



Machine Learning approach for Measuring the Impact of COVID-19 on Distance education: An Applied Case on Saudi Arabia Universities

Rawan Al-Mohammdi¹, Abdullah Saad AL-Malaise AL-Ghamdi², Farrukh Saleem³

Information Systems Department, Faculty of Computing and Information Technology, King Abdulaziz University, Jeddah 21589, Saudi Arabia^{1,2,3}

Abstract: Since the World Health Organization announced the Covid-19 pandemic, many countries have made strict decisions to prevent the spread of the Covid-19 epidemic, so they closed borders, prevented travel, prevented roaming within cities, and transition education from physical education to distance education to achieve physical distance as the most important way to prevent the spread of the epidemic. Saudi Arabia is one of the first countries to transfer physical education to distance education, as the transition was rapid. This research aims to predict the impact of COVID-19 on the distance education of King Abdulaziz University students through a comprehensive framework using a machine learning approach. Machine learning algorithms KNN, Decision Tree, R-Forst, XGBOOST and SVM were used. Based on the factors and challenges that have created an impact on students from multiple aspects, namely psychological, social, educational and health aspects during Distance Education in this emergency situation. The factors were extracted through a questionnaire directed to King Abdulaziz University students. The data collected from the questionnaire were analyzed using SPSS, and then the results of the models used for Prediction were evaluated using multiple metrics, namely: accuracy, precision, recall, F1-measure and Receiver Operating Characteristics (ROC). The results indicated that the SVM model predicted with an accuracy of up to 84.407% compared to other models used in this research. The results of this research are expected to greatly serve the education sector and contribute to knowing the extent of the impact of distance education on King Abdulaziz University students and to knowing the factors that may have an impact on students in such an emergency situation.

Keywords: Covid-19 pandemic, Distance education, Machine learning, Education.

I. INTRODUCTION

In 2020, the World Health Organization (WHO) announced the Covid-19 pandemic and its rapid spread throughout the world[1], the rapid spread of the virus has disrupted many aspects of life globally, such as the economic and educational aspects[2][3]. Physical distancing is one of the most important measures to reduce the spread of the Covid-19 virus[4] most countries have closed schools and colleges and moved physical attendance education to distance education to maintain the continuity of education in the light of the Covid-19 pandemic[5][6]. E-learning is of a great importance in being able to access it during emergencies such as the Covid-19 pandemic[2]. Many of the names of learning by technology include online learning, distance learning, and e-learning[2]. The rapid transition between physical attendance to distance education has created several impacts on students from various perspectives, where many studies related to distance learning have been conducted to find out the factors that affect the extent of student satisfaction and that will enhance the results of distance learning[7]. Student interaction with students and teachers is one of the most important factors affecting students during Distance Learning [8][9]. According to a study conducted on students in Chinese Universities, it indicates that there are factors that negatively affect the physical and psychological health of the student during distance learning during the Covid-19 pandemic, namely the student's fear of transmission of infection, the academic workload, and also separation from school[10]. Artificial intelligence has made its way in educational fields where it can replace humans. Artificial intelligence has been widely used in education where AI technologies can educate students individually [11]. Also, predictive analysis is one of the important artificial intelligence techniques in education, where through predictive analysis, students who are facing problems are supported by evaluating students, in addition to predicting learning levels[11]. Artificial intelligence techniques have been used to predict some factors such as anxiety and its impact on students during distance learning[12]. A study indicated that some of the problems that students face during distance learning, such as sadness over losing friends and also fear of bad grades. Finding the appropriate solution for these problems will be by evaluating students' feelings using machine learning algorithms[13]. This research aims to predict the impact of COVID-19 on the distance education of King Abdulaziz University students through a comprehensive framework using a machine learning approach. The motive behind this research is to take



advantage of machine learning to serve the field of education in particular emergency situations such as the COVID-19 pandemic. The results of this research will serve the education sector in any emergency situation in the future.

