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Early Detection of Developmental Disorders Through Machine Learning Algorithm

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ABSTRACT

Machine learning algorithms have the ability to analyze huge amounts of data and discover patterns that may not be visible to humans. Machine learning offers new hope for faster, more accurate, and cheaper screening for early detection of developmental disorders. This research was conducted with the aim of developing an effective and efficient machine learning algorithm for analyzing child development data. Apart from that, it is also to identify the most relevant features and indicators for the detection of early developmental disorders. The method used by researchers in researching the Detection of Developmental Disorders through Machine Learning Algorithms is to use a quantitative method. The data obtained by researchers was obtained from the results of distributing questionnaires. The distribution of questionnaires carried out by researchers was carried out online using Google From software. The results of data acquisition will also be tested again using the SPSS application. From the research results, it can be seen that this research is expected to produce a model that is not only accurate, but can also be implemented in the wider health system to provide maximum benefits for society. And can improve children's health by enabling faster detection and intervention. Ultimately, this may improve long-term outcomes for children with developmental disorders. From this study, researchers can conclude that with advances in information technology, machine learning-based applications can be accessed via mobile devices and online platforms, allowing initial screening to be carried out easily by parents and educators, even before consulting a medical professional. In recent years, machine learning (ML) technology has shown that it has enormous potential for application in various fields, including health and medical care.

Keywords: *Early Detection, developmental disorders, Machine Learning*

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INTRODUCTION

The initial process of finding problems that are occurring based on signs or symptoms is called early detection (Levis et al., 2019). This process is carried out in stages and aims to reduce the possibility of loss or damage, and even eliminate risks that may be accepted (Zhao et al., 2019). Physical limitations in an individual can be associated with genetic disorders that show differences from normal individuals (Milea et al., 2020). Attitudes and behavior of psychological disorders can be seen from attitudes and behavior, such as disturbances in learning abilities in individuals who are slow learners, disturbances in emotional and interaction abilities, disturbances in speaking abilities, and so on. This social disorder can be seen from abnormal behavior that is unusual in the social environment (Haasnoot et al., 2018).

Early detection of developmental disorders can be observed or through observation and assessment by parents or caregivers as well as examination by a doctor or developmental psychologist (Brasier et al., 2019). By enabling rapid and appropriate intervention and treatment, early detection can promote better developmental outcomes. By identifying developmental disorders at an early stage, it can reduce the long-term negative impact on an individual's social, academic, and emotional life (Liu et al., 2019). Conditions or problems known as developmental disorders are conditions or problems that affect a person's ability to function normally in certain aspects of development such as communication, social interactions, motor skills, or academic abilities (Lu et al., 2020). This disorder can occur at an early age and continue into adulthood, and requires special attention and intervention to help a person reach their best potential.

New opportunities to increase accuracy and efficiency in the early detection of developmental disorders are emerging as a result of technological advances, especially in the field of machine learning algorithms (Musumeci et al., 2019). Machine learning is a branch of artificial intelligence that concentrates on creating algorithms that allow computers to learn from data and make predictions or decisions based on existing data (Diez-Olivan et al., 2019). This technology has a lot of potential for use in various medical applications. This includes disease prediction, medical image analysis, and personalization of patient care. Machine learning algorithms can be used to examine various types of data collected for developmental disorders including genetic, behavioral, and sensory data in the context of early detection of developmental disorders (Murdoch et al., 2019). This algorithm can help identify early signs of developmental disorders more accurately and quickly because it can recognize patterns in data that may not be visible to the human eye (Zhang et al., 2020).

Machine learning is divided into several main categories: supervised learning, unsupervised learning, and reinforcement learning (Roscher et al., 2020). In the context of early detection of developmental disorders, supervised and unsupervised learning are

the most frequently used (Chen et al., 2019). The reason for using supervised learning is that it allows data such as video recordings of children who have been identified to find out whether they are showing signs of developmental disorders or not (Da Costa et al., 2019). After that, the algorithm can recognize label patterns and apply them to new data to make predictions. Based on behavioral observations or biometric data, unsupervised learning can be used to identify subgroups of children who may have developmental disorders in cases of developmental disorder detection (Wen et al., 2019).

