ISSN: 2633-4828 Vol. 4, No.3, December, 2022

International Journal of Applied Engineering & Technology

Performance Analysis of Agriculture Students in Adapting to Distance Learning During COVID-19 Pandemic through Educational Data Mining (EDM) Technique

Chester L. Cofino[1], Ken M. Balogo[2]

[1,2]*Central Philippines State University*

[1]chestercofino@gmail.com, [2]cpsu.balogo@gmail.com

Allemar Jhone P. Delima[3]

Northern Iloilo State University, allemarjhonedelima@nisu.edu.ph

Jan Carlo T. Arroyo[4]

University of Mindanao, jancarlo_arroyo@umindanao.edu.ph

Northern Iloilo State University,j ancarloarroyo@nisu.edu.ph

Date of Submission: 03rd October 2022 Revised: 15thNovember 2022 Accepted: 02ndDecember 2022

How to Cite: Cofino, C., Balogo, K., Delima, A.J., Arroyo, J. C. (2022). Performance Analysis of Agriculture Students in Adapting to Distance Learning During COVID-19 Pandemic through Education Data Mining (EDM) Technique. Journal of Applied Engineering & Technology 4(3), pp.5-10.

***Abstract*- This study intends to collect information on how undergraduate agriculture students at Central Philippines State University, Negros Occidental, Philippines assess the effects of the switch to distance learning. The objective is to identify student performance and surprising benefits using education data mining techniques and to use that information to suggest workable solutions for future crises in higher education. The C4.5 algorithm was used to examine how well respondents adapted to distance learning using the decision tree analysis model. One hundred fifty students accomplished a google form in conducting the survey. Given that many courses in the agricultural education system are practical in character and a complete transition to online mode may not be possible, the insights from this can help develop the curriculum for the new standard in the system.**

***Index Terms* - Agriculture Students, Covid-19 pandemic, Distance Learning, Educational Data Mining (EDM), Performance Analysis**

INTRODUCTION

Learning and teaching methods have changed due to significant technological advancement and the growing desire for creative education delivery [1]. Digital innovation has significantly impacted the education sector [2]. Although, before 2020, student learning was mainly taught inside the classroom, this followed the traditional settings. The foundation of formal academic education has consisted of teachers teaching students in a classroom [3].

However, with the recent health concern, the massive SARS-CoV-2 virus outbreak, and the tens of thousands of deaths brought on by the corona virus COVID-19 [4], several national and international academic societies have decided to switch to distance learning during this challenging period [5].Currently, distance learning offers the student to complete their academic requirements. In addition, students are given free remote access to a university or college's internal network for guidance and details on expected performance[6]. According to some academic and governmental research, distance learning is an effective method of instruction, especially in courses with technology-related subjects [7].

Despite the many benefits distance learning programs provide to the educational system, these benefits have not yet been completely realized in developing nations like the Philippines. It has several challenges that need to be considered. One of these is that not all areas in the provinces have internet connectivity to adopt distance learning[8]. Although it provides an alternative solution during the pandemic, some students encountered difficulty specifically with programs that focus on field activities and do not have computer subjects, especially in the Agri-fishery Arts strand. These are personal barriers, technical barriers, logistical difficulties, and financial barriers, according to a study by [9].

Central Philippines State University, an agricultural-based university in the province of Negros Occidental, offers agricultural courses throughout its extension campuses because of its vast reservation area. During the pandemic, faculty in agriculture programs are also obliged to adopt a distance learning setup. In their senior high school years, these students focused on Agri-arts activities. Due to this concern, it is vital to know the students' performance in adapting the distance learning approach to comply with their requirements in their major subjects during the pandemic.

As a result, distance learning in education is currently the main focus and has to be evaluated. Therefore, this study aims to gather data on how undergraduate students pursuing agriculture courses at Central Philippines State University analyze the impact of the shift to distance learning. Furthermore, the objective is to apply an education data mining model to identify student performance and unexpected advantages, using that information to recommend strategies that can be put into practice when future crises impact higher education.

LITERATURE REVIEW

The amount of data available today is huge, and daily frequency is steadily rising. It is necessary to control that extensive data and it is impossible to analyze and extract relevant data from large databases manually; therefore, automated extraction tools are needed to retrieve user-requested data and find pertinent information[10].

