Online Learning Management During COVID-19 Pandemic: A Case Study of Geoinformatics Course Based on Cloud Application

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Abstract – During the circumstance in which people worldwide have to encounter and deal with COVID-19, there are great impacts on learning management that require adjustment and implementation of the online learning system. Advance technologies in the modern world facilitate the students at the higher education level to learn via the online system. However, problems and limitations on online learning are recognized; for example, it is more difficult to use the active learning approach than in the actual classroom, and the instructional strategies and patterns should be more varied to encourage the learners to focus on the lesson. Therefore, this research proposed the learning management by applying online learning to Geoinformatics with streaming and video-based learning approach via Cloud application and other tools in order to activate the learner to be enthusiastic, express their opinions, and participate in the activities which would enhance their achievement. Research results showed that most learners (more than 90%) had learning achievement at good and very good level when learning with the proposed learning management approach.

Furthermore, such a proposed approach minimized the problems concerned with insufficiency of the quality computers since the learners were able to use any type of device and operating system.

Keywords – COVID-19, Online Learning, GIS

1. Introduction

During the past year, from the beginning of 2020, the number of COVID-19 cases worldwide has increased dramatically and it affects the living of people who have to adjust their way of life [1], such as practice the social distancing, stop the unnecessary traveling, work from home, and the learning management of all levels from the primary and secondary school to the higher education that has to apply online learning instead of on-site learning [2] [3]. In particular, when the great number of the cases increases in the country, the pandemic control or the risk management are necessary, Ministry of Education, Ministry of Higher Education, Science, Research and Innovation, and the universities has set the policy of learning management applying online learning approach [4], [5], by which learners can learn from home or dormitory without traveling to the educational institutes which is one of the measures to mitigate the risk of COVID-19 and the pandemic among the learners and educational personnel. With the online learning approach, the learner will be able to learn from home or anywhere. Current technologies ease the learner to interact with the teacher as the two-way communication. Moreover, the learning is possible anytime with the video-based learning or streaming with the video [6], [7]. Anyway, there are some restrictions on online learning because it requires the computer or mobile device, and the internet network. With such limitations, the affected group of learners is the learners who are in primary and secondary schools and some higher education [8], [9]. Moreover, other limitations include the difficulty in applying active learning and the need of various learning strategies and methods to encourage the learner to concentrate on the lesson.

Nevertheless, when studying the limitations on the learning computer and information technology courses online, which most courses combine the theory and practical session, the learning

DOI: 10.18421/TEM103-14

<https://doi.org/10.18421/TEM103-14>

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Received: 22 March 2021.

Revised: 07 July 2021.

Accepted: 12 July 2021.

Published: 27 August 2021.

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management and problems and limitations are as same as those of other courses; the learner lacks of motivation and does not concentrate on the lesson [10], [11]. For the different aspect, which is mostly found in the computer lab, is that the learner cannot catch up with the teacher or does not dare to let the teacher knows when they have problem. Consequently, they gain insufficient knowledge including further understanding of the following chapter. Moreover, the learner is bored and does not want to attend the class, which they will be finally unable to apply it to the practical work [12], [13]. With the advancement of computer technology and network system, there are numbers of software for the teacher to apply to the active learning approach and interact with the learner. It would minimize such limitations mentioned earlier. This research proposed the online learning approach for GIS Application Development course applying the software and various tools, such as Zoom Meeting, Google Classroom, Socrative.com, Wheelnames.com, Classdojo.com, and Google Earth Engine. Streaming and video method were utilized.