Early detection of developmental disorders is usually more synonymous with development in early childhood. At this early age it is very important to ensure optimal growth and development, which can have an impact on their overall quality of life (Ahneman et al., 2018). If developmental disorders such as autism, attention deficit hyperactivity disorder (ADHD), and speech delays are discovered and treated promptly, there is an opportunity for better intervention and a positive impact on a child's development (Li et al., 2018). Technological advances in this field, particularly in the field of machine learning, offer new, more sophisticated and accurate methods for detecting developmental disorders early (Lee et al., 2018). This machine learning algorithm can help identify early signs of developmental disorders more accurately and quickly because it can recognize patterns in data that may not be visible to the human eye (Syam & Sharma, 2018).

Various factors can cause developmental disorders, such as genes, complications during birth, illnesses or infections experienced by the mother during pregnancy, and exposure to harmful substances (Biggio & Roli, 2018). In children, the early stages of development are especially important because their brains are developing and changing. Early intervention can reduce the negative effects of developmental disorders (Chemali et al., 2018). To help children reach their full potential and improve their quality of life, early detection and appropriate intervention are essential. Therapy, specialized instruction, and organized medical and psychological support are usually part of the intervention approach (Fukami et al., 2019). Identifying developmental disorders early is critical to providing timely and efficient care, and ensuring that children have the best opportunity to reach their full potential.

Using machine learning algorithms to detect early developmental disorders in children is of great importance in the fields of education and health. Where machine learning algorithms can process and analyze data from various sources, such as teacher notes, psychological test results, medical records, and behavioral observations (Du et al., 2019). Overall, the use of machine learning to detect and treat early developmental disorders in children has great potential to improve their health and well-being, provided it is implemented correctly (Schuld & Killoran, 2019). Although machine learning algorithms are very useful, educators and medical professionals must be involved to interpret the results and make final decisions (Wu et al., 2018). Therefore, to avoid errors that could lead to inappropriate diagnosis or treatment, algorithms must be developed and tested carefully.

The type of method used in this research is a quantitative method. This method is used so that the final results of the processed data can be known clearly and precisely regarding Early Detection of Developmental Disorders Through Machine Learning Algorithms (Dong & Cheng, 2023). The data collection process was obtained by the researcher from the results of the respondents' answers that the researcher had carried out. Researchers created a questionnaire with 10 questions, then distributed it via Goggle from. After the data is collected, the data will be calculated into a percentage and presented in table form (House, 2018). In processing research data, researchers use SPSS software which aims to make it easier for researchers to process data, and the data results are more relevant. Furthermore, the researcher really hopes that the next researchers will research and study more deeply regarding Early Detection of Developmental Disorders through Machine Learning Algorithms.

METHOD

Research Design

In researching research on Early Detection of Developmental Disorders Through Machine Learning Algorithms using quantitative methods. The aim of using quantitative methods is to collect research data and test the hypotheses that have been formulated (Fuchs et al., 2021). Then the researchers created a questionnaire created in the Google From application which was distributed online to respondents via the WhatsApp application. The questionnaire contained 20 questions asked by the researcher. To fill out the questionnaire, the researcher has provided four options, namely strongly agree, agree, disagree and disagree. So respondents can respond to the questions asked by the researcher by selecting these four options.

Research Procedure

In this research, researchers investigated the Early Detection of Developmental Disorders Through Machine Learning Algorithms. The aim of the researcher is to investigate this matter so that the researcher can collect, analyze and provide understanding of the data that has been collected (Elmortada et al., 2019). In making questions, the researcher used good language that was easy for respondents to understand when filling out the questionnaire distributed by the researcher later. This aims to ensure that respondents who provide responses to questions asked by researchers can be answered quickly. That way, it will be easier for researchers to test the data being investigated regarding Early Detection of Developmental Disorders Through Machine Learning Algorithms

Research Subject

In researching Early Detection of Developmental Disorders Using Machine Learning Algorithms, researchers of course determine the subjects for their research. In this research, the subject of this research is aimed at teachers and parents regarding early detection of developmental disorders and regarding machine learning algorithms (Matović & Ovesni, 2023). Before the questionnaire was distributed by the researcher, the researcher first asked for the respondents' willingness to spend their time filling out the questionnaire that the researcher would distribute. The questionnaire each contains

10 questions that correspond to the research topic regarding Early Detection of Developmental Disorders Using Machine Learning Algorithms.

