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ATTITUDE TOWARDS ONLINE LEARNING FROM THE EFFECT OF CORONAVIRUS 2019 DISEASE (COVID-19) OF UNIVERSITY STUDENTS IN THAILAND

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ABSTRACT

The Coronavirus epidemic in 2019 has had a tremendous impact on changing the world. One of the consequences is the change in education system. Therefore, the primary objectives of this research are aimed to study the students' attitude and students' perspective of online learning from the impact of coronavirus disease (COVID-19) of students at Thai universities.

Moreover, the research has three sub-objectives which are (1) to study the students' attitudes and students' acceptance of the online learning management in higher education that is affected by the coronavirus disease (COVID-19) situation, (2) to study the cluster of the students' attitudes and students' acceptance of online learning styles management in higher education that is affected by the coronavirus disease (COVID-19) situation, and (3) to evaluate the cluster of the students' attitudes and students' acceptance of online learning styles management in higher education that is affected by the coronavirus disease (COVID-19) situation. The research sample consisted of an online satisfaction questionnaire totaling 492 respondents from University of Phayao, Rajabhat Mahasarakham University, Maha Sarakham University, Roi Et Rajabhat University, and Rajamangala University of Technology Tawan-Ok: Chakrabongse Bhuvanarth Campus. The results of the study revealed that the respondents from all four accepted online teaching and learning with a high level of satisfaction (3.80: Strongly agree).

In addition, the researchers found that four groups of suitable learning obtained from the CRISP-DM process could be applied to appropriate learning management based on characteristics, attitudes, and perceptions of future learning patterns. For the future, it is imperative to prepare for a modern educational model.

INTRODUCTION

Around the beginning of 2020, Thailand found the coronavirus outbreak 2019 from the Lumpinee Boxing Stadium. The immediate aftermath is the deep suffering of the country's tourism-dependent economy and school closures, with an extended period of time delaying the new semester by six weeks. Planning to return to learning and teaching was changed in mid-May start date for the new semester has been moved to July. For many educational institutions, especially higher education institutions, it has responded to the closure of universities, prompting students and lecturers to shift the educational management process to online distance learning. It severely affected the Thai education system. As mentioned above, the Coronavirus 2019 disease (COVID-19) situation affects every dimension (Grechukhina et al., 2020; Pongpirul et al., 2020). Thailand is severely affected in all contexts, including public health, economy, livelihoods of the population and other areas of Thailand (Joob & Wiwanitkit, 2020; Organization, 2020; Sintema, 2020).

In the dimension of the education system in Thailand, they are all affected by the situation of COVID-19. A prime example is that teaching and learning styles have to be eliminated from the traditional ones. Students will need to use a new learning system through digital technology (P. Nuankaew, 2020; W. Nuankaew & Nuankaew, 2020). The consequence is that the technology cannot catch up with the people, the expenses that need to find the learning tools and materials. In addition, the important problem is the internet network system that is not covered in rural areas. It is counter to the history of Thailand's educational management system that the education system in Thailand was primarily physical, with most of the education being conducted in educational institutions such as schools, colleges, learning centers and universities. These institutions formally formulate both formal, informal, and non-formal education models in accordance with the National Education Act

1999 (Commission, 1999, 2003; Navy, 2013; Puncreobutr, 2016). Where these educational models have been developed and improved for a long time (Commission, 1999, 2003; Kantavong & Nethanomsak, 2012).

However, public education cannot wait. It is urgently necessary to study and collect background data to design and plan the education process of people in Thailand during the COVID-19 epidemic and to prevent future management of the problem. It is therefore the origin and importance of this research.

RESEARCH OBJECTIVES

The primary objectives of this research are aimed to study the students' attitude and students' perspective of online learning from the impact of coronavirus disease (COVID-19) of students at Thai universities. Moreover, the research has three sub-objectives which are (1) to study the students' attitudes and students' acceptance of the online learning management in higher education that is affected by the coronavirus disease (COVID-19) situation, (2) to study the cluster of the students' attitudes and students' acceptance of online learning styles management in higher education that is affected by the coronavirus disease (COVID-19) situation, and (3) to evaluate the cluster of the students' attitudes and students' acceptance of online learning styles management in higher education that is affected by the coronavirus disease (COVID-19) situation.

RESEARCH APPROACH

The research approach is divided into two phases as follows: The first phase is to study and collect data for use in basic statistical analysis which consists of percentage, average, and standard deviation. The second phase is the study and analysis with data mining and machine learning tools, which consist of k-Means classification, and finding optimal k value with k-Determination methods (P. Nuankaew & Temdee, 2019).

The data collection consists of student data from five universities in Thailand: University of Phayao, Rajabhat Mahasarakham University, Maha Sarakham University, and Roi Et Rajabhat University, and Rajamangala University of Technology Tawan-Ok: Chakrabongse Bhuvanarth Campus. The research methodology has conducted research according to the process of the CRISP-DM model (Chapman et al., 2000; Huber et al., 2019; Wirth & Hipp, 2000). It consists of six steps: business understanding, data understanding, data preparation, modelling, evaluation, and deployment.

