International journal of basic and applied research
www.pragatipublication.com
ISSN 2249-3352 (P) 2278-0505 (E)
Cosmos Impact Factor-5.86

PREDICTING BEHAVIOR CHANGE IN STUDENTS WITH SPECIAL EDUCATION NEEDS USING MULTIMODAL LEARNING ANALYTICS

[1] *Mr.Karamsetty Shouryadhar,*[2] *M. Tejesvi,*[3] *M. Sonalika,*[4] *M. Jahnavika*
[1]*Assistant Professor,*[234]*Students*
Department Of CSE
Malla Reddy Engineering College for Women

ABSTRACT

Students with special education needs (SEN), whose behavior and learning are particularly sensitive to their bodily conditions and surrounding surroundings, have new options due to the availability of educational data in innovative methods and forms. In order to elucidate the underlying educational insights, multimodal learning analytics (MMLA) collects student and learning environment data in a variety of modalities and analyzes it. In this study, we used MMLA to predict how SEN kids would behave after they get applied behavior analysis (ABA) treatment. ABA therapy is a kind of special education intervention that tries to cure behavioral issues and promote positive behavior changes. Here, we demonstrate how our deep neural network and machine learning models can optimally predict the behavior change of SEN kids with 98% accuracy and 97% precision by importing multimodal educational data. We also show how predictive models with merely standard educational data may perform statistically much better when combined with environmental, psychological, and motion sensor data. Since 2020, the Integrated Intelligent Intervention Learning (3I Learning) System in Singapore and Hong Kong has improved intense ABA therapy for more than 500 SEN kids thanks to our efforts.

1. INTRODUCTION

Adolescents who need special education services (SEN) may display behavioral traits such inattentiveness, emotional instability, and hyperactivity. Numerous people are also vulnerable to social and intellectual issues [1]. According to research, aberrant brain development is linked to improper behaviors in SEN pupils, including those with autism spectrum disorders (ASD) [2]. In addition, some learning difficulties and attention deficit hyperactivity disorder (ADHD) are inherited [3]. Aggression and self-harm are examples of contextually inappropriate behaviors that might impede the social and personal growth of SEN kids. As a result, encouraging good conduct is a crucial special education learning objective.

The goal of applied behavior analysis (ABA) treatment is to modify the behavior of special education (SEN) pupils

International journal of basic and applied research
www.pragatipublication.com
ISSN 2249-3352 (P) 2278-0505 (E)
Cosmos Impact Factor-5.86

[4]. Reinforcement and stimulus control are two behavioral science concepts that serve as the foundation for ABA techniques. Socially relevant results may be enhanced by encouraging the modification of desired behavior [5]. Alves et al. recently provided a thorough analysis of ABA technologies [6], which included ABA application support systems (p. 118667). The examined works included everything from real-time monitoring [8] and data management [9] for individualized intervention to web-based services and data visualisation for educating kids with low-functioning autism [7]. Nevertheless, there aren't many studies focusing on ABA result prediction. It is important to remember that ABA treatment uses very methodical and evidence-based behavior analysis procedures. Because of this, data-driven methods like learning analytics (LA) may be used to improve technology connected to ABA. In the meanwhile, LA has the potential to improve current ABA therapy as it is often used in educational practice to comprehend and optimize learning and the learning environment [10].

By using educational data in many modalities, this effort intends to improve current ABA treatment for SEN kids by forecasting the change in their behavior. More specifically, we used the following research questions to direct our investigation.

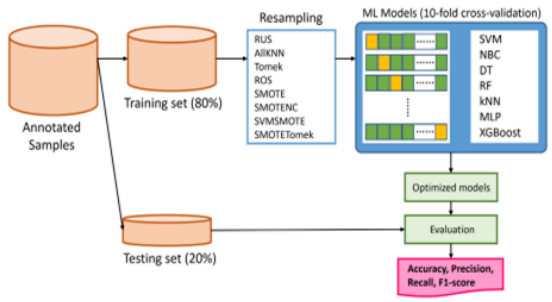
• RQ1: What are the statistical features of the physiological, mobility, and environmental data gathered during ABA treatment sessions for kids with SEN?
• RQ2: Compared to more conventional forms of student data, can sensors and wearable technology improve the accuracy of behavior change predictions for students with SEN?
Question 3 Is it possible to use ML algorithms on MMLA to forecast when SEN pupils' behavior will change, and how well do these algorithms compare to previous MMLA works?

