

A study of applying data mining to early intervention for developmentally-delayed children

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Abstract

The implementation of early intervention has close relation to the growth development of developmentally-delayed children. The earlier the intervention is involved the more significant effects and results it will bring to the benefits of these young children. However, providing early intervention exclusively without finding out the relationship between the two would eventually leave the problematic point remain unsolved. Since a child's becoming developmental delay is resulted from many factors, much of the valuable knowledge among all needs to be unveiled. In the process of knowledge discovery, use data mining approach to nugget out potential knowledge from vast amounts of data. The main purpose of this study is to explore the hidden knowledge among medical history data of developmentally-delayed children. Fields of medical history database belongs to set and binary, so decision tree is constructed to classify delay levels of each type according to physical illness, and association rule is applied to locate correlations between cognitive, language, motor, and social emotional developmental delays. The study results indicate that the majority of illnesses will result in delays in cognitive, language, and motor development. Simultaneously, among all types of delay, motor and cognitive delay mostly accompanies with symptoms of language delay. The results of this study enable healthcare professionals to be on top of the developments of young children during the process of evaluation and diagnosis, and to provide early intervention so that developmentally-delayed children can catch up with their normal peers in development and growth.

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1. Introduction

In recent years, the average number of infants given birth by fertile women between the ages of 15 and 49 years olds has slid down from 1.68 in year 2000 to 1.24 now. Reasons for that are worth discussing. At much earlier era when medical care technology was not fully mature and intervention service mechanism not fully developed, parents, for financial reasons and sometimes being afraid of losing faces, often were unable to appropriately help raising young children who are mentally or physically disabled. As a result, these children missed out on the golden timing

of receiving assistances and rehabilitations. Since this is a serious problem that affects national population growth ratio, many related children welfare laws have been legislated by the government. For instance, articles in “Children Welfare Law” promulgated in 1993 establishes related policies focusing on mentally and physically disabled children specially as stipulated in paragraph 2 of article 13, “all children and youth welfare, education and medical institutions at all levels shall communicate with the municipal and county (city) government authorities if finding any children and youth with allegedly retarded development, or physical or mental disability. The municipal and county (city) government authorities shall establish the databank for management upon receipt of the information, and transfer to appropriate services if necessary”. Then in April 1997, the “protection law for mentally and physically disabled”

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was promulgated, with its emphasis on “protection” and “rehabilitation” that actively intervenes and prevents the occurrence of mentally and physically disabled population. “Children’s Bureau Ministry of Interior ROC” is established in November 1999, an institution responsible for managing and processing nationwide children welfare business. To truly protect the interests and rights of children and youth, the “Children and Youth Welfare Law” is passed in May 1993, and explicitly stipulated in the 1st paragraph of article 19 “to establish the early communication system for children with retarded development and provide early treatment”. Although the need and importance for early intervention was brought up early when the government actively enacted related rules and regulations, no in-depth analysis for causes of developmental delay children and relationships of delays has been discussed yet.

According to the January “Technology Review” in 2000 at Massachusetts Institute of Technology (MIT), it is predicted that data mining is among the top 10 new emerging technologies that would change the future world. As a result, data mining is the most commonly used technology with applications widely ranging in different fields, including banking, finance, marketing, manufacturing, health-care, and etc. Moreover, studies that use case-based reasoning to early interventions have proved to have excellent effects (Chang, 2005), whereas applying data mining technique to areas of retarded development is rarely seen. This study, through medical history of developmentally-delayed young children, uses decision tree to classify and predict which illness will bring out which type of delay from causes of illness classification, vision problems, psycho-intellectual aspects, other physical diseases, etc. Also, it uses association rule to determine correlations among cognitive, language, motor, and social emotional development delays to nugget useable knowledge hidden behind the vast database so that medical care personnel can utilize such valuable knowledge to provide young children with appropriate treatments during examinations.

2. Literature review

2.1. Definitions

All children should grow and develop healthily under the best and most careful care. According to Guo’s definition (Guo, 1996), child development refers to the changes and mature of organ functions and intellection grow as children are aging, such as the strengthening and maturing of each aspect in motor ability, feelings and responses, social adaptation behaviors and emotions, language and cognitive. The definition of retarded development is the slowing down in development or abnormal sequence during the growing and mature process of children under the age of six. Thus, as a general rule, developmentally-delayed children refers to those under the age of six who has abnormality or is falling behind in cognitive development, physical growth, language and communication development,

social-emotional ability, and life self-managing ability. Comparing one child with his/her normal peers of the same age group in developmental areas, once he or she is falling behind 20%, or there is a greater or equal to two standard deviations behind, he or she is a developmentally-delayed child (Zhong, 2000).

For children who are suffering from physical imperfections and thus have retarded growth development, it is a long and lonely journey for their parents to stay beside them and take care of them wholeheartedly. Given that, providing suitable rehabilitation, education, psychological and financial counseling, or even genetics consultations is only beneficial to families with developmentally-delayed children. Therefore, it is crucial to provide these children with appropriate early treatments.

2.2. Early intervention

Early intervention is a series of activities conducted to accelerate children’s development, that assesses children and ability and need of their family to provide appropriate support and monitoring, and services of re-evaluation of the development of these children (Ramey & Ramey, 1998). Therefore, early intervention means to utilize professional integration services, through assistance of professionals, to provide preschool age children (from 0 to 6 years old), who are developmental delay or have impeded development with special needs, and their families services and help to solve every single problem regarding medical care, education, family issues, and society-related matters. The ultimate goal is to enable fully exploration of the potentiality of the developmentally-delayed children and reduce their disability to the minimum, to cultivate complete adaptive ability for schools of young children with expectations to preventatively and effectively eliminate long-term social costs (Guo, 1996). Many advanced countries in the world, such as the Unites States, England, France, Denmark, Swedish, etc. all have regulations and laws to implement early interventions beginning at birth of a child (Lin, 1993). Many researches have verified that early interventions play a crucial role in children’s future growth and development (Bryant & Maxwell, 1996). Therefore, early intervention provides a complete nursing and care service, utilizing all professional integrated services to solve all kinds of problems in medical care, education, family, and society-related matters for developmentally-delayed or developmentally-impeded children. It not only assists these children in exploring their potentiality, but also reduces their retarded levels and other complications simultaneously so that these children can have the ability to live same normal lives as their normal peers of the same age group (Ju, 2000).

In Taiwan, researchers also propose definitions for early intervention. The content of early intervention refers to the many services focusing on children from birth to preschool age. These services basically aim to promote well children growth (Wang, 1996). For developmentally-delayed chil-

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