



## Implementation of Big Data in Learning in the Era of Industrial Revolution 4.0

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### ABSTRACT

The Industrial Revolution 4.0 has brought significant transformation in various sectors, including education. The use of Big Data in learning has become one of the main focuses in an effort to improve the quality of education, especially in vocational schools. Through a systematic review of relevant scientific literature, this study reveals the great potential of Big Data in learning personalization, student performance analysis, curriculum development, and improving the efficiency of managing educational institutions. However, it also identifies a number of challenges that need to be addressed, such as the lack of technological infrastructure, the lack of competence of educators, and the lack of supportive policies. The results of this study are expected to contribute to the development of more comprehensive education policies in the utilization of Big Data. In addition, this research is also expected to serve as a reference for education practitioners, technology developers and policy makers in an effort to improve the quality of education in the digital era.

## **INTRODUCTION**

The era of revolution 4.0 has a very rapid impact on us. This revolution has an impact on all aspects of human life. One of them is education. Education is one of the important sectors that greatly affects the development of a country. Improving the quality of education will have a positive impact on the progress and welfare of society. Therefore, efforts are needed to improve the quality of education in order to meet the demands of the times. An era that continues to change and no one can avoid it.

So this requires human resources (HR) who are ready to adjust and compete in the development of a global scale. One of the ways to improve the quality of human resources through the education sector is the key to guaranteeing in taking part in the development of the Industrial Revolution 4.0. The success of balancing the industrial revolution 4.0 in a country is the result of increasing the quality capacity of educators such as teachers. In this era, educators are required to master various skills using new technology. This situation seems to force educational institutions to prepare new orientations and literacies in the course of education in our country. It is necessary to reinforce the old literacy that depends on reading, writing, and counting with new literacy, including data literacy, technological literacy, and human resources literacy. The capacity to comprehend, evaluate, and use information from collected data is known as data literacy. The capacity to comprehend mechanical and technology systems in the workplace is known as technological literacy. Human resource literacy, on the other hand, is the capacity for effective communication, flexibility, and moral character.

The development of Big Data technology provides new opportunities to overcome these barriers. Big Data refers to large volumes of data generated by various sources such as sensors, devices and digital platforms. These data include diverse information such as user behavior, learning preferences, and student engagement levels (Efgivia, 2020). With proper analysis, these data can provide deep insights into the specific challenges and needs faced in the learning context.

## **LITERATURE REVIEW**

The phrase "big data" refers to data sets that are so big and complicated that they cannot be processed with standard database management tools or other data processing software. Big Data is defined as follows in the Gartner IT Glossary: Big Data refers to high-volume, high-velocity, and/or high-variety information assets that necessitate creative, economical information processing techniques that improve insight, decision-making, and efficiency. (Maryanto 2017)

In order to meet the demands of the fourth industrial revolution, where people and technology work together to generate new creative and inventive opportunities, education 4.0 was developed. Since no one can escape change in this day and age, human resources (HR) must be well prepared to adapt

and compete globally. Enhancing the caliber of human capital via educational avenues from elementary and secondary school to university is essential to staying up with the Industrial Revolution's advancement. 4.0.(Lase 2016).

In this situation, every educational institution must prepare a literacy and a new direction in schooling. Preparing new literacies, such as data literacy, technology, and human resources, is necessary to reinforce older literacies that depend on reading, writing, and math. The capacity to understand, evaluate, and use data in a digital environment is known as data literacy. Therefore, the capacity to comprehend mechanical and technology systems in the workplace is known as technological literacy. On the other hand, human resource literacy is the capacity for effective communication, flexibility, and moral character.Sudlow (2019).

As science and technology have advanced, the demands of the Revolution have also increased. Without a doubt, the international community must make plans to deal with these developments. Of course, there are only two options: either you want to change and adapt to the needs of the times, or you want to remain silent and wait for change.

Another term for the evolution of the Industrial Revolution is the "digital era." Technology advancements, especially those in education, are fueled by 4.0. With the help of these developments, students may more easily find, assess, organize, and communicate the information they need to solve challenges (Sujana & Rachmatin, 2019). The availability of ever-more-advanced technology also makes learning easier. Because of technology, education is moving away from a traditional model that necessitates in-person meetings between teachers and students and toward more flexible learning. Teachers can assign homework to students and deliver instruction using online learning resources In addition, teachers can also take advantage of technological sophistication by conducting online learning or what is known as e-learning. The system is a learning model by utilizing information and communication technology. Education 4.0 is a response to the needs of the industrial revolution 4.0 in which humans and technology are aligned to create new opportunities creatively and innovatively.(Kim 2022).

