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INTELLIGENT LEARNING STYLE CLASSIFICATION MODEL AND CROSS-RELATIONAL STUDY WITH INTELLIGENCE QUOTIENT

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

The electroencephalogram is an effective approach for measuring brainwaves and has been widely used to study mental performance such as learning and intelligence. Conventional assessment methods are exposed to reliability issues which stems from cultural and language barriers. Alternative approach based on electroencephalogram has since been proposed; indicating correlation between resting brainwaves and learning styles. Validity of the findings however, was based on unconfirmed theories. Moreover, a systematic approach for learning style assessment based on brainwaves and advanced modelling technique as yet to be studied. Therefore, this research proposes an intelligent learning style classification model via brainwave features and artificial neural network. Eighty samples from various universities are segregated into four learning style groups based on Kolb's Learning Style Inventory. Twenty samples are identified as Divergers, twenty-two as Assimilators, twenty-one as Convergers and seventeen as Accommodators. Resting electroencephalogram is then recorded from the prefrontal region. Spectral centroid features from theta and alpha bands are then extracted for independent pattern analysis. Meanwhile, k-nearest neighbour is used for feature selection purposes. An intelligent learning style classification model is then constructed using spectral centroid features and multi-layered perceptron network. An independent dataset of fifty samples with varying levels of intelligence is used for a cross-relational mapping by the model. The pattern of features for each learning style group has shown correlation with the Neural Efficiency Hypothesis of intelligence. Subsequently, the fully developed model has attained excellent classification accuracy of 98.8% with mean squared error of 0.07. Moreover, the network has fulfilled all correlation requirements in classifying learning styles. The cross-relational analysis revealed that brighter individuals are predicted to be either Assimilative or Convergent. Meanwhile, the less brilliant ones are predicted to be either Divergent or Accommodative. Therefore, high level of intelligence is linked to excellent analytical skills, whereas low level of intelligence is associated with reliance on intuition rather than cognitive abilities. Conclusively, this thesis has proven that spectral centroid features from the resting brainwaves are suitable descriptors for characterising learning styles. The systematic approach established by the intelligent model provides an alternative for assessing the behaviour via electroencephalogram. Furthermore, the study has also confirmed that brainwaves from the prefrontal region are adequate for classification of learning styles.

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CHAPTER ONE
INTRODUCTION

1.1 Background Study

Constructivism is an established philosophy of education which suggests knowledge as being created in the minds of a learner [1]. The concept is aimed at stimulating the ability of individuals to construct knowledge through optimal learning experience. Such approach would therefore, require instructors to facilitate the learning process using adaptive teaching pedagogies [2]. This is particularly important as each individual will have unique style of perceiving and processing information [3]. Various models have since been developed with Kolb's Experiential Learning Theory (ELT) being the most widely implemented [4]. Since its conception in 1984, the theory has gained much prominence in various aspects of educational [5] and management research [6]. Such widespread acceptance has been attributed to its success in promoting effective teaching [7]. Recent findings have shown that there is a correlation between learning style and brainwaves [8]. Observations were conducted in the absence of mental stimulation and are focused on the prefrontal region which is generally associated with executive functions [9]. Validity of the brainwave patterns however, is debatable as the studies were based on skewed and unconfirmed theories [10]. Hence, this presents an excellent research opportunity in which further investigation into learning styles and brain behaviour can be performed using the electroencephalogram (EEG).

EEG is a non-invasive approach for measuring electrical fluctuations in the brain [11]. By comparing the method with other brain imaging modalities such as functional magnetic resonance imaging (fMRI) [12] and positron emission tomography (PET) [13], EEG is considered as the more convenient alternative as it can be operated under a wide range of experimental settings [14]. Implementation of EEG has allowed both clinicians and psychologists to study brain behaviour and its underlying neurological processes. Among the established applications include investigation on sleep patterns [15], epilepsies [16], schizophrenia [17], autism [18] and depression