Analyzing the impact of sports education and psychological needs on kids' educational outcomes - a machine learning approach

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Abstract

Educators use standardized tests to assess children's ability to learn from other disciplines, such as neuroscience. By looking at this data, we can better understand how kids process and learn data and their ability to learn. This allows us to provide home and school support and specialized learning techniques. A child's development goes through stages from birth to adulthood. Children's growth and development are influenced by numerous factors, including their environment, genetics, and their culture. Kids find it difficult to express themselves, let alone examine their emotions. The field of child psychology can offer vital insight into this situation. Children's development is one of the ultimate goals of these professionals, who aim to improve parenting, child care, education, and psychotherapy by using that knowledge. Psychological and educational variables are removed to understand and research children's education. The modified support vector machine (SVM) method extracts information to predict whether educational and psychological factors influence a child's education. The research work is analyzed in a Java simulation environment, which proves that psychoanalysis based on MSVM has a stronger influence on children's studies.

Keywords: Education Factors, Psychological Study, Kids Study, Kids Developmental Stages, Machine Learning, Support Vector Machine.

Introduction

Educational psychology draws on other subjects like neurobiology and uses standardized testing to assess children's abilities (Al-Dawoodi & Mahmuddin, 2017; Hilpert & Marchand, 2018; Mahmuddin & Al-dawoodi, 2017); this data helps us understand how kids learn and handle data as well as their learning potential (Ghazi et al., 2021; Huda et al., 2018; Noori et al., 2019). Also, it enables us to offer particular learning techniques and supports for home and school (Hodges et al., 2020).

In educational psychology, methods of instruction, learning processes, and individual differences in learning are all studied (Duchesne et al., 2013). This research aims to understand how people learn and retain new information. This area of psychology focuses on the social, emotional, and cognitive aspects of learning throughout the lifespan, not simply in childhood and adolescence (Abrahams et al., 2019). Developmental psychology, behavioral psychology, and cognitive psychology all fall under educational psychology (Eccles & Wigfield, 2020).

With the advancement in technology and continuous development of artificial intelligence machine learning (ML) technology and the Internet of Things (IoT) (Rath, Satpathy, & Oreku, 2021). In the past decade, it has been observed that ML and IoT algorithms have significantly penetrated the educational field (Zong et al., 2022). In recent years, teaching and learning methods have been continuously changing and reforming (Alam, 2022). This plays a significant role in improving the general students' comprehensive abilities, particularly the sports students. In teaching and education, traditional sports theoretical knowledge mainly focuses on teaching students theoretical knowledge rather than focusing on their comprehensive ability and psychological quality (Hooshyar et al., 2021). Hence, to improve the overall educational outcomes based on the students' sports education and psychological needs and to better the psychological quality of students, the machine learning approach has been incorporated into education and learning (Atlam et al., 2022). ML significantly improves their comprehensive abilities and healthy psychological growth, thus resulting in positive educational outcomes (Aggarwal et al., 2022). In the sports

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education and training, the concept of psychological needs varies. According to some scholars, it is a type of education and learning which improves athletes' psychological skills and strengthens their beliefs and ideals (Ahmadzadeh, Badami, & Aghaei, 2019; Lochbaum et al., 2022). At the same time, some believe that psychological needs are the athletes' self-awareness, positive-thinking ability, and beliefs that must be fulfilled. In sports education, there should be a focus on the cultivation and education of sports talents and integrated positive psychology, which refers to an educational activity with sports students as the object with the development and enhancement of the sports students' psychological training, treatment, and counseling, their psychological self-help ability, self-consciousness and skills, thus as to promote and better their overall psychological development (Bustos-Barahona, Delgado-Floody, & Martínez-Salazar, 2020).

When analyzing a problem, researchers in educational psychology, like those in other disciplines of psychology, tend to take on multiple views (Beyer & Zeichner, 2018). According to this viewpoint, all behaviors are taught through conditioning (Rescorla, 2018). Psychologists that hold this viewpoint fully believe in the principles of expedient adapting to elucidate how learning occurs (Van Roy & Zaman, 2019).

