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A STUDY ON SCHOOL DROPOUT PREDICTION SYSTEM USING MACHINE LEARNING TECHNIQUES

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Abstract:

Dropping out of school is being absent from school for several days without a valid reason. Addressing this challenge requires a thorough understanding of the underlying issues and effective planning of interventions. Over the years, machine learning has attracted a lot of attention to address the problem of early school leaving. This is because machine learning techniques can effectively facilitate the identification of at-risk students and the timely planning of interventions. To collect, organize and synthesize existing knowledge in the field of machine learning to combat dropout; Literature in scientific journals, books and case studies was examined. The survey shows that several machine learning algorithms have been proposed in the literature. However, most of these algorithms have been developed and tested in developed countries. Therefore, developing countries face a lack of research on using machine learning to address this problem. Additionally, many studies focus on tackling college dropout using student-level datasets. However, due to limited resources, developing countries must include school-level datasets. Therefore, this paper provides an overview of machine learning in education with a focus on techniques to predict dropout. In addition, the paper reveals open challenges for future research directions.

Keywords: Machine Learning (ML); Learning classification; Secondary education; Behavioral education.

I. Introduction:

Reducing the college dropout rate is one of the challenges facing the education sector worldwide. The issue has raised major concerns in education and policy-making (Aulck et al., 2016). A growing body of literature points to high school dropout rates, which are particularly pronounced in developing countries; with higher rates for girls compared to boys in most parts of the world (Shahidul and Karim 2015). In Tanzania, for example, early school leaving is higher at lower secondary level than at higher level, where girls are much less likely to complete secondary education than boys; 30% of girls drop out of school before reaching grade 4 compared to 15% of boys (Presidents Office et al., 2016). The situation is different in elementary school, where boys drop out more often than girls. Also, to the researchers' knowledge, developing countries lack enough research to

address this problem in higher education. Finding and implementing solutions to this problem has repercussions that go far beyond benefiting individual students. Furthermore, enabling students to complete their education means investing in future progress and a better standard of living with multiplier effects. To effectively address this problem, it is crucial to ensure that all students finish school on time by intervening early when students are at risk of dropping out. This requires data-driven prediction techniques that can facilitate identification of at-risk students and timely planning of interventions (Fei and Yeung 2015). Machine learning approaches are one of the sought-after solutions to address the early school leaving challenge. Various studies have been conducted in developed countries to develop prediction algorithms for students (Adhatrao et al., 2013; Durairaj and Vijitha, 2014; Chen et al., 2014). In addition, there is a significant body of literature on machine learning-based approaches related to tackling early school leaving (Sales et al., 2016; Lakkaraju et al., 2015; Ameri et al., 2016). The knowledge anchored in the literature has the potential to shift the fight against early school leaving from reactive to proactive. This is now more feasible than ever as Information and Communication Technologies (ICT) have already transformed the way data is collected and managed, which is a key factor in any intelligent use of useful patterns of recorded events. Despite several efforts by previous researchers, there are still challenges that need to be addressed. Most of the widely used data sets come from developed countries. However, developing countries face several challenges in creating public datasets to address this problem. Cost and time are factors that have made the data collection process very difficult.

II.Research method:

