

A MODEL FOR PREDICTING SCHOOL READINESS USING DATA MINING TECHNIQUES

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Abstract

Study the school readiness is an interesting domain that has attracted the attention of the public and private sectors in education. Researchers have developed some techniques for assessing the readiness of preschool kids to start school. Here we benefit from an integrated approach which combines data mining and social network analysis towards a robust solution. The main objective of this study is to explore the socio-demographic variables (age, gender, parents' education, parents' work status, and class and neighborhood peers influence, Supportive Family, Health Status, Family Problems, Motivation, Family Problems, Gaming Devices, Sleeping quality, School Support, Extended Family Support) and Average Marks, data that may impact the school readiness. This paper proposes to apply three models of Data Mining Techniques using R and Python Script Languages to predict school readiness. Real data on 148 Primary School children was used from Life school for Creativity and Excellence a private school located in Ramah village, and white-box classification, clustering and association methods, such as induction rules were employed. Experiments attempt to improve their accuracy for predicting which children might fail or dropout by first, using all the available attributes; next, selecting the best attributes; and finally, rebalancing data and using cost sensitive classification. The outcomes have been compared and the models with the best results are shown.

Keywords: *Machine learning, school readiness, socio-economic data, data mining, socio-demographic data, script languages, Python, R Language.*

1. Problem definition

The transition from kindergarten to school is considered one of the critical periods in the life of a child, during which he/she acquires fundamental skills and ways of learning and thinking. For the child, this is a profound change and a transition from a small, intimate setting to a larger setting with more expectations and various demands made upon him/her, Fogel, (2000); Hair et al (2006). The transition also requires the child to adjust to and develop emotional and social relationships in a new environment, Duncan et al. (2007). Generally, the coordination is done by the kindergarten teacher, usually in cooperation with the parents, and is a critical component in the children's development.

Today, it is possible to diagnose various forms of dyslexia, language and attention deficits, motor deficits and cognitive mathematical deficits. It is possible to begin an early intervention at a young age, as needed and acceptable, David, (1999); Donald and Stenner (2005). Thus, school readiness is more than just about children. School readiness, in the broader sense, involves children, families, early environments, schools, and communities. Children are not innately ready or not ready for school. Their skills and development are strongly influenced by their families and through their interactions with other people and environments before coming to school. Assessing school readiness is important to the education of young children. Assessment helps in measuring the current state of children's development and knowledge and can be used to guide classroom and individual education programming, Chambers (2000); David (1999); Feinstein (2003); Hair et al. (2006).

Most of the employed systems and computerized tools concentrate on the child individually and in isolation from his/her community and this leads to incomplete or misleading outcome which may reflect negatively on the personality and behaviour of the child. Some social factors have a great impact on the readiness of a child for school and must be taken into account. These social factors are mostly inspired from the environment where the child belongs; these include friends of a child, siblings and relatives of a child, parents' education level, and parents' employment status.

The evaluation of a child's readiness to transit from kindergarten to school is a major challenge to schools and families and a critical life event of the child him/herself due to the need of new skills and ways of learning and thinking, Suleiman et al. (2010); Condrón (2008). This transition requires the child to adapt to the new environment and to start developing new social relationships with school mates, these factors could be friends of the child, siblings and relatives of the child, parents' education level, and parents' employment status. In addition, this stage is also critical to parents and teachers to help the child to be ready for the new transition, Miller and Emihovich (1986).

2. Proposed solution

A prediction model was proposed to predict if a child is ready for school or not, the model is based on several data mining techniques features that were extracted from the children's social information which is expected to be maintained by schools. Data mining techniques were applied to school data to examine the readiness of children for school. The proposed model was evaluated and the results are encouraging by demonstrating the applicability and effectiveness of the approach.

3. Predicting school readiness

There are at least three arguments that could be invoked to understand the importance and the impact of evaluating school readiness.

First and the strongest argument by far, is the predominant formative character of competence assessment at this age. A correct identification of the most salient aspects of each competence opens the door for efficient interventions, to be remedial or enriching. Relying on a valid assessment, one may precisely circumscribe the target of the intervention and its operational goals. Any individualized instruction requires careful assessment of the existing competences.

Second, a correct assessment of the salient competences may offer critical information for the decision to enter schooling or to delay the integration into the school system, both for parents and children. It is necessary to underline that this information is just one part of the equation but by relying on research data and adequate measurements it is hard to ignore, Raver and Knize (2002). It may also predict later academic achievements and adaptation to primary school-life relying on early education of the relevant competences, Wayne, Fantuzzo, and McDermott, (2004).

