

RESEARCH ARTICLE

The web-based behavior of online learning: An evaluation of different countries during the COVID-19 pandemic

Dilkhaz Yaseen Mohammed

Scientific Research Center, Duhok Polytechnic University, Duhok, 42001, Iraq



Correspondence to: Dilkhaz Yaseen Mohammed, Scientific Research Center, Duhok Polytechnic University, Duhok, 42001, Iraq;
Email: Dilkhaz.mohammed@dpu.edu.krd

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Abstract: COVID-19, a pandemic that the world has not seen in decades, has caused several new obstacles for student learning and education throughout the globe. As a consequence of the worldwide surge of COVID-19 instances, several schools and institutions in almost every region of the globe have closed in 2020 or switched to online or remote learning, which will have a variety of repercussions for student learning. This has led to educators and students spending more time online than ever before, with both groups researching, learning, and familiarizing themselves with information, resources, tools, and frameworks to adapt to online or remote learning. Data mining and analysis are being done to analyze such online activity. For the construction of this dataset, the web-based data in the form of search interests connected to online learning, gathered through Google searches, was mined using Google Trends. Currently, the dataset comprises web-based data related to online learning for the 20 nations that COVID-19 negatively touched at the time of its construction. This project aims to create and evaluate time-series forecasting models of a country's end-of-term performance, explore how the pandemic has influenced the migrations of people throughout the globe, and estimate the nations' future online learning needs. Regression techniques such as linear regression, multilayer regression, and SMO regression are utilized. This is done by looking at previous data, identifying the trends, and creating short-term or long-term projections. The data demonstrate that the approach of SMO regression causes fewer errors with improved accuracy compared to others.

Keywords: Covid-19, pandemic, online learning, regression techniques, Weka forecast

1 Introduction

Coronavirus disease-2019 (COVID-19) is defined as an acute respiratory infection caused by SARS-CoV-2. This new viral disease, which has and continues to pose a severe threat to global health, is considered the third coronavirus outbreak following severe acute respiratory syndrome (SARS) and the Middle East Respiratory Syndrome (MERS). COVID-19 is known to be transmitted through the respiratory tract when someone is nearby or in contact with those infected with the virus (Karakose et al., 2021).

It must be realized that the COVID-19 epidemic has put the whole learning process into pandemonium. The related literature has stated that the level of effect of COVID-19 closely correlates with certain variables such as age, gender, ethnicity, socioeconomic status, and education level (Kallou & Kikilia, 2021). In this context, these inequalities can be cited as higher mortality rates due to COVID-19 in more impoverished settlements, children from low-income families being more harmed by school closures, increased workload of women, and occupational groups that are unable to work from or run their business from home (Tzimopoulos et al., 2021). Another negative consequence of the pandemic is that many students have been forced to continue their education online from home following the physical closure of schools and face-to-face lessons (Poultsakis et al., 2021). Due to the pandemic, the transition from face-to-face to online education has brought digital inequality to the fore for economically disadvantaged students. From this point of view, the relevant literature has stated that a significant portion of students does not have access to technological tools and that some 40% do not have Internet access (Karakose et al., 2021).

It is no longer practical to apply the same teaching approaches as in ordinary courses, and here we must recognize that this is a watershed for schools and the education system to review its assessment (Katsaris & Vidakis, 2021). With this dramatic movement away from the classroom in many places globally, some are asking whether the acceptability of online learning will continue to persist post-pandemic (Thakur et al., 2021). Online learning studies are more sustainable

while instructional activities are more hybrid, provided the challenges experienced during this pandemic are well explored and transformed into opportunities (Adedoyin & Soykan, 2020). Furthermore, behavioural changes during COVID-19 confinement harmed every behaviour studied (Rossinot et al., 2020).