2. Literature Review

2.1. Communication and Video Conference Software

Currently, number of software is applicable to online learning in order to communicate real-time with the students. The popular software that are widely used during the pandemic of COVID-19 is Zoom Meeting [14], [15], Google Meet [16], [17], and Microsoft Team [18]. Each software has different strengths and limitations, such as the maximum members for each class, different functions, and the expenses. When considering from the teacher's point of view, the strengths of Google Meet are the free use and the compatibility with other software to manage the Google Classroom, especially the class size that is not over 100 participants. However, it requires the share screen during learning to display the teacher's screen so the screen showing the learners is invisible. Each window should be minimized in order to view all screen which causes the inconvenience. On the other hand, Microsoft Team can support the large-sized classroom, up to 300 participants. Unfortunately, some functions are available on the free version. Likewise, Zoom Meeting will cut off the communication every 40 minutes and the reconnection is required. Moreover, it limits the number of participants. However, the strength of Zoom Meeting is that it uses the low Band-width so the high-speed internet is not needed. The problem with the loss of images and voice during learning are

very low. Nevertheless, the consideration in choosing the software depends on the various conditions, such as budget, number of learners, learners' preparation, and software capacity.

2.2. Classroom Management

Most software for classroom management supports the teacher to manage the resources or content, such as images, videos, files, and links or URLs. The most widely used software is Google Classroom [19], [20], which is utilized in the pre-higher education and higher education level, and training courses as it contains the tools to support the functions. In addition, the agencies and institutes might develop the learning platforms for the specific organization using the Learning Management System (LMS), and MOODLE (Modular Object-Object Dynamic Learning Environment), the most popular Open-source, is implemented in the educational institutes and organizations widely prior to COVID-19 pandemic [21], [22].

2.3. Software for Creating the Learner Evaluation Test

Currently, the software used for creating the test and evaluating the learner before, during and after learning is web application and mobile application. They not only facilitate the various use of the teacher but also support the learner to utilize the variety devices, such as notebook, smartphone and tablet to complete the test regardless of the type of device and operating system. There is some software that are accepted for learning management to evaluate the learner's efficiency, such as Kahoot [23], Quizizz.com [24], Socrative.com [25], [26], and Google Form [27], [28], but each of them has different and similar strengths and limitations. Thus, the selection of software bases on the situation and the appropriateness to the subject.

2.4. Software for Learning and Practicing GIS Application Development course

Learning GIS application on-site is normally applied the software package, such as ArcGIS Desktop, QGIS and Erdas Imagine [29], [30]. The class is in the computer lab where the software has been installed. However, for the online learning, it is necessary that the learner has the device supporting software installation, such as computer or notebook, whereas only smartphone or tablet is required for the on-site learning. As a result, the learner is unable to practice due to the insufficiency of device. Additionally, the learner who has the device might have the problem with software installation because

of the specification of the device or other technical problems that obstructs the learning. However, the software is now developed to service in a form of cloud application as the commercial software, such as ArcGIS Pro and ArcGIS Online [31], and the Open-source, such as Google Earth Engine [32], [33], [34] and QGIS [35]. The effectiveness of the cloud application in the online learning is that learner does not need to install the software on the device as the application is via the web browser. Moreover, it supports the use in all devices, such as the computer, notebook, smartphone, and tablet. Nonetheless, the condition of this software is that it requires the internet connection. The application of each software has different strengths and limitations, so the selection should base on the various factors, such as the preparation of the learner and the ability of software to support each subject to achieve the objectives of learning.

2.5. Utilities Software

Aside from the 5 mentioned software, there is another type of software that can be applied to the online course to activate the learner to pay attention and follow the lesson, as well as to facilitate the teacher from the attendance checking, recording scores, randomize the individual learner, group the learner randomly, timing the activity, and give the reflection to the student, such as click Like when the learner gives the correct answer. Such software includes wheelofnames.com [36] and classdojo.com [37].

2.6. Online Learning Management approach

Online learning can be performed via various methods, such as streaming, video-based learning, or the integration of the two methods. Each method has different advantages and limitations; streaming allows the teacher to interact with the learner that is similar to the on-site learning and to discuss and ask questions. However, it might have the problem with the smoothness if the internet connection is down. Also, the learner cannot review the lesson after the class. With regard to the video-based learning, the learner can review and repeat the video as desired without relying on the high-speed internet. Anyhow, the learner might lack motivation as there is no interesting activity, such as real-time Q&A, to activate them. For the integrated method, the learner is encouraged by the activities and able to review the lesson on the video when there is loss of internet connection. Moreover, the learner has more option for learning which leads to the better learning achievement. For this reason, the individual method or the integrated method is the alternative to the

learning bases on the context of the course and the readiness of the learner and teacher.