According to Darling-Hammond et al. (2020), it has been noted that in the past 10 years, the time allotted to training and sports activities in Western schools has been reduced to a great extent, and more time has been allotted to curricular and educational activities. Institutions have cut sports and physical activities because of the constraints in their budgets and the pressure to reach higher academic achievements and scholastic execution. As a result, the students' academic achievement has been adversely affected. In the view of Ali and Hayat (2019), the time spent on non-academic activities significantly impacts the students' academic accomplishments. Furthermore, the authors who support school-based active work have suggested that games, active work, and actual training significantly contribute toward the academic excellence of the students either directly in terms of improved grades and academic outcomes or indirectly in terms of more extensive and better social behaviors and outcomes which may affect their academic accomplishments (Wretman, 2017). Particularly youth and adult students become more addicted to internet platforms applications and social media usage, which results in them as their primary source of entertainment, communication, and information (Zhang et al., 2023) . By making the accurate and correct use of technology, the students could become better anchored in reality, increase their reaction speed, develop their spatial vision, and be much more creative. Therefore, technology has opened various doors to new and improved methods of learning and communication (Ganimian, Vegas, & Hess, 2020). The machine learning and artificial intelligence incorporated methods, as Generation Z prefers, mainly impact their communication, face-to-face interactions, and educational outcomes. According to several authors, the evolution of sports is as ancient as mankind itself is. Sports are a significant part of the human race since around 3000 years ago (MacKeddie-Haslam, 2022). In ancient times, sports were considered a part of work, but in today's world, it is seen as a way to endurance first; it is a stage for groups and people. Also, Nations bring a common and equivalent playfield with sports assistance. This shows that sports have become a part of our daily life in almost every work, such as sports in schools, colleges, universities, workplace sports, family get-together, etc.

Instructors can honor pupils' learning by giving them tokens to be swapped for goodies like sweets or toys (Ronnie & Philip, 2021; Sidin, 2021) . The behavioral approach assumes that rewarding "good" behavior and punishing "poor" behavior will help kids learn. This methodology is condemned for avoiding attitudes, emotions, and intrinsic incentives for learning.

The cognitive method has gained popularity recently because it considers how memories, beliefs, emotions, and motivations influence learning. This hypothesis states that people learn because they want to, not because they are rewarded. Cognitive, educational psychologists study how children learn, remember, and solve issues (Hilpert & Marchand, 2018; Wilson-Mah & MacRae, 2022). This research aims to learn about children's psychology and how it impacts their learning behavior. This study retrieved psychological variables of children's learning outcomes.

This section provides a general introduction to and discussion of the psychological variables affecting children. Section 2 describes prior study approaches. Section 3 defines the recommended approaches, appropriate examples, and explanations. Section 4 analyses the research work's performance regarding the simulation results. Section 5 provides the overall conclusion of the research study.

Related Works

Kirschner and Hendrick (2020) focused on a distinct work and explained its essentiality before summarising the research. The book provides a roadmap of the most important discoveries in how learning occurs by examining 28 essential publications on learning and teaching from the domains of educational psychology and cognitive psychology. Each chapter examines a

particular work and explains its relevance before describing the study.

Renninger and Hidi (2022) described that interest has a physiological base and is thus universal—meaning that all people, regardless of age or environment, may be encouraged to generate at least some interest in the topics to be taught. We can help with interest development when these supports are ill-assorted with the learner's interest stage.

Tus (2021) studied the association between parental participation and academic performance in 493 students attending private schools in the Philippines. The following findings were reached: The parents sought to enhance their commitment to school, especially during this tough situation.

Gholamitooranposhti et al. (2018) reported a study to develop and standardize a learning disability test for preschool pupils. A researcher-created visual-spatial assessment with 7 elements (symbolization, space status, visual distinction, visual argumentation, visual memory sequence, maze, and rotational form) whose viability was certified by psychology professors was then administered to 206 preschool pupils.

Willingham (2018) submitted a study material for the Praxis II exam, which contains a list of psychological principles that test-takers should be familiar with ("how knowledge is constructed"), Bandura, Piaget, Bruner, and schema, zone of proximal development, operant conditioning.

