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APPLICATIONS OF MACHINE LEARNING IN DIAGNOSTICS AND SPECIAL EDUCATION INTERVENTIONS

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Abstract

Special education is a basic right for children with special needs. In the technological era, machine learning plays an important role in supporting the education of these children by providing personalized learning, early detection of disorders, assisting communication, and training life skills. With joint efforts, we can create special educational environments that support optimal development for all children, including those with special needs. The importance of special education cannot be ignored and machine learning is emerging as a powerful ally in providing an approach tailored to the needs of each child. Machine Learning can customize curriculum, monitor progress, and provide real-time feedback. This helps create a more personalized and effective learning experience. The literature study approach was used to conduct the research. Data and information about the use of machine learning in special education diagnosis and interventions were gathered through a review of the literature. The concept of special education, issues with diagnosis and intervention in special education, the use of technology in education, the introduction and application of machine learning in the field of education, and the advantages and difficulties of implementing machine learning in special education are all covered in this research.

Keywords: Application, machine learning, diagnostics and intervention, special education

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INTRODUCTION

Based on students' capacity for thinking, Indonesian education uses learning patterns and tactics. It is required of students to be able to thoroughly assess problems and identify the best solutions. In actuality, there isn't a sufficient curriculum or educational system to go along with the approach to pupils' thinking skills. There is perceived to be a deficiency in government penetration when it comes to implementing a reason-based education system, and teacher ability varies greatly between schools. As education business players, we realize that there is a gap between desires and reality in realizing a capable education system (Hawkridge, 2022).

Currently, the application of technology exists in various fields, one of which is education, where it has been proven to be very important in realizing good learning outcomes for students. Education now involves more than just memorization of manuscripts and text lessons. Learning has evolved into an activity with quantifiable objectives and outcomes, both within and outside of the classroom. Education proves to be a dynamic component of the input and output of the learning process across time. Furthermore, these techniques have developed into significant elements that are essential to the advancement of curriculum basics, advancement of learning system components, and enhancement of curriculum effectiveness.

Sharda & Chakraborty (2022) state that these components are used in the planning, implementation, evaluation, follow-up and goal development processes. Education now faces a new frontier in machine learning. Machine learning, one of the most potent emerging technologies, is essential to both artificial intelligence and human communication. A cutting-edge weapon in the fight against terrorism, cancer, and climate change is machine learning. In every discipline, this is a fresh innovation. Machine learning, in essence, makes it possible for computers to find hidden information without having to be instructed to do so. Aside from that, machine learning serves as an accurate forecasting tool (Rahman et al, 2020).

The machine learning technology approach turns out to be able to provide solutions to education problems in Indonesia. The use of machine learning in the world of education is very important because this technology has opened up new opportunities to increase the effectiveness of learning and prepare students for an increasingly digital future. With the ability to deeply analyze student data, machine learning enables personalization of learning, understanding individual needs, and more accurate feedback to educators. This not only helps improve students' academic achievement but also increases their

engagement and motivation in the learning process. In addition, machine learning can also support teachers in developing more relevant and efficient curricula and help maintain academic integrity with sophisticated plagiarism detection. Thus, the use of machine learning not only advances education, but also provides solutions to modern educational challenges.

This article describes how special education activities use machine learning technology as a guiding concept. Machine learning technology can be applied in special education in a number of ways, such as offering a range of learning alternatives so that students can choose the one that best suits them while still taking into account each student's unique characteristics. Machine learning can also be applied to the evaluation of hard-to-understand teachings. In education, machine learning works in tandem with students' demands, meeting their needs at the most convenient time and location (Sekeroglu et al, 2019).

The use of machine learning in the world of education is very important, especially in special education because this technology has opened up new opportunities to increase the effectiveness of learning and prepare students for an increasingly digital future. With the ability to analyze student data in depth, machine learning enables personalization of learning, understanding individual needs, and more accurate feedback to educators (Saiz-Manzanares, 2023). This not only helps improve students' academic achievement but also increases their engagement and motivation in the learning process. In addition, machine learning can also support teachers in developing more relevant and efficient curricula and help maintain academic integrity with sophisticated plagiarism detection. Thus, the use of machine learning not only advances education, but also provides solutions to modern educational challenges.

