

Perception and Attitude Toward Self-Regulated Learning of Thailand's Students in Educational Data Mining Perspective

<https://doi.org/10.3991/ijet.v14i09.10048>

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Abstract—The Self-Regulated Learning (SRL) strategies can be the best. It can be achieved by a sub-goal that will be more important in the younger generation. This paper proposes the process of developing factors (attributes) which are related to the development of learning styles through self-regulated strategies. The objectives of this paper are (1) To study the perception and attitude toward the attributes of students with self-regulated learning of the students in higher education, and (2) To find the level of acceptance towards the factor of SRL using applied statistics and machine learning technology.

The results show that two tools have proved the respondents and the factors of SRL in the accepted level. Besides, the results found that Thai higher education students still focus on formal learning, which conflicts with the behavior and usage of Internet and telephone in the classroom. In future work, the author is committed to develop and apply a self-regulated learning strategy model with a combination of collaborative learning strategies of blended learning. Also, it supports undergraduate students in analyzing the factors and studying the behavior patterns of learners in suitable modern learning.

Keywords—Self-regulated learning strategies, educational model, student model, learning style, data mining in education

1 Introduction

At present, the learning behavior of the younger generation is a sudden change. The learning style of the new generation of children is characterized by a range of learning or vibration called ADHD or Attention Deficit Hyperactivity Disorder [1]. Moreover, the addiction to equipment or mobile addiction intensifies and widespread [2]. Majority of the younger generation between 12 to 30 years old have access to mobile for 300 minutes per day on the average, including weekdays and weekends. It is defined as having Internet addiction [3]. Meanwhile, the social pattern of modern children is reverting changes. They choose to live in an online society rather than interacting with people in normal society [4]. As a result, the management of formal education is not consistent with the behavior of the students [5]. Classroom teaching has problems with the perception and knowledge management of learners [5, 7]. The best solution is to change the knowledge management model and teaching strategies to suit the learners.

The Self-Regulated Learning (SRL) is a widely accepted learning theory [6-7]. It is applied to the Technology Enhanced Learning (TEL) environment that gives the benefits for enhancing the essential skills of the learner [5-6]. The essential principles of the SRL are critical in the development of learning aimed at learning to achieve the goal of self-determination [7]. Regarding the benefit of SRL's strategies, researchers can apply the SRL's strategies to solve problems and design appropriate learning management processes for learners in the regular education system. The overall intent of this paper is the understanding of the perception and attitudes towards the SRL's strategies from higher education students.

In order to achieve this objective, the perceptions and attitudes of students in the survey of the factors of the SRL's strategies are designed and applied to a wide variety of curriculum in higher education. It is aimed

- To study the perception and attitude toward the attributes of students with self-regulated learning of the undergraduate students
- To find the level of acceptance towards the SRL's factors using applied statistics and machine learning, which is initiated by analyzing as followed in Figure 3.

The layout of the paper consists of five sections. The first section is to introduce readers for understanding the importance of problems and research topics. A literature review is presented in Section II for summarizing relevant research works. The research methodology is described in Section III for describing the steps and methods of conducting the research. Section IV presents the research results and discussions and Section V summarizes research findings and recommendations for future work.

2 Literature Reviews

2.1 Self-regulated learning (SRL)

The Self-Regulated Learning (SRL) refers to the process and theories of the knowledge constructive, and a variety of knowledge management processes; such as Constructivism Learning Theories (CLT) [5-6], Social Cognitive Theory (SCT) [8], Brain-Based Learning (BBL) theory [9], and other phenomenological perspectives [10, 14]. However, the typical model of the SRL is focused on 3 phases [11]: forethought phase, the performance phase, and the self-reflection phase as shown in Figure 1.

According to Figure 1, it provides an overview of the implications for SRL's strategies components, including Forethought phase, Performance phase, and Self-Reflection phase. Forethought phase consists of 2 main classes including task analysis and self-motivation beliefs. Performance phase consists of 2 main classes including self-control and self-observation. Self-Reflection phase comprises of 2 main classes including self-judgment and self-reaction.