MATERIALS AND METHODS

The materials and methods of this research are divided into two main sections: research materials and research methods.

RESEARCH MATERIALS

The research materials are divided into three sections: research population, research sample, and research tool. The research population was organization executives, lecturers, staff, and students who have previously managed online learning from five universities during the first semester of the academic year

2020. The population scope for the research was five universities, which consist of University of Phayao, Rajabhat Mahasarakham University, Maha Sarakham University, Roi Et Rajabhat University, and Rajamangala University of Technology Tawan-Ok: Chakrabongse Bhuvanarth Campus.

The research sample consisted of an online satisfaction questionnaire totaling 492 respondents. It consists of 255 respondents from University of Phayao, 171 respondents from Rajabhat Mahasarakham University, 47 respondents from Maha Sarakham University, 13 respondents from Roi Et Rajabhat University, and 6 respondents from Rajamangala University of Technology Tawan-Ok: Chakrabongse Bhuvanarth Campus.

Satisfaction criteria were assessed with the Likert scale as detailed following: A score of 5 indicates that the respondent has the highest level of satisfaction or acceptance. A score of 4 indicates that the respondent has high level of satisfaction or acceptance. A score of 3 indicates that the respondent has moderate level of satisfaction or acceptance. A score of 2 indicates that the respondent has low level of satisfaction or acceptance. A score of 1 indicates that the respondent has the lowest level of satisfaction or acceptance.

While the interpretation is carried out from the following definition: The score range between 4.21 - 5.00 can be interpreted as the overall satisfaction and attitude in the strongly agree with issues and questions. The score range between 3.41 - 4.20 can be interpreted as the overall satisfaction and attitude in the agree with issues and questions. The score range between 2.61 - 3.40 can be interpreted as the overall satisfaction and attitude in the neither agree nor disagree with issues and questions. The score range between 1.81 - 2.60 can be interpreted as the overall satisfaction and attitude in the disagree with issues and questions. The score range between 1.00 - 1.80 can be interpreted as the overall satisfaction and attitude in the strongly disagree with issues and questions.

The research tool is an online questionnaire where all the issues and questions are shown in Table 1.

Table 01 Issues and Topics of the Questionnaire

Issues	**Questions**
Stage 1: Institutional Readiness Dimension for COVID 19 Scenario	
Stage 1.1	The online learning management policy of universities is appropriate for the situation and epidemic prevention of 2019 coronavirus.
Stage 1.2	The online learning approach of universities is appropriate for the situation and epidemic prevention of 2019 coronavirus.
Stage 1.3	Learners and instructors are clarified by the university for their support and preparation for the online learning management.
Stage 1.4	The university provides grievance and coordination channels for solving problems related to online learning management.

Stage 1.5	The satisfaction with the university's preparation for online learning management policy of educational institutions.
Stage 2: Dimensions of Timing, Environment, and Communication for COVID 19 Scenario	
Stage 2.1	The duration of the online instructional course is appropriate to the situation of the 2019 coronavirus.
Stage 2.2	The environment of the online instructional course is appropriate to the situation of the 2019 coronavirus.
Stage 2.3	The communication of the online instructional course is appropriate to the situation of the 2019 coronavirus.
Stage 3: Instructor Readiness Dimension for COVID 19 Scenario	
Stage 3.1	Instructors are ready to use online teaching materials.
Stage 3.2	Instructors have the ability to solve various problems during online learning to ensure continuity of learning.
Stage 3.3	Instructors have planned an online teaching preparation in advance.
Stage 3.4	Instructors have the ability to pass on knowledge, enabling learning in the subject matter.
Stage 3.5	The instructors are knowledgeable in the subject they teach as well.
Stage 3.6	The instructors are very cognizant of the changing science and technology.
Stage 3.7	The instructors are friendly, give advice and listen to opinions.
State 4: Learning Management and Activities Readiness Dimension for COVID 19 Scenario	
Stage 4.1	The teaching and learning process has created knowledge and understanding in line with the objectives and goals of educational management.
Stage 4.2	The teaching and learning process emphasized the participation of learners in line with the objectives and goals of educational management.
Stage 4.3	The teaching and learning process used materials and innovative technology to enhance learners in line with the objectives and goals of educational management.
Stage 4.4	The teaching and learning process invited experts and communities to participate in learning activities to promote learner experiences.
Stage 4.5	The teaching and learning process used a variety of teaching methods suitable for the subject matter learned.
Stage 4.6	The teaching and learning process has activities that encourage learners to develop thinking processes, discussion, questioning, and expressing opinions.
Stage 4.7	The teaching and learning process has organized activities to encourage students to learn on their own.
Stage 4.8	The teaching and learning process has activities to promote research and knowledge continuously.
Stage 4.9	The teaching and learning process has activities to promote

