Enhancing Cognitive and Metacognitive Domains of Autistic Children using Machine Learning

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Abstract— **Autism Spectrum Disorder (ASD) poses special difficulty in both cognitive and metacognitive development, necessitating specialized educational strategies. This research proposes LearnMate, a web-based application powered by machine learning techniques that aims to improve the cognitive and metacognitive abilities of children with autism. Utilize classification models learned from medical data, LearnMate forecasts skill acquisition and suggests personalized learning activities according to the strengths and developmental requirements of the child. The system permits instructors to monitor progress through real-time feedback, enabling adaptive learning approaches. Experimental results provide high prediction accuracy, with Logistic Regression achieving 97% for cognitive domain assessment and Quadratic Discriminant Analysis (QDA) achieving 96% for metacognitive evaluation. Pilot application to more than 100 children showed significant gains in problem-solving, attention, and self-regulation. The results demonstrate the immense potential for change through machine learning in special education to facilitate data-driven, personalized learning opportunities that enhance the capabilities of both autistic students and teachers. Future work will increase the dataset and include IoT-driven real-time monitoring for greater personalization.**

Keywords—Autistic Spectrum Disorder, cognitive, metacognitive, machine learning, customized learning, prediction accuracy

I. INTRODUCTION

Autism Spectrum Disorder (ASD) encompasses a wide spectrum of problems marked by some level of difficulty with social interactions, communication, restricted and repetitive behaviours, or challenges. There is no clear cause of Autism. It can afflict individuals in the same family; therefore, it may occasionally be passed down to a child through genetics. Different autistic children's talents and requirements may vary, which might lead to changes over time. Autism has a significant impact on education and employment chances. An epidemiological study conducted at the Neuro-Developmental Centre in Northern Sri Lanka analysed 123 clinical records of children with Autism Spectrum Disorder. It was identified that the average age of diagnosis to be 3.4 years, with 71.5% being males; also, the majority of the children, 69.9%, showed mild to moderate ASD symptoms [1].

According to studies, 25-61% of autistic children experience a complete lack of verbal communication, as well as deficits that create poor imagination and attentional skills [2]. Furthermore, it demonstrates that it is typical for autistic children to be placed in general education classrooms, which is favourable, as at most 44% of learners can be categorized as being of average or above cognitive ability [3]. As a result, many schools are hesitant to provide educational opportunities for children with autism.

The cognitive development of children with Autistic Spectrum Disorder is a top focus for improving their learning abilities. This cognitive learning area of study focuses on intellectual talents such as problem solving, critical thinking, and knowledge base development. Most children with ASD have limited cognitive abilities in these areas [4].

Hierarchical activeness of the learning process in the cognitive domain involves a sequence of information processing, understanding construction, and knowledge application through problem solving and research. There are six levels of cognitive complexity [5].

- Knowledge - Ability to remember facts without necessarily understanding
- Comprehension - Ability to understand and interpret learned information
- Application - Ability to use learned material in new situations
- Analysis - Ability to break down information into its components
- Synthesis - Ability to put parts together
- Evaluation - Ability to judge value of material for given purpose

Strengthening the cognitive domain in ASD maximizes learning by remediating issues such as attention, memory, executive functioning, and information processing that impact school and daily skills. Focusing on cognitive processes can allow children with ASD to perceive and respond to their environment, learn more effectively, and develop problem-solving abilities. Strengthening cognitive functioning can lead to greater learning, communication, social interaction, and adaptive behaviours.

In order to improve the cognitive domain of an autistic child, meta-cognition should also be improved. The awareness of one's own thought and learning processes and understand the patterns behind them is known as the metacognitive domain. It includes a variety of talents and skills that enable kids to control their mental processes in situations involving learning and solving problems [6]. Essential elements of children's metacognitive realm consist of:

Metacognitive Knowledge

- Declarative knowledge: Understanding potential useful solutions.
- Procedural knowledge: Understanding how to apply tactics.
- Conditional Knowledge: Understanding which methods to use and why.

Metacognitive Regulation

- Planning: Deciding on strategies and establishing goals before a learning an assignment.
- Monitoring: Examine and rating one's comprehension and performance during the work.
- Evaluating: Rethink and evaluating the results, after finishing a task [7].