Khan, Cheng, and Bee (2018) developed a diagnostic and classification system based on machine learning. The system was trained using human expert-classified data from 857 schoolchildren's test scores. The information was gathered as part of that other crucial study involving the development of special exams for people with dyslexia. The threshold was set at the 25th percentile. Scores equal to or below the threshold were deemed markers of dyslexic children, while scores above the barrier were considered indicators of non-dyslexic children.

Starley (2019) discovered perfectionism's growth and link with learning and behavior, as well as the perceived hazards and benefits of high degrees of perfectionism. The prevalent discourse is a multidimensional concept of perfectionism influenced by genes, upbringing, personality, and experience.

Boyes et al. (2021) included dyslexia in their investigation. A wait-list control group of 20 kids was assigned to Clever Kids (n = 20). Internalizing and externalizing symptoms and coping skills were assessed before, after, and three months after the treatment.

Kokkinos and Voulgaridou (2018) used self-report to examine the relationships between self-motivational beliefs, perceived academic ability, self-esteem, and learning practices among 134 Greek junior high school students. A model including motivational factors as mediators between perceived academic competence and self-esteem and participants' language learning practices were examined.

According to Daly-Smith et al. (2020), institutions should integrate Sports Education Model into their physical and educational learning settings and processes. Physical education focuses primarily on games, competition, and curricular activities (Zhang & Min, 2020). In such activities, students can experience roles such as team supporter, players, match devices, referees, managers, athletes, coaches, and others. This approach provides a broader experience to the learners because which they could become more competent in sports, have a better understanding of sports values, and become more enthusiastic about learning (Manninen & Campbell, 2022). Overall, they would get a wider and better learning experience. By incorporating sports education, students can have opportunities for discussion, communication, and interaction among their fellows (Worku & Alemu, 2020). In sports education, students do not directly interact with their teachers regarding their academics. In this, students get to discuss with their coaches and teammates and learn what real activity is. Sports education also develops a spirit of sportsmanship among students, and they learn several life skills (Khan et al., 2021). Sports education provides students with the spirit of competition, which would eventually help them in various settings of practical life and assist them in improving their academic results (Xu, Lin, & Xia, 2021).

When students have such goals, they learn to be self-disciplined and independent. It also helps them in decision-making and is to be held accountable (Singaram, Naidoo, & Singh, 2022). Through sports education, students feel responsible for their actions and activities and for others; they are held accountable, such as their teams, if they are coaches, and so on. Sports education is a learning process of diverting the responsibilities from teachers to students and developing life skills. Machine learning significantly impacts education (Ayasrah et al., 2022). By utilizing the adaptive learning approach, it analysis the performance of the student in real-time and the modifications and changes that happened in the methods of teaching based on the research. Consequently, by integrating machine learning, the path of learning becomes personalized for the students so that every individual can get better experiences in their education. Machine learning increases the efficiency and quality of the learning processes (Chen et al., 2020).

Educational and Psychological Analysis of Kids' Education

Child psychology is a subset of psychology. This division concentrates on children's minds and behaviors from birth to puberty. Child psychology studies children's mental, emotional, and social development and physical growth. Historically, children were generally seen as miniature adults. The ultimate goal of this profession is to understand better how children develop and to utilize that knowledge to improve parenting, education, child care, and psychotherapy. Child psychology emphasizes child development.

Educational psychology is important because it can help students and teachers (Minkos & Gelbar, 2021). It provides important information for educators to help them create educational experiences, measure learning, and improve student motivation. Psychology produces new learning theories for better education (MacIntyre, Gregersen, & Mercer, 2019). With the help of psychology, the teacher learns to modify the students' behavior. Psychology teaches the teacher why a child behaves in a certain situation differently than others. Educational psychology is important because it can help students and teachers (Minkos & Gelbar, 2021). It provides important information for educators to help them create educational experiences, measure learning, and improve student motivation. Psychology produces new theories of learning for better education. With the help of psychology, the teacher learns to modify the behaviour of the students. Psychology teaches the teacher why a child behaves in a certain situation differently than others.