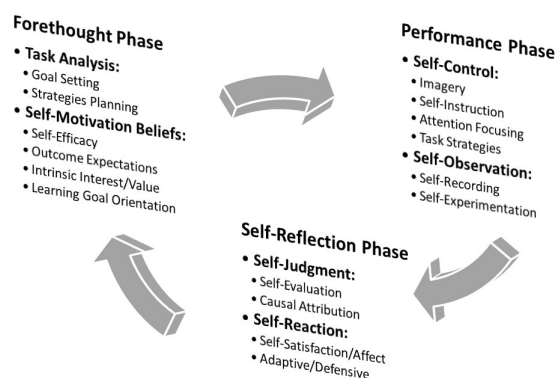


Fig. 1. Phases and Sub-process of Self-Regulation [11]

However, SRL's strategies are also mentioned in the different dimension of group analysis, learning models, and research approaches; such as Broadbent and Poon [12]. It provided reviews on the influencing factors in the SRL strategy and academic achievement in the online learning environment and the higher education in nine dimensions. Pintrich presented a conceptual framework for understanding the RSL in four stages including planning, goal setting, controlling, and reflecting [13]. He seeks to understand the learner's talent, which studies the learners' ability for learning of metacognition, cognition, and motivation activities in the learning process toward attaining the goals. Also, there are other interesting research works which are related to SRL's strategies [14].

In Thailand, SRL's strategies are receiving significant attention from numerous researchers in many fields of learning; such as education, science, social science, behavioral science, and information technology [15]. However, the research which is presented in Thailand mainly focuses on data analysis in the dimension of statistical analysis. The current trend of behavioral analysis has been changed from a fundamental statistical analysis of data analysis by machine learning technology, also known as data science [16]. The details of operation with machine learning technology will be presented in the next section and research methodology topics.

2.2 Thai education model and child behavior

As the explanation of The National Education Act B.E. 2542 and the Compulsory Education Act B.E. 2545, Thailand has three types of education. There are formal education, non-formal education, and informal education [21]. Generally, formal education is the standard form of the education system in Thailand. Its concept is based on the government design and management. Usually, it is specified by their purposes, methodologies, and various conditional managements. In addition, non-formal education is a different system of formal education. It has a learning model which is not defined by the fixed pattern. With the flexibility of the education system, it has high flexibility to change or control the contents based on changeable requirements individually. Moreover, informal education provides different learning style which focuses on interest and motivation. Obviously, this education system applies the learning style which follows the specific interests and knowledge of individuals.

However, the education system in Thailand can also be separated into two levels individually. There are primary education and higher education. Typically, primary education supports the students in the range of pre-elementary, elementary, and secondary. Besides, higher education provides advanced learning system for older students. It has two levels of education, which is a diploma and degree as shown in Figure 2 [21, 22].

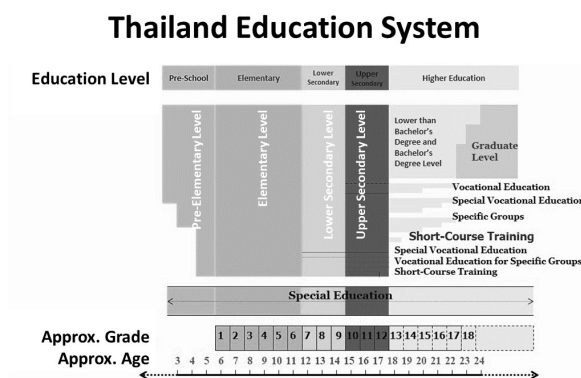


Fig. 2. Structure of Education in Thailand

The students in the primary education level are aged between 3-18 years. Most of the educational process is mainly to educate for life and general knowledge. Learning styles for learners at this level deserve to be conveyed by teachers. While the tertiary level is characterized by educational management to promote careers, the behavior of the learner is more responsive to learning from what the learner is more interested than receiving the instruction from the teacher. Many research works demonstrate the learning outcomes reflecting student behavior [23]. Majority of the student's achievement indicators are from the student's attitude and interested [23-24]. However, the behavior and low interest of the learners also reflects the impact on the current educational model. Thus, it is evident that the study of attitudes and perceptions of learners are essential aspects of shaping the ideal education.

For this reason, this research aims to study the attitudes and satisfaction of the educational model that students require. This paper is only scoped the group's study in the higher education level from the formal education system in public university.

2.3 Data mining in education

Data mining is the process of analyzing data in a way that contains so many the information called big data [16, 25]. Meanwhile, data mining is used to identify the data in the database for finding the relationship between the data called KDD (Knowledge Discovery in Databases). KDD is a process of discovering useful knowledge from a dataset. The data mining techniques are widely used in the preparation process and data cleansing by using prior knowledge about data collection and interpretation of the answers correcting observations.