To help kids with autism understand better and manage their own learning, they need to learn how to think about their thinking. Being aware of themselves and managing their actions helps them solve problems and do well in school. By learning these skills, kids with autism can feel more confident and independent, making their everyday tasks easier. This growth also helps them overall, both in school and in dealing with challenges, supporting their social and personal development.

As very few of the existing studies are related to autism detection or offer general recommendations, "LearnMate" will be an excellent tool for children with ASD to enhance their cognitive and metacognitive capabilities.

II. Literature Review

The main goal of this research work is to enhance the cognitive and metacognitive domains in children with Autism Spectrum Disorder (ASD). Therefore, a survey on various existing research works to improve these skills using machine learning techniques are reviewed and discussed.

A. *Cognitive Domain*

Kiddie Grid: an e-learning platform developed by Y. A. G. U. T. Gunathilake et al. that helps to improve cognitive abilities of autistic children in their middle childhood, caters to educational needs across Sri Lanka using technologies including Augmented Reality(AR), image processing, eye tracking, and machine learning. This application focuses on improving vocabulary skills using Augmented Reality and detecting emotions with a pre-trained Convolutional Neural Network (CNN) model [8].

In their work, Francys Z. Oyuela et al. focused on developing an AI-based backup robot to enhance cognitive skills, especially speech development, in those children with Down Syndrome. In this regard, V-model methodology was utilized for the required systematic approach in the development of the robot. All the various steps of the V-model methodology, from defining objectives to designing and then implementing the robot, were followed up with testing to meet the required needs. In that case, researchers have used Raspberry Pi, 3D printing, AI, and facial recognition; with only a few algorithms implemented in python. This project provided children with Down Syndrome personalized feedback. Researchers further mentioned that the development of the interactive robot for speech learning skills in children with Down Syndrome that was supported by AI was very promising and effective [9].

Autism Spectrum Disorder in children detection research was done by a group of researchers, kindling from Kaushik Vakadar et al. This research focuses on better ways to enhance the precision and speed of diagnosing ASD using machine learning tools, since the traditional method of diagnosis is very time-consuming and costly. The paper evaluates five machine learning models, namely the Support Vector Machine, Random Forest Classifier, Naïve Bayes, Logistic Regression, and K-Nearest Neighbours. The researchers used the confusion matrix and the F1 score to evaluate the five models and identified Logistic Regression to be the best among the five since it gives the highest accuracy. The above paper throws light on the gap between the initial suspicion and the general steps taken towards the actual diagnosis of Autism, which can be filled with solutions using the Machine Learning techniques. Scarcity of large and open-source ASD datasets has been the primary limitation identified from this work of research [10].

Jesus Peral et al. presents an architecture that brings together machine learning and integration based approaches to detect cognitive disorders, with a focus on early autism screening. In a nutshell, this is an architecture for fusing multi-source data to improve accuracy and reliability in the detection of these conditions. Adoption of various machine learning algorithms will be utilized for processing and analysing data. The architecture has huge potential for identifying, early enough, cognitive disorders and especially autism spectrum disorder by its analysis of diverse data types. In this case, different data sources are integrated to enhance detection accuracy, leading to earlier diagnosis of autism or more trustworthy diagnoses [11].

Chelsea M. Parlett-Pelleriti et al. reviews the applications of unsupervised machine learning on autism spectrum disorder research. It examines the diverse ways these techniques, like clustering and dimensionality reduction, can be employed to analyze large and unlabeled datasets and expose the latent patterns in ASD data. The authors reviewed such unsupervised machine learning methods as k-means clustering, hierarchical clustering, model-based clustering, and self-organizing maps. The review epitomizes how unsupervised machine learning techniques identify subgroups within the autistic spectrum disorder population, which could be especially important in understanding the heterogeneity of the disorder. These techniques help in discovering the patterns and subtypes of autism that supervised learning cannot find, thus giving further insight into ASD and, therefore, better-targeted interventions [12].