3. Materials and Methods

3.1. Online Learning Management approach

The group of learners comprised 21 fourth year students from the Information Technology Program, Prince of Songkla University, and Surat Thani Campus. The course used for the online learning management was GIS Application Development, which originally provided on-site learning, with the lecture and workshop in the lab. This research proposed the online learning management with the integration of streaming and video-based emphasizing on the active learning to activate the learner and the training on Geoinformatics in order to apply the knowledge to the project or the future career.

3.2. Tools and Software

Zoom Meeting with the basic license, 14.99 USD per month, was used for the streaming continuing learning and supporting the number of learners. Google classroom was used for classroom management to share the lesson-related documents and links, the individual and group assignments. YouTube was also used to upload the video so the learner was able to access it after class to review the lesson. Further, some video clips could be published in order to increase interest among the people. Socrative.com was utilized to create pre-test, post-test, and the test during the learning to evaluate the learner as it allowed the learner to use the different device without software installation. Besides, it allowed the teacher to give the reflection to the learner, such as to show the summary of the test and show which of the question the learner gave the correct or wrong answer, so the teacher applied the results to improve the learning efficiency by adding the complement to the content. Also, it showed the individual results to indicate the level of understanding. Additionally, it supported other functions, such as the Space Race test, the test with feedback, and the export of score for achievement evaluation, which facilitated both the teacher and learner. The following were the software for Geoinformatics training in GIS Application Development course.

Google Earth Engine - This software was used because it was the open-source cloud application. Thus, the software installation was not required on the learner's device. For this reason, there was no problem about the device which mitigated the learning problem. Moreover, Google Earth Engine supported the programming to analyze and process the spatial data analytics. As it was open data, it saved the

time to download data and it was very convenient to use.

Google Colab - It could be used for the computer programming with Python and was compatible with other libraries related to Geoinformatics and Machine Learning, such as Sci-kit learn, Bokeh, Geopandas, Matplotlib, and Google Earth Engine.

The use of the above software assisted the learner to practice Geoinformatics and meet the course objectives, as well as to produce Geoinformatics tasks and applications quickly.

3.3. Learning Methods and Model

Active learning approach was applied by emphasizing on the learner to participate in the classroom activity, both theoretical and practical session, so they could demonstrate the related concept and matter to Geoinformatics, and use the software or applications to produce the assigned tasks or the desired work. More Importantly, they would be able to apply such knowledge in the future to accelerate their career. Details of method and model of learning management were as follows.

3.3.1. Pre-test evaluation - Prior to learning, the teacher created test for each lesson, 10-15 questions, using Socrative.com. The test consisted of the multiple-choice questions, true-false test, and write-up test. The learner had to complete the test within the defined time. The learner would only know the score without knowing the correct answer of each question.

3.3.2. Learning management for the theoretical session was divided into 3 models, streaming, video-based learning, and self-learning to create the presentation video or live presentation. For the last model, it mostly highlighted the application of knowledge to study the assigned topic based on learner's interest. On the other hand, learning by the teacher would rely on the content of each week.

3.3.3. Learning management for the computer training applied video-based learning method, which was created before the learning of each week by uploading on the YouTube. The teacher observed online class to investigate the result of the practice. During the class, the learner could share the screen to the teacher and other classmates to help to resolve the problem, if any. It was the peer-assist and learning by doing approach. The sample of video used in the learning management with the Google Earth Engine is shown in Figure 1.

