



## Online Assessment of Electric Circuit based on Machine Learning During Covid-19 Pandemic Situation

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### ABSTRACT

Due to the Covid-19 pandemic crisis, educational institutions have to change their teaching styles because students cannot go to the school (on-site). Therefore, the purpose of this study was to learning online assessment of electric circuit based on machine learning. To achieve the online assessment, machine learning has been applied as a powerful algorithm to realize the novel online assessment for electric circuit course of bachelor students at the department of electrical technology education, King Mongkut's University of Technology Thonburi, Thailand. To achieve the data collection process, speech to text algorithm has been applied. Next, feature extraction would be adopted as the main key to extracting the knowledge from the data from speech to text algorithm. The output of feature extraction is the dataset of the proposed system. Finally, the clustering algorithm would be applied to set up the learning process of the proposed method. The accuracy of the proposed method can reach 100% when the word feature is appropriate.

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## 1. INTRODUCTION

Today, Outcome Based Education (OBE) teaching is proven by educators around the world as an education that produces high academic achievement. Educators and researchers around the world have developed new lessons and teaching processes to make learners have a learning experience effectively. Then this can lead to further creating value for learners and society. The most important educational response is learning outcomes (LO). Lesson design Instructors must design lessons in accordance with the learning outcomes set for the teaching goals (Hussain et al., 2021; Pardede & Lyons, 2012; Nafsi et al., 2021; Estrellan et al., 2021; Chen et al., 2007).

In 2021, a 5E learning model is introduced to enhance learning outcomes for vocational students. From the study, it was found that teaching by applying the 5E model Significantly higher student learning outcomes (Rahmawati et al., 2021). The virtual classroom teaching was studied for a comparative analysis for junior high school. The study found that students' abilities in introductory physics increased by 54%. An analysis of the results showed that students' abilities were higher. In terms of measurements, because the teaching of the virtual experiment allows students to see the phenomenon that is close to the on-site experiment (Azizah et al., 2021). Not only teaching science only. The teaching and learning of linguistics have problems with learning outcomes. At present, learners have problems with a lack of motivation to study and are easily bored. The researcher presented problem-based learning (PBL) teaching method for English reading. with the assumption that Learners will be more motivated to learn. From the results of the study, it was found that Learners had higher reading proficiency than those who did not study PBL (Sidik & Masek, 2021).

During the COVID-19 outbreak, closing schools by allowing learners and teachers to engage in online educational activities had an impact on learning outcomes. Teaching in video format has been used as part of the teaching and learning process in Indonesia (Hernawati et al., 2021). The goal of using video media in online teaching and learning is to increase student motivation for the lesson. Online teaching in the old form resulted in a noticeable drop in student learning outcomes. The study found that after using video media to support online teaching, the learning ability of students increased by 12.9%.

In the aspect of student assessment, an appraisal that applied fuzzy set methods was proposed to enhance student understanding. The evaluation process in the proposed fuzzy set consists of four sub-processes. From the experiments, it was found that besides the higher the efficiency of the student assessment, the proposed method allowed the student and the teacher to create a good agreement. For improving teaching quality with a focus on the student learning experience, in the case of many students, Machine Learning (ML) was proposed to design instruction to meet the change of learners with relatively high differences. However, when designing instruction in a machine learning model, it is extremely important to analyze the data to select it as a lesson for the machine. The designer must understand the lesson very well (Yanes et al, 2020).

This research presents a lesson design for teaching in the process of artificial intelligence. The proposed process consists of 4 sub-processes including data, collection feature extraction, creating a dataset, and teaching process. The purpose of this study was to learning online assessment of electric circuit based on machine learning. To prove the design of the lesson for the presented machine. This research conducted a comparative experiment if the distinctive feature of the word has been modified to simulate that when the teacher has changed the nature of the lesson what happened to the abilities of the learners.

## 2. METHOD

The basic idea of evaluating learners, whether it is human learning or machine learning style of instruction, is that it is extremely important to extract the distinctive characteristics of the responses the students express. In addition, the convenience of answering questions is a matter of concern. While doing research on this subject, the world has been affected by the COVID-19 outbreak. Assessment of learners through audio data is therefore applied to the proposed machine learning system. The researcher is interested in the basic types of electrical engineering. Introduction to electric circuits is the foundation of every subject. subjects in electrical engineering. To explain the proposed concepts, this section describes the whole system to have access to the functions of the proposed system as well.

### 2.1. The System Overviews

To design an assessment system using machine learning, extracted features in which students answer questions are extremely important. The system designer cannot select all the information from the student's answers to teach the machine at all. The proposed system consists of four main components: data collection (speech to text), feature extraction, dataset, Clustering analysis. **Figure 1** shows an overview of the proposed system. The input of the integrated system is the learner's voice from answering the questions.