In education, data mining is used to analyze student behavior and introduce appropriate educational programs in many applications. For example, Nuankaew et al. presented the education models to describe the relationship between the general knowledge and in-depth knowledge for lifelong learning [17]. They applied the data mining process to link the knowledge relationships in general education courses with specialized courses in the field of professional education through the association rules [17]. Moreover, Nuankaew et al. also suggested the application for prediction of learning outcomes for learning strategies and learning achievement [18]. They analyzed student learning patterns and behaviors through the factors that influenced the decision-making process of the educational program. It is developed into a mobile application.

Also, data mining has also been used to develop educational models in a variety of patterns [19]. The benefits and essential aspects of educational data mining are the ability to analyze both holistic and individual behaviors effectively [17, 19]. The SRL has a unique learning style. The analysis of the appropriate learning styles should be analyzed. Therefore, this research uses data mining to study the perceptions and attitudes of learners towards the SRL by presenting the similarity of them. The used tool is called k-means, which is discussed in the research methodology.

3 Research Methodology

The scope of the research frameworks follows the research methodology including

- Determining the research questions
- Identifying the population
- Sampling frame
- Building tools and validation of tools
- Gathering data
- Analyzing data
- Summarizing research results as shown in Figure 3.

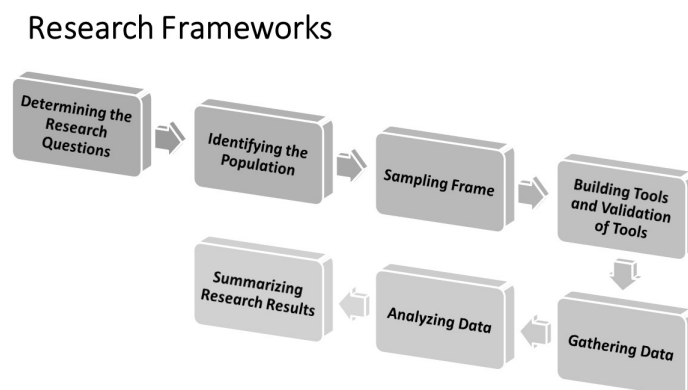


Fig. 3. Research Frameworks

3.1 Determining the research questions

The research questions are two main issues including

- What are the significant factors (attributes) in the theory of Self-Regulated Learning (SRL) that affect learners' perceptions and acceptability?
- How much the learner can accept the factors (attributes) of Self-Regulated Learning (SRL) theory to adapt their learning behavior?

3.2 Identifying the population

The population is the undergraduate students who are studying in the academic year 2018 at Phayao University, Thailand.

3.3 Sampling frame

A sampling frame is a process of setting the data samples. The purpose is to represent a list of population units that will be analyzed as the sample. The sample size is based on the finite population formula as shown in Figure 4 [20].

$$n = \frac{N}{(1 + Ne^2)} \quad (1)$$

Where

n = corrected sample size,
 N = population size, and
 e = Margin of error (MoE), e = 0.05 based on the research condition

Fig. 4. Finite Population Calculation [20]

The analyzed dataset is the 357 students who enrolled in the Fundamental Information Technology in Business course in the first semester of the academic year 2018 at Phayao University, Thailand. According to Formula (1), the sample size needed to be collected as equal to 189 students as shown in Figure 5. However, the gathering data of the research samples are compiled rather than calculated. There are 309 respondents, which are useful for research.

Given that the population is 357. At 5% MoE,
 then the sample size would be:

$$n = \frac{N}{(1+Ne^2)}$$

$$n = \frac{357}{(1+357(0.05)^2)}$$

$$n = \frac{357}{(1+0.8075)} = 188.6394 \sim 189$$

Fig. 5. Finite Population Calculation Results

3.4 Building tools and validation of tools

The questionnaire is considered and selected for data collection. Steps for the development of the questionnaire is analyzed by criteria that emphasized the balance between the independence of the learner and the control of the teacher. Based on this criterion, the developed questionnaire could provide significant feedback and express of acceptance of the factors, which is consistent with student behavior [5-7].