II. LITERATURE REVIEW

In 2020, the World Health Organization announced the Covid-19 pandemic[1]. The Covid-19 pandemic affected the entire world, as cases of infection with the virus were increasing at a tremendous speed [1][6]. In many countries, several attempts have been made to prevent the spread of the Covid-19 pandemic, including banning travel, closing borders, and closing schools. The goal behind this is to achieve social distancing to keep everyone safe and reduce the risks of COVID-19. As a result of the closing of schools, universities, and institutes, education rapid transition from physical attendance education to distance education to ensure the continuity of education during the Covid-19 pandemic, the other reason is to reduce the spread of the epidemic and the damage caused by the pandemic[5][6].

Education is the basis of development in all countries. Epidemiological diseases affect the education system with many challenges, from changes in educational curricula to the closure of the education system.[14]The transition from traditional education to distance education in a record time had a significant impact on students. Many researchers studied this effect from various aspects of the psychological aspect such as anxiety [12] [15]and the educational aspect, such as the performance of students during their distance study period[16].A great deal of previous research into the impact of Covid 19 pandemic has focused on the education system, and knowing the challenges students and teachers of they faced during distance education during the Covid-19 pandemic for example [17], [18],[19]

The rapid transition from physical education to distance education has created many effects on students from different points of view. The factors and challenges found to affect students during Distance Education in the covid-19 pandemic have been explored in several studies from different countries and on different age groups[20] [21][22]

In[23] indicated that there are 8 criteria that contribute to student satisfaction for distance education in the covid-19 pandemic: The structure of the course should be organized -the sources should be available and numerous -providing explanatory feedback-facilitating meaningful discussions-meeting the needs of students -wide access to content -motivation that contributes to student achievement-effective communication.

Results from earlier studies demonstrate a strong and consistent association between the educational process and artificial intelligence techniques. Machine learning has proven its effectiveness in multiple areas such as online shopping, circulation, the health field with disease prediction, and others, as well as the educational sector[24]. In particular, during the outbreak of the Covid-19 epidemic, artificial intelligence techniques were relied upon to achieve the goals of distance education, which contributed to improving the student's learning experience more enjoyably and easily. Artificial intelligence techniques are also used to understand and solve problems in more accurate ways[25]. Machine learning greatly serves the educational sector to face the effects of Covid 19, as a preliminary study conducted in South Korea made the data of research open-source so that other researchers can use machine learning to confront the effects of the Covid-19 epidemic on the educational sector[26]. Many studies have benefited from machine learning in the field of education and provided research that serves the educational sector from different aspects, especially in the COVID-19 pandemic[12], [13].

III.METHODOLOGY

The main purpose of the research is to use the machine learning approach to predicting the impact of covid-19 on distance education on King Abdulaziz University students, machine learning algorithms that are commonly used for predicting were used and proved effective in predicting, namely KNN, Decision Tree, R-Forst, XGBOOST and SVM.

Based on the challenges and factors that create an impact on students while going through the experience of distance education in this emergency, data was collected through a questionnaire that examines the impact from psychological, social, academic and health aspects. And then analyze the questionnaire with a SPSS. Based on the results, we used learning algorithms to predict, multiple metrics were used namely: accuracy, precision, recall, F1-measure, to ensure the performance of the models and obtain the best results. Then we concluded the results, future work.

The following figure shows the basic stages of research:

