*2022 IEEE 7th International conference for Convergence in Technology (I2CT)*
*Pune, India. Apr 07-09, 2022*

# AI and Machine Learning Based E – Learning System For Secondary Education

Wijayawardena G.C.S
*Department of Information Systems Engineering*
*Faculty of Computing*
*Sri Lanka Institute of Information Technology*
Malabe, Sri Lanka
it18005790@my.sliit.lk

Subasinghe S.G.T.S
*Department of Information Systems Engineering*
*Faculty of Computing*
*Sri Lanka Institute of Information Technology*
Malabe, Sri Lanka
it18113464@my.sliit.lk

Bismi K.H.P
*Department of Information Systems Engineering*
*Faculty of Computing*
*Sri Lanka Institute of Information Technology*
Malabe, Sri Lanka
it18185508@my.sliit.lk

Anjalie Gamage
*Department of Information Technology*
*Faculty of Computing*
*Sri Lanka Institute of Information Technology*
Malabe, Sri Lanka
anjalie.g@sliit.lk

2022 IEEE 7th International conference for Convergence in Technology (I2CT) | 978-1-6654-2168-3/22/$31.00 ©2022 IEEE | DOI: 10.1109/I2CT54291.2022.9824643

***Abstract*—One of the key functions directly shifted to online platforms under COVID-19 is education. The paper is about an E-learning system for secondary education in Sri Lanka. Learners and teachers can access information, resources, and tools through an E-Learning system, which is a Learning Management System that integrates a number of online activities. The main functions provided through the proposed system are chatbot, final grade prediction and weak area prediction of the students. Chatbots are becoming increasingly popular in a wide range of applications, especially in those that provide intelligence support to the user, according to recent research. So, in order to speed up the aid process, these systems are often integrated with Chatbots, which can quickly and accurately read the user's questions. This paper describes the implementation of a Chatbot prototype in the educational domain: a system for providing support to students. In the beginning, the goal was to design a special architecture and communication model that would help students get the proper answers. The final grade prediction component plays major role in the system. Because when the students are graded by their marks, they can review which areas that they have to improve and work on them. This is helpful for students as well as teachers. Weak area prediction also plays a significant role, because it can help to find out the weak areas of each subject and generate Individual Student Progress Plans to predict the students' weak subjects and the subject areas of the students. This motivates students to get higher marks easily because this part is mainly focused on weak areas of students and improve those weak areas by providing several learning activities. These are the major parts of this system to have a good E-learning system for both students and Teachers.**

***Keywords—Learning Management System, Machine Learning, Natural Language Processing, E - Learning***

## I. INTRODUCTION

Corona Virus, commonly known as Covid-19, is a fatal and contagious disease that has had a profound impact on the world economy. In addition to the education industry, this tragedy has shaken it, and this dread is going to be felt around the world. Because of the Covid-19 pandemic epidemic, several schools and colleges were forced to close for a period of time [1]. E-learning is accompanied with a number of arguments. Online education is characterized by accessibility, affordability, flexibility, learning methodology, personal development, and policies. Online education is said to be easy to access and can even reach rural and inaccessible regions. As a result of decreased transportation, lodging, and total costs, it is believed to be a considerably affordable kind of education [1].

Therefore, teachers are unable to provide pupils with individual attention and children have difficulty engaging in productive learning activities, according to this pandemic survey. Several studies have shown that a lack of individualized help leads to poor learning results, high dropout rates, and dissatisfaction among students. Most students would benefit from having one teacher per class because the teacher and students are not in same classroom as before. According to this the teacher and student connection is complicated. A financial and organizational constraint prevents this [2].

The reason for most students to continue their studies in English Language is to stabilize their future. That is the dream of both students and parents. The base is put to this in Grade 6 when students change their medium from Sinhala or Tamil to English. There should be a strong mechanism to help students create a strong base.