	the use of English language and retrieval of knowledge.
Stage 4.10	The teaching and learning process has activities that are linked and integrated with the academic services for society, research, art and culture.
Stage 5: Assessment and Evaluation Readiness Dimension for COVID 19 Scenario	
Stage 5.1	Instructional management uses a variety of techniques, measurement, and evaluation methods.
Stage 5.2	Instructional management uses effective techniques, measurement, and evaluation methods.
Stage 5.3	Instructional management has an assessment of teaching and learning results in accordance with the learning activities provided to the learner and is based on the learner's development.
Stage 5.4	Instructional management has been answered and guidance of the answer knows the learning outcome
Stage 5.5	Instructional management has disclosed the scores obtained from the assessment.
Stage 5.6	Instructional management provides feedback leading to personal development.
Stage 5.7	Instructional management are measured and evaluated with clarity and fairness.
Stage 6: Instructional Support Factors Readiness Dimension for COVID 19 Scenario	
Stage 6.1	Educational institutions have provided classrooms, libraries, and learning spaces to facilitate learning in an appropriate and sufficient.
Stage 6.2	Educational institutions have provided online materials to facilitate learning in an appropriate and sufficient.
Stage 6.3	Educational institutions have provided physical materials to facilitate learning in an appropriate and sufficient.
Stage 6.4	Educational institutions provide research publications and dissertations to facilitate learning in an appropriate and sufficient.
Stage 6.5	Educational institutions have provided computer and printer materials to facilitate learning in an appropriate and sufficient.
Stage 6.6	Educational institutions have provided communication network materials to facilitate learning in an appropriate and sufficient.

Table 1 shows the issues and questions used in the online questionnaire. It consists of six stages and thirty-eight questions. The online questionnaire is presented on the Internet through the website: https://bit.ly/35Sg7Jg. Where the data collected is presented on the website: https://bit.ly/2Ks2mZy. Details of the data that were collected are summarized and presented in Tables 2 to Table 4.

RESEARCH METHODS

The research methods were carried out according to the Cross Industry Standard Process for Data Mining principles, known as CRISP-DM. There are six phases of CRISP-DM methodology: Business Understanding, Data Understanding, Data Preparation, Modeling, Evaluation, and Deployment.

BUSINESS UNDERSTANDING

The business understanding phase is the initial stage necessary for finding business problems. It usually comes with a situation, a policy, a global impact, and personal interests. What is gained from this phase is the purpose or goal that is desired from the operation.

In this research, the research problem formulation arises from the situation affected by the education system caused by the Coronavirus 2019 (Covid-19) epidemic situation in universities. The immediate and serious impact on the Thai education system is the inability to provide a normal education at the universities. It is essential to organize the educational process through online media.

After Thailand has been able to control the spread of the Coronavirus (Covid-19) disease, many universities have returned to conduct regular studies. It organizes the teaching and learning process at the universities. Therefore, to prepare for situations that can arise unexpectedly. The researchers, therefore, conducted research to prepare for the epidemic Coronavirus 2019 (Covid-19) second around in the future.

DATA UNDERSTANDING

Data understanding phase is directly related to understanding a research problem or business problem, which was the previous phase. The key to this section is to understand the source of the data. Typically, it contains of four components: data collection report, data description report, data exploration report, and data quality report (Chapman et al., 2000; Huber et al., 2019; P. Nuankaew, 2019; Wirth & Hipp, 2000).

In this research, data understanding is the study of perceptions and attitudes towards new styles of learning with online learning. The most important thing when changing learning styles is self-regulated learning (P. Nuankaew, 2020). By learning through a network or online learning system, students have the opportunity to lose their interest in learning, even if the content of the lesson is perfect. It is for this reason that the researcher harnesses the input from the students, the classroom activities organized through the virtual world. The event is an activity that learners and instructors performed simultaneously.

DATA PREPARATION

The main purpose of the data preparation phase is to be used to develop the complete model (Chapman et al., 2000; Huber et al., 2019; Wirth & Hipp, 2000). It involves defining a data structure for gathering activities to be concluded in the selection of tools for model development. There are five sub-

steps to data preparation: select data, clean data, construct data, integrate data, and format data (Chapman et al., 2000; Wirth & Hipp, 2000).

In this research, the preparation of data is to prepare students from four courses from two universities. It consists of course 221110 Fundamental Information Technology in Business, 221203 Technology for Business Application from University of Phayao, course 7000103 Mathematic and Statistics for Information Technology, and course 7011303 Data Warehouse and Data Mining from Rajabhat Mahasarakham University. In addition, the researchers collected data through a collaborative network of researchers from the Maha Sarakham University, Roi Et Rajabhat University, and the Rajamangala University of Technology Tawan-Ok: Chakrabongse Bhuvanarth Campus.

MODELING

In the modeling phase, there are various modeling techniques that are selected and applied with the technical parameters to obtain the optimum values and objectives. There are four elements: select modeling technique, generate test design, build model, and assess model (Chapman et al., 2000; Wirth & Hipp, 2000).

According to research objectives there are three objectives. It is necessary to select the appropriate tools for the research objectives that are defined. For the first objective, the most appropriate tool selected is the basic statistical tool. It consists of the frequency, percentage, mean, standard deviation, and interpretation where the analysis results are shown in Table 2 to Table 5.