Research Ethics

To maintain public trust, ensure scientific validity, and protect the rights of people participating in research, research ethics are very important for researchers to maintain. Research ethics is known as a set of ethical principles that govern how people act and make decisions during research (Busienei et al., 2019). The aim of this ethics is to ensure that research is conducted in a way that is fair, responsible, and respects the rights and welfare of all parties involved. In addition, researchers also provide actual information about their research to maintain their commitment. Researchers do this in order to obtain maximum research results, and remain consistent in developing better research patterns with the research they conduct.

Data Collection and Analysis

This time, researchers used quantitative methods to collect research data. The researcher also used a T-test as previously mentioned by the researcher. The purpose of collecting this data is to find relationships and become a benchmark between research object materials entitled Early Detection of Developmental Disorders Using Machine Learning Algorithms. Researchers also carried out tests first using SPSS software to ensure that respondents' responses were very accurate and reliable. Thus, researchers must be very careful when collecting processed data (Froehlich et al., 2020).

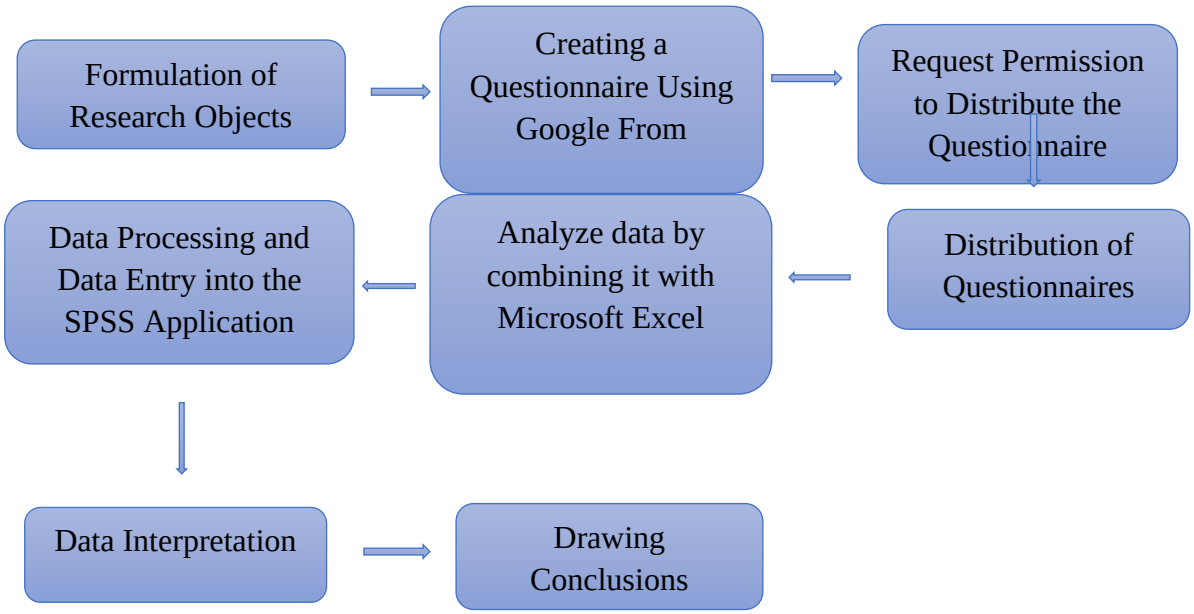
Table 1

Category Early Detection of Developmental Disorders Through Machine Learning Algorithms.

No	Earning Category	Level of Education	Percentage (%)
1	Earning Category	Teachers and Parents	>90%
2	Strongly agree	Teachers and Parents	35-70%
3	Agree Disagree	Teachers and Parents	15-30%
4	Disagree Don't agree	Teachers and Parents	5-15%

Figure 1

Data Collection and Analysis Flow



hows how researchers collect and analyze research data. The results of data acquisition came from respondents' answers to the researcher's questions. Furthermore, in the quantitative research method, the researcher will also test again using the T-test which will be used to enter research data into the SPPS application. The number of questions asked by the researcher was 20 questions, where each question was divided into ten questions with different questions. Only after the questionnaire is distributed can researchers formulate and draw conclusions from the research object.