According to Jones[11], data mining for education is a developing field that aims to provide techniques for examining substantial amounts of data from educational environments to understand pupils better. Furthermore, it uses statistical methods and machine learning algorithms to assist the user in deciphering a student's study habits, academic achievement, and potential for improvement [12].The paper of [13]considers the impact of using the internet as a learning resource and the result of students' use of social media on their academic achievement. They used machine learning techniques. For example, the decision tree model found five factors—out of four techniques—as significant influences on students' success.

When it comes to the development and improvement of education, data is crucial. Data on education comes from various sources of teaching activities and the gathering of education management processes [14]. Extensive educational data archives have been developed due to the expansion of e-learning resources [15]. With the adaption of the SUCs in distance learning, it is essential to assess students' performance using data mining techniques to determine if they have learned and achieved the graduate attributes to be ready to be employed. The paper of [16] asserts that data mining is the most effective way to uncover hidden trends and recommends improving pupils' performance.

One study found that data mining is the most significant way to discover hidden trends and make recommendations that enhance students' performance [17]. To forecast the performance, the group of [18] recommended using knowledge discovery techniques to analyze past student course grade data.

The Decision Tree (DT) method was used to evaluate academic achievement based on information about how people learn from online courses and how completing task points influences student achievement. Followed by the completion and average score of chapter tests, the quantity of course interaction and the middle grade of homework have the most negligible influence. The idea of predicting student achievement has received much interest from researchers in educational data mining[19]. As a result, standard data mining techniques have been used to handle various responsibilities relating to the students [20].

Using a decision tree algorithm and criteria including student academic information and student activity, the study of [21] examined how well students performed academically with records of 22 undergraduate students from Oman's private higher education institution's Spring 2017 semester. They assert that a data mining tool assesses the decision tree method's effectiveness for determining student achievement and Moodle access time.

The study of[22] stated that they employed prediction models, including Bayesian networks, decision trees, and artificial neural networks, to select students' character traits and academic performance as input attributions (BNs)with 97.60%. The results showed that all three machine learning techniques helped predict student dropouts, but DT performed the best with 98.33%.Among the five data mining algorithms employed by [23]in their study to forecast students' performance using a classification approach from 1,841 respondents, the third-best accuracy was the Decision Tree predictor with 87.5%. This shows that predicting students' results using their performance is possible. The study's foundation was the model put out by [17]. The decision tree analysis presented in Figure 1 was used to determine agriculture students' performance at Central Philippines State University. The model consisted of four steps. Data collection, attribute selection, results from the evaluation, and application algorithms.

METHODOLOGY

The study's foundation was the model put out by [15]. Decision tree analysis was used to determine agriculture students' performance in the Central Philippines State University system. The model consisted of four steps. Data collection, attribute selection, results evaluation and applying algorithms.

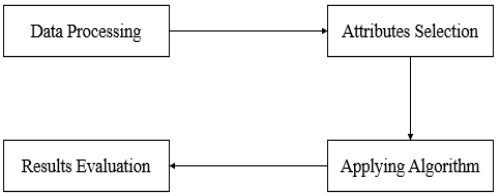

FIGURE 1 MODEL DIAGRAM

The Decision Tree (DT) Analysis method, specifically the C4.5 algorithm, is used as a data mining technique to analyze the respondents' performance in adapting to distance learning. The C4.5 algorithm is used to process the attributes using the WEKA tool to determine the performance of agriculture students. C4.5 can assist with both making accurate predictions from the data and illuminating its patterns [23]. For example, the dataset of the senior student was collected by the group [24] for their study on academic student performance. Based on their comparison of the data mining classification methods, they discovered that the C4.5 algorithm was best suited for this task.

A. Data Processing

A total of 150 students were asked to fill up the google form to conduct the survey. The instrument used in the study is adopted from the research paper of[24]. The device consisted of two (2) parts. First is the basic profile of the respondents, such as name (optional), gender, year level, and course. Second is the respondents' actual online learning perception scale (OLPS) in adapting the distance learning approach.

Table 1 displays the class description, kind, and potential respondent responses. Possible value in numeric value {1;2;3;4;5} has a specific description, where 5 represents the value of "Strongly Agree", 4 represents "Agree", 3 is "Neutral", 2 is "Disagree", and 1 represents "Strongly Disagree".