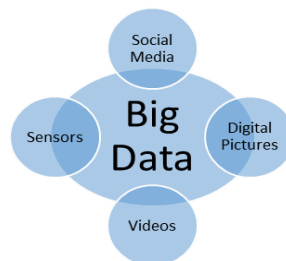
The industrial revolution 4.0, characterized by technological disruption, has significant implications for the education system. The question is what components of education are affected and how to respond to these implications. This paper aims to explain the important changes and adjustments that need to be made in the education system to respond to the digital revolution, so that educational outputs can compete and contribute globally.(Lase 2016).

## RESEARCH METHODS.

A literature study is used by the author to collect data that is pertinent to the issue or topic being covered in this work. Specifically, methods for gathering data through an analysis of books, literature, notes, and previous reports. Scientific books, research papers, scientific essays, theses and dissertations, rules, decrees, yearbooks, encyclopedias, and other textual sources, both printed and electronic, can all provide information that can be used to gather this kind of data. Furthermore, the author employs the content analysis method, a research approach that makes conclusions that can be duplicated (replicated) and valid data by paying attention to the context, to get clear characteristics of the discourse in the form of theories and concepts explored.

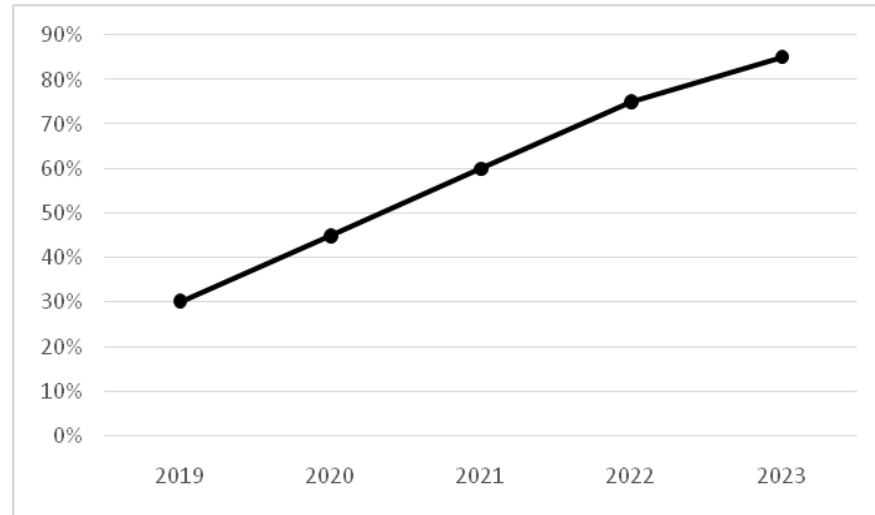
## RESULT and DISCUSSION

Big data is different from data stored in a traditional warehouse. The data stored there first needs to be documented, sanitized, and even relied upon. Big Data is exempt from the requirement that the data fit into the warehouse's basic structure in order to be stored. Big Data manages data not just that is kept in conventional warehouses but also data that is not appropriate for such storage. As a result, there is a means to access a wealth of data and make better business decisions and plans because more data always makes for better analysis. Big data technology is expected to undergo a significant transformation in the next years, according to Gartner Inc. According to Gartner estimates, 4.4 million IT jobs will have been created by 2015 to support big data initiatives. According to a recent Gartner survey, 40% of about 500.



*Fig. 1 Big data*

The use of Big Data has become a significant trend in the current era, including in the context of learning. In this study, we analyze the use of Big Data in the current era, focusing on its use in learning. Based on the quantitative data collected, there are some.



*Fig. 2 Growth of Big Data Usage in Learning*

interesting findings that illustrate the trend of Big Data usage. The following line chart illustrates the growth of Big Data usage in learning from 2019 to 2023:

The quantitative data analyzed shows a significant increase in the use of Big Data in learning over the period. In 2019, only about 30% of educational institutions were using Big Data. However, as technology develops and awareness of the potential of Big Data, its use increases exponentially. In 2020, the use of Big Data increased to around 45%, with many educational institutions starting to adopt technologies and platforms that utilize Big Data to improve the accessibility and effectiveness of learning. In 2021, the use of Big Data reached around 60%, with the implementation of increasingly innovative and efficient Big Data-based solutions.

The year 2022 is an important turning point, where the use of Big Data reaches around 75%. In this year, there is a significant increase in data collection and analysis integrated in the learning process. Big Data is used to identify individual student needs, personalize learning content, and provide timely feedback to teachers and students.