B. *Metacognitive Domain*

The aforementioned study by Ruan et al. looks into the convergence of emotional experiences present during learning and metacognitive processes in both typically developing children and individuals with Autism Spectrum Disorder (ASD). Researchers developed 'Meta-BrainHood,' an application that incorporated the facial emotion recognition algorithm based on machine learning for the detection of both basic and epistemic emotions. The preliminary findings indicate a significant relationship between facial emotional expressions and metacognitive monitoring performances. The authors propose that this kind of technology integrated into intelligent tutoring systems would be beneficial for enhancing metacognitive monitoring and learning outcomes for children in general, but especially those with ASD [13].

Mitsea et al. (2022) discuss metacognition and its role in some ASD individuals and examine the potential of digital technologies to alleviate metacognitive deficits. ASD individuals commonly face a lot of challenges in many metacognitive domains, as the authors have stated. Among the metacognitive skill training technologies mentioned are robotics, virtual reality, mobile applications, and serious games. Such technologies should therefore be applied in educational settings to facilitate inclusion and provide a better outcome for students with ASD [14].

Moraiti et al. 2023 offer a thorough literature review of integrating students with autism spectrum disorder (ASD) in schools through technical interventions. The authors describe different perceptions of teachers in designing inclusive classrooms and propose different strategies to support students with ASD. The majority of the focus areas on the difficulties of these students encompass such issues in terms of communication, memory, and attention. The authors point to assistive technologies such as web and mobile applications to improve communication, organizational skills, memory, and attention. This study points to the important role that technology can play in improving the inclusion and integration of individuals with ASD [15].

In their 2020 paper, Mitsea et al. start from the premise that metacognitive training, mindfulness practices, and robotic interventions could be combined for the benefit of children with ASD. The authors mention difficulties children with ASD face in the domains of communication, socialization, and emotional regulation. The review suggests that, through the development of metacognitive skills, social abilities, and emotional awareness, human-robot interaction can be beneficial in this regard. The highlighted combination of art, programming, cooperative games, and mindfulness training with robot assistance is viewed as a broad strategy for helping children with ASD develop self-regulation, self-reflection, and decision-making skills [16].

III. METHODOLOGY

LearnMate is a web application created to help kids with autism to acquire their skills and knowledge. LearnMate aims to minimize the gap by providing focused procedures to assist these kids in overcoming their obstacles and developing their personalities, in contrast to traditional methods that mostly concentrate on diagnosing autism. It is designed to meet the specific requirements of autistic children, which differ from those of typical children. The program makes use of machine learning techniques to identify the challenges that each child faces and offer customized solutions. The two main domains that make up the learning process are cognitive and metacognitive.

LearnMate evaluates each of these areas, predicts the child's competence in each, and provides exercises that are personalized to the children. These are not usual activities; instead, they have been carefully chosen and offered with the advice of subject-matter specialists to guarantee that they meet the specific requirements of every child. LearnMate helps autistic children to overcome their limitations, acquire essential abilities, and create a strong, independent identity by focusing on development rather than just identification.

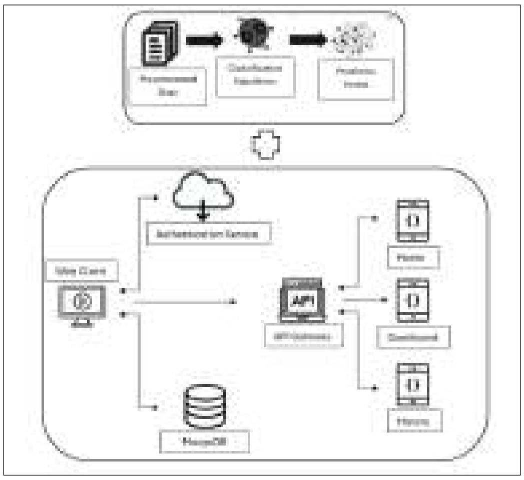

Fig. 1. System Diagram

A. *Requirements & Data Gathering*

To improve the development and efficiency of this application for skill-building, data is being gathered from hospitals and learning centres specializing in serving children with autism. Additionally, an online survey was created to collect data from parents of autistic children. Moreover, meetings were held with professionals such as psychiatrists, teachers, and doctors specializing in autism to collect the necessary requirements and details. Information has been collected about the areas where these children face the most challenges, the meditations and practices being used to support their development, and additional use cases.