AI and ML have left their footprints in the world of sports (Hu & Xu, 2022). For instance, in the game, analytics and activity for tracking the player and balls, classification of match events or shots, sports betting, and umpire assistance (Naik, Hashmi, & Bokde, 2022). ML is used for acquisition and talent identification, such as biomechanics, measurement of players' performance, and player recruitment (Aresta et al., 2023). ML and AI for coaching and training, such as coaching and training like player injury modeling, tactical planning, and team formation efficacy and efficiency assessment (Liu, Mahapatra, & Mayuri, 2021). ML for business and fan-focused such as virtual and augmented reality sports applications highlight packaging, wearable and sensor design, ticket pricing optimization (dynamic and variable), modeling demand for event attendance, measuring a player's economic value, etc. (Chmait & Westerbeek, 2021).

Educational psychology helps teachers understand what their students need and are required to succeed in their schools, academics, and life as a whole (Sethi & Scales, 2020). Teachers need to understand the psychological needs of their students. It also assists educators in planning lessons and evaluating the progress of students. The machine learning approach helps the students develop a personalized lesson plan and curricular and extra-curricular activities for each student (So et al., 2021). It also helps them understand the behavior and personality of students.

The advancement of ML modifies the education experience for both teachers and students. It also personalizes and optimizes the learning experience for the students and the teachers to grade more accurately and quickly (Alam, 2021b). Also, as computers and technology get better at learning and education like humans, it assists teachers in learning more about the student's performance in more depth. By incorporating ML into learning processes, the teachers learn about students' learning patterns and understanding, weaknesses, strengths, and related issues and challenges (Webb et al., 2021). It also plays a great role in taking necessary actions to help the instructor and educator continue with their course plans. Machine learning and AI have proven advantageous in tackling the associated issues and challenges with the student's educational outcomes and psychological needs (Ho, Cheong, & Weldon, 2021). ML approaches are used by stakeholders, policymakers, business leaders, coaches, sports audiences, sports business professionals, and others to analyze sports performance and related problems (Crespo Celda et al., 2022). According to several authors, machine learning can potentially shape the future of sports in the coming years. In order to understand how machine learning is widely used in a range of applications in sports, it is necessary to look into the difference between traditional analytical approaches related to Sports and artificial Intelligence and particularly machine learning approaches to analyze sports activities and education as a whole (Chmait & Westerbeek, 2021). The traditional approach to sports analysis starts with a set of particular rules which constitute the definition of a problem. Then the data is analyzed using applications or programs which would answer the underlying problem. While in contrast to this, a machine learning approach works significantly differently from a traditional approach. In ML, one starts by inputting the corresponding data set and a set of solved problems and relevant answers, followed by algorithms that narrow down the rules of solving a particular problem (Wen, Dematties, & Zhang, 2021). These rules are further used by making several predictions, and then they would be validated and evaluated by testing their accuracy over the provided data set.

In today's world, educational platforms provide teachers and learners with the content to solve problems. ML

increases the database by providing high-quality transcription and translation (Han, 2019). Furthermore, ML provides content in numerous ways, such as presentations, videos, audio, texts, images, etc. (Moshayedi et al., 2022). It is very important to understand a player's worth and psychology to predict their future and performance. By assisting sports with ML in their education, students can make better decisions when signing the players and when existing rosters (Hall, 2023). It helps supervise sports using particular algorithms such as "Naive Bayes, decision trees, linear regression, and neural networks" (Barman & Demir, 2021). There are also certain unsupervised machine learning algorithms, including "k-means clustering and association rules" (Shen, 2021). In sports, ML predictive analysis can be utilized to enhance players' health and fitness (Huang & Jiang, 2021). This also includes certain software that is specialized in telling what the wear and tear places, which helps the athletes in staying healthy and fit are. Machine learning can spot the trends in flaws, methods, and tactics during games and sports. ML is developing and using tools and models for learning about data and information. It also involves computer programming processes for estimating magnitudes and classifying corresponding data in a presentable and understandable manner (Sarker, 2021). In the coming decade, AI and especially ML are likely to enhance decision-making objectivity in sports education and activities significantly, and it has the potential to enhance individuals' academic outcomes (Alam, 2021a).

1. Feature Extraction and Analysis

The investigation began with an examination with a professional psychologist to determine youngsters' most common mental health issues. Then the specialists were observed diagnosing. A machine-learning algorithm was developed to diagnose five common mental health issues accurately. If the patient's known evidence is supplied, this model helps specialists pinpoint the problem.