As we discussed with several school teachers and students, we found out that students in grade 6 English medium class are facing difficulties when engaging in these E – learning platforms. The reason for this is that up to grade 5 students are learning in one particular language and that is either Sinhala medium or Tamil medium. But in grade 6 their learning environment becomes quite uncomfortable because there medium suddenly changes. Due to this reason, they need constant supervision and support from their teachers. But due to the COVID-19 pandemic that has become far from possible. As a result, students are in real trouble.

Using examples from other industries, Chatbot can be used to handle this issue. A rising number of Chatbots are being employed in today's culture, ranging from personal assistants on mobile devices to technical assistance over the phone, and even for healthcare services. As a result of their rapid reaction times and availability 24 hours a day, Chatbot boost user satisfaction. Chatbot in education have been somewhat rare up to this point. As an alternative, studies

have attempted to embed educational operatives and classical online learning systems into learning environments [2].

Because of the Covid pandemic, schools are closed, and the studies are conducted through online modes. Students may become demotivated and withdraw from modules if they do not receive any support about the modules' complexity and domain. There is a tremendous need to design a solution that will assist students in retaining information in e-learning environments. As a result, pupils' learning processes will be improved based on expected grades [3]. Since humans and machines can converse using human language, Chatbots are becoming increasingly common in human-machine interactions. The complexity of the information can also be hidden via a Chatbot, which can give it without the need for time-consuming search efforts.

Predicting student grades in modules can be done using a variety of various models, which provide significant information that can help students stay engaged. Students at danger can be identified early using this information, and a system can propose that teachers give them more attention. This information can also be used to forecast students' results in different classes, allowing colleges to better monitor their productivity and improve students' learning [3].

It allows learners to determine their personal educational needs, objectives, and resources, as well as apply learning methodologies and assess learning outcomes [4].

Student involvement with the E-learning system is used to categories students, which is represented by the Learning Management System LMS of student activity. We can learn more about the domain by modeling additional variables, and beneficial relationships can be found. The proposed methodology can also be used to "fill in" unlabeled, but vital, information, as well. Educators need to understand how students' engagement activities affect their results in order to get the most out of platform [5].

## II. Literature Review

According to [6], we'll look at the online learning research that was done during the COVID-19 crisis, as well as some other research on online learning challenges and educational technologies. The study revealed that students had a positive opinion of e-learning in education. The study's purpose for building and delivering courses about e- learning and application is one of its main strengths. COVID-19 epidemic forced numerous schools to close temporarily. A large number of schools have stopped teaching in person. Teaching methods would be negatively affected by this because social distance is necessary at this period. As a result of this challenging situation, educational authorities are seeking to develop alternate solutions. Therefore, there was no stoppage in education as a result of this shutdown. Student participation and reviews have been discussed by a number of schools [3].

Students' personal information has grown in bulk in recent years as online education systems have expanded. By analyzing educational data using machine learning techniques, it is feasible to derive rules and make recommendations about pupils. Students' social environment, learning environment, and course notes can all be designed to estimate their strength or weakness [1].

Learning and teaching may be made more student-centered, inventive, and adaptable by using online learning as a technique. In its simplest form, online education is characterized as "learning experiences in real-time or real-time situations using diverse devices (such as mobile phones, laptops, etc.) that have internet connectivity." "In these environments, students can learn and connect with teachers and other students from anywhere (independence)." [2].

In 2018, Rainer Winkler from University of St. Gallen done a research based on Unleashing the Potential of Chatbot in Education. According to that research paper, Chatbot, on the other hand, communicate with students in a synchronous manner, allowing them to respond to specific requests. Based on the current popular constructivist learning concept, this helps students to maintain control of their education process and actively participate in it. Bots in education hold great promise for improving learning and enjoyment. Few researches have indicated that Chatbot have been successfully deployed in learning contexts. As a result of the lack of individual help provided by teachers, Chatbot are particularly useful in large-scale subject areas at schools and in web - based learning. With minimal financial and operational resources, this ensures that Chatbot can be used to provide individual learning assistance [1].