While the second objective, it is more complicated. It is therefore necessary to use analytical data mining tools to cluster learners appropriately based on their attitudes and perceptions towards online teaching and learning management. The tools are used by the k-Mean (Hamerly & Drake, 2015). The reason why this tool was chosen was because it was an appropriate clustering analysis. The k-Mean clustering is a method for determining the area of the partition. It is intended to divide n observations into k clusters where each observation belongs to the cluster with the nearest mean. After getting the number of clusters, it gives the center point of each cluster. The cluster center (knows as average within centroid value) acts as a prototype of the cluster, resulting in the division of data areas into partitions. The average within centroid value also serves as the prototype of the cluster and is used to assign clusters to new members.

Finally, the last objective is intended to find the optimal number of clusters. The chosen tool is called the k-Determination (P. Nuankaew & Temdee, 2019). It is explained the principles and necessity of the method in the evaluation phase.

EVALUATION

The key to the evaluation is to review what has been done. This evaluation phase is therefore a review of the developed models before to their

deployment. The process of the assessment phase therefore consists of three parts: evaluate results, review process, and determine next steps (P. Nuankaew & Temdee, 2019).

In this research, the evaluation phase is the answer to the third research objective. The principle and instrument called k-Determination, which is the principle of selecting the appropriate k-Value (P. Nuankaew & Temdee, 2019). It is based on the elbow principle of decision making. The principle of performing a k-Determination is to use a graph in determining the point where the graph is shifting strongly from vertical to horizontal or horizontal to vertical (P. Nuankaew & Temdee, 2019). An example of appropriate k-Value with k-Determination as shown in Figure 1.

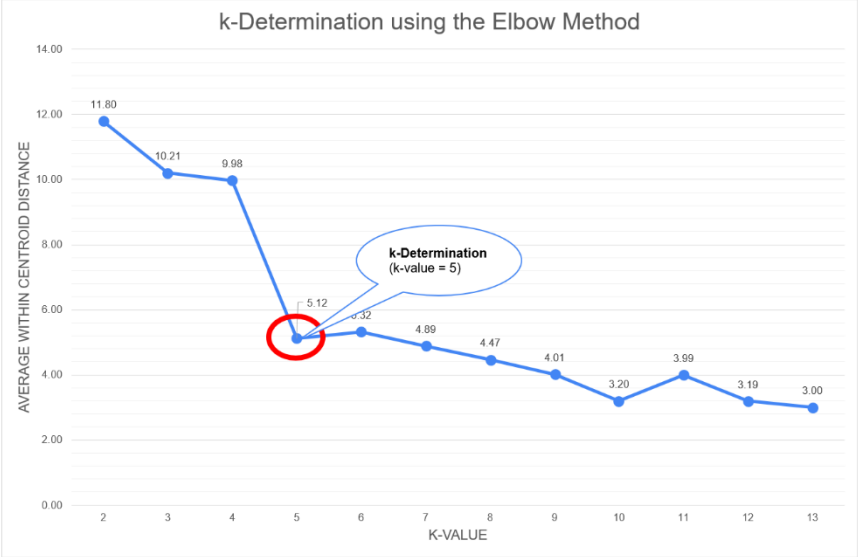

Fig. 1. k-Determination

From Figure 1, it can be seen that the k-Value has a sudden change in k = 5. Therefore, it can be concluded that the k-Value should be used in the development of the model as k = 5.

DEPLOYMENT

The final phase of the CRISP-DM process is the deployment. It is known that the knowledge gained must be organized and presented in a way that can be used by the user (Chapman et al., 2000; P. Nuankaew, 2020; Wirth & Hipp, 2000). In many cases, the user is not a data analyst who will execute the deployment phase. At the same time, it is based on the need to deploy the process and requirements of the relevant stakeholders may need to be as simple or complex reports, establish the basis for the use of data mining process in the future. There are four components: plan deployment, plan monitoring and maintenance, produce final report, and review project (Chapman et al., 2000; Wirth & Hipp, 2000).

In this research, the researchers directly report to the executive committee to plan for second round of the Covid-19. Deployment is to create a management plan in preparation for an education system that might have been affected by the outbreak of a new round corona virus.

RESULTS AND DISCUSSION

Research results and research discussion divide the content of the report into two sections: The first section is the reporting of research results. It consists of reporting of data collection, analysis of attitudes and perceptions towards the online teaching and learning process during the Coronavirus 2019 disease (COVID-19) pandemic, and an appropriate cluster of the learners. The second part is to discuss the findings of the research collected, and to analyze the data as designed.

RESEARCH RESULTS

Research results are divided into three reports: report of the data collection, report of the attitudes and perceptions towards the online teaching and learning process during the Coronavirus 2019 disease (COVID-19) pandemic, and report of the appropriate cluster of the learners.