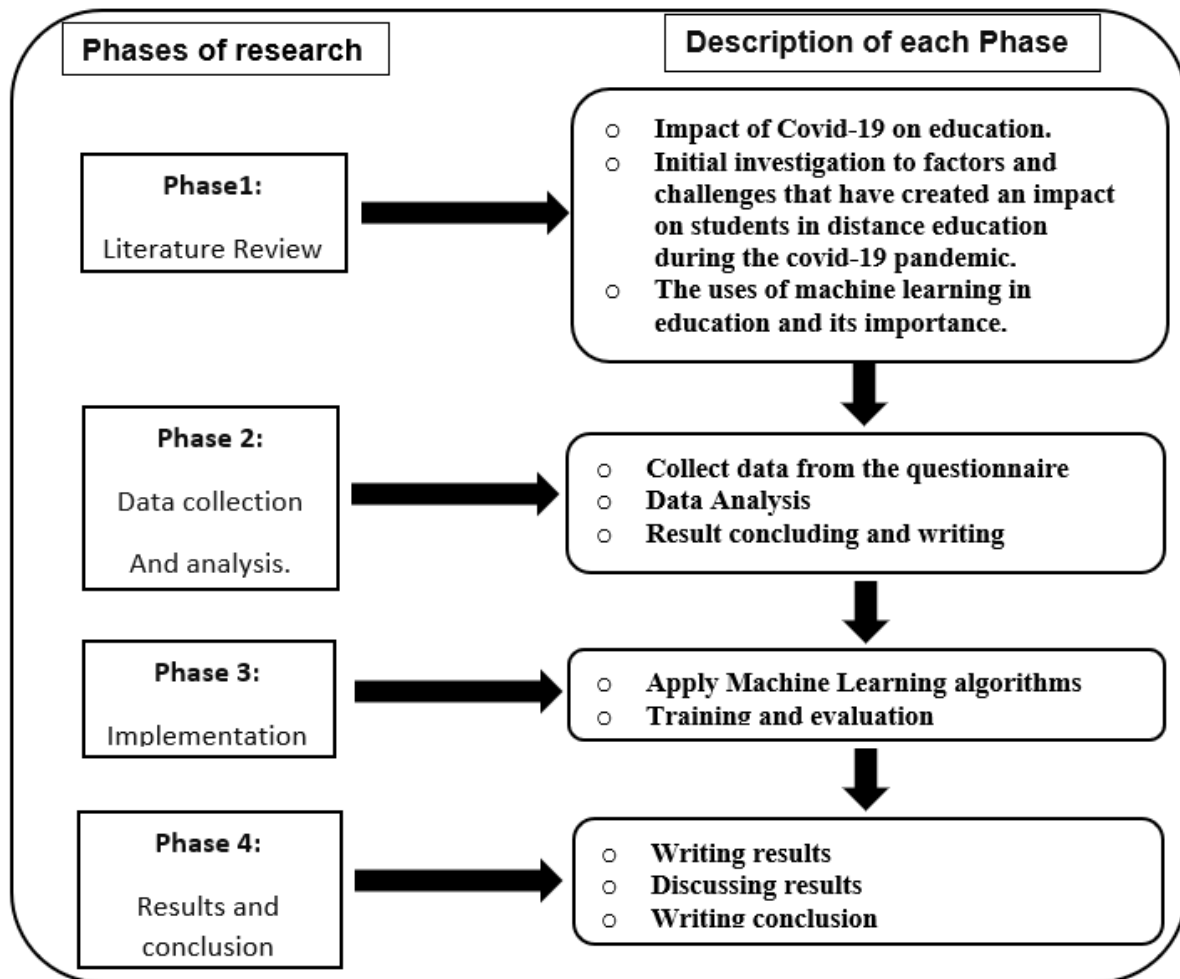


Fig. 1 Research Steps

IV. RESULTS AND ANALYSIS

A. Descriptive Analysis: Data were collected using Google forms service and entered into SPSS version 25.0 for data analysis. The frequencies, percentage, mean and standard deviation were computed for describing the variables. Chi square (X²) was conducted to test the relationship between gender and the study aspects.

General information : 779 university students participated in the current study including 83.57% female and 16.43% male. 64.31% were college students, followed by graduate student with 25.29% then new student with only 10.40%.

The Psychological and Health aspects: 54.81% reported that the spread of the virus (COVID19) negatively affected the mental state, while only 26.32% reported that it was very effected. 45.44% felt anxious and fearful about developments related to the virus, and it had an impact on your studies and academic level. 42.23% reported that the impact of the mind on the academic work affected slightly negatively, and 20.41% were affected vey negatively, while 37.36% had no effectiveness.

The educational aspects: 45.31% able to gradually adapt to distance education in light of the emergency situation (COVID19), and 42.62% adapted quickly. 47.63% reported that sometimes have problems understanding the content of some or all of the materials, while 43.65% had no problem understanding the content of the course material. 50.32% were slightly affected of indirect communication with faculty members and students during remote study under this pandemic period, and 23.49% were very affected, however, 26.19% did not care. 37.36% did not care about the impact of not using the laboratories for practical applications or practical materials during this pandemic, while 34.02%, and 28.63% were slightly affected.