RESEARCH METHOD

The type of research used is qualitative research using a literature study approach. Literature study is a data collection method that is carried out by searching for information through books, journals, scientific works, encyclopedias, the internet, publications from agencies, and other sources related to the application of machine learning in diagnostics and special education interventions. The process of gathering data for this study involves looking for and creating sources from a variety of sources, such as books, journals, and completed research (Mardalis, 1999 in Mirzaqon, 2017).

To bolster the claims and concepts, library materials gathered from a variety of references are critically examined and need to be thoroughly

explored. The researcher identifies the issue to be studied then looks for reading materials in journals or books that contain discussions and theories about the topic to be researched. This research aims to find out how machine learning is applied in special education diagnostics and interventions.

RESULT AND DISCUSSION

Special Education Concept

Education is the human right of every individual, and the concept of inclusive education has emerged as an important foundation in providing equal access to education for all. Special education is not just about accommodating students with special needs, but rather a commitment to creating a learning environment that supports the development of every student, regardless of background, abilities, or other differences (Savolainen et al, 2018).

Every child has the same rights as others, regardless of the obstacles they experience. Special education is important for children with learning disabilities, because it can provide them with opportunities for quality education that suits their needs. Special education provides an adequate learning environment for children with special needs. Children with disabilities can participate in the same school life as other children. Schools have ways or methods to involve them in learning so that they feel welcome. In some cases when children with special needs have learning difficulties, there will be special education teachers and related experts such as therapists, psychologists and doctors.

Special education is teaching designed for children with unique characteristics whose needs are not found in the standard school curriculum. Furthermore, it was also stated that "Special education is delivered to each child according to an individualized educational program that has been developed for that child". This means that special education is to serve according to the conditions of each child using an individualized educational program (Nielsen & Mortroff-Albert, 1089).

Special education respects the principle of equality in all segments of Education. Learning is carried out not only in class, but also in other activities where children get the same opportunities. For example, learning the art of music, no matter how difficult they are, they can actively participate in it. One of these music lessons can increase the sense of acceptance and self-confidence of children with special needs. Apart from that, in practice teachers also teach other children about tolerance and accepting differences.

In this case, Lohbeck et al (2024) further stated that who is considered a student with disabilities who needs education and where they receive their education depends on two factors: (1) how and to what degree the student differs from the average student in general, and (2) what resources are available in the school and community. Based on these two factors, their education is implemented in the form of integration in regular classes, regular classes with consultant teachers, visiting teacher services, resource teachers, teaching in hospitals and at home, special schools without boarding or daily, and special boarding schools.

The various forms of providing educational services for those who are considered disabled are a phenomenon of changes in the form of services intended for them. Services starting with segregation, mainstreaming, integration and inclusion. Segregation is a form of separate administration of public schools; mainstreaming in the form of joint administration in public schools, but in special services students with special needs enter special rooms or resource rooms; integration means that students with special needs study together with general students in public schools and when studying with the help of special guidance teachers; Inclusion is the full integration of various conditions of disability, disorder or special needs that are served in regular schools and teachers must serve by modifying according to the needs of the child and must be able to collaborate with the various conditions of the students served. Each of these forms of service emerged and developed due to various problems that have become trends in special education (Crockett, 2014).

Diagnostic and Intervention Issues in Special Education

Kotkin et al (2021) stated that the diagnosis of children with special needs is very subjective in nature. There are no tissue or blood tests to detect whether a child has autism (a developmental problem in children characterized by problems with reciprocal social interactions, communication, and repetitive patterns of behavior and narrow interests), bipolar disorder (a mental disorder characterized by changes in mood , dramatic thoughts, energy, and behavior), ADHD (a disorder characterized by difficulty concentrating, difficulty restraining, or difficulty controlling desires, and controlling movement).