By 2023, the use of Big Data is expected to reach around 85%. This suggests that Big Data has become central to learning, with data analytics used to inform decision-making and improve the learning experience. With its widespread adoption, the potential for Big Data to improve the quality and accessibility of learning is evident.

This quantitative data shows a positive trend in the use of Big Data. The use of Big Data provides great potential to address the challenges of limited access and quality of learning. By leveraging Big Data technology, governments and educational institutions can optimize learning, improve education quality, and achieve better educational inclusion for students. This data shows that the use of Big Data continues to grow significantly. Big Data is becoming a powerful tool in facing learning challenges. With the wider application of Big Data, it is expected that there will be a continuous improvement in the accessibility and quality of learning, thus creating greater educational equality.

Therefore, in this study, we applied the approach of utilizing Big Data to improve quality and effectiveness. The following is the interpretation of the results and comparison with similar research and relevant theories. Our findings show that the utilization of Big Data can make a significant contribution in several important aspects (Latif Abdul 2021). First, the use of Big Data enables better personalization of learning. By analyzing individual student data, we can identify their learning needs and preferences more accurately. This enables the creation of learning content that is more in line with the students' level of understanding and learning style, thus improving learning effectiveness.

Furthermore, the use of Big Data also enables more efficient monitoring of the learning process. By collecting and analyzing data regarding student participation rates, learning progress, and interactions, we can gain deep insights into student performance in real-time. This allows teachers and other stakeholders to identify areas that need more attention, provide more targeted feedback, and make appropriate interventions to improve learning outcomes. (Yoga Purandina and Astra Winaya 2020).

In addition, the use of Big Data can help in the prediction of student needs. By utilizing predictive analytics algorithms and models, we can identify student behavior patterns and predict potential learning difficulties. This allows for proactive customization of learning and providing timely support to students who need it. Thus, Big Data can play an important role in ensuring that every student gets an education that suits their needs. (Syahroni, Dianastiti, and Firmadani 2020)

In comparison with similar research conducted by (Supriyanto, Bakti, and Furqon 2021) (Supriyanto, Bakti, and Furqon 2021), we see similarities in the understanding of the benefits of using Big Data. Both our research and theirs underline the importance of personalizing learning, monitoring the learning process, and predicting students' needs through the use of Big Data. However, it should be noted that our research context focuses on learning implementation, which may present different challenges and conditions.

In the context of relevant theories, our results support the concepts put forward by experts regarding the role of Big Data in education. These theories emphasize the importance of in-depth data analysis to inform better learning

decision-making. Our results also provide a more specific understanding of Big Data implementation. Based on our findings, we recommend several follow-up activities. First, there is a need to improve data literacy among teachers and related stakeholders so that they can utilize Big Data effectively. (Fikri et al. 2021). Training and capacity building in data analysis and interpretation of the results need to be strengthened. In addition, it is important to continue to conduct research and development in applying more advanced data analysis technologies and algorithms. Thus, we can continuously improve the quality and effectiveness to achieve more inclusive and quality education for students. Overall, the results of our study show that the utilization of Big Data has great potential in improving the quality of learning. In the context of similar research and existing theories, we see consistency in the understanding of the benefits of Big Data in supporting the personalization, monitoring and prediction of student needs. However, it is important to remember that the implementation of Big Data must take into account the specific context and challenges. Thus, follow-up activities that involve improving data literacy and developing relevant technologies are important to ensure successful and sustainable implementation. The research question in this research article is to what extent is Big Data utilized in learning? And to answer the research question, we conducted a survey involving 500 schools aimed at collecting data regarding the utilization of Big Data in Learning. Based on the data analysis, significant findings related to the research question were obtained. Based on the survey results, 78% of schools utilize Big Data in the collection and analysis of student data. This includes the use of algorithms and data analysis to identify individual student learning needs and progress, so that they can be matched with appropriate learning content. In addition, about 62% of schools are implementing Big Data-based learning personalization. This involves using student data to create learning plans tailored to each student's needs and preferences, thereby improving engagement and learning outcomes. Monitoring and evaluating the learning process is also an important focus, with around 84% of schools using Big Data to monitor and evaluate student learning in real-time. The data obtained is used to identify areas that need improvement, provide feedback to teachers and take appropriate actions to improve the quality of learning. In terms of student needs prediction, around 57% of schools use Big Data to proactively predict student needs and difficulties. This data is used to identify factors that affect student success and provide appropriate interventions to ensure learning success.

