCKS) is presented. SOCKS uses (1) a database of students' activities and assessments to advise students on their further studies and to provide immediate feedback after a quiz or test, and (2) a grade prediction component that takes the results of self-study activities (marks) of online assignments, quizzes, post-tests after finishing a study section, and mid-term tests to predict the final grade of the students.

Students can get assignments, or take post-tests, quizzes and mid-term tests only if they reach sufficient attendance during the course. Attendance is based on the students' learning records (with a time counter).

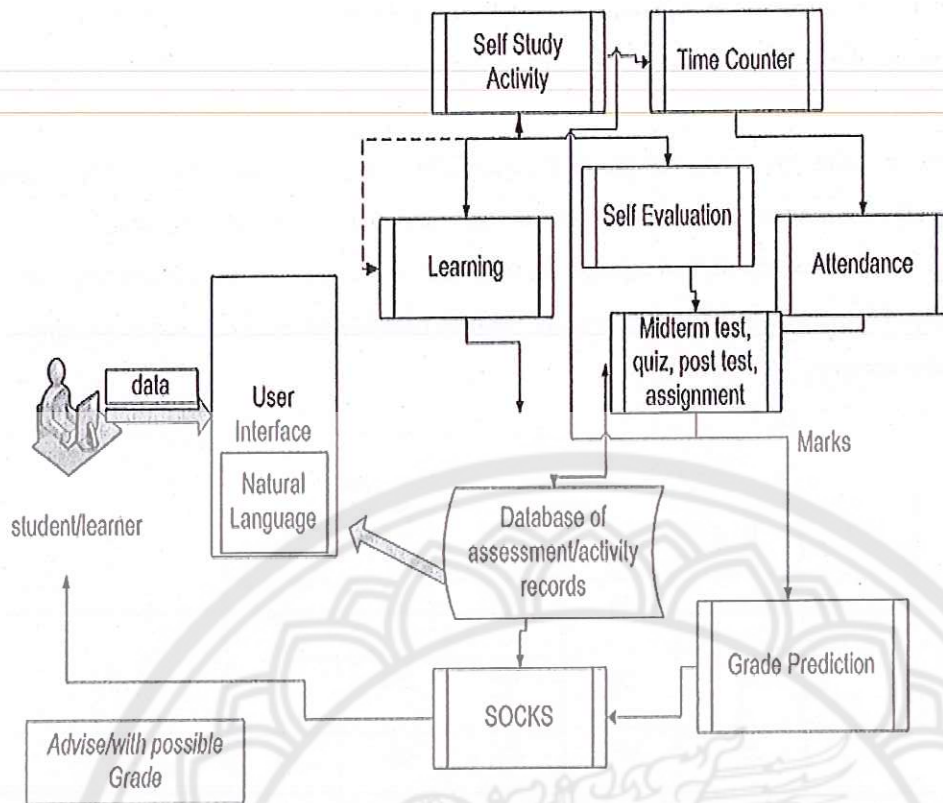


Figure 3 System framework of SOCKS

#### User Interface Design of SOCKS

User Interface Design of SOCKS contains two main parts (students and teachers) which are described below.

Students: Figure 4 illustrates the main menu for students interface. The main page contains:

Change Password: is for changing student passwords which should be done every three months,

Login Statistics: is for checking attendance of students in the course,

Student Statistics: is for Checking student behavior of learning course

Suggestion-Feedback: is for giving feedback and suggestions to students or identifying what to consult or suggest and how,

Assessment Result: is for assessing how much the student knows and how well and to decide where and how much help is needed,

Logout from the system.

There are also learning subjects available for students, updating system, history of all students, exit from each lesson and log out from the system.

Login Statistics: Figure 5 illustrates checking attendance which a student must log in to the learning course by providing the student ID and password. The system recognizes the IP of the computer that a student uses

for the first time and checks every time the student logs in. Thus, students must use the same computer for learning throughout the course.

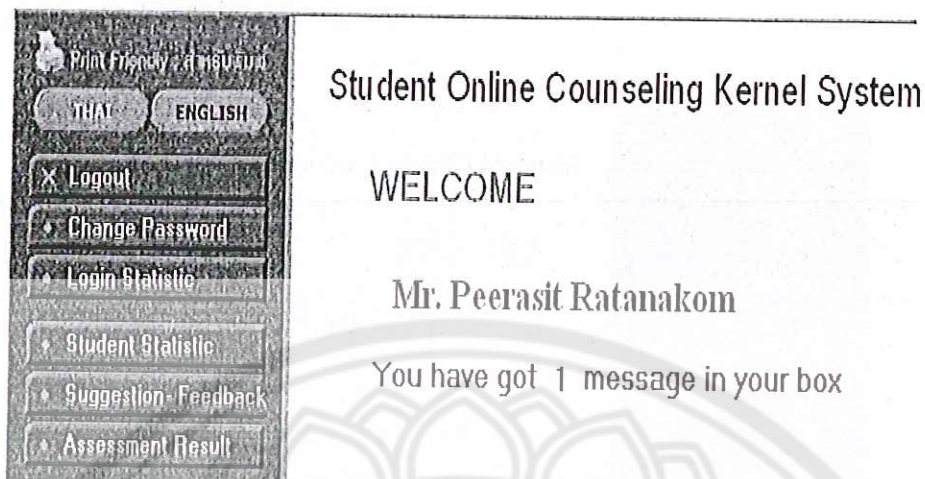


Figure 4 interface of SOCKS: student part

CAMPUS Phitsanulok  
 ACADEMIC YEAR 2551/1 DEGREE B.Sc. Computer Science  
 COURSE 254552 : Artificial Intelligence