This work provides an overview of the literature in scientific journals, books and case studies. The aim is to collect, organize and synthesize existing knowledge related to machine learning approaches for predicting dropout. The articles surveyed focused on several works done on machine learning in education such as predicting school dropout, predicting student academic performance, predicting student final score, etc. The results of these studies are very useful for understanding the problem and improving measures to address the solution. We searched multiple databases such as Research Gate, Elsevier, Association for Computing Machinery (ACM), Science Direct, Springer Link, IEEE Xplore, and other computer science journals. When searching for phrases and keywords, we used predicting early school leaving, predicting early leaving using machine learning techniques, applying machine learning in education, and predicting early leaving using machine learning techniques. We examined the reference list of each article to identify potentially relevant research or journal titles.The publication periods considered are 2018 to 2022. For the types of text we are looking for, we use PDF, documents and full paper with abstract and keywords. In addition, we used journal articles, conference papers, workshop papers, topic-related blogs, expert lectures or talks, and other topic-related communities such as the machine learning educational community in the search terms. A significant subset of the articles selected helped justify inclusion in this study. (Huang et. al., 2018) propose the region-based temporal aggregation (RTA) method which leverages the temporal information in videos to simulate the sampling procedure. (Silva et. al., 2019) propose three different models to predict school dropout. Through an analysis of the current picture of manufacturing and a literature review about the already existing DT environment (Cimino et. al., 2019) identify what is still missing in the implemented DT to be compliant to their description in literature. This approach includes the learning process by trial and error (Guiné, 2019). (Gomes et. al., 2019) aim to provide a comprehensive mapping study review of recent research efforts on automatically bug report severity prediction. A state-of-the-art-review on phase change materials for cooling applications is presented, in terms of smart ventilations, intelligent PCMs charging/discharging, deterministic parametrical analysis, stochastic uncertainty-based performance prediction and optimisation (Zhou et. al., 2020). (Sandoval-Palis et. al., 2020) introduce a model to predict student dropout rates in the Escuela Politecnica Nacional leveling course. (Nascimento et. al., 2021) propose to examine the use of some regression methods commonly used in the Statistical Learning literature for estimating school dropout in the context of elementary school from the state of Pernambuco.

(Zhang et. al., 2021) review the application of machine learning techniques in building load prediction under the organization and logic of the machine learning, which is to perform tasks T using Performance measure P and based on learning from Experience E. Firstly, (Zhang et. al., 2021) review the applications of building load prediction model (task T). (Damuri et. al., 2021) will produce a system proposal that will be the basis for the development of distance teaching and learning methods, using e-learning media at an educational level, namely public high schools with a proposed system, so it can be the best suggestion in the future.

III. The Impact of Machine Learning on School Dropouts:

In recent years, the rise of machine learning has had a dramatic impact on the rate of school dropouts. Machine learning can help identify early signs of students at risk of dropping out and intervene before it's too late. It can provide insights into why a student might be considering dropping out, and help provide the right resources to prevent it. (Chung et. al., 2019) use the random forests in machine learning to predict students at risk of dropping out. (Zimmermann-Niefield et. al., 2019) describe a design experiment exploring how to introduce youth to making ML models within the context of their athletic interests. Nowadays, the public has little understanding of the workings and implications of AI techniques that are already entering their lives in many ways. (Estevez et. al., 2019) aim to achieve widespread public understanding of these issues in an experiential learning framework. (Salas-Rueda, 2019) aim at the planning, construction and implementation of a web application to facilitate the educational process on the Normal Distribution through the technological, pedagogical and content knowledge of the Technological Pedagogical Content Knowledge (TPACK) model. (MARQUES et. al., 2020) identify 30 instructional units mostly focusing on ML basics and neural networks. The main subject of (Rebai et. al., 2020) is to identify the key factors that impact schools' academic performance and to explore their relationships through a two-stage analysis based on a sample of Tunisian secondary schools. (Rueda, 2020) propose the consultation of YouTube videos (before class), collaborative work through MySQL software (during class) and individual aim of (Rueda, 2020). (Salas-Rueda, 2020) aim to analyze the impact of the Web Application for the Teaching-Learning process on Simple Discount (WATLSD) through data science and machine learning (linear regression). (So et. al., 2020) propose the first secure aggregation framework, named Turbo-Aggregate, that in a network with N users achieves a secure aggregation overhead of $O(N\log{N})$, as opposed to $O(N^2)$, while tolerating up to a user dropout rate of 50%. (Rezapour, 2021) discuss the impact of the Covid-19 pandemic on alcohol consumption habit changes among healthcare workers in the United States.

IV. Investigating Reasons for High School Dropout Rates:

Due to the big data accumulated in educational administrative systems and due to the advance of machine learning techniques, a new scientific discipline has emerged in the last few years, namely educational data science. An important research objective of this field is to predict dropout and improve graduation rates, in particular in STEM higher education.The purpose of (Kiss et. al., 2019) is to identify students at risk of dropping out at a large Hungarian technical university using predictive analytical tools. (Gao et. al., 2020) aim to explore the following questions: Can we measure the multiple dimensions of high school students learning engagement including emotional, behavioural and cognitive engagement with sensing data in the wild? Massive Online Open Courses (MOOCs) are a good tool to boost Climate literacy through education to address the issue due to their characteristics. (Ferrari-Lagos et. al., 2020) use this tool to investigate the Climate Competence in primary and secondary teachers and developed a research program around this issue. (Camacho et. al., 2020) present the results obtained in different experiments conducted in a secondary school in a long-term participatory learning context. As an alternative (Gao et. al., 2020) investigate whether (Gao et. al., 2020) predict engagement at multiple dimensions, just using sensors. A social support framework was adopted to investigate the structure and makeup of the social support networks of underrepresented minority (URM) graduate