Report of the data collection

The data collection is a data set of 492 organization executives, lecturers, staff, and students who have previously managed online learning from five universities during the first semester of the academic year 2020. There are four educational institutions: Rajabhat Mahasarakham University (RMU), Maha Sarakham University (MSU), Roi Et Rajabhat University (RERU), and Rajamangala University of Technology Tawan-Ok: Chakrabongse Bhuvanarth Campus (CPC), and University of Phayao (UP). The data gathered from online questionnaires, which is used as a compiling tool, where the online questionnaire manuscript files are displayed, are uploaded into the website: https://bit.ly/3eAlhwj.

The questionnaire consists of three parts: The first part is the inquiry of the general information of the respondents. The second part is the satisfaction survey on the management of online instruction on the impact of the coronavirus 2019 (COVID-19) situation. The third part is the feedback from the respondents. The data collected were analyzed and classified according to the research issue as shown in Table 2 to Table 4.

Table 02 Data collected classify by gender and education level

Data Collected	Bachelor's degree	Master's degree	Doctorate's degree	Total
Male	177 (35.98%)	3 (0.61%)	14 (2.85%)	194 (39.43%)
Female	282 (57.32%)	8 (1.63%)	8 (1.63%)	298 (60.57%)
Total	459 (93.29%)	11 (2.24%)	22 (4.47%)	492 (100%)

Table 2 shows the data collected classified by gender and education level, with a total of 492 respondents. The data showed that respondents were more female than male. The proportion of respondents was 298 females per 194 males, or equivalent to 60.57% per 39.43%. While most of the respondents had a bachelor's degree, with 459 respondents (93.29%).

Table 03 Data collected classify by career and related academic disciplines

Data Collected	Organization Executives	Lecturer	Staff	Student	Total
Social Science	2 (0.41%)	12 (2.44%)	3 (0.61%)	179 (36.38%)	196 (39.84%)
Science and Technology	1 (0.20%)	10 (2.03%)	1 (0.20%)	277 (56.30%)	289 (58.74%)
Health Science	0	2 (0.41%)	0	5 (1.02%)	7 (1.42%)
Total	3 (0.61%)	24 (4.88%)	4 (0.81%)	461 (93.70%)	492 (100%)

Table 3 shows the data collected classified by status and related academic disciplines, with a total of 492 respondents. The data showed that most respondents were student with 461 respondents, or equivalent to 93.07%. Most of the respondents were majoring in science and technology, with 289 respondents or equivalent to 58.74%.

Table 04 Data collected classify by university and academic year

Data Collected	1st year	2nd year	3rd year	4th year	Graduate	Total
CPC:	0	0	0	0	6 (1.22%)	6 (1.22%)
MSU:	15 (3.05%)	9 (1.83%)	9 (1.83%)	5 (1.02%)	9 (1.83%)	47 (9.55%)
RERU:	3 (0.61%)	0	1 (0.20%)	0	9 (1.83%)	13 (2.64%)
RMU:	73 (14.84%)	19 (3.86%)	74 (15.04%)	2 (0.41%)	3 (0.61%)	171 (34.76%)
UP:	127 (25.81%)	89 (18.09%)	25 (5.08%)	10 (2.03%)	4 (0.81%)	255 (51.83%)
Total	218 (44.31%)	117 (23.78%)	109 (22.15%)	17 (3.46%)	31 (6.30%)	492 (100%)

UP: University of Phayao, RMU: Rajabhat Mahasarakham University, MSU: Maha Sarakham University,
RERU: Roi Et Rajabhat University, CPC: Rajamangala University of Technology Tawan-Ok: Chakrabongse Bhuvanarth Campus,

Table 4 shows the data collected classified by university and academic year, with a total of 492 respondents. The data showed that most respondents were students from the University of Phayao with 255 respondents, or equivalent to 51.83%. Most of the respondents were in their 1st academic year, with 218 respondents or equivalent to 44.31%.

Report of the attitudes and perceptions towards the online teaching and learning process during the Coronavirus 2019 disease (COVID-19) pandemic.

After summarizing the general information of the respondents, the second part is the satisfaction survey on the management of online instruction on the impact of the coronavirus 2019 (COVID-19) situation. It consists of six stages: stage 1 is institutional readiness dimension for COVID 19 scenario, stage 2 is dimensions of timing, environment, and communication for COVID 19 scenario, stage 3 is instructor readiness dimension for COVID 19 scenario, state 4 is learning management and activities readiness dimension for COVID 19 scenario, stage 5 is assessment and evaluation readiness dimension for COVID 19 scenario, and stage 6 is instructional support factors readiness dimension for COVID 19 scenario. The details are shown and summarized in Table 5.