For studying such online conduct in the form of data mining and analysis, coming from several places of the globe, and issues related to digital training in different nations on COVID-19. As a result, this study delivers an open-access dataset that includes web activity associated with online learning from various countries worldwide monthly from 2019 to 2021. Web activity data in search interests relevant to online learning was obtained via Google searches to compile this dataset. Even though the first case of COVID-19 in humans was recorded in November 2019, the dataset presents the web behaviour data related to online learning starting from January 2019, so that the degrees to which web behaviour related to online learning changed and the trends in these changes in different countries of the world can be quantified and interpreted easily. Currently, the dataset contains the web activity data connected to online learning for the 20 countries that COVID-19 severely hit at the time of the compilation of this dataset (Ritchie et al., 2020).

This research aims to assess how the pandemic has changed people's movements throughout the globe and estimate the countries' future online learning behaviour web-based after two years using Weka time series forecasting. Learning techniques such as linear regression, multilayer regression, and SMO regression are utilized.

2 Methods and techniques used for online learning

2.1 Dataset collector

The data was taken using Google Trends on October 7, 2021. This dataset has been gathered monthly in this range from January 2019 to October 2021, representing each of these 20 countries: the United States, India, Brazil, the United Kingdom, Russia, France, Turkey, Iran, Argentina, Colombia, Spain, Italy, Indonesia, Germany, Mexico, Poland, South Africa, the Philippines, Ukraine, and Peru studied in this study. This illustrates the monthly search interest in online learning from that country over this period. This search interest has a minimum value of 0 and 100.

2.2 Data pre-processing

There are 680 instances and four attributes in the dataset utilized for our study. The dataset is generally preprocessed before being transmitted to the Weka Time Series Forecasting (Forecast) Package. To finish data processing, it is essential to raise the data quality. Data aggregation, data sampling, data discretization, variable transformation, and management of missing information are only a few of the methods applied in the data processing.

2.3 Using techniques with Weka

WEKA, also known as the Waikato Environment for Knowledge Analysis from the University of Waikato in New Zealand, is the foundation for the algorithms used in this study (WEKA). It is an open-source program developed in Java and a collection of machine learning techniques that allow the researcher to mine his data for trends and patterns, and the methods may be applied directly to a dataset. In this article, the reader will study the different techniques by which he/she may measure the machine learning model's performance in the Waikato Environment for Knowledge Analysis (version 3.8.5) tool, which has been utilized for time series forecasting. It offers both command-line and GUI user interfaces. From the menu bar, the Tool menu features the Package Manager. It has a time series forecasting package. Install the time series forecasting package (University of Waikato).

There are two settings in WEKA Forecasting. They are titled "Basic configuration" and "Advanced configuration," respectively. The primary learner is available; it includes preset settings unique to the learning algorithm. In this case, WEKA learning methods such as linear regression, multilayer regression, and SMO regression are utilized. These algorithms are capable of predicting a numeric quantity. However, in an advanced setup, evaluation on training and 24 held out instances was done. The input data set is given in Attribute-Relation File Format (ARFF).

Therefore, the first thing to consider about the performance of regression approaches is their metric accuracy. The second one is to estimate future possibilities and risks offered by the data.

The final one is to determine which independent variables are related to the dependent variable and study these relationships' nature.

3 Results and discussion

In this part, the author used several algorithms on the dataset. The pre-proceed dataset consists of 680 data instances and is transformed into online learning. Weka Tool will make use of ARFF. First, the present study will hold the last two years of data back and analyze projections on this data. Given that the data is monthly, the last 24 observations will be utilized as test data. The author will use the SMO regression approach to test model performance. This indicates that each time step in the test dataset will be enumerated, and a model constructed on primary data will be tested against the predicted value. The observation will then be added to the training dataset and repeated operation. SMO regression is a realistic way to analyze time series prediction models, as one would expect models to be updated when new data is made available (Brownlee, 2020). Finally, predictions will be tested using root mean squared error or RMSE. This metric is used to analyze the regression problem's correctness. The data imply that the approach for SMO regression generates fewer errors with improved accuracy than current WEKA learning algorithms. Table 1 shows the training assessment and the 24 held out situations.

