

Development of Bayesian-based Diagnostic Model for Mathematics Learning Difficulties for Computerized Adaptive Testing

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ABSTRACT

The objective of this study is to provide a diagnostic framework for identifying mathematics learning challenges using a Bayesian Network approach within the context of Computerized Adaptive Testing. The primary aims of this research are as follows: (1) to develop a diagnostic test instrument that can effectively assess learning difficulties in mathematics, with a specific focus on the topic of numbers in the revised 2013 curriculum of 2018; (2) to create a diagnostic test instrument of high quality that can accurately identify learning difficulties in mathematics, with a specific emphasis on the topic of numbers in the revised 2013 curriculum of 2018; (3) to construct a Bayesian Network model that is suitable for diagnosing learning difficulties in mathematics, specifically pertaining to the topic of numbers in the revised 2013 curriculum of 2018; (4) to generate individualized diagnostic test reports for each student. The study was carried out at three public junior high schools located in the city of Cirebon, West Java, over the period from 2022 to 2023.

This study pertains to the creation of diagnostic test items utilizing Tessmer's formative research development paradigm. The development of a student model for diagnosing learning issues in mathematics pertaining to the theme of numbers is achieved through the utilization of Evidence Centered Design (ECD). The study encompasses the entire population of public junior high schools located in the city of Cirebon, West Java. The research sample comprises 929 pupils that attend three public junior high schools in Cirebon. The process of collecting data involves the administration of diagnostic assessments designed to measure mathematical difficulties in areas connected to numbers. These assessments typically consist of multiple-choice questions, each presenting four possible answer alternatives, along with their corresponding solution methods.

Aiken's formula is employed to evaluate the content validity, utilizing a panel of five assessors. The calculation of score dependability is performed by the utilization of the KR-20 formula, which is a particular instance of Cronbach's α . This calculation is conducted using IBM SPSS 26. The measurement of test item quality is conducted by the utilization of Item Response Theory 3-PL. The validation of the diagnostic test instrument is conducted through the utilization of Confirmatory Factor Analysis (CFA), while the assessment of reliability is performed by employing the information function. The validation of the student model is conducted empirically through the implementation of leave-one-out cross-validation.

The research result encompasses a collection of diagnostic test instruments, a Bayesian Network model designed for the identification of learning issues in mathematics, and individualized diagnostic test reports for every student. These items are incorporated into computer software designed for the purpose of diagnosing learning issues specifically related to numerical concepts in the field of mathematics.

Kata Kunci: *Bayesian Network, numbers, Diagnostic Test*