Table 05 Satisfaction with online learning management on the impact of COVID-19

Stage / Issue	**Ranking Level**					**Mean**	**S.D.**	**Interpretation**
	1	**2**	**3**	**4**	**5**			
Stage 1: Institutional Readiness Dimension for COVID 19 Scenario								
Stage 1.1	12	33	140	181	129	3.77	0.99	Agree
Stage 1.2	8	32	139	186	130	3.80	0.96	Agree
Stage 1.3	10	37	151	170	127	3.74	0.99	Agree
Stage 1.4	12	56	159	165	103	3.59	1.02	Agree
Stage 1.5	15	40	156	177	107	3.65	1.00	Agree
Average	*11.40*	*39.60*	*149.00*	*175.80*	*119.20*	*3.70*	*0.99*	*Agree*
Stage 2: Dimensions of Timing, Environment, and Communication for COVID 19 Scenario								
Stage 2.1	6	26	163	191	109	3.75	0.90	Agree
Stage 2.2	7	38	159	193	98	3.68	0.92	Agree
Stage 2.3	10	40	170	165	110	3.65	0.98	Agree
Average	*7.67*	*34.67*	*164.00*	*183.00*	*105.67*	*3.69*	*0.93*	*Agree*

Stage 3: Instructor Readiness Dimension for COVID 19 Scenario								
Stage 3.1	4	32	127	193	139	3.87	0.92	Agree
Stage 3.2	5	29	145	205	111	3.78	0.89	Agree
Stage 3.3	4	22	120	186	163	3.97	0.91	Agree
Stage 3.4	4	17	133	196	145	3.93	0.88	Agree
Stage 3.5	3	10	109	198	175	4.08	0.84	Agree
Stage 3.6	2	17	127	206	143	3.95	0.85	Agree
Stage 3.7	3	13	119	195	165	4.02	0.86	Agree
Average	*3.57*	*20.00*	*125.71*	*197.00*	*148.71*	*3.94*	*0.88*	*Agree*
State 4: Learning Management and Activities Readiness Dimension for COVID 19 Scenario								
Stage 4.1	3	16	142	212	122	3.88	0.84	Agree
Stage 4.2	6	22	164	186	117	3.78	0.90	Agree
Stage 4.3	3	20	166	182	124	3.82	0.88	Agree
Stage 4.4	7	34	167	177	110	3.70	0.94	Agree
Stage 4.5	5	28	168	178	116	3.75	0.91	Agree
Stage 4.6	2	35	148	184	126	3.80	0.91	Agree
Stage 4.7	2	23	163	179	128	3.82	0.88	Agree
Stage 4.8	3	31	153	175	133	3.82	0.92	Agree
Stage 4.9	6	28	185	170	106	3.69	0.91	Agree
Stage 4.10	10	23	181	181	100	3.68	0.91	Agree
Average	*4.70*	*26.00*	*163.70*	*182.40*	*118.20*	*3.77*	*0.90*	*Agree*
Stage 5: Assessment and Evaluation Readiness Dimension for COVID 19 Scenario								
Stage 5.1	4	31	156	173	131	3.80	0.93	Agree
Stage 5.2	5	27	151	184	128	3.81	0.92	Agree
Stage 5.3	3	28	155	199	110	3.78	0.88	Agree
Stage	5	20	167	187	116	3.78	0.90	Agree

5.4								
Stage 5.5	3	22	153	180	137	3.86	0.90	Agree
Stage 5.6	3	21	175	181	115	3.77	0.87	Agree
Stage 5.7	1	19	152	185	138	3.89	0.86	Agree
Average	*3.43*	*24.00*	*158.43*	*184.14*	*125.00*	*3.81*	*0.89*	*Agree*
Stage 6: Instructional Support Factors Readiness Dimension for COVID 19 Scenario								
Stage 6.1	3	18	138	198	138	3.91	0.87	Agree
Stage 6.2	3	24	157	194	117	3.80	0.87	Agree
Stage 6.3	5	23	179	169	119	3.75	0.91	Agree
Stage 6.4	5	26	174	173	117	3.75	0.91	Agree
Stage 6.5	10	29	192	146	118	3.67	0.97	Agree
Stage 6.6	10	25	165	175	120	3.75	0.95	Agree
Average	*6.00*	*24.17*	*167.50*	*175.83*	*121.50*	*3.77*	*0.92*	*Agree*
Summary						**3.80**	**0.92**	Agree

Table 5 shows the data analysis compiled according to statistical principles: frequency, percentage, mean, standard deviation (S.D.), and interpretation. The results of the analysis showed that the respondents had a 'highest satisfied' level with Stage 3: Instructor Readiness Dimension for COVID 19 Scenario, with a total average of 3.94 (Strongly agree). While the second most favored dimension was Stage 5: Assessment and Evaluation Readiness Dimension for COVID 19 Scenario, with an overall average of 3.81 (Strongly agree). The third satisfied dimension was Stage 6: Instructional Support Factors Readiness Dimension for COVID 19 Scenario, with an overall average of 3.77 (Strongly agree). The fourth satisfied dimension was Stage 4: Learning Management and Activities Readiness Dimension for COVID 19 Scenario, with an overall average of 3.77 (Strongly agree). The fifth satisfied dimension was Stage 1: Institutional Readiness Dimension for COVID 19 Scenario, with an overall average of 3.70 (Strongly agree). The last satisfied dimension was Stage 2: Dimensions of Timing, Environment, and Communication for COVID 19 Scenario, with an overall average of 3.69 (Strongly agree).

Finally, the overall satisfaction from the questionnaire was the highly average (3.80: Strongly agree) out of 492 respondents. The next step is to cluster the respondents according to their attitude towards different dimensions to develop the models of online learning strategies for Thai students on learning management in the Coronavirus 2019 scenario.