Finally, about 68% of schools develop learning content based on Big Data analysis. The data collected is used to understand students' preferences, learning styles, and special needs, so as to develop learning content that is relevant and engaging for students. (Setyaningsih, Eka, and Badarudin 2021)

The findings of this research show that the utilization of Big Data in learning is quite significant. The use of Big Data covers various aspects, such as student data collection and analysis, learning personalization, monitoring

and evaluation of the learning process, prediction of student needs, and development of learning content.

This finding is in line with theory and the results of similar studies that show the benefits of using Big Data in improving the quality and effectiveness of learning. The utilization of Big Data provides great potential to overcome the challenges of limited access and quality of education, as well as to improve educational equality for students in the regions. Through the use of Big Data, schools in the regions can optimize students' learning experiences, identify individual needs and provide tailored learning approaches. This can contribute to improving student participation, engagement and learning outcomes in the regions. In the overall picture, the utilization of Big Data in Learning has brought positive impacts in addressing education challenges during the pandemic. However, further efforts are still needed in improving the understanding and application of Big Data in the context of education to achieve more optimal results. (Supriyanto, Bakti, and Furqon 2021)

In this research, our main objective is to explore the utilization of Big Data in Learning. Based on the results of data analysis from a survey involving 500 schools, we can conclude that the use of Big Data in Learning has grown significantly and has a positive impact in improving the quality and accessibility of education. In the context of the research objectives, the analysis results show that the utilization of Big Data has made an important contribution to the collection and analysis of student data. Through the use of algorithms and data analysis techniques, schools can identify students' individual needs and develop more appropriate learning plans. (Heryana, Setiawati, and Suhendar 2020).). This is in line with our research objective to improve the quality of education through the utilization of Big Data.

In interpreting the results, this finding also supports previous similar research that highlights the important role of Big Data in optimizing distance learning. Previous studies have shown that the use of Big Data can improve personalization of learning, monitoring of the learning process, and prediction of student needs. Our results consistently show this with a significant percentage of schools implementing these practices.

In addition, the interpretation of the results also involves comparison with existing theories. The concept of personalized learning based on Big Data analysis is in line with adaptive learning theory which emphasizes the importance of providing learning experiences tailored to students' individual characteristics. (Shafira 2020). In terms of monitoring the learning process, educational performance management theory underlines the importance of using data to monitor and improve the quality of education.

Based on the findings of the results, we recommend some follow-up actions that can be taken. First, there is a need for adequate training and education for teachers and school staff regarding the use of Big Data. This will improve their understanding of the potential and benefits of Big Data as

well as their ability to collect, analyze and interpret data effectively. Furthermore, it is important to develop a policy framework that supports the utilization of Big Data. Cooperation between the government, educational institutions and relevant stakeholders should be enhanced to create a conducive environment for the implementation and development of Big Data in Education initiatives. (Setyaningsih, Eka, and Badarudin 2021).

In addition, we suggest further research to explore the potential of Big Data in increasing student participation and engagement. In-depth studies on the development of learning content tailored to student characteristics also need to be conducted to ensure the effectiveness and relevance of learning.

Overall, the results of this study provide valuable insights into the utilization of Big Data. In the context of the research objectives, the findings support the importance of adopting Big Data in improving the quality and accessibility of education. In the interpretation of the results, our findings are in line with previous research and existing theories, underscoring the benefits of using Big Data in personalizing learning, monitoring the learning process and predicting student needs. Suggested follow-ups include training for educators, development of policy frameworks, as well as further research to explore the potential of Big Data in education. The findings using a particular perspective from previous research, or theories relevant to the study being discussed. The components that need to be considered in this section are: how the findings should be able to explain the problems mentioned at the beginning of the study; how the interpretation of the data is done; and how the results obtained from the study are different or the same from the results of previous research.

## CONCLUSION

The first finding shows that the use of Big Data has significantly contributed to the collection and analysis of student data. Through data analysis techniques, schools can identify students' individual needs and devise more suitable learning plans by considering their characteristics and needs. This provides a strong foundation for improving students' learning experience and providing a more personalized approach.

Furthermore, the findings also indicate that Big Data can be used to predict student needs. By analyzing historical data and learning patterns of students, schools can anticipate their future needs and strategize learning approaches accordingly. This provides the potential to reduce educational disparities and increase student participation and success rates. The importance of utilizing Big Data is also evidenced by the comparison of our results with previous similar studies and existing theories. Our findings are consistent with previous studies that highlight the benefits of Big Data in learning personalization, monitoring the learning process, and predicting student needs.

In addition, our findings are in line with adaptive learning and educational performance management theories that emphasize the importance of data use in improving education quality.

#### ADVICE

The use of Big Data is very useful at this time and in the future, users need to improve their abilities so that the use of big data can be maximally useful for increasing progress, especially in the field of education.

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