E-learning can benefit from Chatbot technology, which has shown to become the most inventive way to bridge the gap among technology and education. Student contact with Chatbot is similar to one-on-one teaching. A student's skills can be improved by using bots to test their behavior and keep a record of their progress. By delivering regular reminders and alerts, they also can play an important role in motivating students to work. Chatbot can also be used to give a tailored educational experience, since each learner learns and absorbs information at a different rate. Chatbot make it easy to adjust a student's learning pace without becoming overly demanding [7].

Although the bot adapts to each learner individually, it may also be used to foster student bonding. Using this technology, teachers can give homework assignments and group work to students, increasing student engagement and encouraging communication between students. Teachers can use Chatbot to assist with their daily tasks, such as answering students' inquiries or inspecting their schoolwork [7].

Although both teachers and students have had the ability to engage with online education platforms such as mobile-based learning, computer-based learning, and web-based learning, the hurdles to accessing e-learning have diminished [3].

Performance of students is crucial in higher education institutions. For one thing, high-quality universities have a strong track record of academic success. The learning evaluation and co-curriculum can be used to determine a performance of the students. Module framework, assessment score, final term result, and extracurricular activities are all factors in determining a student's final grade.

Students' competence and the efficiency of the learning experience depend on the results of the evaluation, which is crucial to maintaining both. Through the analysis of students' productivity, a well-planned educational program was implemented through their time in an educational facility [8]. Data mining in education is the term used for this process. From a large educational database, educational data mining extracts important information and patterns. Students' progress can be predicted with the help of the helpful data

and patterns. They will be able to provide an effective education style. Additionally, teachers may keep tabs on their pupils' progress through the use of this tool. To improve reliability, students should increase their learning process [8].

The goal of this research was to discover students' hurdles during the current world situation and alternative approaches that can enhance their performance and help them overcome these challenges in the future, with a special focus on Obstacles of e-Learning during the COVID-19 Pandemic.

## III. Objectives

Main Objective

To assist the students who are changing their medium to English from grade 5 to grade 6. Because students have to get used to a new learning environment when they are changing their medium to English from either Sinhala or Tamil. Due to the Covid-19 situation students face difficulties when adapting to the new environment because of the inability to engage with teachers in physical classrooms [9]. The reason for us to select grade 6 English medium is that according to a survey done by us it was identified that grade 6 students are the ones who are most affected by this Covid-19 situation. So, our objective is to provide them a stress free easy online learning platform.

Specific Objectives

### *A. To Act as A Teaching Assistant*

Some subjects are difficult for students to learn in the online environment without assistance of a teacher. Searching for answers is found as a difficult task for students. Sometimes, students should go through their textbooks repeatedly to search for an answer which is very time consuming. In such case, teaching assistance can be provided to students to help them get access to online study material related to their questions.

1) Some of the tasks that the Chatbot can perform to assist teachers are,
2) General questions related to a particular subject can be answered by a Chatbot
3) Students can be provided with personalized feedback to help them improve their overall learning experience
4) Relevant online learning content can be suggested by the Chatbot regarding a specific subject

### *B. Final grade prediction will be done for secondary education in Sri Lanka. (Grade 6)*

Most of the research are done for students in higher education. Such as, predicting final grade of the semester, predicting final grades of the year and predicting the CGPA. In our research we will be done this for secondary education. In that, we will be focused on grade 6 English medium students. Because, due to this covid-19 pandemic situation most of the students and teachers are facing many difficulties. Among them grade 6 students are the ones who are most affected by this Covid-19 situation.Because, regarding to the sudden change of their medium from Sinhala to English and they are unable to meet physically and also unable to perform their academic activities as before.

### *C. Predict Weak Areas of Each Subject and Generate Individual Student Progress Plans for predict the students of their weak subjects and the subject areas of each subject.*

By looking at the performance of each student (e.g.: - question answering patterns and marks, tutorial answering patterns) the system predicts the difficult areas of a particular subject and suggest individual progress plans for students. For example, if student has got low marks for grammar in English, the system can notify the student that the student lacks knowledge in that area and suggest some more questions regarding that area.