RESULTS

Machine learning algorithms are an innovative approach to detect developmental disorders in children early and enable rapid intervention. Machine learning algorithms can be trained to identify patterns that indicate developmental disorders by collecting relevant data, such as medical records, developmental milestones, and environmental information (Vabalas et al., 2019). To ensure that the collected data are consistent and accurate, they must be processed and normalized. Logistic regression, decision trees, artificial neural networks, and coincidence forests are frequently used algorithms as they are able to analyze and predict complex data. Once the model is trained and validated with metrics such as accuracy, precision, and recall, it can be used to monitor child development consistently.

Table 2

Recap of Percentage Results from Respondents' Answers

No.	Question	strongly agree	Agree	Disagree	Don't Agree
1	Early detection of developmental disorders through machine learning algorithms enables early identification of problems	62%	26%	12%	0%
2	Machine learning algorithms can analyze child development data to detect signs of impairment	47%	33%	10%	10%
3	The use of machine learning in early detection aids faster and more effective intervention	58%	26%	10%	6%
4	Data used in early detection includes medical records, developmental milestones, and environmental information	45%	35%	20%	0%
5	Machine learning algorithms can be trained to recognize patterns that indicate developmental disorders	25%	55%	12%	8%
6	Data pre-processing is important to ensure the quality and consistency of the data used	30%	67%	3%	0%
7	Logistic regression is often used to predict the likelihood of developmental disorders	25%	20%	35%	20%
8	Decision trees help identify key factors that contribute to impairment	24%	27%	31%	18%
9	Artificial neural networks are able to analyze complex and large data with high accuracy	14%	30%	23%	33%
10	Random forest improves prediction accuracy by combining multiple decision trees	38%	32%	18%	12%

Table 2 above shows the distribution of questionnaires that have been conducted by researchers. This questionnaire contains ten questions about early detection of developmental disorders through machine learning algorithms. In addition, during the distribution of the questionnaire, the researcher has percented each response result from the respondents. Therefore, respondents can choose to answer researchers' questions by providing options such as strongly agree, agree, disagree, or disagree. And it can also be seen from the first question asked by researchers regarding early detection of developmental disorders through machine learning algorithms allows early identification of problems, getting the highest score of 62% in the strongly agree option.

Furthermore, question number two about machine learning algorithms can analyze child development data to detect signs of disorders, received the highest score of 47% in the strongly agree option. The third question about the use of machine learning in early detection helps faster and more effective interventions, received a score of 58% in the strongly agree option. The fourth question about the data used in early detection includes medical records, developmental milestones, and environmental information, received the highest score of 45% in the strongly agree option. The fifth question about Machine learning algorithms can be trained to recognize patterns that indicate developmental disorders, scored 55% in the strongly agree option. The sixth question about Data pre-processing is important to ensure the quality and consistency of the data used, scored the highest at 67% in the agree option.

Then in question number seven about logistic regression is often used to predict the likelihood of developmental disorders, getting the highest score of 35% in the disagree option. In the eighth question about Decision trees help identify key factors that contribute to disorders, getting the highest score of 31% in the disagree option. In the ninth question about artificial neural networks being able to analyze complex and large data with high accuracy, getting the highest score of 33% in the disagree option. The last question about random forest improves prediction accuracy by combining multiple decision trees, got the highest score of 38% in the strongly agree option.

Table 3

Recap of Percentage Results from Respondents' Answers

No.	Question	strongly agree	Agree	Disagree	Don't Agree
1	Machine learning algorithms can detect developmental disorders such as autism and ADHD	33%	59%	3%	5 %
2	Model evaluation using metrics such as accuracy, precision, recall, and F1-score ensures reliability	54%	26%	10%	10%
3	Implementation of machine learning models requires constant monitoring to maintain accuracy	43%	24%	13%	20%
4	Use of child health and development data must adhere to ethical and privacy standards	25%	25%	33%	17%
5	Ensuring bias-free data is important to produce fair and accurate predictions	56%	20%	23%	1%
6	Interpretability of the model is necessary for the predicted results to be understood by parents and health professionals	27%	29%	44%	0%

7	Machine learning enables real-time analysis of child development data	35%	45%	20%	0%
8	Algorithms can be adapted to detect different types of developmental disorders	80%	10%	10%	0%
9	Machine learning technology can reduce the burden on health workers in detecting developmental disorders	13%	15%	67%	5%
10	Early detection through machine learning has the potential to improve child development outcomes with timely intervention	75%	15%	7%	3%

In the table 3 statement above, researchers have also made ten questions. Which can be seen from the first question regarding machine learning algorithms can detect developmental disorders such as autism and ADHD, getting a percentage result of 59% in the agree option. Next question number two about model evaluation using metrics such as accuracy, precision, recall, and F1-score ensures reliability, getting a percentage score of 54% in the strongly agree option. The third question that the implementation of machine learning models requires constant monitoring to maintain accuracy, received a percentage score of 43% in the strongly agree option. The fourth question about the use of child health and development data must comply with ethical and privacy standards, received a percentage score of 33% in the disagree option.