TABLE I.
QUESTIONNAIRE DESCRIPTION

Class	No.	Description	Possible Value
Demographic Data	Q1	Course	BS in Agriculture, BS in Agri-Business, BS in Animal Science
	Q2	Year	1,2,3,4
	Q3	Campus	Main, San Carlos, Hinobaan, Moises Padilla, Victorias, Hinigaran
	Q4	Gender	Male Female
Computer/Internet self-efficacy (CIS)	Q5	I am competent in using Microsoft Office products' fundamental features (MS Word, MS Excel, and MS PowerPoint).	1,2,3,4,5
	Q6	I feel confident in my knowledge and skills of how to manage software for online learning.	1,2,3,4,5
	Q7	I'm comfortable searching the Internet (Google, Yahoo) for information or gathering it for online learning.	1,2,3,4,5
Self-directed learning (SDL)	Q8	I follow my own study schedule.	1,2,3
	Q9	When I have learning issues, I get help.	1,2,3
	Q10	I'm good at managing my time.	1,2,3
	Q11	I created my learning objectives.	1,2,3
	Q12	My standards for learning performance are higher.	1,2,3
Learner control (LC)	Q13	I can control how quickly I learn new things.	1,2,3,4,5
	Q14	I am not interrupted while learning online by other things to do online (instant messages, Internet surfing).	1,2,3,4,5
	Q15	I went over the internet to study materials multiple times depending on my needs.	1,2,3,4,5
Motivation for learning (ML)	Q16	I welcome fresh suggestions.	1,2,3
	Q17	I'm driven to discover new things.	1,2,3
	Q18	I learn from my errors.	1,2,3
	Q19	I enjoy talking about my opinions with others.	1,2,3
Online communication self-efficacy (OCS)	Q20	I am comfortable using internet tools to communicate with people (email, conversation).	1,2,3,4,5
	Q21	I'm comfortable expressing myself through language, including my emotions and humor.	1,2,3,4,5
	Q22	I'm comfortable asking inquiries on online forums.	1,2,3,4,5

B. Attributes Selection

The C4.5 algorithm is used to process the attributes using the WEKA tool to determine the performance of agriculture students.

In this step, items with high correlation are identified as recommended points in determining the respondents' performance.

Then, the filter Correlation Attribute Eval is used to check the correlation between the class and the attributes.

Table 2 displays the average correlation of the attributes using the ranker search method and the Correlation Attribute Eval filter as the attribute evaluator. Out of 22 points, 21 were selected for better accuracy of the result.

TABLE II.
CORRELATION BETWEEN ATTRIBUTES

Sequence	Average	No.
1	0.268	Q13
2	0.2624	Q20
3	0.2429	Q21
4	0.2275	Q14
5	0.2201	Q6
6	0.1676	Q5
7	0.1349	Q10
8	0.1158	Q11
9	0.1068	Q8
10	0.101	Q7
11	0.0903	Q12
12	0.0882	Q2
13	0.0824	Q1
14	0.0705	Q19
15	0.0671	Q9
16	0.0625	Q18
17	0.0617	Q3
18	0.0557	Q17
19	0.0551	Q15
20	0.0528	Q16
21	0.0456	Q4

C. Algorithm Integration

The C4.5 algorithm was used in the data processing following the four phases from selecting an attribute as the first root. Next, create a branch for each value. Put the dataset on the third branch, and then repeat steps two through four until all classes have the same value.

Equation (1) is a formula for entropy where S stands for entropy and p for class proportion in the output [25].

$$\text{Entropy}(S) = \sum_{i=1}^{n} -Pi * Log2\text{Pi} \qquad (1)$$

Additionally, the root characteristic is the one with the most significant gain value. The gain formula is shown in Equation (2), where S is the number of cases in the set, |Si| is the number of cases to *i*, A is an attribute of the instances, and |S| is the number of cases in the set[25].

$$\text{Gain}(S, A) = \text{Entropy}\,(S) \sum_{i=1}^{n} -Pi * Entropy\,(S) \quad (2)$$

RESULTS AND DISCUSSION

This paper uses the C4.5 algorithm to determine the competency of agriculture students during distance learning. Figure 2 shows that respondents are confident in managing online learning. This influences the classification decision. Most of the students from the different agriculture courses have the same thoughts on the self-efficacy of online learning.

The study of [25], which asserts that self-efficacy is essential to success in all activities, including online learning, confirmed the findings.