Handling children with special needs in the world of special education is called intervention (service/treatment). Interventions in the world of special education in dealing with children with special needs are no less important than those carried out in the medical and social psychological world. However, in

educational interventions, success is largely determined by the age factor. The younger or earlier the child receives intervention, the more obstacles they will experience and prevent negative impacts that can arise in the future. Therefore, intervention must be carried out as soon as possible from birth to toddler age. Vellutino et al (1998) state that one of the propositions that is generally accepted in the world of education is that the earlier a child with special needs and the parents receive appropriate intervention, the greater the opportunity for the child and family to develop in a more positive direction in later. It can be seen, for example, that physical development, muscle maturity factors and the nervous system of parts of the body have an important role in mastering motor development, such as sitting, crawling and walking, and can be achieved without special training, but it seems that a certain amount of stimulation from the environment is needed to be able to accelerate maturation process or developmental tempo. This is proven by various experiments which show that children who receive little attention and have little opportunity to move freely will be able to sit, stand and walk more slowly than normal children in general. Parks (2011) notes that in relation to the development of intelligence, neurological investigations reveal that an infant's brain has approximately 100 billion neurons at birth, all of which are prepared to form connections between cells. A baby's brain grows at an incredibly fast rate throughout the first year of life, creating more connections between neurons than are necessary trillions. It is necessary to reinforce this link using a variety of psychosocial factors. This is because connections that are not strengthened will experience atrophy (shrinkage) and be destroyed. This is what will ultimately affect the child's intelligence level. This has been proven by the results of research at Baylor College of Medicine which found that if children rarely receive educational stimulation, their brain development is 20-30 percent smaller than the normal size for children their age. It is known that the development of children's intelligence in the early years of life occurs very quickly. It is actually true that a youngster reaches approximately 50% of adult intelligence capacities at age four, 80% at age eight, and the culmination point at age eighteen. This shows that early psycho-social stimulation is crucial for the development of children's intelligence, as intelligence never grows once it has passed, regardless of an individual's level of achievement. Meanwhile, Fletcher et al (2018) emphasized that children whose learning opportunities are blocked early in life (1-3 years), such as not being spoken to, not having stories read to them, or not being encouraged to explore the environment, will lag far behind in their language

skills and intellectually when they start school and may never be able to catch up.

Based on the description above in special education interventions, the function of adult involvement through intervention or stimulation and encouragement given from an early age, early life, or early development, is not just to provide various experiences and learning opportunities, but rather functions to provide convenience and an opportunity to achieve optimization of the child's overall development, by minimizing the possibility of negative impacts arising from deficiencies in congenital factors.

The complexity of the needs and obstacles in children with special needs means that no single program can meet all children's needs, these programs are specifically created individually collaboratively by involving teachers, parents and professional staff, and these programs cannot be given to other children with special needs even if they have the same abnormality.

Application of Technology in Special Education

It has become mandatory for educational institutions today to optimize learning technology. The use of technology is increasingly widespread with various digital platform developments that make things easier for people, including in the field of special education. There are at least three types of digital platforms that can support learning, namely communication-based, visual and audio-visual digital technology (Olakanmi et al, 2020).

One of the main benefits of educational technology in special education is accessibility. With the help of technology, students with special needs can access learning materials in a format that suits their abilities. For example, there is software and apps specifically designed to help students with hearing or vision impairments. Technology can also provide an alternative for students who face physical difficulties in accessing school buildings or educational facilities. Additionally, educational technology can help provide an inclusive learning environment. Through the use of adaptive learning software, teachers can adapt learning materials to suit each student's individual needs. This allows each student to learn in the most effective way for them, which in turn increases engagement and learning outcomes (Cheng & Lai, 2020).

Technology can also facilitate collaboration and communication between students, teachers, and parents. In the special education context, effective communication is essential to ensure each individual is engaged in the learning process. By using digital platforms, students can interact with each other, share thoughts, and collaborate on joint projects. (Cagiltay et al, 2019).

Teachers can also use technology to communicate with students' parents or guardians regularly, thereby strengthening the connection between home and school. Additionally, educational technology can help in overcoming geographic limitations. Sometimes, students with special needs may live in areas far from inclusive schools. In such cases, technology can provide access to quality education through distance learning.

Through online learning platforms, students can take classes virtually and participate in discussions with fellow students and teachers, without having to travel far. Finally, educational technology can help improve monitoring and evaluation of student progress. Through learning management software, teachers can track individual progress and provide relevant feedback. This allows teachers to identify areas that need extra attention and provide appropriate assistance to students. With more effective monitoring, students with special needs can receive appropriate support in their learning journey.
Overall, educational technology plays an important role in special education. By ensuring accessibility, creating inclusive learning environments, facilitating communication, overcoming geographic limitations, and improving student monitoring, educational technology helps create equal learning opportunities for all individuals. In this digital era, utilizing technology effectively in inclusive education is a very important step towards a more inclusive and just educational future (Arhipova & Sergeeva, 2015).