The factors and rationale for each question reviewed in the literature, listed in Table 1. All questions are presented in Thai Language regarding the data collection process, while some questions change the form of the original questionnaire.

Table 1. Rationals of the Questionnaire

Question	Rationale and Comments
Q1: What is the name of the major you studied?	These fundamental questions are intended to gather the context of student responses.
Q2: Which subject area do you mostly to study in your major?	
Q3: What are the ways in which you will choose to learn? Answer options: (1) Formal education, (2) Informal education	
Q4: Which type of courses do you prefer to study beyond the classroom? Please explain your preference.	It is a set of student perspectives in recognition of the needs. It is the level of difficulty in attending the course of study.
Q5: Think of your learning style, SRL's strategy can support academic achievement rather than formal education. Answer options for acceptable level: (1) low level: 0-30%, (2) medium level: 31-70%, (3) high level: 71-100%	This is intended to identify a general picture about the distribution of student perceptions toward the SRL's strategy.
Q6: How do you encourage SRL or independent learning in your study program?	This is an assessment of student behavior in promoting SRL in actual practice.
Q7: Self-assessment is significant for online learning.	This is an assessment of learners' perceptions of learning styles and self-assessment in the self-reflection phase.
Q8: Learning by seeking knowledge can be applied better than learning in the classroom.	This is an assessment of learners' perceptions of learners' performance in the performance phase.
Q9: Inspiration and self-motivation beliefs are more influential than guided by the teacher.	This is an assessment of learners' perceptions of learners' motivation in the forethought phase.

The developing questionnaire is based on the objectives and research goals. It is sent to the experts who have a good understanding of the SRL for considering the content and format. In addition, the author provided a brief guide to the SRL's strategy before proceeding to the data collection for communicating the context of the survey with the participants.

3.5 Gathering data

The data gathering is conducted from the 309 students who enrolled in the Fundamental Information Technology in Business course in the first semester of the academic year 2018 at Phayao University as followed URL: <https://goo.gl/ZXG1JE>, as shown the respondents in Table 2.

Table 2. Data Gathering

Discipline	Data Gathering		Preferred Learning Style (Q3)	
	Enrolled	Collected	Formal Ed.	Informal Ed.
Accounting	147	117	110	7
Business Computer	33	33	19	14
Information Technology	35	30	26	4
Laws and Accounting*	25	25	24	1
Management	3	3	1	2
Marketing	54	43	26	17
Tourism	96	58	52	6
Total:	357	309	258 (83.50%)	51 (16.50%)

Q3 = Question 3, * = Double Degree Program

According to Table 2, it indicates that the number of samples consisting of seven disciplines from the University of Phayao. The total sample size is 309 students with the largest group are the accounting discipline (117 students) and the smallest group with the management discipline (3 students).

3.6 Analyzing data

The data analysis process is divided into two parts for analyzing data from two perspectives, corresponding descriptive of statistical analysis and data analysis by machine learning.

Statistical analysis: The questionnaire asked the participants to assess the perception and attitudes towards the SRL’s strategies in several situations. The summarized importance in each dimension is as shown in Figure 6-8.

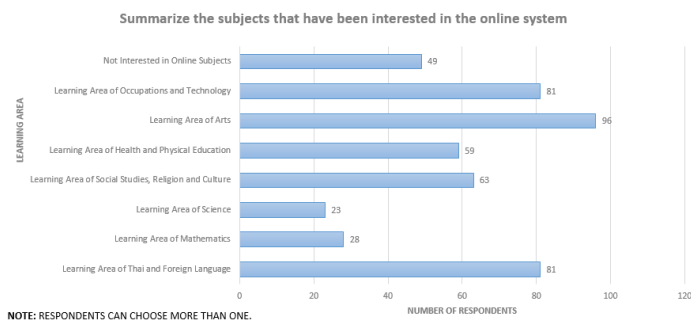


Fig. 6. Summarize the subjects that have been interested in the online system

Figure 6 represents the various courses according to the interests of the learners (Question 4) in the regular courses. The most popular is art subjects with 95 supporters (31.6%). The second is linguistics subjects with 81 supporters (26.9%). The last is science subjects with 22 supporters (7.3%). However, there are 49 people (16.3%) who do not interest in online subjects.