47.11% reported that the technical malfunctions and internet quality on distance education under these circumstances had a great impact and caused many problems and difficulty in communication, and 42.36% reported a little effect.

68.04% reported that academic level positively affected during distance studies in the (COVID19) pandemic than before the pandemic

The social aspects: 47.63% reported that the direct communication and the formation of social relationships with the classmates an obstacle to studying remotely in light of the (COVID19) pandemic. 72.79% reported that the transfer of conferences, courses and interactive meetings to remote communication platforms created a negative or positive impact on. 58.41% did not care about the disruption of group trips during the distance studies in the (COVID19) pandemic affect, while 27.73% had slightly affected and 13.86% had very affected.

B. Machine learning algorithms and performance: The following table combines the models used and the results for the metrics used.

TABLE 1 Evaluation metrics results

	Models	F1-measure	recall	precision	accuracy
1	knn	37.325	39.921	36.83	43.21
2	svm	84.361	81.766	88.163	84.407
3	DT	50.198	50.198	50.198	62.963
4	RF	64.318	60.04	79.773	70.37
5	xgb	68.199	63.452	78.975	69.136

As shown in Table 1, combining the model and the results of the metrics accuracy, precision, recall and F1-measure: it turns out that SVM surpasses the rest of the models with an accuracy of 84.407%, precision by 88.163%, recall by 81.766% and F1-measure by 84.361%. Models from best to lowest performance: SVM, R-Forst, XGBOOST, Decision Tree and KNN.

C. Receiver Operating Characteristics (ROC): the ROC curve is used to show how effective the model is in distinguishing between specific classes. In the following figures, an explanation of the effectiveness of models using the ROC curve. The ROC value whenever it is close to 1 is evidence of better performance of the model.

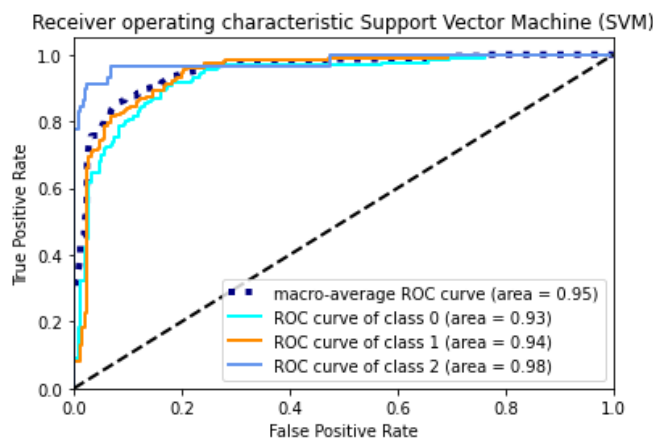


Fig. 2 Receiver Operating Characteristic SVM

As shown in Fig. 2, the value of ROC =0.93 in Support vector machine.

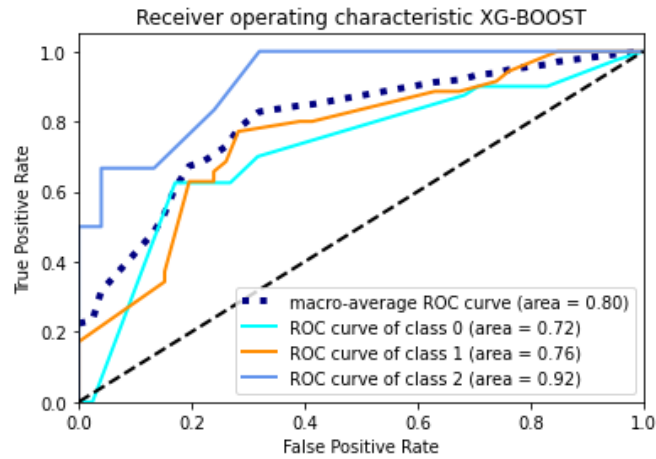


Fig. 3 Receiver Operating Characteristic XGBOOSTS

As shown in Fig. 3, the value of ROC =0.72 in XGBOOSTS.