Last but not least, the measurement of the efficacy and effectiveness of any program (or curriculum) implemented in early education requires reliable assessment of children competences, able to offer precise information about the baseline and the outcomes of the program (curriculum). Without longitudinal assessment of relevant competences, the superiority of a particular early education program over any other has no empirical support.

To summarize, the assessment of school readiness has a critical practical and theoretical importance. Some of these assessments may be implemented by computer testing, but most of them are not, due to the age of the children and their low computer skills, so they will be administered in a classical format. However, it is extremely important to create a computerized platform capable to offer the management of all the assessment data for each child, collected by using different methods and various informants.

3.1. Critical competences for school readiness

Several extensive and authoritative searches of the literature, Denham (2006); Ionescu and Benga (2007); Blair (2002) allow us to consider that the most relevant competences for school readiness refer to cognitive development, socio affective development and characteristics related to temperament/personality.

3.2. Cognitive competences

Cognitive competences are the abilities to process information, and may differentiate between general cognitive abilities and curriculum-based (specific) cognitive skills. General cognitive abilities are those involved in almost any kind of problem solving and refer to the processes of attention, memory, language, reasoning and executive functions. Curriculum-based cognitive skills are those knowledge and problem-solving abilities that are the outcomes of a specific curriculum or intervention program in early childhood as for example early literacy skills. They refer, for example, to the ability to recognize several capital letters, perform simple arithmetical operations, and understand the connection between sound and letter. They are relying on general cognitive abilities but they are not direct emergencies from these abilities, requiring domain-specific learning.

3.3. Socio-emotional competences

Socio-emotional competence is a complex construct that has two components: one rather social, focused on social information processing and performance in social contexts (e.g., interpersonal interactions, social problem-solving), and another rather emotional, concerned with understanding, sending/receiving emotional messages and emotion regulation, Lemerise and Arsenio (2000); Crick and Dodge (1994). Although some of the tasks a preschool age child is facing are primarily social (e.g., working cooperatively), whereas others are more emotional (e.g., self-regulation of fear), much of the time they are strongly intermingled, Dodge et al. (2002). Consequently, any assessment of social skills should include the assessment of emotional competences. The evaluation of socio-affective abilities at preschool children predicts: (a) Academic success in the first and then later elementary years, even controlling former academic success or cognitive skills, Carlton (1999); Izard et al. (2001); (b) Participation in the classroom and acceptance of peers and teachers, Carlton and Winsler (1999); (c) Task persistence and drop-out rate in primary school, Robins and Ruther (1990); Raver and Knitze (2002); (d) Delinquency and antisocial behaviour later in life. Kochenderfer and Ladd (2006).

3.4. Temperament/personality characteristics

The temperament is referring to those individual differences in reactivity and self-regulation and is assumed to have an important constitutional basis. However, during the early years it strongly interacts with the environment and the regulatory dimensions become more important due to anterior cortical brain development. Beginning with the age of three the temperament begins to be differentiated into personality and later on personality characteristics themselves become more differentiated, approaching the big five model of personality (extraversion, agreeableness, conscientiousness, neuroticism and openness to experience). The assessment of temperament and emerging personality characteristics in early childhood may offer salient data for adaptation to school environment and constitute a prerequisite for many remedial interventions. Denham (2005).

4. Aims

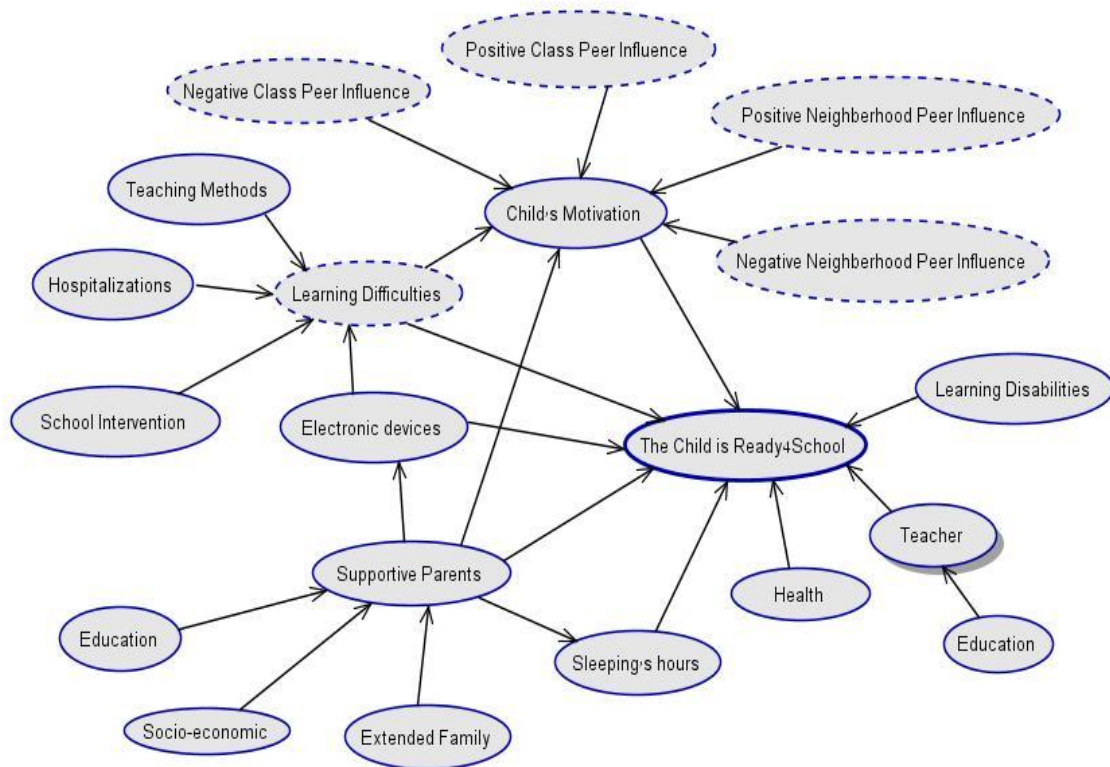
This research focuses on predicting school readiness using data mining techniques, while trying to shed light on the ways social-economic data might influence this readiness.