Report of the appropriate cluster of the learners

The steps for finding the appropriate cluster of the learners are k-Means clustering as composed of four stages (Hamerly & Drake, 2015): (1) The first stage is determining the number of groups to cluster the data by replacing the value with k. (2) The second stage is the algorithm that calculates the center value of each cluster, known as the centroid. (3) The third stage is to calculate the distance from the various data points (data sets) to the center. The data is clustered with the nearest center point. Calculating distance from a data point with Centroid using a formula (1), known as the Euclidean Distance. (4) The last stage is to find the mean of each cluster to redefine the center, then the third stage is repeated until the mean or center does not change.

Formula >

$$d(\mathbf{p}, \mathbf{q}) = \sqrt{\sum_{i=1}^{n} (q_i - p_i)^2}$$

p, q = two points in Euclidean n-space
q_i, p_i = Euclidean vectors, starting from the origin of the space (initial point)
n = n-space

To determine the consistency of k-Value in this research, the k-Determination was selected. The principle of k-determination operation is known as the elbow principle, using graphs in consideration by choosing the point where the graph is shifting strongly from vertical to horizontal or horizontal to vertical (P. Nuankaew & Temdee, 2019). The results are separated into two reports: the appropriate k-Value, and the centroid report for each cluster.

Appropriate k-Value

The appropriate k-Value was divided into two parts: the first part is the appropriate k-Value analysis as shown in Figure 2. The second part is the k-Value analysis results as shown in Table 6.

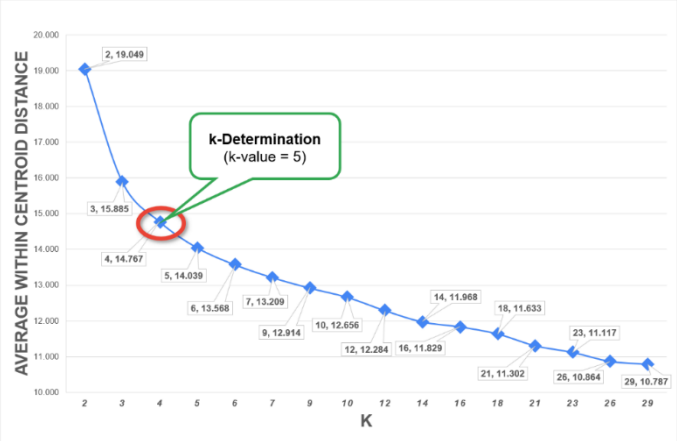

Fig. 2. The Appropriate k-Value

Figure 2 shows the appropriate k-Value. It found that the k-Value should be developed in the models of online learning strategies for Thai students on learning management in the coronavirus 2019 scenario: k-Value is equal to 4. The reasons for the selection of k-Value equal to 4 are shown in Figure 2 and Table 6.

Table 06 Average within Centroid Distance

k-Value	**ACD**	**k-Value**	**ACD**	**k-Value**	**ACD**
k-Value = 2	19.049	k-Value = 3	15.885	**k-Value = 4***	**14.767***
k-Value = 5	14.039	k-Value = 6	13.568	k-Value = 7	13.209
k-Value = 8	13.200	k-Value = 9	13.038	k-Value = 10	12.681
k-Value = 12	12.142	k-Value = 14	12.233	k-Value = 16	11.780
k-Value = 19	11.519	k-Value = 22	11.271	k-Value = 25	11.026
k-Value = 29	10.822				

ACD: Average within Centroid Distance

It was concluded that the data from the respondents should be categorized for the satisfaction with the teaching and learning of five groups. The researcher summarized the centroid value in Table 6.

Centroid report for each cluster

The centroid reports for each cluster by k-Value are summarized and displayed as shown in Table 7.

Table 07 Summary of centroid values in each cluster

Attributes / Clusters / Centroid Values	**Cluster_0**	**Cluster_1**	**Cluster_2**	**Cluster_3**
Stage 1: Institutional Readiness Dimension for COVID 19 Scenario				
Stage 1.1	2.067	4.643	3.933	3.038
Stage 1.2	2.200	4.667	3.938	3.101
Stage 1.3	2.000	4.651	3.907	2.975
Stage 1.4	2.200	4.611	3.575	2.911
Stage 1.5	1.867	4.651	3.705	2.943
Stage 2: Dimensions of Timing, Environment, and Communication for COVID 19 Scenario				
Stage 2.1	2.067	4.651	3.829	3.089
Stage 2.2	2.333	4.579	3.808	2.930
Stage 2.3	2.067	4.571	3.798	2.899