B. *Designing*

A comprehensive personnel progress chart is provided in detail and made accessible to responsible personnel such as educators and teachers. The aspect of the dashboard was important as it has to contain all necessary data, which needed to be easily viewed. Following this, there is a change in the interface where the child is presented with specific recommendations tailored to them. This interface is designed to facilitate the completion of these tasks while remaining simple, clear, and appropriate for a child.

Considering that autistic children are sensitive to different stimuli, the application is designed with soft colours and a touch of warm tones. The complete set of UI elements, including buttons, forms, and activities, has been kept simple, as the primary users are teachers.

C. *Implementation*

As for the implementation phase, the actual product in terms of the strategic plan is produced. The first one is the necessity to structure the received dataset into a table because most of the data would be based on the perspectives of each school or learning centre. Once the dataset is structured, the data is then pre-processed to remove unwanted data. Using the pre-processed datasets, classification techniques and neural networks were used to build machine-learning models for predicting the autistic level in each domain. The collected datasets were applied to train the models, and each use of the model found the best for each domain to predict the level of the autistic child accurately.

Models that use GridSearchCV, in a systematic manner, have performed an exhaustive search for the combination of best hyperparameters at each evaluation, using cross-validation to evaluate various configurations each time. These models were executed about 100–150 times in order to do hyperparameter tuning, changing one hyperparameter in each run to check how it affects the performance. Some of the Hyperparameters such as the regularization strength in Logistic Regression, the selection of the kernel in SVM, and the number of estimators in the XGBoost were modified in order to enhance the model performance. Additionally, the SMOTE technique was used to balance the class ratio, as it may impact hyperparameter tuning and thus the model generalization.

The primary reason for selecting classification models for this study is their ability to categorize children's skills into levels like mild, moderate, and severe. Autistic children present dissimilar learning patterns across different domains, such that classification serves the need for structured decision-making to fit each child to the most appropriate skill category. Conventionally, these models perform best when trained with labelled datasets where proper predictions can be made given past observed patterns of data. Besides this, classification is able to provide scalability and real-time predictions, thus making these models suitable to be implemented in a web-based application that provides instant recommendations. Such a classification-based system assists in personalizing interventions; each child would receive activity suited to his or her cognitive and metacognitive development profile.

The recommendations will involve small tasks to improve the child's planning, regulation, monitoring, and self-evaluation abilities. After the child is finished, teachers have to track time taken, number of retries, and a mark allocated for correct tries to be filled in the form given. Then the resulting score (percentage) will be calculated using an algorithm that we fed to the model and will be displayed in the dashboard. The child's progress shall be served in the form of graphs and the application of colour theory to ensure that the information can be easily comprehensible by the general population.

Algorithm:

$$P = 100\,x\left(1-\left(\frac{T_{child}-T_{typical}}{T_{child}+T_{typical}}\right)\right)x\left(1-\left(\frac{R_{child}-R_{typical}}{R_{child}+R_{typical}+1}\right)\right)x\left(\frac{M}{10}\right)$$

Equation 1. Progress Calculation Logic

- T_child : Time taken by the autistic child to complete the task.
- R_child : Number of retries taken by the autistic child.
- T_typical : Average time taken by a normal child.
- R_typical : Average retries by a normal child.
- M: A score given by teacher (1 to 10) to reflect the child's performance.

This formula assumes that lower time and fewer retries indicate better performance.

D. *Testing*

A starting set of performance matrices, such as accuracy, precision, recall, and the Mean Squared Error statistics, will measure the efficiencies of models that would predict the domain level and give relevant recommendations. After that, activities were introduced to the constituents that interacted with them after specialists verified their execution and ascertained that the results produced were correct. This guarantees that whatever recommendation is given is in the best interest of that child.