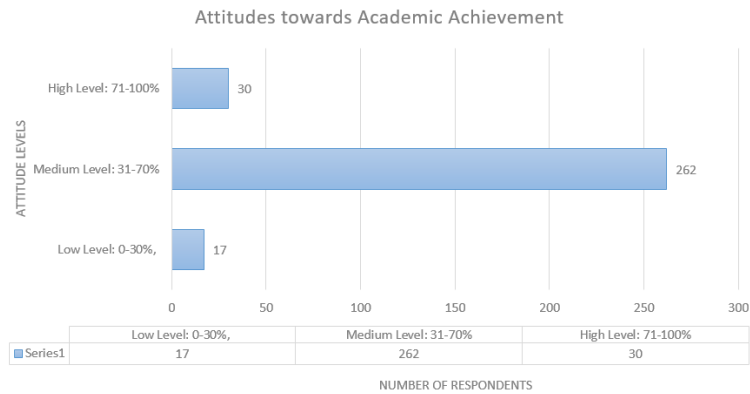


Fig. 7. Attitudes towards Academic Achievement by SRL's Strategy

According to Figure 7, it demonstrates the overall attitudes towards academic achievement (Question 5), which is entirely seen by the same attitude. It is generally agreed that the adoption of SRL's strategy for academic achievement at a medium level, or 84.89 percent of the respondents.

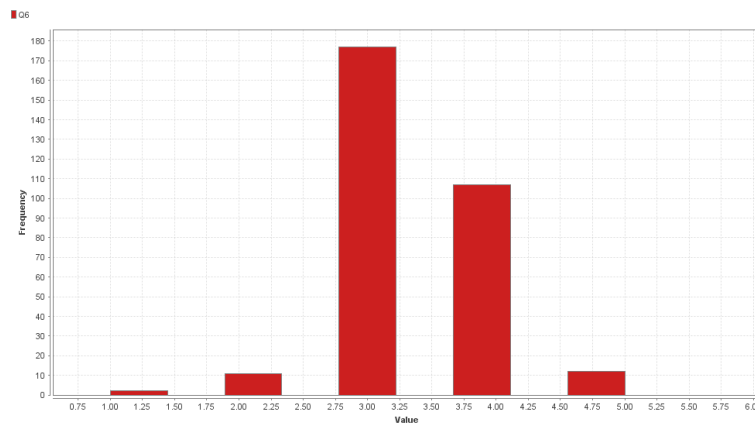


Fig. 8. Summarize the perception of SRL's strategies

Figure 8 expresses confidence and independence towards SRL's strategies (Question 6). It found that the factors that build confidence and independence in the perception of SRL's strategies are at the medium level, with an average of 3.375 and 0.651 for the standard deviation (S.D.). Last but not least, the level of feedback towards the factors of the SRL's strategies which is summarized in Table 3.

Table 3. Attitude towards the Factors of SRL's Strategies

Discipline	An Overview of Acceptance				Interpreted
	Statistical		Contributors		
	Mean	S.D.	Accept	Deny	
Forethought Phase (FP):	3.644	0.827	174 (56.12%)	135 (43.88%)	Accepted
Performance Phase (PP):	3.469	0.820	148 (47.90%)	161 (52.10%)	Rejected
Self-Reflection Phase (SP):	3.825	0.891	196 (63.43%)	113 (36.57%)	Accepted

Accept is a score between 4-5 points, while Deny is a score between 1-3 point.

According to Table 3, an overview of the attitude towards the SRL's strategies is shown in the acceptance level. The self-reflection phase is highly accepted with 196 supporters (63.43%). The second is the forethought phase, which has 174 supporters (56.12%). Though the performance phase is rejected, there are 161 non-supporters (52.10%). However, there are nearly half of the respondents or 148 supporters (47.90%). In conclusion, the overall picture of the attitude towards the SRL’ factors is at the acceptable level.

Machine learning technology: At this stage, the data is presented by machine learning. The purpose in this step is to show the groups of similar attitudes toward the SRL's strategies by using clustering techniques called the k-means. k-means is a simple clustering tool. It is used to manage groups of the sample which do not know the answer type [17]. The result of the attitude clustering is the factor towards SRL's strategies as shown in Figure 9 and Table 4.