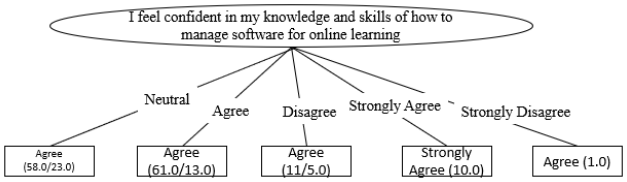

FIGURE 2C4.5 CLASSIFIER TREE FOR COMPUTER/INTERNET SELF-EFFICACY (CIS)

The study examined the self-directed learning of the respondents in managing time and creating learning objectives in distance learning during the pandemic. Figure 3 presents the self-directed learning rated by the respondents. Female students usually seek assistance from their instructors if they face learning problems. At the same time, male students tried to manage and look for solutions to their learning concerns. The paper of [26] justifies the findings that most respondents (70%) are prepared to choose online classes to handle the curriculum during this epidemic, according to the study's findings. Additionally, the majority of students favor using smart phones for online research.

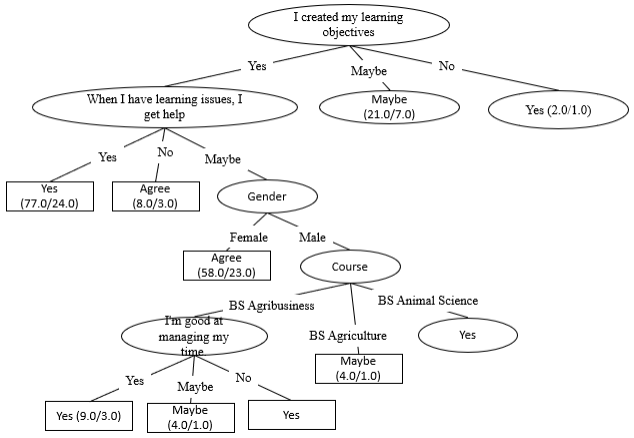

FIGURE 3C4.5 CLASSIFIER TREE FOR SELF-DIRECTED LEARNING (SDL)

The study's goal was to ascertain how agriculture students can learn new things in adapting to distance learning.

Figure 4 illustrates learner control by demonstrating that BS Agricultural Business students are not diverted from their studies by other online activities (instant messages, Internet surfing).

FIGURE 4C4.5 CLASSIFIER TREE FOR LEARNER CONTROL

The study looked into the motivation of the learners in adapting to distance learning during the pandemic. Figure 5 presents the respondents' motivation for adopting the distance learning approach. Based on the analysis found in the process, the students have the commitment and motivation to learn using an online learning platform and are open to new knowledge that they may learn and adapt to during the COVID-19 pandemic. Furthermore, some of the respondents who encountered concerns in using online platforms planned to improve themselves as they knew they were now in the new typical setting.

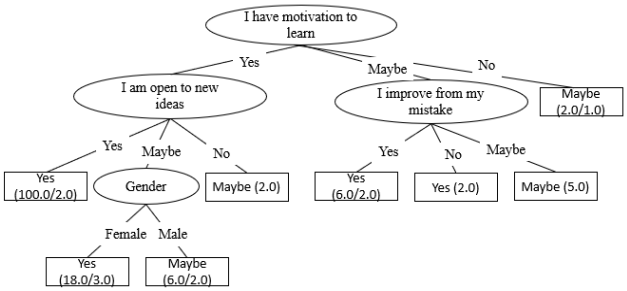

FIGURE 5CLASSIFIER TREE FOR MOTIVATION FOR LEARNING

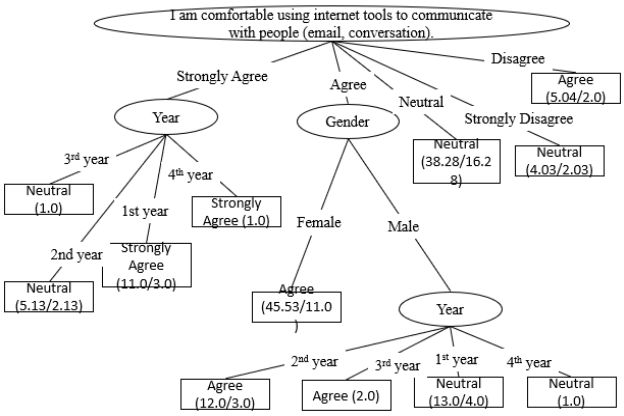

FIGURE 6C4.5 CLASSIFIER FOR ONLINE COMMUNICATION SELF-EFFICACY (OCS)

The study expected to know how comfortable the learners were in communicating with their instructors through online communication. Figure 6 presents how students perform and communicate with their instructors during the pandemic. Most respondents can share via email and participate in online learning discussions.

Moreover, most of these students are female. According to [27], female (vs male) individuals had significantly better social interaction and communication.