IV. Results and Discussion

A. *Prediction Accuracies of Cognitive and Metacognitive Skills*

LearnMate uses machine learning algorithms (classification) to predict the skill levels of children in both cognitive and metacognitive domains. The accuracy of these predictions is important for the effectiveness of the customized recommendations. Often considered as a primary attribute, accuracy might not be the only one and is the case especially when the dataset is imbalanced. Precision and Recall are the main factors in a situation where errors in detecting false positives or false negatives might lead to different outcomes, and in this regard, F1-score, with its evenly distributed algorithm, offers a complete solution.

In the cognitive domain, logistic regression is the most powerful model. **Logistic Regression** has a test accuracy of 0.9762 and offers high precision (0.9776) and recall (0.9756). Although SVM got a perfect result, Logistic Regression, which has a balance in performance and generalizability, is a more stable choice as the risk of overfitting would be lower. With its less complex assumptions, Logistic Regression provides a more stable and interpretable approach. This is particularly appealing within educational/psychological research contexts, where affordance is a key concern. Not only can it be considered as a good fit, but it can also produce probabilistic impressions that inform more nuanced decision making. It is also quite amenable to classification of varying levels of cognitive skills.

For the Metacognitive Domain, **Quadratic Discriminant Analysis** (QDA) turns out to be the best model and gets glory coming from the highest accuracy achieved in the test (0.9571). Along with that, the model's precision is strong (0.9628), the recall is high (0.9571), and the F1-score is almost perfect (0.9575). These numbers suggest QDA can discriminate between levels of metacognitive skills. The assumption of QDA is that each class has its own covariance structure, which matches the natural variation and complexity of metacognitive behavior reasonably well. QDA's covariance structuring permits consistency in the model's ability to discover and model the subtle differences between skill levels, and it is unlikely that this model will lack integrity as a relatively valid and reliable option for predicting the metacognitive domain.

Cognitive Domain:

Table 1. Train-Test Accuracies of Models for Cognitive Domain

Model	Train Accuracy	Test Accuracy	Precision	Recall
XGBoost	0.9484	0.8810	0.8933	0.8810
Random Forest	0.9977	0.9286	0.9287	0.9286
SVM	1.0000	1.0000	1.0000	1.0000
Logistic Regression	0.9756	0.9762	0.9776	0.9756

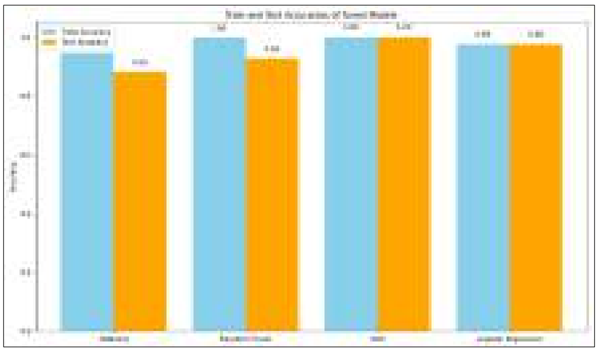

Fig. 2. Performance Metrics of Models for Cognitive Domain

Metacognitive Domain:

Table 2. Train-Test Accuracies of Models for Metacognitive Domain

Model	Train Accuracy	Test Accuracy	Precision	Recall	F1 Score
XGBoost	0.9895	0.9286	0.9306	0.9286	0.9287
MLP	0.8846	0.8429	0.8526	0.8429	0.8436
QDA	0.9692	0.9571	0.9628	0.9571	0.9575
SVM	0.9436	0.8429	0.8731	0.8429	0.8491

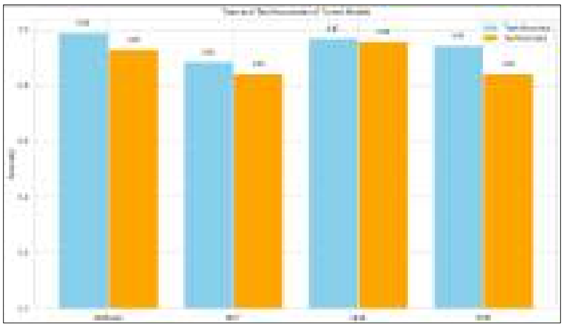

Fig. 3. Performance Metrics of Models for Metacognitive Domain

B. Effectiveness of Customized Learning Exercises

The LearnMate system implements a sophisticated intervention framework that activates once a child's ability level has been predicted through its machine learning classification model. This predictive assessment serves as the foundation for a highly personalized educational experience tailored to each child's unique developmental profile. The intervention selection process employs a multidimensional matching algorithm that considers several critical factors simultaneously:

1. Domain-Specific Ability Level: Activities are precisely calibrated to the child's predicted level (mild, moderate, or severe) within the developmental domain, ensuring appropriate challenge without overwhelming the child.