Then in question number five that ensuring bias-free data is important to produce fair and accurate predictions, received a percentage score of 56% in the strongly agree option. The sixth question about model interpretability is needed so that the prediction results can be understood by parents and health professionals, getting a percentage score of 44% in the disagree option. The seventh question about Machine learning allows real-time analysis of child development data, received a percentage score of 45% in the agree option. The eighth question about Algorithms can be adapted to detect different types of developmental disorders, received a percentage score of 80% in the strongly agree option. The ninth question about Machine learning technology can reduce the burden on health workers in detecting developmental disorders, received a percentage score of 67% in the disagree option. The last question about Early detection through machine learning has the potential to improve child development outcomes with timely intervention, scored 75% in the strongly agree option.

Diagram 1

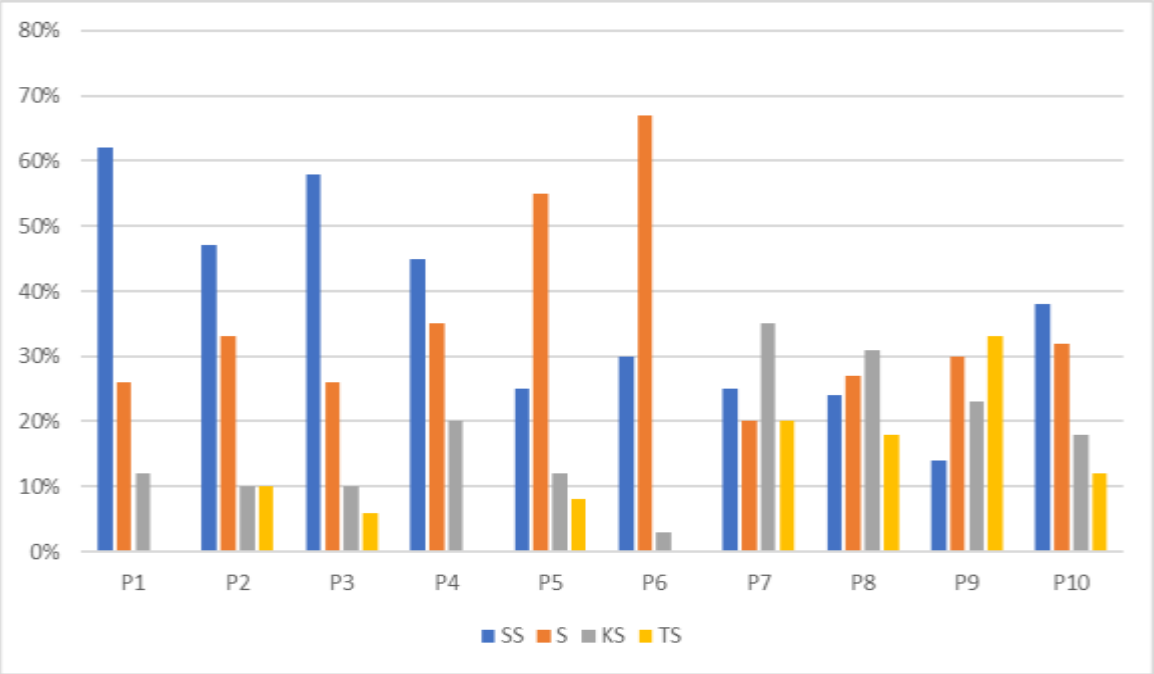


Diagram 2

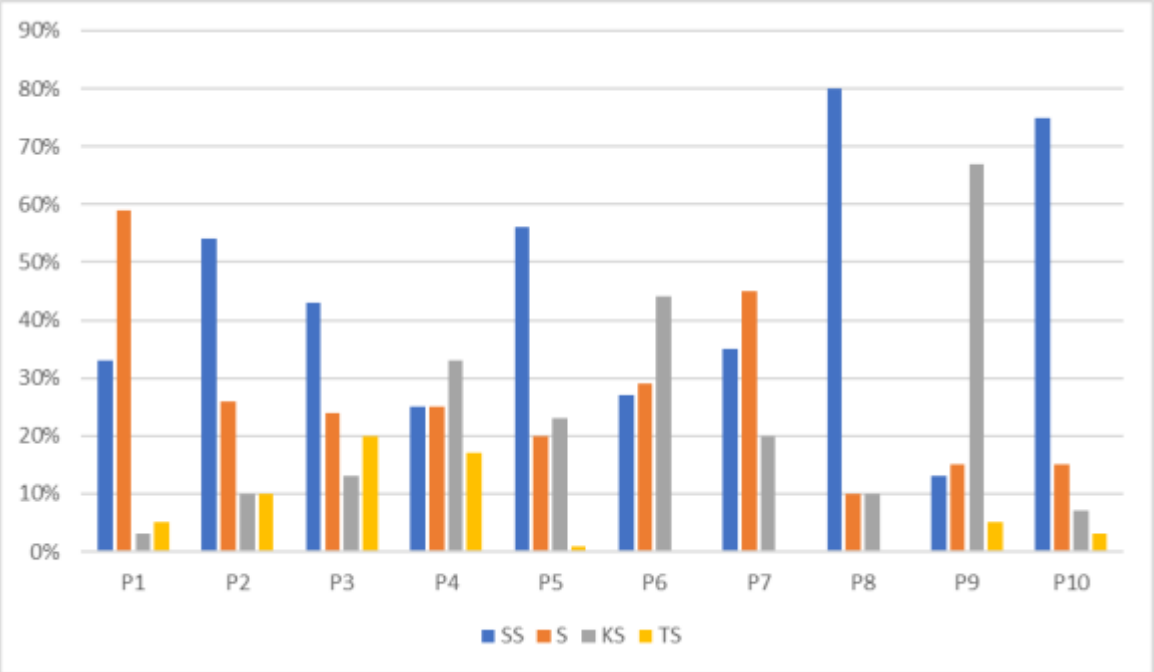


Table 3

T-Test on Early Detection of Developmental Disorders through Machine Learning Algorithms

Paired Samples Statistics

	Mean	N	Std. Deviation	Std. Error Mean

Pair 1	PRE TEST	40.4500	20	18.98330	4.24480
	POST TEST	30.9500	20	14.95423	3.34387

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	PRE TEST & POST TEST	20	-.374	.104

Paired Samples Test

		Paired Differences				
					95% Confidence Interval Difference	
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper
Pair 1	PRE TEST - POST TEST	9.50000	28.22000	6.31018	-3.70737	22.7073

