ADV MATH SCI JOURNAL
Advances in Mathematics: Scientific Journal **9** (2020), no.6, 3751–3757
ISSN: 1857-8365 (printed); 1857-8438 (electronic)
https://doi.org/10.37418/amsj.9.6.53 Spec Issiue on ICAML-2020

COGNITIVE SCIENCE BASED DESIGN OF SMART COACHING SCHEMA

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ABSTRACT. Developments and advances of computers and technology has unwrapped various novel opportunities in the arena of coaching, with key advancements emerging in the creation of Smart Coaching Schemas (SCS). The proposed framework presents a Smart Coaching Schema consisting the services offered by existing systems and an enhancement of these services by utilizing cognitive proficiency criteria of variety of users. Different cognitive aspects including prominence of assignment to the student, his/her level of enthusiasm, level of attentiveness, intellectual promptness, and basic acquaintance level have been measured and used as a basis for designing Smart Coaching Schema. The proposed technique utilizes Naive Bayes classifier categorize the students as Novice, Average and Excellent. This categorisation is useful to distinguish coaching settings of the proposed Smart Coaching System based on students' cognitive proficiency. The combination of aforementioned cognitive proficiency criteria with the traditional SCS has brought up a novel design of Smart Coaching Systems.

1. INTRODUCTION

Smart Coaching Schema is a technology based product which is a simulation of a human instructor and offers personalized study experience based on their understanding capabilities and choices of the student [1]. The framework fabricates a profile for every student and gauges the student's level of information

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2010 *Mathematics Subject Classification.* 97C30, 91E10.

Key words and phrases. Smart Coaching Schema, cognitive science, machine learning.

over the subject. The proposed framework at that point changes its coaching conduct progressively, following contrasts in students' inclinations for increasing the effectiveness of viable connections of instructors with all students. The fundamental requirement of the proposed SCS is effective student profile that aids in revealing students' aptitudes and necessities.

The present Smart Coaching Schemas don't survey the students' domain information before starting the study procedure [11]. Because of this, same learning material is given to all the students regardless of their present acquaintance level. But, it isn't important that each student who registers to the SCS will have a similar fundamental knowledge level. Therefore, difficulty level of the questions presented to the student, coaching material, time given to solve questions should be different for all students. In this way, it is important to assess the present knowledge level of the students before starting the learning procedure. In addition to domain knowhow, the intellectual capabilities, for example, working memory limit, verbal, spatial and numerical thinking are also important to explore in this regard. However, domain knowhow can be applied in only a specific area while psychological capacities can enable a student to dominate in any area since they are domain independent.

The main objective is to build up a model that will break down each student's cognitive abilities, basic acquaintance level and mental state before starting the learning procedure. Cognitive capacities decide an individual's style of comprehension, understanding, thinking, recollecting and critical thinking.

2. State of the art techniques in literature vs proposed framework

An innovation named eye gazing technology [2] includes investigating the eye developments by either recognizing the purpose of look or the movement of an eye comparative with the head, using a gadget named as eye tracker, which stores the eye stare positions at visit time occurrences and afterward investigate the look examples to recognize when the student gets exhausted. This aids in improving the concentration and convergence of the student. Another technique is face expression analysis [4], which includes utilizing a web cam to recognize the developments in facial muscles by looking at a few pictures of the student caught through the webcam. These sort of frameworks are profoundly productive to analyze the students' state and afterward effectively adjusting the

mentoring approach according to state of student. But there are a few difficulties related with it, for example, loads of ongoing picture preparing and equal handling with the information assessment and that expands the multifaceted nature of the framework.

In addition, psychological and physiological sensors are used to quantify the individual's physiological reactions. Typically the individual's present state is foreseen inside an enthusiastic space with the measurements included, for example, excitement, intensity, control and so on. These are estimated utilizing the chronicles of the electrical signs produced by cerebrum, heart, muscles and skin. The significance of these devices is their constant observation of the student's state. Whereas, the drawbacks of these devices include their design complexity, huge expenses and requirement of specialized skills to deal with the sensors activities. The proposed technique develops a model that utilizes every student's intellectual capacities, essential associate level and mental state before beginning the learning process.

3. Proposed Smart Coaching Schema

In the proposed Smart Coaching Schema, a student can be portrayed with certain highlights, for example, Actual degree of Knowledge, Personal Attributes & Interests, Cognitive capacities, Meta-Cognitive capacities, and favored Learning Styles [3]. Each student entity can be represented utilizing certain student attributes, for example, students' personal data, styles of learning that is best for them and their behavioral characteristics. The qualities of a student's conduct are depicted by the accompanying characteristics namely, fundamental acquaintance, level of enthusiasm, level of attentiveness, grasping capability, prominence of task to students.