2. Age-Appropriate Content: Beyond ability level, the system incorporates age-appropriate themes, vocabulary, and interaction patterns to maintain engagement and relevance.

3. Evidence-Based Practice: Each recommended exercise emerges from a rigorous development process involving multidisciplinary collaboration among autism specialists, developmental psychologists, special educators, and behavioural therapists. This expert involvement ensures activities align with established best practices in autism intervention.

4. Comprehensive Validation: Before inclusion in the LearnMate library, each activity undergoes extensive validation through:

- Pre/post testing to measure specific skill improvement
- Structured teacher feedback from classroom implementation
- Systematic parental observations in home environments
- Iterative refinement based on collected implementation data

This multi-layered validation approach ensures that the recommended activities not only match the child's current capabilities but also have demonstrated effectiveness in supporting developmental progress for children with similar profiles. By bridging expert knowledge with data-driven personalisation, LearnMate provides caregivers and educators with an intervention toolkit optimized for each child's unique learning journey.

C. User Experience and Engagement

A pilot version of the web-based application was conducted over two months with a larger sample of autistic children (more than 100) selected from various data collection centers. The pilot was developed to assess user engagement, practical usability, and elicit feedback from teachers and educators to inform future development. The pilot was not constructed to generalize but it had important value as a feasibility study and identified some early positive outcomes.

After one month of consistent individual use of the recommended personalized exercises, many participants showed statistically significant improvement in the key developmental areas of attention span, problem-solving, and self-regulation. Moreover, qualitative feedback from the educators indicated significant increases in motivation and engagement with the learning activities. For example, one teacher reported that “a participant showed a 20% increase in their ability to follow multi-step instructions after doing the sequencing exercises for two weeks.”

Table 3: Observed Improvements during the Pilot Study

Skill Area	Observed Improvements	Evidence Source
Attention Span	Improved focus during tasks (↑ ~18%)	Teacher reports and activity logs
Problem Solving	Faster response and better accuracy (↑ ~22%)	Performance assessments
Self- Regulation	Fewer behavioral interruptions (↑ ~15%)	Classroom behavior observations
Instruction Following	Increased ability to complete sequences (↑ ~20%)	Teacher testimonials

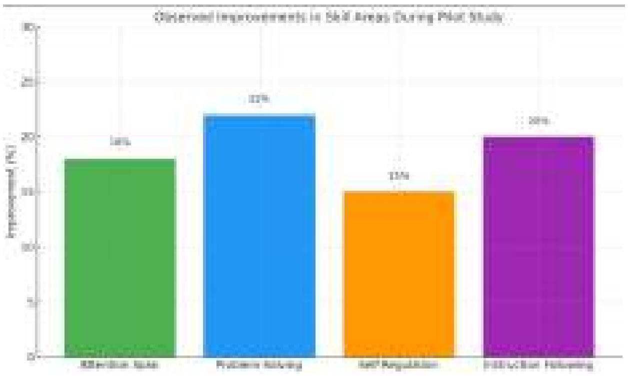

Fig. 4. Observed Improvements in Skill Areas During Pilot Study

D. *Importance of the application*

It is understood nowadays that at least one child with special needs can be found in the majority of the schools. Their cognitive styles, skills, and behaviours are believed to differ considerably from that of a typical child, thereby necessitating an approach to their special education. Likewise, many teachers do not know how to effectively teach such children. In terms like that, our web approach can assist the educators in controlling many situations adequately, and they can also monitor the children's performances at the end of the day.