Based on the results of table 3 above, it is a T-test using the SPSS application. From the results of the study, researchers can conclude that the T-test in the first output section explains Mean as an average. In the Pre Test, the resulting average amount is 40.4500, while in the Post Test it is 30.9500. Based on these results it can be formulated that there is a difference from the results of the respondents' answers. Furthermore, in the Paired Samples Correlations section, obtaining Correlations of -.374, as well as a large sig acquisition of .104. Furthermore, in the Paired Samples Test section, the results obtained are 28.22000 in the Std. Deviation section, while in the Std. Error Mean section obtained a result of 6.31018. Based on these results, early detection of developmental disorders through machine learning algorithms is indeed very influential.

Table 4

T-Test on Early Detection of Developmental Disorders through Machine Learning Algorithms

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	PRE TEST	20.2000	20	15.63599	3.49631
	POST TEST	8.4000	20	9.16171	2.04862

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	PRE TEST & POST TEST	20	.151	.526

Paired Samples Test

		Paired Differences				
					95% Confidence Interva Difference	
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper
Pair 1	PRE TEST - POST TEST	11.80000	16.88849	3.77638	3.89594	19.7040

Furthermore, in table 4, it is also the result of research using the T-test. It can be seen in the first output section from the acquisition of the Pre Test results of 20.2000, and the Post Test of 8.4000. In the Paired Samples Correlations section, obtaining Correlations of .151, with the acquisition of Sig results of .526. While in the Paired Samples Test section, obtained results of 16.88849 in the Std. Diviation, and Std. Error Meanya as much as 3.77638. Based on the results of this study, it can be seen between each question asked by researchers regarding Early Detection of Developmental Disorders Through Machine Learning Algorithms.