The present paper's Sections IV and V provide comprehensive answers to the problems mentioned above. Here are some of the ways in which our work contributes:
• We gather information from 1,130 ABA treatment sessions, analyze it using a multimodal data gathering system that we designed and developed, and then we provide in-depth statistical interpretations of our findings.
We provide statistical proof that SEN kids' behavior change predictions may be much improved using sensors and wearable data compared to more conventional educational data.
• We show that ML algorithms and DNNs can reliably forecast when SEN pupils' behavior will change. Our prediction models are thoroughly tested and evaluated, and we compare our findings to those of other studies.

International journal of basic and applied research
www.pragatipublication.com
ISSN 2249-3352 (P) 2278-0505 (E)
Cosmos Impact Factor-5.86

Our study will shed light on ABA methods in new ways, particularly when it comes to using IOT sensors and wearables to anticipate students' learning. This effort will help the engineering community as a whole see how MMLA may improve behavioral interventions for students with SEN and help them acquire new skills. Furthermore, this article's updated results serve as excellent pointers for further studies on assistive technology in the field of special education.

2. SYSTEM ARCHITECTURE



3. EXISTING SYSTEM

The acronym ABA refers to Applied Behavior Analysis, an intervention strategy in behavior analysis that systematically employs instructional strategies grounded on behavior principles to reduce problematic behaviors and improve desirable social behaviors [4]. Using behavioral experiments, researchers have looked at the set of basic principles, which are claims about the inputs that environmental influences have on a behavior function (p.155). When a child engages in behavior, it is because he or she is engaging with the world around them via the use of motor skills. Everything around us has a role in the learning process. The learning environment includes both the student's immediate surroundings and the physical space around them.

The goal of applied behavior analysis (ABA) is to help students improve their communication and daily living skills so that they may have more fulfilling lives. A systematic and quantitative approach to evaluating behavior is set up before the ABA classes begin. By using positive incentives and dividing the desired behavior into smaller tasks, goal attainment is often promoted. Some of the criteria used for assessment include the following: the degree to which the student is off task, the degree to which the desired task has been completed (plus or minus), and the degree to which the student requires prompting from the therapist to finish the job. The effectiveness of behavior adjustment depends on its durability [11]. Therefore, a follow-up assessment of the behavioral changes is necessary to ensure the treatment's effectiveness.

Students with special needs may be more susceptible to environmental hazards because they have trouble interpreting sensory information. A previous study found that children with SEN, and especially those with ADHD, experienced fatigue and

International journal of basic and applied research
www.pragatipublication.com
ISSN 2249-3352 (P) 2278-0505 (E)
Cosmos Impact Factor-5.86

difficulty focusing when exposed to environments with high levels of CO2 [12]. Another study found that toddlers with intellectual impairments had higher than normal temperatures, which may have an effect on their mental and physical health as well as their capacity to learn [13]. Research suggests that pupils with intellectual disabilities (ID) may be more prone to auditory discomforts due to the psychological demands of their circumstances (p.115). Both the lighting in the classroom and the comfort of students with SEN were also examined. While they did find that SEN children were typically irritated and exhausted from lighting discomfort, they also found that each student was impacted differently by glare and poor lighting [14]. On the other hand, therapists and educators often just have the ability to toggle the lights on and off (p.105).

Emotions may influence kids' learning and engagement levels, regardless of whether they have special needs or not. Particularly anxious behavior is a symptom of internal stress experienced by students with ID. The physiological markers of stress that hinder learning include heart rate, blood pressure, and body temperature [15]. Research suggests that children with SEN may see a reduction in these inhibitors in more moderate settings [16]. Excessively high or low levels of skin conductance, as measured by the galvanic skin response (GSR) [17], are known to impair the learning capacity of children with SEN. Moving their bodies with the use of motion-based technology also helped students with SEN with their short-term memory, according to a study.