CONCLUSION

The study investigated the implicit relationships between various subjects using the decision tree analysis method and can design decision analysis trees to evaluate how well students acquire new learning and skills using computer software tools during the COVID-19 pandemic. The decision tree model also demonstrated that not all attributes are utilized in the categorization process. The results of model classification rules generated by the C4.5algorithm show that the learning performance of agriculture students in adapting to distance learning has a good impact and helped them continue learning during the COVID-19 pandemic. Studying through Online Distance Learning (ODL) by non-IT students is no longer an issue; they can adapt it to their subjects. The insights from this article can help build the curriculum for the new normal in the agricultural education system since many courses are practical, and a complete move to online mode may not be feasible.

ACKNOWLEDGMENT

This is to acknowledge the support of Central Philippines State University in the publication of this paper. To the students of the agriculture program for their full support in the conduct of the study.

REFERENCES

[1] M. Sadeghi, "A Shift from Classroom to Distance Learning: Advantages and Limitations," International Journal of Research in English Education, vol. 4, no. 1, pp. 80–88, Mar. 2019, doi: 10.29252/ijree.4.1.80.

[2] Cofino Chester L., G. N. A. Atillo, and VelosSeverina P., "e-XTENSION: A Virtual Learning Environment (VLE) System for a State University," Article in International Journal of Computing Sciences Research, vol. 5, pp. 663–678, 2021, doi: 10.25147/ijcsr.2017.001.1.66.

[3] E. Armstrong-Mensah, K. Ramsey-White, B. Yankey, and S. Self-Brown, "COVID-19 and Distance Learning: Effects on Georgia State University School of Public Health Students," Front Public Health, vol. 8, Sep. 2020, doi: 10.3389/fpubh.2020.576227.

[4] M. Ciotti, M. Ciccozzi, A. Terrinoni, W. C. Jiang, C. bin Wang, and S. Bernardini, "The COVID-19 pandemic," Critical Reviews in Clinical Laboratory Sciences. Taylor and Francis Ltd., pp. 365–388, 2020. doi: 10.1080/10408363.2020.1783198.

[5] S. L. Schneider and M. L. Council, "Distance learning in the era of COVID-19," Arch Dermatol Res, vol. 313, no. 5, pp. 389–390, Jul. 2021, doi: 10.1007/s00403-020-02088-9.

[6] S. Bukhkalo, A. Ageicheva, and O. Komarova, "DISTANCE LEARNING MAIN TRENDS," Інформаційнітехнології: наука, техніка, технологія, освіта, здоров'я, vol. 4, no. 11, pp. 162–168, 2018.

[7] M. Al-Balaset al., "Distance learning in clinical medical education amid COVID-19 pandemic in Jordan: Current situation, challenges, and perspectives," BMC Med Educ, vol. 20, no. 1, Oct. 2020, doi: 10.1186/s12909-020-02257-4.

[8] Z. Lassoued, M. Alhendawi, and R. Bashitialshaaer, "An exploratory study of the obstacles for achieving quality in distance learning during the covid-19 pandemic," EducSci (Basel), vol. 10, no. 9, pp. 1–13, Sep. 2020, doi: 10.3390/educsci10090232.

[9] S. Abuhammad, "Barriers to distance learning during the COVID-19 outbreak: A qualitative review from parents' perspective," Heliyon, vol. 6, no. 11, Nov. 2020, doi: 10.1016/j.heliyon.2020.e05482.

[10] J. Mughal, M. Jawad, and H. Mughal, "Data Mining: Web Data MiningTechniques, Tools and Algorithms:An Overview," IJACSA) International Journal of Advanced Computer Science and Applications, vol. 9, no. 6, 2018.

[11] A. Villanueva and L. G. Moreno, "Data mining techniques applied in educational environments: Literature review Andrés Villanueva Manjarres Data mining techniques applied in educational environments: Literature review," 2018. [Online]. Available: http://greav.ub.edu/der/

[12] Institute of Electrical and Electronics Engineers and ManavRachna International Institute of Research and Studies, Proceedings of the International Conference on Machine Learning, Big Data, Cloud and Parallel Computing : trends, prespectives and prospects : COMITCON-2019 : 14th-16th February, 2019.

[13] H. Altabrawee, O. Abdul, J. Ali, and Q. Ajmi, "Predicting Students' Performance Using Machine Learning Techniques," Pure and Applied Sciences, vol. 27, no. 1, 2019.

[14] Institute of Electrical and Electronics Engineers, LixiaJi, Xiao Zhang, and Lei Zhang, Proceedings of 2nd International Conference on Computer Science and Educational Informatization : IEEE CSEI 2020 : Xinxiang, China, June 12-14, 2020. 2022.