Stage 3: Instructor Readiness Dimension for COVID 19 Scenario				
Stage 3.1	2.000	4.690	4.062	3.158
Stage 3.2	1.933	4.611	3.886	3.171
Stage 3.3	2.333	4.841	4.073	3.316
Stage 3.4	2.067	4.770	4.016	3.335
Stage 3.5	2.400	4.810	4.114	3.601
Stage 3.6	2.267	4.786	3.979	3.411
Stage 3.7	2.267	4.810	4.083	3.487
State 4: Learning Management and Activities Readiness Dimension for COVID 19 Scenario				
Stage 4.1	2.133	4.722	3.974	3.247
Stage 4.2	1.933	4.778	3.839	3.082
Stage 4.3	2.200	4.738	3.876	3.158
Stage 4.4	2.067	4.714	3.705	3.051
Stage 4.5	2.067	4.754	3.772	3.082
Stage 4.6	2.200	4.738	3.896	3.089
Stage 4.7	2.067	4.746	3.917	3.139
Stage 4.8	2.333	4.754	3.938	3.057
Stage 4.9	2.333	4.643	3.725	3.013
Stage 4.10	2.267	4.690	3.699	2.987
Stage 5: Assessment and Evaluation Readiness Dimension for COVID 19 Scenario				
Stage 5.1	2.000	4.794	3.855	3.108
Stage 5.2	2.133	4.770	3.912	3.089
Stage 5.3	2.067	4.667	3.891	3.089
Stage 5.4	2.133	4.635	3.829	3.209
Stage 5.5	2.467	4.675	3.969	3.209
Stage 5.6	2.133	4.635	3.881	3.114
Stage 5.7	2.333	4.754	3.969	3.247
Stage 6: Instructional Support Factors Readiness Dimension for COVID 19 Scenario				
Stage 6.1	2.467	4.706	3.990	3.310
Stage 6.2	2.000	4.714	3.865	3.171
Stage 6.3	2.000	4.762	3.751	3.120
Stage 6.4	2.133	4.698	3.808	3.070
Stage 6.5	2.133	4.643	3.632	3.089
Stage 6.6	2.000	4.683	3.725	3.190

Table 7 shows a summary of centroid values in each cluster. It shows the distribution of each cluster in detail. The next part is to develop the model and select significant features for predicting the clustering of respondents based on their attitude and satisfaction.

RESEARCH DISCUSSION

Research discussion are divided into two perspectives: discussion of the data collection, discussion of the appropriate cluster of the learners.

DISCUSSION OF THE DATA COLLECTION

The data was collected from an online questionnaire with a total of 492 respondents were classified into five universities. It consists of 255 respondents from University of Phayao, 171 respondents from Rajabhat Mahasarakham University, 47 respondents from Maha Sarakham University, 13 respondents from Roi Et Rajabhat University, and 6 respondents from Rajamangala University of Technology Tawan-Ok: Chakrabongse Bhuvanarth Campus. The respondents consisted of organization executives, lecturers, staff, and students who have previously managed online learning from five universities during the first semester of the academic year 2020. The summarization information shown in Tables 2 to Table 5 provides complete descriptions of the data collection.

By collecting the data, the researchers found that the respondents in control were largely cooperative, with the investigators organizing four-course assessment activities: 221110 Fundamental Information Technology in Business, 221203 Technology for Business Application from University of Phayao, course 7000103 Mathematic and Statistics for Information Technology, and course 7011303 Data Warehouse and Data Mining from Rajabhat Mahasarakham University. It results in the use of the collected data to be analyzed for specific applications for future research.

Discussion of the appropriate cluster of the learners

From the analysis for appropriate clustering, the researchers found that the research process selected by the researchers were extremely appropriate. It can present a logical and effective method of clustering. It can be used in the future for learners who are expected to be affected by uncommon situations, they can take online questionnaires, and the lecturer can effectively group appropriate learning with learners. Moreover, administrators can plan the teaching and learning group according to the changing learning situation.

CONCLUSIONS

The primary objectives of this research are aimed to study the students' attitude and students' perspective of online learning from the impact of coronavirus disease (COVID-19) of students at Thai universities. In addition, the research has three sub-objectives which are (1) to study the students' attitudes and students' acceptance of the online learning management in higher education that is affected by the coronavirus disease (COVID-19) situation, (2) to study the cluster of the students' attitudes and students' acceptance of online learning styles management in higher education that is affected by the coronavirus disease (COVID-19) situation, and (3) to evaluate the cluster of the students' attitudes and students' acceptance of online learning styles management in higher education that is affected by the coronavirus disease (COVID-19) situation.

The research sample consisted of an online satisfaction questionnaire totaling 492 respondents from University of Phayao, Rajabhat Mahasarakham University, Maha Sarakham University, Roi Et Rajabhat University, and Rajamangala University of Technology Tawan-Ok: Chakrabongse Bhuvanarth Campus. The results of the study revealed that the respondents from all four accepted online teaching and learning with a high level of satisfaction (3.80: Strongly agree).

According to the objectives, research is successful in all research goals. Where the first objective, the researchers discovered the attitudes that learners had in the provision of online learning, summarizing the mean values and points of interest as shown in Table 5. While the second objective, the researcher found a suitable number of clusters to group learning to construct appropriate learning based on attitudes and perceptions as shown in Figure 2 and Table 6. Finally, the last objective was achieved as research can find the value of average within centroid distance which the cluster could be assessed for the new member. For the future, it is imperative to prepare for a modern educational model.

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