## IV. Methodology

A learning environment will be created that is both relevant and useful as a result of this decision. Student involvement and parental conduct in electronic learning systems have a substantial impact on student success, according to this study, which also seeks to identify if any other elements play a vital role in increasing students' performance.

As the Chatbot are built and performed inside distinct cultures, this may be considered an examination of social trends. Because of this, a descriptive methodology was used, as were the data collection and analysis techniques.

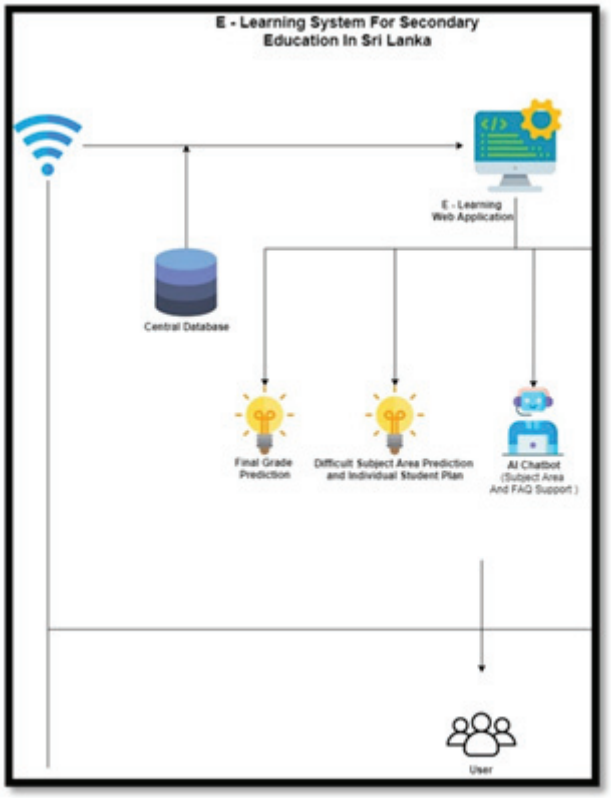


Fig. 1. overall system diagram

### *A. AI Chatbot Using Machine Learning And NLP*

The data collection of the chatbot was done using grade six English medium Health Science and Information and Communication Technology texts books which were published by the Educational Publications Department Sri Lanka. Data were questions and answers created using the above-mentioned books to train the bot.

The front end of the bot was implemented using java script, CSS (bootstrap), and html. SQLite was utilized as the database. Pytorch model was set up and the training pipeline was implemented. Implementation of the training pipeline was done according to the following steps.

A feed forward neural net was used to train the data. The input for this was the bag of words. Bag of words model is used in machine learning algorithms to simply represent words within a text in numbers. At the end of the training different probabilities for the different classes will be given. Finally, the class with the highest probability value is chosen as the output.

In order to convert a sentence to a bag of words, two NLP techniques was utilized. The first technique was tokenization. This means splitting a sentence into meaningful units [10]. The next technique that was used is stemming. It is an NLP technique that generates the root form of the words [11].

NLP preprocessing pipeline which was used in the algorithm is represented by the following example.

Natural Language Tool Kit (NLTK) was utilized to create the training data. It is a Python library to work with human language data which helps them to be usable by computer programs [12]. The concepts such as tokenization, stemming, and bag of words can be applied with the use of this toolkit.

After the implementation of the chat bot, it was trained using the knowledge base which was created at the beginning. Time to time the chat was updated with new questions and answers.

The chatbot was implemented in a way which it could answer the same question in different formats. But if the chatbot was unable to provide answers for a specific question, the student was notified about that and was able to open a help ticket. First the subject had to be selected and according to that subject student was able to insert the relevant question. The question was redirected to the teachers' help tickets section. Once the teacher logs into the system, he/ she was able to provide the answer to the help ticket and resolve it. This method saves the time of both students and teachers. By allowing students to get answers to their short and simple questions using the chatbot. And to resolve their complex questions with the help of teachers. It also assists teachers by saving their time to help students resolve more complex questions.