A clinical psychologist's data set is used to anticipate mental health issues. Table 1 lists the data set's characteristics. The qualities are all nominal. Problem forecasting requires simply a few characteristics.

Table 1

Attributes from the dataset

No	Attribute	Meaning	Values	No	Attribute	Meaning	Values
1	Age	The age group of the child, Infant/Early Childhood/Middle Childhood/Adolescent	(Bazezew, 2019A)	14	Attention sustained	The child's ability to administer and concentrate cognitive activity on certain stimuli.	(Bazezew, 2019)
2	Family history	Present/Absence of psychological disorder in the family	{Y, N}	15	CBCL score	A checklist is entered by an instructor, parent, or self-report to discover abnormal behavior in children.	{BC, EC, AC}
3	Pregnancy complication	Present/Absence of Obstacles during Pregnancy	{Y, N}	16	IQ Test score	A standardized exam is used to determine a child's intellectual level. The grade could be below, average, or above average.	{BA, A, AA}
4	Delayed speech	Present/absence of deferral in the evolution of speech	{Y, N}	17	ADHD positive	Diagnostic test result for Attention Deficit/Hyperactivity Disorder.	{Y, N}
5	Under medication	Whether the infant is subject to any medication supervision	{Y, N}	18	ODD positive	An Oppositional Defiant Disorder, a diagnostic test score assesses the child's aggressive and belligerent behavior.	{Y, N}

No	Attribute	Meaning	Values	No	Attribute	Meaning	Values
6	Academic performance	Whether the child's academic achievement is adequate or lacking.	{A, I}	19	Manic episode test score	A child's mood is checked for excessive excitement or restlessness using a diagnostic test for a psychotic state.	{Y, N}
7	Relationship information	The child's capacity to interact with other children, family members, and teachers should be evaluated.	{A, I}	20	General anxiety disorder	Measurement of the child's anxiousness through a screening test.	{Y, N}
8	Behavioral problems	Behavior issues, such as cheating or telling lies.	{Y, N}	21	Major depressive episode	A child's major depressive disorder diagnostic test result	{Y, N}
9	Concentration	The child's capacity to maintain concentration on a single item or action is evaluated.	{A, I}	22	CDI Score	A diagnostic test outcome that measures a child's level of depressive symptoms.	{AC, EC, BC}
10	Restless	If the child can pause or is continuously on the go	{Y, N}	23	PDD score	Diagnostic assessment outcome to determine the phase of a kid's developmental disability	{MODERATE, NO, MILD}
11	Seizures	The brain's abrupt burst of electrical activity can lead to various symptoms, such as unconsciousness, rigidity of the muscles, and involuntary body movement.	{Y, N}	24	Autism Score	Assessment of the child's communication and relationship-building abilities and their ability to comprehend intellectual concepts via a screening test.	{MODERATE, NO, MILD}
12	Learning Difficulty	The inability of kids to acquire age-appropriate information or abilities	{Y, N}	25	Problem	The class characteristic represents the child's mental illness.	{ATT_ACA, ANX_SYM, ANX_DEP_SYMP, PDD, DEV_DELAY, AUT_SYMP, ACA, ATT_BEH, ATT_EMO}
13	Attention Aroused	Whether or not the infant is mentally attentive, awake, and alert	{Y, N}				

2. Feature Learning to Predict Kids Psychological Effects Using Modified SVM

A modified SVM technique is used to learn and predict the attack. Pin loss-based modified SVM is introduced here. To combine the benefits of SVM and pin loss, we propose modifying the pinball loss and applying it to SVM models. Because the horizontal part of the loss function curve is related to sparsity, we make the negative part flat at a specific place. The constant $s > 0$ is the hinge point $-s$. In addition, all correctly identified points are penalized, preserving feature noise insensitivity of the pinball loss. The modified pinball loss is named after the function curve.

An auxiliary function is developed: $H_\tau(u) = \max\{\tau u, 0\}\{\forall u \in R\}$, here τ is a constant. The modified pinball loss is described as follows:

$$P_{\tau,s}(u) = H_{1+\tau}(u) - (H_\tau(u+s) - \tau s)$$

$$= \begin{cases} \tau s & (u \le -s) \\ -\tau u & (-s < u < 0) \\ u & (u \ge 0) \end{cases}$$

Here $0 \le \tau \le 1$.