**Figure 1.** Block diagram of the proposed machine learning system.

### 2.2 Data Collection Process

To assess the validity of the proposed machine learning system, we pooled 30 sample student responses to questions related to Kirchoff's current law. Because the teaching is in Thai language courses, the audio-to-text conversion is done through an algorithm that supports Thai language. The student responses were made via speech to text with the output of the data. This output of data collection will be passed on to the next step (feature extraction. An algorithm to convert the learner's responses from audio formats to text. This research was conducted through Python programming. The choice of an algorithm for converting sound to text affects the validity of the assessment. Therefore, analysing the accuracy of each part is extremely important.

### 2.3. Feature Extraction

After the data collection step, the next step is to do feature extraction from student responses. The key features, of course, involve both matching words and non-conforming answers. for example, answers that contain the word "กระแส" (current) are more likely to be understood and correct by students. While student responses containing the word "แรงดัน" (voltage) were more likely to be wrong, features related to the number of words students answered were more likely to be wrong. It is important to be used as a feature in the machine teaching process.

## 2.4. Dataset

After the data collection and feature extraction steps, the data is in the form of a dataset. Compared to human learning teaching methods, the data in this dataset is like the lessons for general teaching and learning. Whether or not learners will have additional capabilities depends on the design of this dataset is important. In this research, the researchers intend to study the relationship between the number of extracted features and the evaluation validity of machine learning. If cells are displayed in red indicates that it is in the wrong answer category. And if the cell shows green, it means that it is in the range of the correct answer.

## 2.5. Data Clustering

Once we have the appropriate dataset the next step is to analyze the data in the form of data clustering to analyze the clustering of the data in each cluster. This step helps system designers determine whether the selected extracted features are appropriate or not. However, data clustering was not able to determine the ability to assess learners. This is because the results of the assessment of learners using the machine learning method will be presented after taking the data in another dataset to test the system.

## 3. RESULTS AND DISCUSSION

### 3.1. Machine Learning

In proving the concept of applying machine learning to assess learners in the basic electrical circuits course, the researcher divided the dataset into 4 cases, 1) Case 6 words, 2) Case 7 words, 3) Case 9 words, and 4) Case 10 words. The research tested the proposed machine learning system by teaching and testing each case. **Figures 2-5** show the distribution of data for the 6-word, 7-word, and 10-word case trials, respectively. **Figure 6** shows the results of the student assessment using the proposed machine learning method. Accuracy in evaluating learners is higher when increasing the number of words for feature extraction, like the addition of a lesson more lesson (Ma & Zhou, 2000). The abilities of the learners are even higher. The assessment accuracy of the proposed machine learning is 70% (6-word case), 90% (7-word case), 95% (9-word case), and 100% (10-word case).

- (i) Experiment 1: 6 words feature after learning and testing processes, the accuracy of assessment is 70%
- (ii) Experiment 2: 7 words feature after learning and testing processes, the accuracy of assessment is 90%
- (iii) Experiment 3: 9 words feature after learning and testing processes, the accuracy of assessment is 95%
- (iv) Experiment 4: 10 words feature after learning and testing processes, the accuracy of assessment is 100%

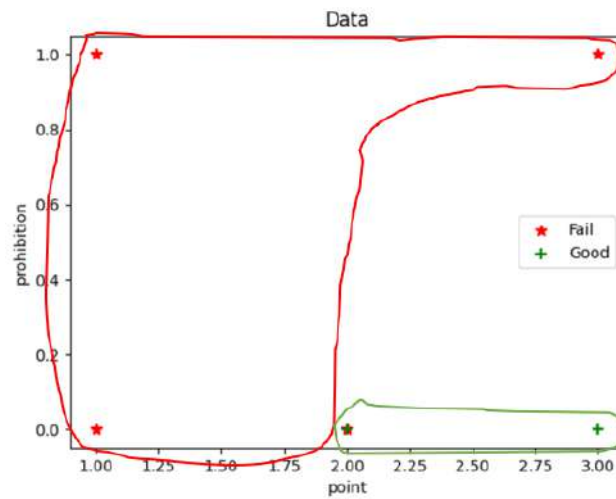


Figure 2. data distribution of 6-word case.

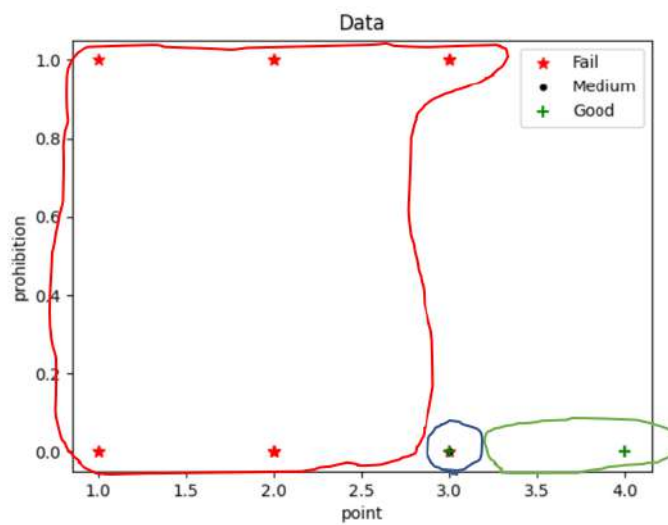


Figure 3. data distribution of 7-word case.