### *B. Final Grading Prediction Using Machine Learning*

The front end of the final mark prediction was implemented by using Java script, CSS (Bootstrap) and HTML. The used database was SQLite. Data manipulation was done by using Pandas framework. Python was the language used for mark prediction. The web framework used for this was Flask. Peewee (ORM) was used to connect the Database (SQLlite) and Sklearn – Scikit ML library to set up the model. The used IDE is VScode.

In order to do the prediction of final marks, following steps were done. First, Uploaded the CSV file, read and stored the data using Pandas Framework. The dataset was divided into the scores, hours and ID. Converted it into json. Then compared the sizes of both hours data and the scores of data, next passed the arrays. Next used the linear regression method to train the model and plot a graph by adding the variable. Then got the train data, drew a best fit line using linear regression. Next got the average of studied hours of each student, got the coefficient of the variance and predict the marks based on the average studied hours using ML. After that got the data, wrote each individual records to the database and checked the records are already exists or not. If exists, only uploaded or else created the prediction and insert. Then loaded the data into the page and created reports using chart.js. In those reports included final predicted mark, average studied hours, the name of the student, name of the subject and the percentage of the gained marks per hour studied.

### *C. Weak Area Prediction Using Machine Learning*

The front end of the weak area prediction was implemented by using Java script, CSS (Bootstrap) and HTML. The used database was SQLite. The language used for weak area prediction was Python. The web framework used for this was Flask. The machine learning library used was Sklearn – Scikit. The used IDE was PyCharm.

The pipeline for weak area prediction is like following. First uploaded the dataset and stored into the database and calculated the average marks for the each area (Lesson1, 2.etc). Then used Autoregressive integrated moving average (Arima) model for the train the dataset and tested the data. After that select and fit the best version of the Arima model (0,0,0). Next save and run the model. Finally, type the date which need to be predict weak areas, system will be notify the marks relevant to each area.

The system is aided by a web application designed according to the UI/UX best practices. The simple user interfaces make it easier for school students to engage with the system. The system will provide basic facilities of an E – Learning system for teachers and students such as manage courses, manage student profiles, manage assignment schedules, provide important date notifications, and as a commercialization aspect the system will allow tutors and stationary suppliers to advertise their details in a separate advertising platform. Some of the user interfaces of the system are as follows.

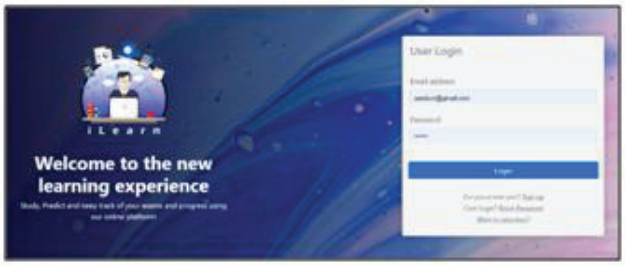


Fig. 1- User Login

Fig. 2- help ticket

Fig. 3. Final Grade Prediction Page

Fig. 4. ChatBot Page

Fig. 6. Final Marks Prediction Graph

## V. Results And Discussion

The key outcomes of the research will be an e learning system which enables schoolteachers and students to engage in the teaching and learning process easily and effectively. The integrated system with the three main components will allow students to instantly receive answers for their questions, get a clear understanding about their final grade and work towards improving it, identify their weak subject areas and practice on how to become experts in those areas. According to the interviews that were conducted by the research team, it was identified that the main difficulties which the students face is inability to do self-studies, difficulty to reach out to teachers via the existing online study modes instantly, issues in understanding their current education level, and practicing to overcome the tough subjects.