3.3.4. Learner evaluation during learning applied multiple models including Q&A which randomize the learner with a wheel on wheelofnames.com and classdojo.com. Group discussion used the Group Maker from classdojo.com to group the learner automatically. Think Pair Share was also used to set questions so the learner exchanged their opinions. During the evaluation, the teacher gave the reflection to the learner and added the additional

aspects to enhance their understanding. The individual or group evaluation in each period would depend on the content of the lesson.

3.3.5. Post-test evaluation - After the theoretical session, the learner was evaluated with the post-test, the same one with the pre-test, to see if they had more or less understanding after learning. With this test, the learner knew what aspect they needed more knowledge while the teacher could have applied the results to prepare the extra class for individual learner or entire class. The learner would get the reflection and knew which question they were wrong and what was the correct answer. The sample of the post-test is shown in Figure 2.

Figure 1. Sample of video used in the learning management with the Google Earth Engine

Figure 2. Sample of the post-test

3.4. Learner Satisfaction Evaluation

The evaluation was divided into 2 parts, the evaluation using the evaluation form of the Prince of Songkla University and using the rating scale online form, which was created for evaluating the streaming and video-based learning method, to see the level of the learner's quality, which included the assertiveness, enthusiasm, determination, and learning exchange, and the learning achievement comparing to other subjects in the same department.

4. Results and Discussion

4.1. Results of Software Application to the Learning Management

The sample of Zoom Meeting and Google Earth Engine application is shown in Figure 3. It was obvious that such software could be applied to the streaming and video-based learning. They allowed the learner to interact with the teacher. Moreover, Google Earth Engine enabled the learner to code the program via web browser which saved the time for the installation of the related software. In addition, the learner was able to share the code to the classmates and teacher. For the use of other tools, such as Wheelnames.com, Classdojo.com and Socrative.com, it helped to encourage the learner to focus on the lesson as they had to prepare themselves to take part in the Q&A, discussion and expressing their opinions, individually or in group, if they were randomized by the Wheelnames.com and Classdojo.com. The sample of using the wheel to randomize the learner to answer the question and join the class activities is shown in Figure 4 while the sample of the use of Classdojo.com to give feedback to the participated learner is shown in Figure 5. Figure 6 shows the activities to encourage the learner to express the opinions and discuss the proposed topic. In regard to the use of Socrative.com, the learner recognized the evaluation results from the post-test so they reviewed the lesson that they had less understanding or gave the wrong answer. Further, the teacher could use such data to the extra teaching which would affect the learning achievement and be useful for the higher education level. The sample of the feedback is shown in Figure 7.

Figure 3. Sample of software for learning management

Figure 4. Sample of using wheel to randomize the learner to answer the question in the online class

Figure 5. Sample of using Classdojo.com to give feedback

Figure 6. Sample of the discussion and leaning exchange in the online learning

Figure 7. Sample of giving the feedback to the learner

4.2. Results of Online Learning Management

Results of online learning using streaming and video-based learning methods in the theoretical and practical session of Geoinformatics indicated that the learner had the interaction with the teacher. If they had any problems or queries, they could ask the questions. Further, they were able to join online class activities. For the practice that used cloud application, the learner could participate in the practice though different device or operating system.

Moreover, they were able to code the program using Google Earth Engine and Google Colab, which was available on the web browser quickly without software installation on the device. The sample of the individual achievement from the online learning is shown in Figure 8 while the group work is shown in Figure 9. Besides, online learning presented in this research encouraged the learner to express their opinion and present their work via online system, as well as to take part in the assigned activities, as shown in Figure 10.

Figure 8. Sample of the individual achievement in Geoinformatics practice during the online class

Figure 9. Sample of group achievement from the assigned task

Figure 10. Sample of the participation in the assigned activity

4.3. Learner Achievement Evaluation results

From the learning achievement within online learning with streaming and video-based learning methods, it was found that the achievement of most learners was at good to very good level; 16 out of 17 students (94.12%) was at good level. The learning achievement within the online learning in GIS Application Development course is shown in Figure 11 and Table 1.