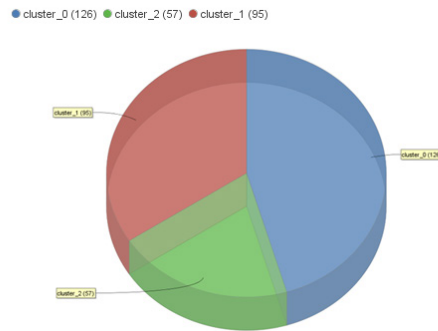


Fig. 9. Clustering an attitude towards the factors of SRL's Strategies

Table 4. Attitude towards the Factors of SRL's Strategies

Cluster	An Overview of Acceptance			Members
	Forethought	Performance	Self-Reflection	
Cluster_0	2.841	3.714	4.143	63
Cluster_1	3.106	2.691	2.883	94
Cluster_2	4.309	3.849	4.276	152

According to Figure 9 and Table 4, it shows that the clustering of perceptions and opinions is separated. The distribution of the centroid in each group is unity while the overall attitude towards the factor, which is the most acceptable.

3.7 Summarizing research results

The analysis of the data obtained from the survey is including statistical analysis and machine learning tools. The overview of Table 2 shows that the respondents are most interested in formal education or accepted 258 respondents. Acceptance of the SRL's strategies in learning is accepted at the medium level, shown in Figure 7. The overall the attitude of the three factors of SRL is accepted level, as shown in Table 3. Furthermore, cluster analysis shows that the distribution of opinions in the same direction, as shown in Figure 8 and Table 4.

4 Research Results and Discussions

Two main issues are required to be discussed including

- The sample collection
- The perceived dimension for the data analysis in different tools.

4.1 Discussions of sample collection

The data gathering also has an uneven distribution. For example, some subjects have less number of respondents (management discipline) while some subjects have a higher number of respondents (accounting discipline) as shown in Table 2. Therefore, the perception dimension and the level of feedback are analyzed towards the SRL's factors. The analysis is done holistically without fragmentary analysis. However, the researcher network is required to be collected a variety of data without bias in the next research.

4.2 Dimensions of perception in data analysis

The primary purpose of using different data analysis tools is to compare the results in different dimensions. It can be seen by the overview of the two tools analysis which is in the same direction. Nevertheless, the results are different in perception.

An important example is the statistical tools analyzed in an overview of all data. It shows that the majority of the respondents pay attention to the accepted level of awareness of SRL's factors, as shown in Table 3. k-means can demonstrate the distribution in each cluster, as shown in Figure 9 and Table 4. Most respondents are interested in the factors of the SRL's strategies, which showed the centroid of each cluster with a high average.

Regarding the differences emphasize the direction and belief of respondents, the inquiry towards SRL's factors. Eventually, the two tools have proved that the re-

spondents accept the factors of the SRL's strategies, as shown in Table 3, Table 4, and Figure 9.

5 Conclusion

This research aims to suggest a process for developing factors which are related to the development of learning styles through the SRL's strategies. The goals are

- To study the perception and attitude toward the attributes of students with self-regulated learning of the students in higher education
- To find the level of acceptance towards the factor of SRL's strategies using applied statistics and machine learning.

The research methodology is based on the scope of the seven steps research procedures including determining the research questions, identifying the population, sampling frame, building tools and validation of tools, gathering data, analyzing data, and summarizing research results. While, the data collection is conducted by the first semester of the academic year 2018 at the University of Phayao with 309 students who enrolled in the Fundamental Information Technology in Business. It includes seven disciplines, which are accounting, business computer, information technology, laws and accounting, management, marketing, and tourism. The results showed that both statistic and machine learning tool could prove the respondent's acceptance in the high level of SRL's factors. The two factors are accepted, especially forethought and self-reflection.

Although the findings of the study are not consistent with the author's assumptions, the style of learning does not necessarily correspond to the behavior of the students. It causes attitudes towards learning, which is relevant to the current educational model of the learner. In future work, authors intend to collect additional data to reduce the bias of the respondents as discussed in the previous section. Besides, authors aim to develop and apply a self-regulated learning strategies model with a combination of collaborative learning strategies for blended learning for undergraduate students.

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7 Acknowledgement

This paper is supported by the University of Phayao, Rajabhat Mahasarakham University, Rajamangala University of Technology Tawan-Ok, and Naresuan University in Thailand. The authors would like to thanks the lecturers, the students, the respondents, the technicians for their entire supports.

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Article submitted 2018-12-24. Resubmitted 2019-01-28. Final acceptance 2019-01-30. Final version published as submitted by the authors.