Testing the chatbot was analyzed under three main parameters. For this, fifty test questions and expected answers were selected. And each test case was marked as pass or fail according to the actual outcomes. Firstly, it was examined whether the chatbot could identify to which subject a given question belonged to. Secondly, it was examined how many test questions could the chatbot answer with the expected answers. Thirdly, the chatbot was asked the same question with different variations and tested whether it was able to deliver the same answer for the different question variations. The third testing technique was done utilizing different questions. Finally, actual participants were allowed to use the chatbot and their feedback was gathered. It required the participants to answer questions like whether they were encouraged to learn in the online learning environment more than prior to having the Chatbot. The findings of the above-mentioned tests provided strong support for our research and also inspired us to think into how an AI Chatbot is able to increase students' online learning process. Results also conveyed that 98% of the questions were answered correctly. The following example shows how the Chatbot was able to identify the same question with different variations and answer them with the expected answer.

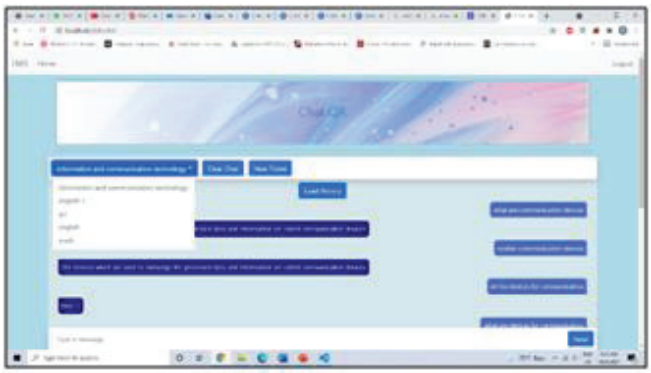

Fig. 7. Chatbot UI

According to the above-mentioned figure it is clearly visible that chatbot can provide the correct answer to 99% of the questions. What also contributes to the positive impact on using an AI Chatbot for our LMS is that it will change the learning behavior of the students into an interactive one.

The final mark prediction for a student was done by using the average of studied hours by a student for 5 exams, got the coefficient of the variance and predicted the final marks based on the above-mentioned average studied hours.

The below mentioned chart shows the outcome.

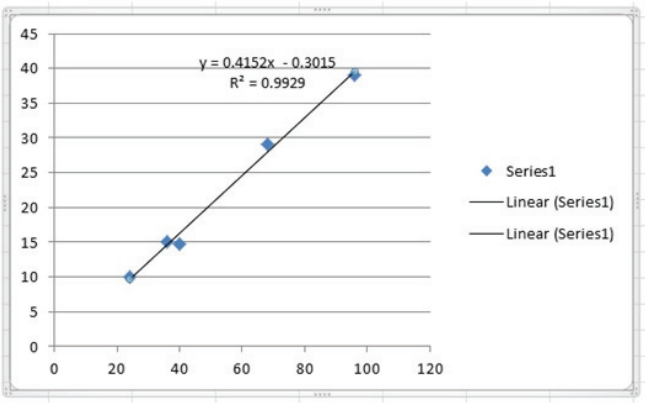


Fig. 8. Grade Prediction Accuracy Check Graph

In here, y = the studied hours for the exam by per student, x = the gained marks for exams by per student, and c = the gained marks per hour studied by the student. R2 is a statistic that gives the information about the goodness of fit of a model. This R2 coefficient represents the statistical measure that how well the regression predictions are approximated the real data points which is similar to the accuracy level. The accuracy level of this prediction is 0.9929 which is 99%. When coming to the real-world examples there is a small possibility to vary this value.

## VI. Conclusion

In this study, novel methods to Chatbot, Final grade prediction and weak areas of students' prediction are presented for the first time. A student e-learning platform is at the heart of the system. Developing a Chatbot for kids was based on a real-life case study that was explored. A successful pilot effort has produced positive results that point to the future potential of this type of strategy. In the future, we plan to apply the proposed approach in a variety of scenarios and improve our e-learning platform. Using supervised machine learning approaches, this study examined the effectiveness of learners' primary approach in an e-learning system. By using question answering patterns and marks, tutorial answering patterns approaches, this study helps us better grasp the importance of social cases in determining student achievement. If the statistics show that some students are less engaging than others, educators can send them messages to encourage them to become more engaged. In this pandemic situation e-learning as a learning tool in secondary school in Sri Lanka has a number of obstacles and issues that influence adoption and use. In this way, a strategic plan for e-learning may be developed, and technology can be viewed as a constructive step towards growth and transformation.