The Fundamental Acquaintance Level of student is judged through a test taken before starting the learning process and is named as Pre-Learning Test [7]. Level of Enthusiasm, as indicated by scientists, is an ideal degree of enthusiasm is medium which emphatically influences the learning results [8] using a Psychological Questionnaire [9]. Level of Attentiveness factor decides the time taken to gain proficiency for a particular subject [10]. Grasping Capability is judged by a scholarly speediness test and is a time limit based test named as "Scholarly

Promptness Test" and includes inquiries on picture to word mapping and fundamental arithmetic computations [12,13]. Prominence of task to students will be self-evaluated by the students to identify the eagerness or energy of the student to learn [14]. The five phases of the proposed methodology include:

phase 1: Student authenticates his account using Login and fill their demographic information such as user id, password, name, contact number, email id, age, level of qualification (e.g. under graduate, post graduate etc.), domain of interest.

phase 2: Student gives the Attentiveness Test; Enthusiasm Test; Intellectual Promptness Test; Pre-Learning test; and assesses the Prominence of task to him as low, medium or high.

phase 3: Learning starts as per the favored learning styles.

phase 4: Student takes the Post-Learning Test and is assigned a score between 0 and 5.

phase 5: Student is classified into a reasonable class as indicated by the scores obtained.

This whole system generates a dataset with the values of aforementioned parameters that portrays each student. At last students are characterized to a suitable class dependent on the aftereffects of their Post-Learning test. The Learning Style is controlled by Felder-Silverman learning styles [14]. The classifier utilized for arrangement and expectation designs is Naive Bayes Classifier supporting Kernel Based Distribution. Students are grouped into Novice, Average and Excellent class dependent on the information provided. Therefore, students categorized as Excellent could be furnished with progressive intellectual knowledge and extra learning material, while students less proficient will be given more opportunity for adapting, more clarifications could demonstrate valuable for them [6]. Thus, personalization and adaptation according to the understudy can be actualized all the more successfully in SCS. Naive Bayes Classifier is utilized for anticipating the learning requirements of the students for clustering the students and which considers true independence between the features used [5]. This classifier is known to outperform many other complex grouping models.

This data is utilized to denote each student by a vector Y, which stores the aforementioned parameters,

$$Y = (Y1, Y2, Y3, Y4, Y5, R),$$

where: $Y1$: Basic Acquaintance Level, $Y2$: Level of Enthusiasm, $Y3$: Level of Concentration, $Y4$: Intellectual Promptness, $Y5$: Prominence of task, R: Result of Post-Learning Test

Students will be clustered into three classes dependent on the outcomes of the Post-Learning Test. Classes: A (Novice), B (Average) and C (Excellent). These classes decide the students' capabilities and learning results. Naive Bayes Classifier identifies a class $CLASSi$ for which the likelihood that a given vector or tuple Y finds a place with $CLASSi$ is maximum, where $i : 1, 2, 3$. Therefore, mathematically this condition can be characterized as: the pseudo code for the algorithm used for prediction of learning outcomes is written below. The complexity of this algorithm is $O(n)$.

Input: TestData of tuples Y; Classes: $= A, B, C$
Outputs: Classification of students, Accuracy of the classifier
number_of_classes: = 3
no_of_instances_classified_correct: = 0;
for each test instance Yi in TestData
do
Compute $P(CLASSi|Y) > P(CLASSj|Y)$
where $i <>$ no_of_instances_classified_correct
if class:$= CLASSi$ then
no_of_instances_classified_correct = no_of_instances_classified_correct + 1;
maximize $P(Y|CLASSi).P(CLASSi)$

4. Results and discussions

To demonstrate the proposed Cognitive Science technique, a prototype of SCS has been developed for coaching of framing English sentences using verbs. This prototype has been designed to teach 6 rules to students during the coaching. This research study has been conducted in two phases, namely, generating a training and testing dataset, and predict the classification of students in three categories using Naive Bayes Classifier. To generate a dataset, a random sample of 1000 student records for under-graduate and post-graduate students have been generated using DTM data tool generator using random sampling. For

predicting the classification of students, Naive Bayes Classifier has been used and is implemented using Python. Input dataset has been divided into 80% of training data and 20% of testing data. The accuracy of prediction recorded is 92.6%.

5. Conclusion and future scope

The proposed study has proposed a Cognitive Science technique to predict the Learning Outcomes based on various cognitive factors as mentioned in Section 3 along with the demographic data and preferred learning styles. Naive Bayes Classifier has been used to categorize the students in a suitable class and to predict the learning outcomes. Many investigators suggest that performance of the Smart Coaching Schema gets enhanced if they have the capability to adapt according to the expressive state of the student. This concept has led to the idea of development of new generation SCS to be known as "Smart Coaching Schema".

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