Algorithm:

Input: $L^0 := 0, U^0 := (1+\tau)Ce, \alpha^0 := 0, \epsilon > 0, k := 0$

Output: The solution α^* and the decision function

Repeat

Project α^k to $L^k \le \alpha \le U^k$, and assign the output as an initial value

Solve the following problem

$\min_\alpha \frac{1}{2}\alpha^T Q\alpha - e^T\alpha$

s.t. $\alpha^T Ye = 0, L \le \alpha \le U$

Assign the solution as α^{k+1}

Calculate b^{k+1}

Evaluate δ^{k+1}

$L^{k+1} := -\delta^k$

$U^{k+1} := (1+\tau)Ce - \delta^{k+1}$

Calculate the function value of $\hat{J}(\alpha^{k+1})$

K:=k+1

Until k>1 and $\left|\left(\hat{J}(\alpha^k) - \hat{J}(\alpha^{k-1})\right)/\hat{J}(\alpha^1)\right| < \epsilon$

Results and Discussion

Assess the performance of Kid Psychology prediction using Modified SVM. The performance of SVM-based kid psychology behavior prediction, is compared with the conventional techniques.

The specificity, sensitivity, and Area Under the Receiver Curve (AUC) are utilized in this study to measure the prediction models' accuracy. If the TP, FP, TN, and FN in the confusion matrix are True Positives (TP), False Positives (FP), True Negatives (TN), and False Negatives (FN), then the sensitivity is (TP/(TP+FN)).

The specificity is defined as (TN/((TN+FP)). ROC analysis can be used to evaluate a classifier's accuracy irrespective of any threshold. A ROC curve's horizontal and vertical axes are described.

x=1− specificity (t)

y=sensitivity (t)

To evaluate the efficiency of a technique, the AUC can be calculated.