In future work, we plan to make the Chatbot more user friendly by adding a special feature that will allow it to continue the chat with the student.

## VII. Future Work

- The system can be improved to facilitate students with multiple languages.
- Currently, the system has a scope of grade 6 English Medium. It can be expanded to cover all grades and subjects.
- More tools which help students to collaborate can be integrated to the Learning Management System.
- The Chatbot component can be developed to monitor each individual students' performance and to act as a student motivator.

## References


[1] S. Dhawan, "Online Learning: A Panacea in the Time of COVID-19 Crisis," *J. Educ. Technol. Syst.*, vol. 49, no. 1, pp. 5–22, 2020, doi: 10.1177/0047239520934018.

[2] R. Winkler and M. Soellner, "Unleashing the Potential of Chatbots in Education: A State-Of-The-Art Analysis," *Acad. Manag. Proc.*, vol. 2018, no. 1, p. 15903, 2018, doi: 10.5465/ambpp.2018.15903abstract.

[3] Z. Iqbal, J. Qadir, A. N. Mian, and F. Kamiran, "Machine Learning Based Student Grade Prediction: A Case Study," no. September, 2017.

[4] Q. Qi, Y. Liu, F. Wu, X. Yan, and N. Wu, "Temporal models for personalized grade prediction in massive open online courses," *ACM Int. Conf. Proceeding Ser.*, pp. 67–72, 2018, doi: 10.1145/3210713.3210730.

[5] N. A. Alzahrani and M. A. Abdullah, "Student Engagement Effectiveness In E-Learning System," *Biosci. Biotechnol. Res. Commun.*, vol. 12, no. 1, pp. 208–218, 2019, doi: 10.21786/bbrc/12.1/24.

[6] M. Mahyoob, "Challenges of e-Learning during the COVID-19 Pandemic Experienced by EFL Learners," *Arab World English J.*, vol. 11, no. 4, pp. 351–362, 2020, doi: 10.24093/awej/vol11no4.23.

[7] F. Colace, M. De Santo, M. Lombardi, F. Pascale, A. Pietrosanto, and S. Lemma, "Chatbot for e-learning: A case of study," *Int. J. Mech. Eng. Robot. Res.*, vol. 7, no. 5, pp. 528–533, 2018, doi: 10.18178/ijmerr.7.5.528-533.

[8] A. M. Shahiri, W. Husain, and N. A. Rashid, "A Review on Predicting Student's Performance Using Data Mining Techniques," *Procedia Comput. Sci.*, vol. 72, pp. 414–422, 2015, doi: 10.1016/j.procs.2015.12.157.

[9] R. M. Nassr, A. Aborujilah, D. A. Aldossary, and A. A. A. Aldossary, "Understanding education difficulty during covid-19 lockdown: Reports on Malaysian university students' experience," *IEEE Access*, vol. 8, pp. 186939–186950, 2020, doi: 10.1109/ACCESS.2020.3029967.

[10] I. Olenych, M. Prytula, O. Sinkevych, and O. Khamar, "System of Automatic Determination of Ukrainian Text Tone," pp. 80–83, 2021, doi: 10.1109/elit53502.2021.9501124.

[11] P. Chatterjee, K. Damevski, and L. Pollock, "Automatic Extraction of Opinion-Based Q&A from Online Developer Chats," pp. 1260–1272, 2021, doi: 10.1109/icse43902.2021.00115.

[12] M. R. Mia and A. S. M. Latiful Hoque, "Question Bank Similarity Searching System (QB3S) Using NLP and Information Retrieval Technique," *1st Int. Conf. Adv. Sci. Eng. Robot. Technol. 2019, ICASERT 2019*, vol. 2019, no. Icasert, 2019, doi: 10.1109/ICASERT.2019.8934449.