E. *Limitations and Future Directions*

The study encountered several limitations that may have influenced the scope and generalizability of its findings. One of the primary constraints was the relatively small sample size, which may not fully represent the wider population and thus could affect the robustness of the conclusions drawn. Additionally, the nature of the data collected was sensitive, potentially limiting participant responses and introducing bias or incomplete data sets. Time constraints also posed a challenge, as the study had to be conducted within a limited timeframe, restricting the depth of exploration and data analysis. Another notable limitation was the geographical coverage of the data collection process, which was confined to centres within the Western Province. This narrow focus may limit the applicability of the findings to other regions with different demographic or socioeconomic characteristics. To address these issues, future research should aim to broaden the geographical scope of data collection and increase sample size. This would help in developing more generalized and personalized recommendations that better reflect diverse populations.

This study's limitations will be addressed in future work involving linking Internet of Things (IoT) in ways that facilitate more scalable, accurate, and real-time data collection for cognitive and metacognitive work. Specifically, once we embed IoT-enabled devices (e.g., wearables, environmental monitors, smart assessment tools) in children's natural settings, we can collect continuous and unobtrusive data on their cognitive and metacognitive behaviours in the context of learning. For example, we can use sensors to record physiological measures (e.g., heart rate, temperature, stress), activity histories, and physical, environmental factors to determine children’s cognitive and metacognitive actions during learning.

In addition, integrating IoT will allow us to adjust our recommendation plans in real-time based on the respective performance and needs of the child in a personalized way. We can also combine the data collected to show change in each child's progress over time, which can inform effective interventions as well as decision-making by caregivers or educators. Ultimately, IoT will strengthen the validity of assessment and the effectiveness of our personalized development plans with children.

V. CONCLUSION

Supporting learning domain development in children with autism is an important component of their cognitive, social, emotional and physical development. The present research explored the feasibility of machine learning methods to assess and support development in different skills for children with autism. Using classification modelling techniques, the system successfully identified domain-wise levels related to their skill ratings. When predicting domain levels for any given child, the system could provide unique feedback to generate individualized recommendations that can be used to structure domain development. Results from this research illustrate the capabilities of machine learning to recognize and support learning processes in children with autism. Context-specific recommendations based on machine learning would enhance the effectiveness of current strategies. Further, the deployment of a web-based format allows for optimal access and use by a range of stakeholders, including family, therapists, and teachers, even those without prior expertise. The resulting convenience supports early interventions and provides ongoing, real-time support from caregivers who can adapt approaches based on feedback.

Although the study utilizes promising data, this study also describes several challenges that must be addressed to help improve the validity and applicability of the system proposed. The primary challenge is the quality and availability of data. Learning skills are a complex phenomenon that differs broadly among individuals; thus, collecting a comprehensive dataset that is rich and varied is still a central consideration for enhancing overall model performance. In addition, machine learning systems must be shown to generalize across many age groups, domain levels, and cultures to validate the model's robustness. Ethical considerations (data privacy, informed consent) also need to be addressed to ensure trust and transparency when applying machine learning in sensitive contexts such as these.

Future directions for study should focus on validation of the data in terms of maintenance and expansion of the dataset by including longitudinal data as well as real-time monitoring and assessments to reflect the dynamic nature of personality development and learning. Continuous monitoring of children and their learning patterns and contextual variables using IoTs offers a greater understanding of their learning patterns. Recent research and advances in how we use smart devices for assessments could also help support the tuition of data through XAI-enhanced reporting and analytics, providing more meaning to educators and caregivers about the reasoning behind the recommendations of the system.

Collaborating with experts in autism, psychology, and education will help to improve the recommendation system to fit with evidence-based approaches to therapy. Adaptive learning strategies can be applied to increase the personalization of interventions, tailoring support based on each child's specific developmental trajectory. Elements of gamification or interactive features could also enhance engagement and motivation of children and create a positive learning experience. By applying machine learning in conjunction with personalized support strategies, this study supports the ongoing movement in improving the learning and social well-being of autistic children. Further development in technology around the use of educational and therapy tools will provide opportunities to develop new and novel strategies that support the development of vital skills for autistic children. As the recommendations of the machine learning-based system get further improvements and validation, there is potential for machine learning strategies to influence personalized learning and intervention support, thereby promoting independence for autistic children and improving the overall quality of life.

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