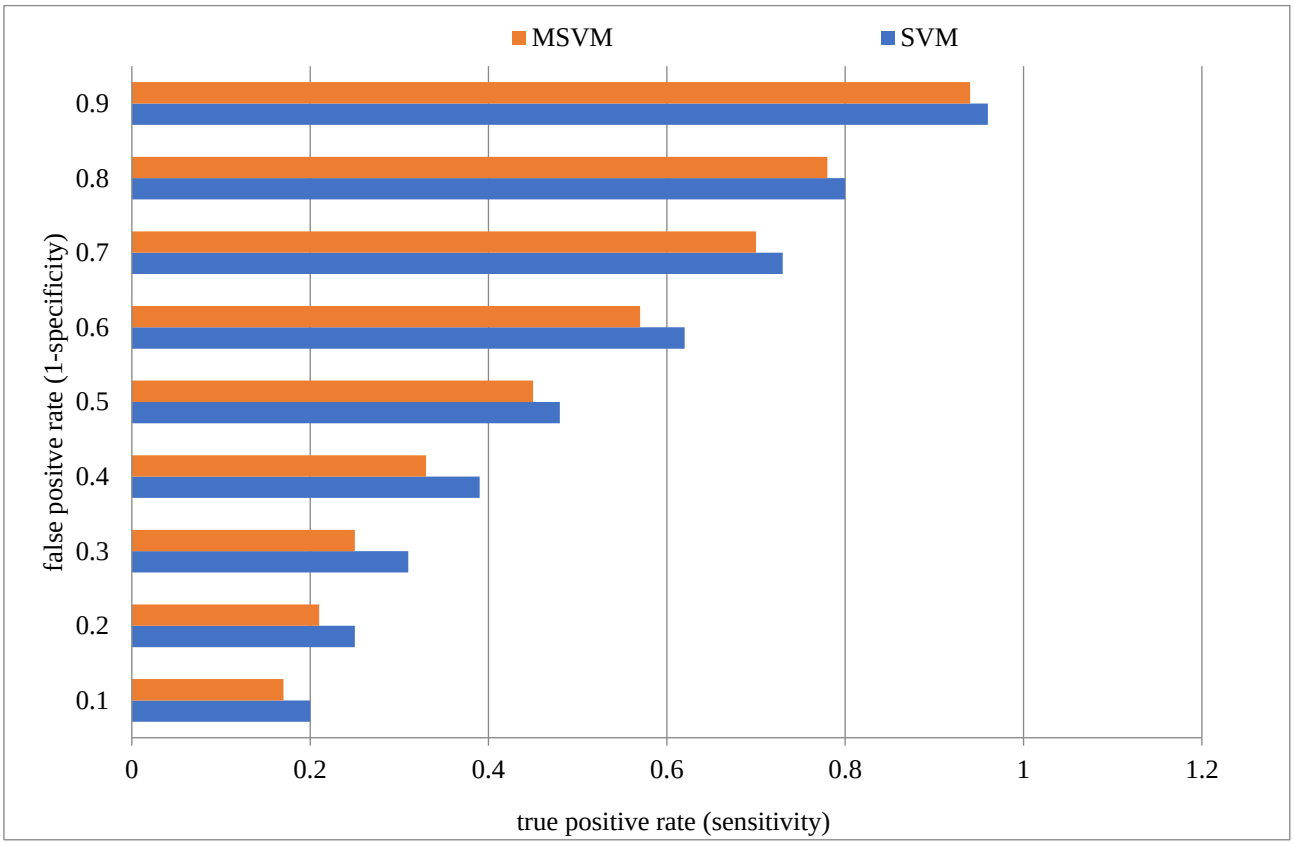

Figure 1: ROC curves of the separation

Figure 1 depicts the separation's efficiency, including the maximum sensitivity and specificity cutoff point. After that, the MSVM theory is implemented in the training data to obtain customer samples. The suggested MSVM technique's attribute selection rate is 96%, with a specificity value of 90 % in the training sample.