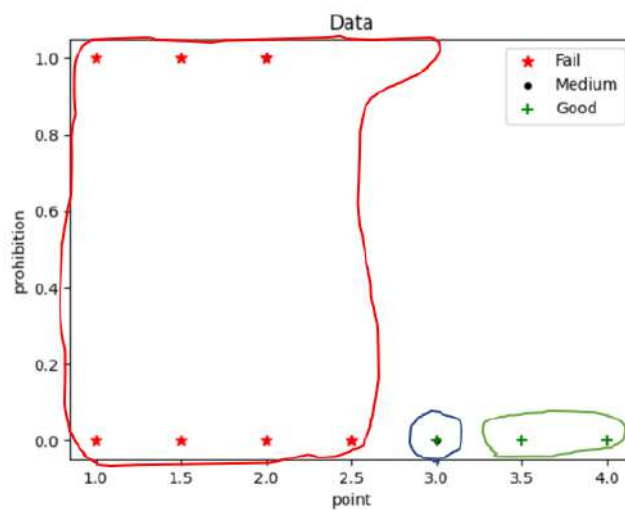
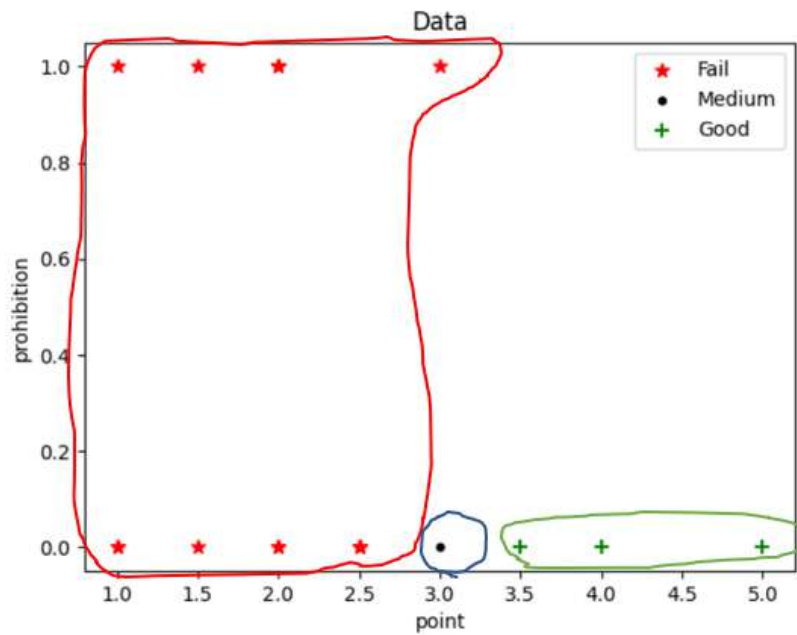
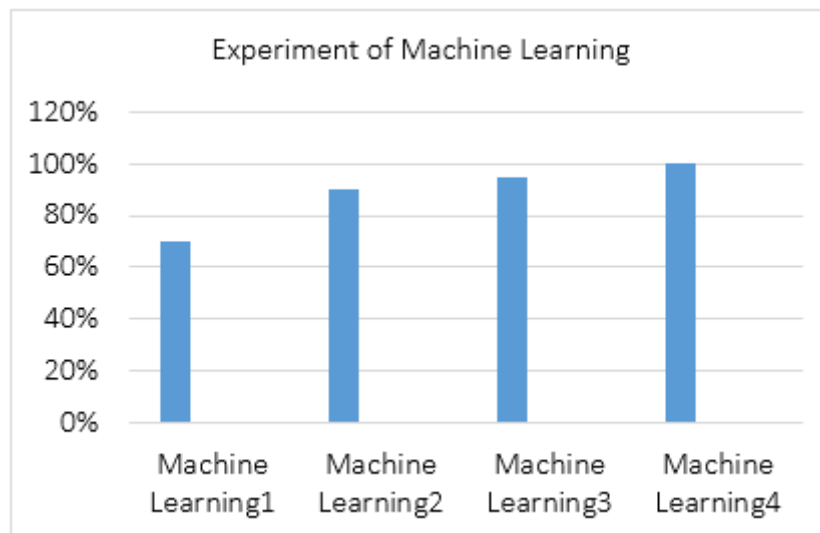


Figure 4. data distribution of 9-word case.



**Figure 5.** data distribution of 10-word case.



**Figure 6.** Comparison of the assessment accuracy for four cases in experiments.

#### 4. CONCLUSION

This paper presents online learning to make students more comfortable by applying sound technology or speech to text and we have adopted speech to text in the online learning system. The system did teach Machine Learning 4 times. By changing the number of words, it can divide into comprehension criteria. Results of the first experiment where the accuracy of assessment is 70%. results of the second experiment where the accuracy of assessment is 90%. Results of the third experiment where the accuracy of assessment is 95%. Finally results of the fourth experiment where the accuracy of assessment is 100%. This experiment can be concluded that the program will try to learn from the input samples. It gets smarter based on the amount of data entered.

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## 6. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

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