CODE	NAME	IP	EDIT Point1 ATT1	EDIT ST1/ FT1	EDIT Point2 ATT2	EDIT ST2/ FT2	EDIT Point3 ATT3	EDIT ST3/ FT3	TOTAL
49070899	MR. PEERASIT RATANAKOM	10.31.23.62	1	10:00/ 11:50	0	10:35/ 11:45	0.5	10:20/ 11:50	1.5

Figure 5 interface of SOCKS: Login Statistic

ATT is for marking attendance, ST and FT are starting time and finishing time of learning respectively. TOTAL is for keeping the overall mark of attendance. The marks of attendance are based on time constrain, e.g. 1 means you log in and learn within the time limit (10:00 to 11:50) 0.5 means students are less than 30 minutes late (10:20) and get, and 0 means students are more than 30 minutes late (10:35) or absent. IP refers to the regular seat/computer that students must use for learning.

Assessment Result is to evaluate how well has a student done and to help students drawing conclusions for the learning improvement and purpose using appropriate response parameters as follows:

- Very well      no action
- Well            whenever get a chance, review related concepts
- Not so well    give exercises

Not well      review concepts, exercises

Not at all    teach

Forgotten    review, no exercise

Teachers: Figure 6 shows the main interface for the teachers and the administrators of SOCKS. This page contains:

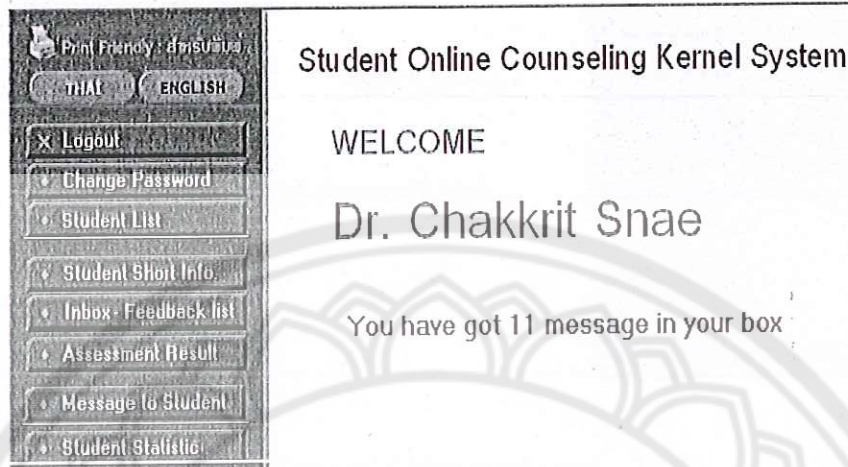


Figure 6 Interface of SOCKS: Teacher part

Change Password: is for changing teacher passwords, which should be done every three months,  
Student List: is for checking the number of students attending the course ,  
Student Short Information: checking necessary student information,  
Inbox-Feedback List: is for getting feedback and suggestions from students,  
Assessment Result: is for assessing how much the student knows (and how well) and to decide where and how much help is needed,  
Message to Student: is for creating and sending messages to students,  
Student Statistics: is for checking student behavior of learning course,  
Logout from the system.

Add Subjects, Add Chapters and Add Exam are also on this page.

Student Statistics: Checking student behavior of learning in the course by providing the time spent on TST-TSG, TSV, TSO, and quizzes that students have taken for each chapter (Figure 7). The system recognizes the lessons and chapters that a student has already studied during the course.

Figure 7 shows times that students spent and post-test after learning in each lesson. The threshold is up to check a minimum of time that student should spend in each chapter.

CODE	NAME	IP	Lesson	TST+TSG	TSV	TSO	Quiz	MidTest
49070899	MR. PEERASIT RATANAKOM	10.31.23.62	Chap1	45	23	78	15	
			Chap2	59	38	97	13	
			Chap3	89	30	119	9	
			Chap4	74	35	109	16	
			Chap5	87	33	120	14	
			Chap6	-	-	-	-	

Figure 7 interface of SOCKS: Student Statistic

The minimum of time is computed by the average of times that all students spend in each chapter. If the student spend less time at the threshold and the marks of quizzes are less than standard then the students are advised to revise each lesson at the end of lesson otherwise they will not allow to take mid-term examination.

### วิเคราะห์และสรุปผล

This paper has presented the results of a design and create research project during which a system framework for a Student Online Counseling Kernel System (SOCKS) presented earlier (Snae, Brückner, & Wongthai, 2008), has been implemented, tested, operated and evaluated. The system has been introduced in order to raise the level of acceptance of e-learning among students. The tests have been carried out during an e-learning course on Software Engineering with 120 participants.

Another area of related research is an evaluation of how SOCKS can be used to enable a social network of learning, in which peers and instructors work together (Berlanga, Sloep, Brouns, Van Rosmalen, Bitter-Rijkema, & Koper, 2007).

Quiz and Tests should be classified into type of examination such as analysis, memorizing, understanding, or mixed between them and then to develop the system to keep all data of tests, e.g. which answers of multiple choices that students chose the most or which questions most students answered correctly. This can help to improve the questions by teachers.

To calculate the grade, predictions based on attendance, post test, quiz, and mid-term test have to be implemented.

## กิตติกรรมประกาศ

โครงการนี้ได้รับทุนสนับสนุนจาก เงินงบประมาณรายได้ประจำปี 2550 กองทุนวิจัย แผนงานวิจัย งานวิจัย พัฒนาและถ่ายทอดเทคโนโลยี หมวดเงินอุดหนุน ทุนอุดหนุนการวิจัย ของสำนักงานเลขาธิการคณะ วิทยาศาสตร์ จึงขอขอบคุณไว้ ณ ที่นี้ด้วย

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