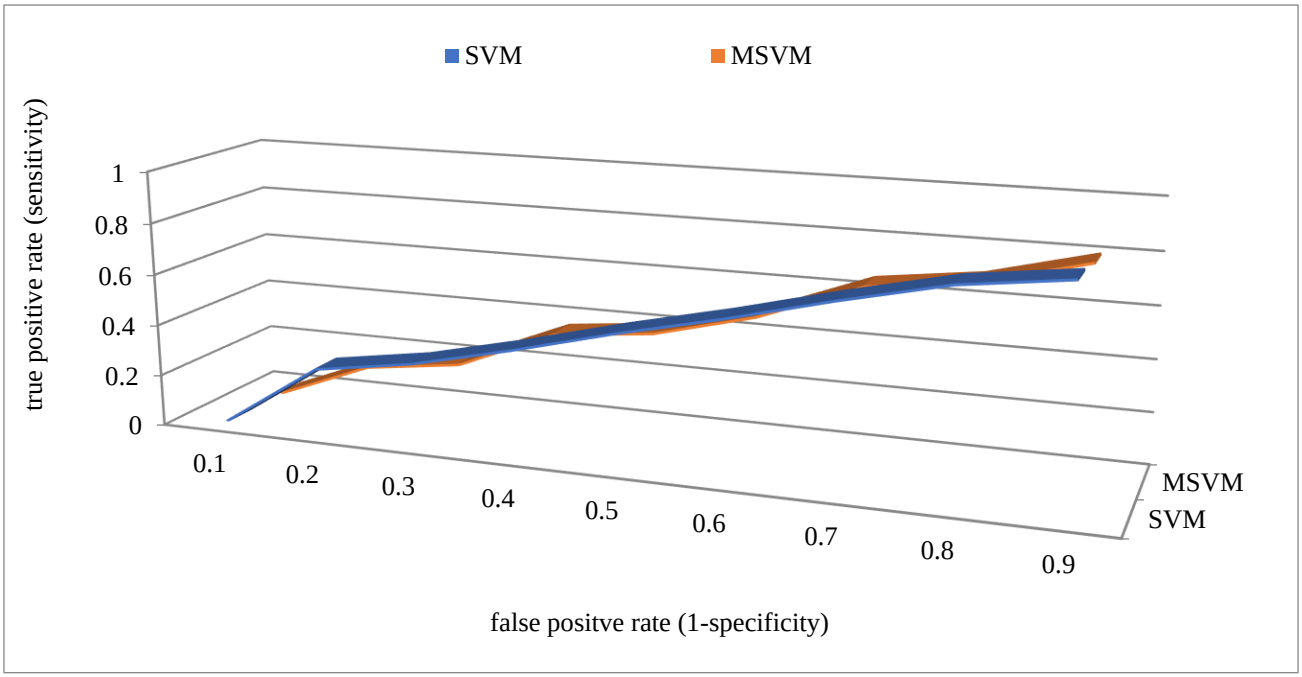

Figure 2: ROC curves of predictions on samples

Figure 2 illustrates that the ROC curve of the suggested churn estimation method is positioned above approaches for customers who belong to the training samples, with the Curve increasing from 80.13 % to 83 %. The MSVM method outperforms the conventional SVM approach by a wide margin.

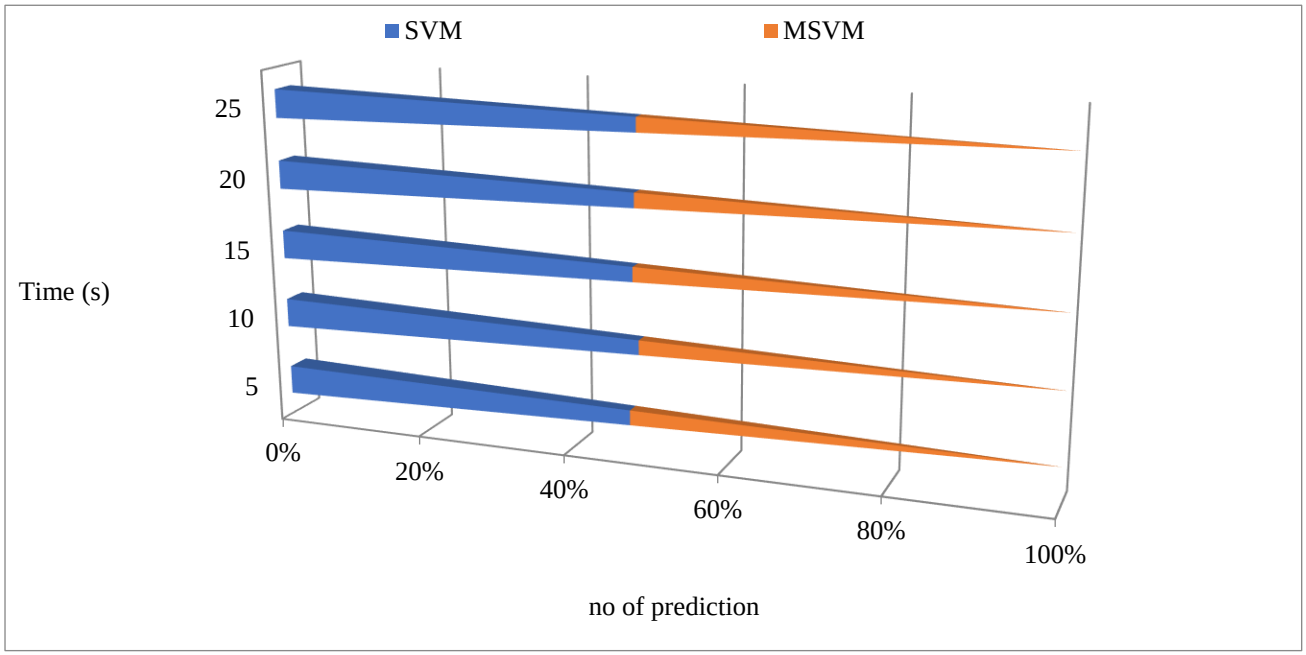

Figure 3: Processing time comparison

The MSVM predictive algorithm reveals frequent churn forecasting and higher effectiveness than the previous SVM forecasting approach displayed in Figure 3. The MSVM is significantly faster than SVM.

Conclusion

Expert systems are now used in medicine to predict the early psychological behavior of children to treat them effectively and efficiently. Expert systems in mental health are also being developed to predict problems earlier. Researchers examined SVM and Modified SVM in classifying mental health issues. The results show that the Modified Support Vector Machine is more effective. The data set is small and future studies may use a larger data set to improve accuracy. Before using any prediction technique, the classifiers must be trained.

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