Activity logs, audio, video, and biosensors are just a few of the educational data sources and formats used by MMLA to enhance learning analytics [19]. Because they simplify the collection of multimodal data from the complex learning environment, Internet of Things (IoT) technologies substantially enhance MMLA [20]. Internet of Things (IoT) sensors record data from several sources, including the physical learning environment (light, humidity, temperature, and noise), the learners' head and body movements, and their physiological activities (heart rate, brain waves, and skin pigmentation). These were input into MMLA after being extracted from physical objects or human bodies and encoded in a machine-readable format [21]. Possible explanations for the observed learning process might be offered by validating learning theories.

Disadvantages

Teachers and therapists have little information about kids' ABA learning since our prediction goal is a binary output.

• One-on-one therapy sessions between students and therapists are the focus of the present data collecting method. When working with students who have exceptional

International journal of basic and applied research
www.pragatipublication.com
ISSN 2249-3352 (P) 2278-0505 (E)
Cosmos Impact Factor-5.86

needs, classroom instruction is often one-on-one or small groups.
• Expensive measuring gear is used in this investigation. One example is the adoption of Empatica E4 bracelets, which may cost over $1,000 USD.

4. PROPOSED SYSTEM

Teachers and therapists have little information about kids' ABA learning since our prediction goal is a binary output.
• One-on-one therapy sessions between students and therapists are the focus of the present data collecting method. When working with students who have exceptional needs, classroom instruction is often one-on-one or small groups.
• Expensive measuring gear is used in this investigation. One example is the adoption of Empatica E4 bracelets, which may cost over $1,000 USD.

Advantages

• We gather information from 1,130 ABA treatment sessions, analyze it using a multimodal data gathering system that we designed and developed, and then we provide in-depth statistical interpretations of our findings. We provide statistical proof that SEN kids' behavior change predictions may be much improved using sensors and wearable data compared to more conventional educational data.
• We show that ML algorithms and DNNs can reliably forecast when SEN pupils' behavior will change. In addition, we compare our findings to those of other studies and provide thorough assessments of how well our prediction models function.

5. IMPLEMENTATION

Modules description

Service Provider

A valid username and password are required for the Service Provider to access this module. Once he logs in, he'll have access to features like the ability to browse and train and test data sets. Check the Bar Chart for Trained and Tested Accuracy, See the Results of the Trained and Tested Accuracy, The Student Behavior Change Status Ratio and the Prediction of Their Status Have Been Viewed. Get your hands on trained data sets, Discover the outcomes of the student behavior change status ratio, See Who Is Remotely Connected.

View and Authorize Users

The admin can get a complete rundown of all registered users in this section. Here, the administrator may see the user's information (name, email, and address) and grant them access.

Remote User

All all, there are n users in this module. Registration is required prior to performing any operations. Details will be entered into the database after a user registers. He will need to log in using the permitted username and password when registration is

International journal of basic and applied research
www.pragatipublication.com
ISSN 2249-3352 (P) 2278-0505 (E)
Cosmos Impact Factor-5.86

completed. Following a successful login, users will be able to access features such as the following: see their profile, predict the kind of behavior change in students, and register and log in.

6. CONCLUSION

In this study, we used MMLA to forecast behavioral changes in special education (SEN) adolescents undergoing ABA therapy. A new MML technique is provided for predicting the success of behavior modification in ABA treatment for special education kids. To create statistical models for ABA therapy, we introduced data from IOT sensors, such as ambient environmental measurements (CO2 level, humidity, light intensity, and temperature), physiological measurements (IBI, BVP, GSR, and skin temperature), and motion measurements (accelerometer values in X, Y, and Z directions). Additionally, we use ML and DNN approaches to forecast behavioral changes in SEN kids.