[15] M. K., N., 2021. A Fuzzy Based Distributed Approach to Maintain Connectivity of Nodes in Mobile Ad-Hoc Networks Considering Pursue Mobility Model. International Journal of Information Technology and Knowledge Management, 1(2), pp.79-84.

[16] C. Romero and S. Ventura, "Educational data mining and learning analytics: An updated survey," Wiley Interdiscip Rev Data Min KnowlDiscov, vol. 10, no. 3, May 2020, doi: 10.1002/widm.1355.

[17] S. L. Schneider and M. L. Council, "Distance learning in the era of COVID-19," Arch Dermatol Res, vol. 313, no. 5, pp. 389–390, Jul. 2021, doi: 10.1007/s00403-020-02088-9.

[18] AlaaKhalafHamoud, Ali Salah Hashim, and WidAqeelAwadh, "Predicting Student Performance in Higher Education Institutions Using Decision Tree Analysis," International Journal of Interactive Multimedia and Artificial, vol. 5, no. 2, p. 27, Feb. 2018.

[19] C. Burgos, M. L. Campanario, D. de la Peña, J. A. Lara, D. Lizcano, and M. A. Martínez, "Data mining for modeling students' performance: A tutoring action plan to prevent academic dropout," Computers and Electrical Engineering, vol. 66, pp. 541–556, Feb. 2018, doi: 10.1016/j.compeleceng.2017.03.005.

[20] Y. Yang, "The Evaluation of Online Education Course Performance Using Decision Tree Mining Algorithm," Complexity, vol. 2021, 2021, doi: 10.1155/2021/5519647.

[21] A. Daud, M. D. Lytras, N. R. Aljohani, F. Abbas, R. A. Abbasi, and J. S. Alowibdi, "Predicting student performance using advanced learning analytics," in 26th International World Wide Web Conference 2017, WWW 2017 Companion, 2017, pp. 415–421. doi: 10.1145/3041021.3054164.

[22] Rozenes, S., Kukliansky, I. and Vitner, G., 2020. Predicting A Successful ERP Implementation: Empirical Results. Chinese Journal of Decision Sciences, 2(1).

[23] RazaHasan, Abdul Rafi ez Abdul Raziff, SellappanPalaniappan, Salman Mahmood, and Kamal UddinSarker, "Student Academic Performance Prediction by using Decision Tree Algorithm," in 4th International Conference on Computer and Information Sciences (ICCOINS), 2018.

[24] M. Tan and P. Shao, "Prediction of student dropout in E-learning program through the use of machine learning method," International Journal of Emerging Technologies in Learning, vol. 10, no. 1, pp. 11–17, 2015, doi: 10.3991/ijet.v10i1.4189.

[25] A. B. E. D. Ahmed and I. S. Elaraby, "Data Mining: A prediction for Student's Performance Using Classification Method," World Journal of Computer Application and Technology, vol. 2, no. 2, pp. 43–47, Feb. 2014, doi: 10.13189/wjcat.2014.020203.

[26] H. C. Wei and C. Chou, "Online learning performance and satisfaction: do perceptions and readiness matter?," Distance Education, vol. 41, no. 1, pp. 48–69, Jan. 2020, doi: 10.1080/01587919.2020.1724768.

[27] E. Budiman, Haviluddin, N. Dengan, A. H. Kridalaksana, M. Wati, and Purnawansyah, "Performance of Decision Tree C4.5 Algorithm in Student Academic Evaluation," in Lecture Notes in Electrical Engineering, 2018, vol. 488, pp. 380–389. doi: 10.1007/978-981-10-8276-4_36.

[28] T. Muthuprasad, S. Aiswarya, K. S. Aditya, and G. K. Jha, "Students' perception and preference for online education in India during COVID -19 pandemic," Social Sciences & Humanities Open, vol. 3, no. 1, p. 100101, 2021, doi: 10.1016/j.ssaho.2020.100101.

[29] H. Wood-Downie, B. Wong, H. Kovshoff, S. Cortese, and J. A. Hadwin, "Research Review: A systematic review and meta-analysis of sex/gender differences in social interaction and communication in autistic and nonautistic children and adolescents," Journal of Child Psychology and Psychiatry and Allied Disciplines, vol. 62, no. 8. John Wiley and Sons Inc, pp. 922–936, Aug. 01, 2021. doi: 10.1111/jcpp.13337.