5. Method

School failure of students is also known as the "one thousand factors problem", Márquez-Vera (2013), due to the large amount of risk factors or characteristics of the students that can influence school failure, such as demographics, cultural, social, family, or educational background, socioeconomic status, psychological profile, and study progress.

In this section, information has been used from pre-school children enrolled in *Life school for Creativity and Excellence* for three consecutive academic years, Sep 2017- June 2020. The information used was only about pre-school children, where most children are between the ages of 5 and 6, as this is the year for moving from pre-school to 1st grade. All the information used in this study has been gathered from a general survey was designed and administered to all children during the aforementioned period, its purpose was to obtain personal and family information and socio-economic data to identify some important factors that could affect school performance.

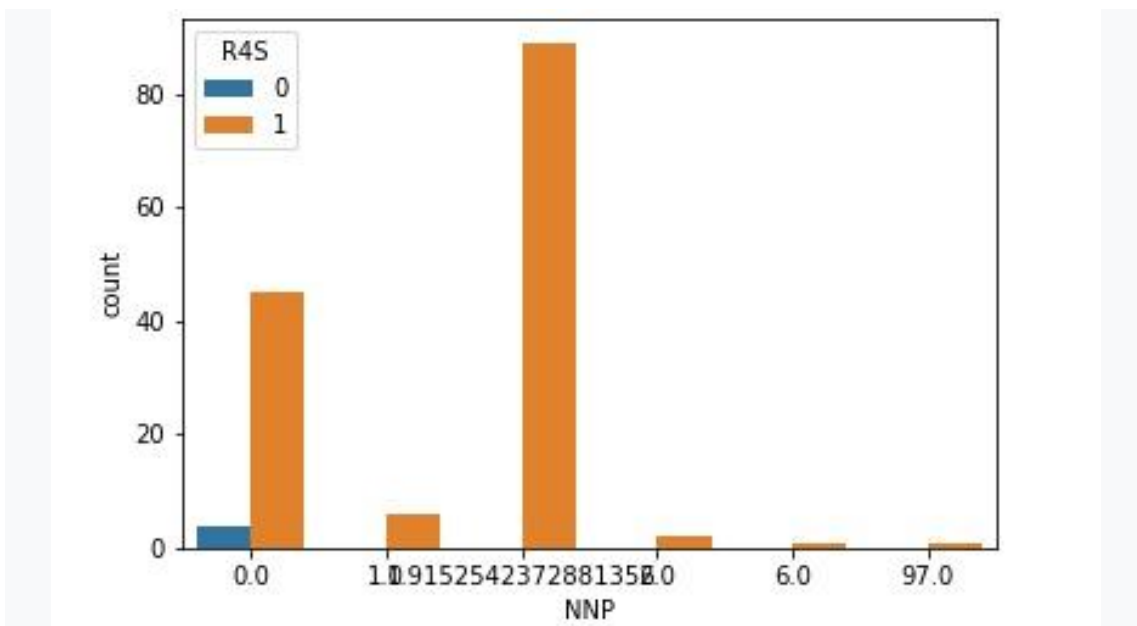
Figure 1. The below diagram shows the connections between the above parameters.



6. Results

In the results section, we create a graph for each parameter in the above table. for example.

Graph 1. The graph for Number of friends who influence him/her in a negative way in the neighborhood shows that 5 peers in school of the children can influence him/her in a negative way.



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