After examining the multimodal educational data's statistical properties, we discovered that the majority of our data are not normally distributed. Although there were notable correlations between the variables, our variables did not exhibit multicollinearity. We also demonstrated how wearable data and sensors might greatly improve the prediction of behavior modification accomplishment for SEN kids. A DNN and other ML algorithms were constructed, improved, and assessed. Our findings showed that ML, particularly deep learning, may be used in conjunction with MMLA to forecast behavioral changes in SEN kids. While our classifiers and DNN outperform the majority of the current MMLA models in terms of performance. But we also noticed differences in the prediction objectives amongst the models that were compared.

Fostering good behaviors in special education (SEN) kids is crucial for their social and emotional growth. In addition, ABA treatment is a successful intervention strategy that targets behavior modification in this particular demographic. awareness the acquisition of behavior skills and their impact on later behavior modification requires an awareness of the learning environment and the physiological circumstances of the learner during ABA treatment sessions. The predicted relationships between the learner's physiology, the learning environment, and the learning result in ABA treatment have been validated by the present research. There are also a number of restrictions and essential future projects listed. All things considered, our research supports the increasing calls for using ML to support students with neurological and developmental issues in their schooling. [43].

REFERENCES

[1] P. A. Alberto and A. C. Troutman, *Applied Behavior Analysis for Teachers*, 9th ed. Upper Saddle River, NJ, USA: Pearson, 2013.

[2] B. S. Abrahams and D. H. Geschwind, ‘‘Advances in autism genetics: On the threshold of a new neurobiology,’’ *Nature Rev. Genet.*, vol. 9, no. 5, pp. 341–355, May 2008.

[3] L. Bassarath, ‘‘Conduct disorder: A biophysical review,’’ *Can. J. Psychiatry*, vol. 46, no. 7, pp. 609–617, 2001.

[4] J. O. Cooper, T. E. Heron, and W. L. Heward, *Applied Behavior Analysis*, 3rd ed. Hoboken, NJ, USA: Pearson, 2020.

[5] R. Pennington, ‘‘Applied behavior analysis: A valuable partner in special education,’’ *Teach. Except. Child.*, vol. 54, no. 4, pp. 315–317, 2022.

[6] F. J. Alves, E. A. De Carvalho, J. Aguilar, L. L. De Brito, and G. S. Bastos, ‘‘Applied behavior analysis for the treatment of autism:
A systematic review of assistive technologies,’’ *IEEE Access*, vol. 8, pp. 118664–118672, 2020.

[7] M. C. Buzzi, M. Buzzi, B. Rapisarda, C. Senette, and M. Tesconi, ‘‘Teaching low-functioning autistic children: ABCD SW,’’ in *Proc. Eur. Conf. Technol. Enhanced Learn.* Berlin, Germany: Springer, 2013, pp. 43–56.

[8] V. Bartalesi, M. C. Buzzi, M. Buzzi, B. Leporini, and C. Senette, ‘‘An analytic tool for assessing learning in children with autism,’’ in *Universal Access in Human-Computer Interaction, Universal Access to Information and Knowledge*, vol. 8514, C. Stephanidis and M. Antona, Eds. Cham, Switzerland: Springer, 2014.

[9] G. Presti, M. Scagnelli, M. Lombardo, M. Pozzi, and P. Moderato, ‘‘SMART SPACES: A backbone to manage ABA intervention in autism across settings and digital learning platforms,’’ in *Proc. AIP Conf.*, vol. 2040, 2018, Art. no. 140002.

[10] G. Siemens and R. S. J. D. Baker, ‘‘Learning analytics and educational data mining: Towards communication and collaboration,’’ in *Proc. 2nd Int. Conf. Learn. Analytics Knowl.*, Apr. 2012, pp. 252–254.

[11] D. M. Baer, M. M. Wolf, and T. Risley, ‘‘Current dimensions of applied experimental analysis of behavior,’’ *J. Appl. Behav. Anal.*, vol. 1, pp. 91–97, Jan. 1968.

[12] S. Vilcekova, L. Meciarova, E. K. Burdova, J. Katunska, D. Kosicanova, and S. Doroudiani, ‘‘Indoor environmental quality of classrooms and occupants’ comfort in a special education school in Slovak Republic,’’ *Building Environ.*, vol. 120, pp. 29–40, Aug. 2017.