Table 1 Training assessment

| Target | 1-step-ahead | |
|---------------------------|---------------|-----------|
| | Training Data | Test Data |
| N | 644 | 24 |
| Root mean squared error | 0.3146 | 1.4286 |
| Total number of instances | 656 | 24 |

Figure 1 & Figure 2. Showing the future graph predictions, the researcher may hold out the last few instances of the dataset for testing and see their performance. Multi-step future forecasts tend to accrue mistakes, and he or she may examine the influence of this by looking at 1-step-ahead – or indeed, any number of steps-ahead – predictions on held-out test data.

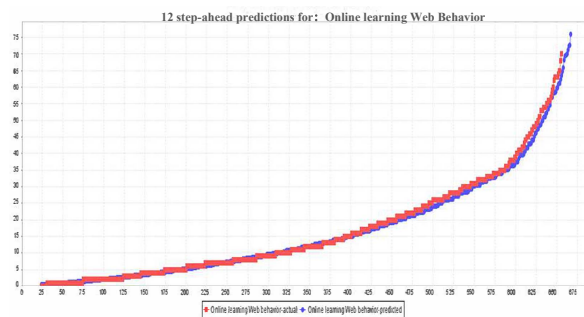


Figure 1 Train future prediction of online learning

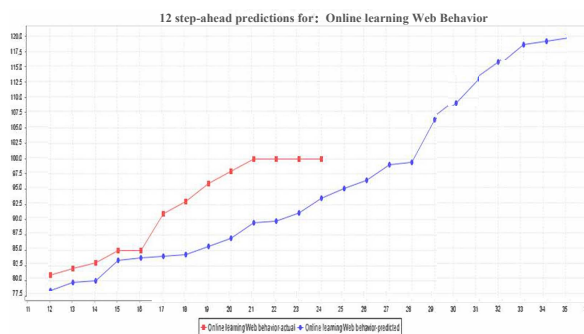


Figure 2 Test future prediction of online learning

4 Conclusion

It is well known that education and teaching practices are affected by technological developments. In recent years, the ubiquitous spread of information and communication technologies has forced educational institutions to undergo a digital transformation to keep up with today's technological age (Konstantopoulou et al., 2022). Educational activities have become sustainable in virtually all environments and under virtually all conditions, with interactive whiteboards having long since replaced the traditional blackboard in most schools (Papadopoulou et al., 2022). Changes emerging today include revised job definitions, changing patterns of daily life, and the desire for economic value; together, they represent the immediate results of this digital transformation (Karakose et al., 2021).

It is well acknowledged that the roles of both school administrators and teachers have changed due to the global education crisis caused by COVID-19. During this challenging and critical period, it is essential to investigate how those working in the education sector who undertake strategic tasks for sustainable education are affected by the new conditions of the COVID-19 pandemic (Karakose et al., 2022).

In the last 50 years, significant developments and improvements have been achieved in educational activities worldwide and at all levels. However, the COVID-19 pandemic has posed perhaps the most significant challenge that any national education system has ever faced. The global pandemic has deeply shaken education systems to the core, with the impact having directly affected some 1.6 billion students in more than 200 countries. The fact that more than 94% of the world's student population has been affected during this challenging and critical period clearly shows the extent of the pandemic's impact on global education. The reopening of schools following the relaxation of restrictions has also brought specific harsh measures. When schools were closed to face-to-face education, online learning tools and distance education were seen as the saviour to a continuance of basic level education. However, the transition from traditional face-to-face classroom-based learning to a fully online learning environment presented a different experience for both students and educators. Both were expected to adapt quickly to this new situation in just a brief period.

Along with emergency distance education, teachers were asked to utilize information technologies within online educational environments regardless of their digital literacy levels (Karakose et al., 2022). The online learning research during COVID-19 is an active field of study focusing on generating, developing, implementing, and assessing novel models and approaches to help in the war against the coronavirus. After using each Weka algorithm in our study, the final results indicated three critical regression approaches, such as linear regression, multilayer regression, and SMO regression, were applied. The results show that the method for SMO regression generates fewer errors with improved accuracy compared to others. Furthermore, different scholars might change this study by using various approaches.

Conflict of Interest

The author declares that he does not have any conflict of interest.

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