Figure 11. Learning achievement of GIS Application Development Course from the online learning

Table 1. Learning achievement of GIS Application Development Course from the online learning

Grade	Number of Students	Percentage
A	11	64.71
B+	4	23.53
B	1	5.88
C+	1	5.88

4.4. Evaluation Results of the Learner Satisfaction

From the first part of evaluation results, teaching evaluation result of GIS Application Development course, it was found out that the result was at the very good level, average at 4.88%. When considering by aspect, the highest satisfaction was on the promotion of efficient learning environment and learning management (4.93%), followed by teacher profession (4.88%) and evaluation (4.78%). The evaluation results are shown in Table 2. The feedback from the learner on this evaluation results was that they would like this topic to be available for the learner in other curriculum for further benefits.

Table 2. Teaching evaluation result

Topic	Mean
Promotion of efficient learning environment	4.93
Learning management	4.93
Evaluation	4.78
Teacher profession	4.88
Mean	4.88

The second part of evaluation results was the evaluation from the learner about online learning affecting their level of quality. The list of evaluation comprised assertiveness, enthusiasm, determination, punctual work submission, interaction with the teacher, and lesson review channel. The evaluation results are shown in Table 3. The evaluation results indicated that the average was 4.50 with the standard deviation at 0.82, which was at high level. When considering by aspect, its highest result was on the interaction with the teacher, average was 4.59 and the standard deviation was 0.94, followed by the enthusiasm and lesson review channel, average was 4.53 and the standard deviation was 0.80. The learner expressed that using the video allowed them to have time for the review and ask questions when they

were uncertain. Further, there was the discussion and exchange of idea so they were not bored. The test helped them to recognize if they did right or wrong. Additionally, the screen could be shared to the classmates or teacher via cloud when the learner had a problem, which was very convenient as it did not need the program installation. The activities also made them paid more attention to the lesson while the utility software, such as the random wheel and Like button to give the score entertained them to stay focus on the class.

Table 3. Satisfaction evaluation results of the learners towards the online learning affecting the learners

Topic	Mean	Standard Deviation (SD)
Assertiveness	4.47	0.80
Enthusiasm	4.53	0.80
Determination	4.47	0.80
Punctual work submission	4.41	0.87
Interaction with the teacher	4.59	0.94
Lesson review channel	4.53	0.80
Mean	4.50	0.82

From 4 parts of the results, results of software application to the learning management, results of learning management, achievement evaluation results using streaming and video-based learning methods via cloud application in the theoretical and practical session of GIS Application Development course, it was clear that the learner was able to learn from anywhere where the internet connection was available. Moreover, it solved the problem related to the insufficiency of the efficient computer to install specific software. Consequently, the learner had the opportunity to learn equally regardless of the type of device as they could use smartphone, tablet, notebook or computer. Besides, the implementation of the learning management proposed in this research enhanced the learning achievement of the learner to good and very good level. In addition, it helped to resolve the problem with the enthusiasm and motivation of the learner during the online learning, and promote assertiveness of the learner.

5. Conclusion

The online learning of GIS Application Development course using the software and tools, such as Zoom Meeting, Google Classroom, Socrative.com, Wheelnames.com, Classdojo.com, and Google Earth Engine with the streaming and video-based learning methods was very useful for the learner and teacher. The learner could choose any type of device for learning, had the channel to communicate with the teacher, was able to review the lesson from the video retrospectively, was evaluated the understanding via the pre-test and post-test, had more enthusiasm and assertiveness, and achieved the better achievement. Meanwhile, the teacher could improve the teaching efficiency by using the evaluation results from the pre-test and post-test and provide the extra class in order to suit the individual and the entire class which finally affected the better

learning achievement. In addition, the learning management approach and the software proposed in this research could be applied to other computer courses, such as Computer Programming, Geospatial Analytics, Big Data Analytics, and Geographic Information System.

Acknowledgements

This research was financially supported by Prince of Songkla University, Surat Thani Campus.

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