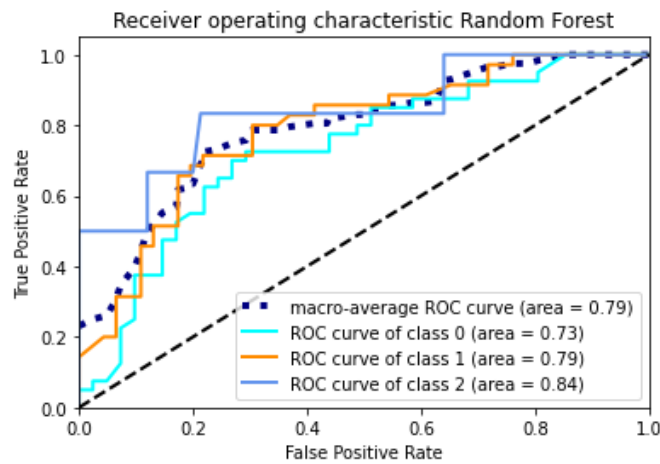


Fig. 4 Receiver Operating Characteristic RF

As shown in Fig. 4, the value of ROC =0.73 in Random Forest.

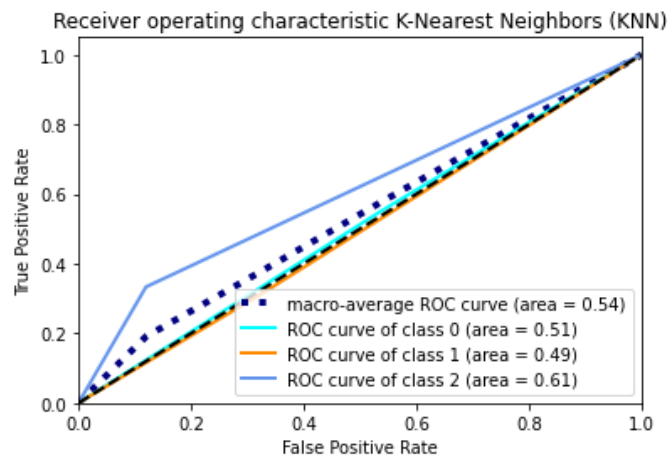


Fig. 5 Receiver Operating Characteristic KNN

As shown in Fig. 5, the value of ROC =0.54 in KNN.

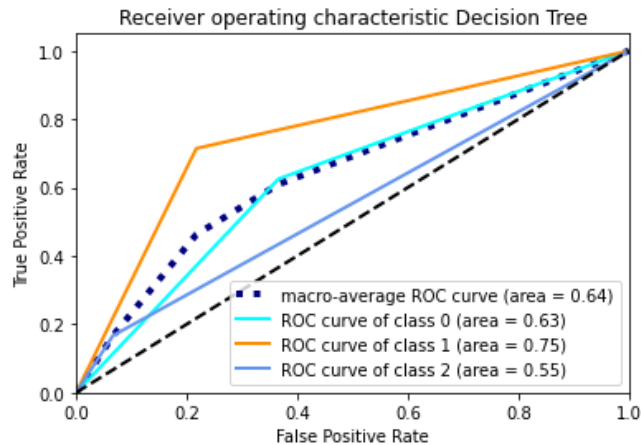


Fig. 6 Receiver Operating Characteristic Decision Tree

As shown in Fig.6, the value of ROC =0.64 in Decision Tree.

Finally, it turns out that SVM performance gave better results to predict the impact of covid-19 on distance education compared to the models that were used, so SVM shows this through the metrics that were used and also a ROC Curve gave a perception of the performance of the models

V. CONCLUSION

Education is the basis of development and growth in all countries in the world, with the occurrence of the covid-19 pandemic, many things have changed in life, including the transition from traditional education to distance education in order to avoid the damage of this epidemic to humanity. This research aims to predict the impact of covid-19 on distance education among King Abdulaziz University students using the machine learning approach, based on the factors and challenges that created an impact on students from multiple aspects, namely psychological, social, educational and health aspects during Distance Education in the covid-19 pandemic, the factors were extracted through a questionnaire. the research results indicate that the SVM model gave high performance results for prediction by 84.407% compared to the other models. The results of this research will serve the education sector in any emergency situation in the future.

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