DISCUSSION

An important process to ensure children get the necessary interventions early on is early detection of developmental disorders (Van Den Veyver, 2019). This involves observing and evaluating a child's development in various aspects such as motor, language, social-emotional, and cognitive. Early detection helps find developmental disorders or delays before they become more serious problems (Dutta et al., 2021). Therefore, appropriate interventions can be made early, allowing the child to reach his or her full potential. Early detection methods require the cooperation of parents, teachers, and healthcare professionals (Ahn et al., 2023). Parents are usually the first to notice any developmental disorders or delays in their child. Teachers at schools or childcare centers are also very important to monitor the child's development regularly and inform parents or health professionals of any concerns (Quintanilla-Villanueva et al., 2023).

Developmental tests and screening tools are essential for detecting early developmental disorders (Zaynagalina, 2020). The Denver Developmental Screening Test (DDST), Ages and Stages Questionnaires (ASQ), and Bayley Scales of Infant Development are some of the frequently used tools. These tools are useful for evaluating different aspects of a child's development and finding areas that may need

intervention (Eteng-Uket, 2023). In terms of educational inclusion, early diagnosis of developmental disorders is very important. Children with special needs can be identified early and given appropriate support in their educational environment to ensure that they are not left behind and have equal opportunities to learn and develop (Kouki et al., 2020). In addition, by providing timely and effective interventions, early detection helps families reduce emotional and financial stress.

Overall, early detection of developmental disorders is an important step to ensure optimal child development and well-being (Sansavini et al., 2021). Machine learning algorithms are the core of artificial intelligence that allow computer systems to learn from data and make decisions or predictions without being explicitly programmed to perform a specific task (Sarker, 2021). These algorithms work by identifying patterns in data and using these patterns to predict the outcome of new data. Supervised learning, unsupervised learning, and reinforcement learning are some types of machine learning algorithms (Flah et al., 2021). Each of these groups has a unique way of solving problems. Supervised learning uses a labeled dataset, which means that each data input is connected to a proper output (T.K. et al., 2021). Linear regression, decision trees, and artificial neural networks are some examples of commonly used algorithms.

In contrast, unsupervised learning works with unlabeled datasets. Unsupervised learning algorithms such as clustering (like K-means) and association (like Apriori) are often used for market segmentation, customer data grouping, or text analysis (Santos et al., 2020). Reinforcement learning is a technique in which an algorithm learns from its environment and obtains a reward or punishment in response. In situations where decisions must be made sequentially, and the future state and final outcome are affected by each action, these algorithms are used (Zhou et al., 2021). Computer games, robotics, and automatic control are some examples of reinforcement learning applications. In the development of systems that can adapt and learn from experience in real-time, reinforcement learning is becoming increasingly important. An innovative method that uses machine learning algorithms to detect developmental disorders at an early age by combining new technologies with medical knowledge to identify developmental problems in children (W. Zhang et al., 2021).

By using very large and complex data, such as medical records, behavioral patterns, and developmental test results, machine learning algorithms can find patterns that traditional approaches may miss. They can make more accurate and rapid predictions about developmental disorders by collecting and analyzing data from multiple sources (Huang et al., 2021). The main advantage of using machine learning algorithms in early detection of developmental disorders is their ability to process large amounts of data quickly and produce objective results (Jones et al., 2021). As a result, children identified as having developmental disorders can immediately get the help they need. By implementing this technology, education and health systems can address developmental disorders more proactively. This will benefit society and individuals as a whole (Heinzen et al., 2023).

CONCLUSION

Machine learning algorithms enable early detection of developmental disorders. It is an innovative and efficient way to discover possible developmental problems in children early on. These algorithms can make faster and more accurate predictions due to their ability to analyze large and complex data. More efficient and objective routine screening is made possible by machine learning techniques such as classification and clustering, which help education and health professionals make more timely and data-driven interventions. In the early detection process, the use of machine learning algorithms not only increases the efficiency and speed of detection, but also ensures that the interventions provided are better suited to the needs of individual children. Children identified as having developmental disorders can immediately get the help they need, such as therapy or special education, which can significantly improve their developmental outcomes. Therefore, this technology is crucial to helping children develop well and the well-being of families. It also helps the education and health system as a whole.

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