students at predominantly white institutions (PWIs) (Tullis et. al., 2021). (Makhloga et. al., 2021) use advance machine learning algorithms like logistic regression, decision trees and K-nearest neighbours to predict whether a student will drop out or continue his/her education. (Raulino et. al., 2021) aim to report the process development and usability tests of AGNES. (Zhao et. al., 2022) present a large-scale study which investigates students' reaction to game-based learning as part of programming courses. Other influential work includes (Wu et. al., 2020).High school dropout rates are an important topic for discussion for many communities, as high dropout rates can have a ripple effect on the future of a community. Unfortunately, high school dropout rates are still too high in many places. Investing in understanding why high school dropout rates are so high is an important step in being able to address them. Reasons for high school dropout rates vary, but can include things like students not having enough support at home or at school, or students feeling like they don't belong or have a place in the school. Other issues can include students feeling like their classes or curriculum isn't challenging enough, or feeling like there are too many distractions or outside pressures. There is no one-size-fits-all solution to addressing high school dropout rates, but understanding the reasons behind them is an important step toward finding solutions.V

V.The Future of Machine Learning in Education :

(Zhang et. al., 2019) analyze future video frames to deliver context-aware autofocus for the current frame. (Alhussein et. al., 2020) propose a deep learning framework based on a combination of a convolutional neural network (CNN) and long short-term memory (LSTM). (Christien et. al., 2020) present initial investigations on the prediction of conflict free aircraft trajectories using supervised machine learning. Students were given the main materials required to complete the project, namely a small programmable robot powered by a smartphone (Porras et. al., 2020). Increasing demands on a highly efficient air traffic management system go hand in hand with increasing requirements for predicting the aircraft's future position. In this context, the airport collaborative decision-making framework provides a standardized approach to improve airport performance by defining operationally important milestones along the aircraft trajectory (Chen et. al., 2020). There is already a large but fragmented literature on ML for reliability and safety applications, and it can be overwhelming to navigate and integrate into a coherent whole. (Xu et. al., 2020) facilitate this task by providing a synthesis of, and a roadmap to this ever-expanding analytical landscape and highlighting its major landmarks and pathways. The rigid work templates from prior research are also not scalable to cover the inter and intra-class variability in historical schedule activities. (Amer et. al., 2021) aim at fulfilling these needs via a new method to automatically learn construction knowledge from historical project planning and scheduling records and digitize such knowledge in a flexible and generalizable data schema. A novel machine learning enabled traffic prediction method is developed and integrated with a speed optimization algorithm for connected and autonomous electric vehicles (Shao et. al., 2021). (Shaikh et. al., 2021) conduct searches using terms such as artificial intelligence, learning during a pandemic, and Machine learning, among other things. (Shao et. al., 2022) present AttentionCode, a new class of feedback codes leveraging deep learning (DL) technologies.As technology advances, so does the role of machine learning in education. Machine learning is a form of artificial intelligence that enables computers to learn from data and automate tasks. In the future, machine learning will revolutionize the educational system. It could provide personalized learning experiences tailored to the needs of each student, help identify potential school dropouts before they happen, and improve the accuracy of assessment results. With machine learning, educators can better understand the needs of their students and develop educational solutions to ensure success. As machine learning technology advances, it has the potential to create dynamic, interactive and adaptive learning experiences for students of all ages.

VI.Conclusion

This paper concludes that machine learning has the potential to revolutionize the way we tackle school dropouts by providing insights into reasons behind high dropout rates, such as financial difficulties and lack of motivation. Additionally, it highlights a need for more research on using machine learning in developing countries with limited resources which must include school-level datasets. Finally, this paper reveals open challenges for future research directions.

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