Introduction to Machine Learning

In 2020, Badillo et al. assert Artificial intelligence includes machine learning, which enables computers to learn from data without explicit programming. This involves creating methods and algorithms that let computers see trends in information, forecast outcomes, and make choices with little to no help from humans. In the realm of artificial intelligence, machine learning is a cutting-edge discipline that enables computers to learn from data and experience. With this approach, the system can identify patterns, make predictions, and make decisions without the need for explicit programming.

Every technological advancement is designed to make human work easier. Likewise with machine learning, machine learning has its own way of working which varies according to the technique to be used. The main concept of machine learning remains the same, namely including data collection, data cleaning, data exploration, data selection, technique selection. providing training on models, and evaluating ML results.

Generally speaking, there are three categories of machine learning: reinforcement learning, unsupervised learning, and supervised learning. An algorithm trained to identify patterns in the relationship between input data and output labels is called supervised learning. Categorized data are necessary for supervised learning. An algorithm known as "unsupervised learning" searches for patterns that may not have been recognized in the past. Data labels are not required for this algorithm to function. The second kind is reinforcement learning, which is an algorithm that uses data gathered from interactions with the environment to choose the best course of action to reduce risk and maximize output. This algorithm will keep learning new things over and over (Alpaydin, 2020).

Utilization of Machine Learning in the Education Sector

The field of education is one where machine learning is being applied. The application of machine learning in the field of education has resulted in numerous advancements and improvements. Both teachers and students gain a great deal from the use of machine learning in the classroom (Alenezi & Faisal, 2020). It is therefore advised that all schools implement this kind of learning platform, like the EdTech revolution initiative. This makes learning simpler, more effective, and more customizable to meet the needs of individual students. It is feasible to gather a variety of information regarding student behavior, particularly during learning activities, by employing techniques associated with digital learning. Variables including completion time, video views, group discussion activities, and test scores are included in the measurements that are gathered. Such measurements are relevant in the context of machine learning-based feature engineering. Experts contend that algorithms are able to identify relationships between particular student behaviors and how well they learn.

These outcomes are what are used to calculate the total efficiency that a specific machine program exhibits. A more apparent target for machine learning is recommender systems. The usage of this technology on some of the most well-known software platforms, like LinkedIn and Amazon, serves as an example of its experience. Recommender systems are thought to be the most popular systems in use today by education researchers.

Recommender systems that are in some way learning-oriented can assist learners in accurately identifying relevant content when used in the context of human learning. In this instance, the anticipated competency development goals in terms of machine-oriented education are guaranteed to

be realized. Machine learning has gained significant traction in education thanks to advancements in the field. Indeed, machine learning is to be commended for having made it feasible and beneficial to pursue in the field of education (Halde, 2016). Machine learning has integrated and made use of elements of mathematical methods to produce these outcomes. Education researchers have attempted to use machine learning into the educational system. The intention is to use machine learning as a teaching assistant to help human educators in their work. This method aids in the provision of data on student performance together with suggested and targeted actions to enhance the educational experience for students. In terms of its broad use, machine learning has become increasingly important in tools connected to educational technology.

Following are some important ways in which machine learning is used in education according to Yousafzai et al (2020):

1. Adaptive Learning: One of the main applications of machine learning is in the development of adaptive learning systems. This technology allows learning platforms to automatically assess students' level of understanding and customize learning content on an individual basis. This way, students can learn at their own pace, increasing efficiency and learning outcomes.
2. Student Data Analysis: Machine learning is used to analyze data collected from student behavior, including assessments, tests, and assignments. This helps educators to gain deeper insight into students' strengths and weaknesses as well as their learning patterns. With this information, they can design more effective teaching strategies.
3. Prediction of Student Performance: Machine learning can be used to predict future student performance. This helps educators and school administrators to identify students who may need additional attention or special support to avoid drop-out rates.
4. Plagiarism Detection: Machine learning technology can be used to automatically detect plagiarism in student assignments and papers. This helps in maintaining academic integrity and teaches students about writing ethics.
5. Curriculum Development: Machine learning is used to analyze student learning outcome data and assess the effectiveness of various curriculum elements. This allows educators to design more relevant and efficient curricula.
6. Personalization of Education: With machine learning, learning systems can provide more personalized recommendations to students, including

learning resources that suit their interests and abilities. This helps increase student engagement and their motivation in learning.

7. Teacher Professional Development: Machine learning can also be used to support teacher professional development. This system can provide feedback to teachers based on student learning outcomes, helping them to improve their teaching methods.
8. Online Exam Proctoring: To maintain the integrity of online exams, machine learning is used to detect cheating or cheating behavior during the exam. This helps maintain the fairness and validity of the exam.
9. Inclusive Education: Machine learning is also used to support inclusive education by providing tools and solutions that enable accessibility for students with various special needs.

Benefits and Challenges of Applying Machine Learning in Special Education

The importance of special education cannot be ignored and Machine Learning is emerging as a powerful ally in providing a tailored approach to the needs of each child. Machine Learning can customize curriculum, monitor progress, and provide real-time feedback. This helps create a more personalized and effective learning experience (Alberiki et a (2021). Virtual assistants powered by Machine Learning can be very effective companions for children with special needs. They can provide assistance in answering questions, provide additional explanations, or even serve as interactive study companions. The presence of such virtual assistants helps create a friendly and supportive learning environment.

Children with special needs often face challenges in developing social skills. Through Machine Learning, programs can be built that support social interaction training. Avatars or virtual characters can help children practice recognizing facial expressions, interpreting emotions, and practicing communication skills.

The mental health of children with special needs is an important focus. Machine Learning can help in monitoring behavioral changes that may indicate mental health problems. With careful data analysis, this technology can provide experts with valuable information to design appropriate interventions. Children are often more responsive to learning through play (Buehler et al, 2016).

By utilizing Machine Learning, game-based educational applications can be developed specifically for children with special needs. This game is not only fun but can also help improve their cognitive and motor skills. Machine Learning can also be used to increase accessibility for children with special needs. Apps

and software that use voice or gesture recognition technology can help children with various physical or sensory challenges to interact with digital devices more easily (Rashid et al, 2021).

Machine Learning has had a positive impact in creating a more effective and efficient inclusive educational environment. The following are some of the important roles of Machine Learning according to Zhang et al (2022) in supporting the education of children with special needs:

1. Personalize learning
   Machine Learning allows for a personalized learning approach tailored to individual needs. Machine Learning systems can identify each student's skill level, interests and special needs and create learning plans that suit the user's needs.
2. Disturbance recognition and early detection
   Through data analysis and pattern recognition, Machine Learning can help detect developmental disorders in children with special needs. The sooner the disorder is identified, the better the chance for effective intervention.
3. Communication assistance
   Children who experience problems in verbal communication often face difficulties. Machine Learning has been utilized to support them in interacting using sign language, images, or even electronically generated sounds.
4. Increasing teacher capabilities
   The use of Machine Learning can support training for educators in teaching children who require special attention. In this case, Machine Learning provides guidance regarding effective teaching strategies and suggestions tailored to each student's abilities.
5. Development of life skills
   Students with special needs often need guidance in developing specific life skills. Machine Learning can be used to create software that makes it easier to learn skills, including social skills, independence, and the ability to adapt in social environments.

Although Machine Learning has great potential in supporting the education of children with special needs, there are several challenges that need to be overcome. The use of Machine Learning in special education must pay attention to issues of privacy, data security, and the risk of discrimination. In addition, the role of teachers in the education of these children remains very important. Machine Learning should not be a replacement for teachers, but

rather a supporting tool. Effective special education for children with special needs requires a holistic approach involving educators, parents, medical personnel, and technology. Machine Learning is an important tool that can help create more inclusive education, but it needs to be managed wisely and ethically.

CONCLUSION

The importance of special education cannot be ignored and machine learning is emerging as a powerful ally in providing an approach tailored to the needs of each child. Machine Learning can customize curriculum, monitor progress, and provide real-time feedback. This helps create a more personalized and effective learning experience. The application of machine learning in the field of education has resulted in numerous advancements and improvements. The application of machine learning in the classroom has several advantages for both educators and learners. The foundation of special education activities is machine learning.

Machine learning technology can be applied in special education in a number of ways, such as offering a range of learning alternatives so that students can choose the one that best suits them while still taking into account each student's unique characteristics. Machine learning can also be applied to the evaluation of hard-to-understand teachings. When it comes to education, machine learning works in tandem with students' requirements, meeting them at the most convenient time and location.

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