Student Performance Assessment Model based on the Item-Response Theory

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ABSTRACT: *This paper proposes the development of a computational model which will be integrated into Virtual Learning Environment (Virtual-TANEB) that uses the Item Response Theory, statistical Models (Logistic Model of a parameter for dichotomous items with a population and Logistic Model parameters for three dichotomous items with a population) , to evaluate the proficiency of students in any area of knowledge. This computer application is adapted to the student's cognitive level through Artificial Intelligence (software agents: Adaptability, Pro-activity, Sociability, Autonomy and Reactivity). Initially, this software includes only the mathematics discipline content of 4th grade of elementary school, specially geometry providing the financial burden reduction and less time to deliver the student evaluation result.*

Keywords: Software Agents, Item Response Theory, Educational Assessment

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1. Introduction

The Item Response Theory is a collection of mathematical models (Dalton, 2000) queestimam abilities of individuals probabilistically predict items of evidence that are submitted. Showing statistically that a person with greater proficiency *j* will be able to hit an item *i* of proof, and also an item be hit accidentally by an individual without the ability to respond to it [1] [2].

The Item Response Theory (IRT) arose from the need to overcome limitations of the present results only by percentage of correct responses or test scores and also the difficulty of comparing results of different tests in different situations [2].

2. Mathematical Models of Item Response Theory

The IRT is a set of mathematical models that seek to represent the probability that an individual has a response to an item on the basis of item parameters and ability (or abilities) of the respondent [2] [3].

The TRI has several mathematical models, and these are applied in accordance with the factors of the problem. The three fundamental factors of the TRI, by priority, are:

i) Number of people involved

ii) the nature of the item

iii) Amount of skills.

Dichotomous Logistic models are frequently used because they represent the questions of right or wrong.

3. Logistic Model Parameters for Three Dichotomous Items With a Population

A. Birnbaum also proposed this model, which uses the parameter of the difficulty, discrimination and the likelihood of success by chance the item. It assumes that these parameters influence the probability of the correctness of the item, as in (1).

$$P(\theta_i) = c_i + (1 - c_i)\frac{1}{1 + e^{-a_i(\theta - b_i)}} \qquad (1)$$

4. Logistic Model Parameters for Dichotomous Items With a Population

Bock (1972) developed a model based on two-parameter logistic model that can be applied to all categories of response chosen in a test with multiple-choice items, as in (2). [1].

According [1], this model attempts to obtain more information from responses of individuals to determine whether the answers are right or wrong. Bock assumed that the probability that an individual would select an option j k mi of options i would be assessable item: as in (2)

$$P(\theta_i) = \frac{1}{1 + e^{a_i(\theta - b_i)}} \qquad (2)$$

5. Software Agents

There are various definitions in literature for software agent, although no consensus among authors, since each set according to the agent application addressed in their research. Some authors define the term as:

• An agent is a computer system, positioned in any environment, which is able to act independently flexible in order to achieve the objectives for which it was designed.

• Computational agents are active virtual entities that, together, form societies, and are embedded in an environment.

Each agent is able to interact with information perceived from the environment and/or other agents. According to the agents can be characterized by presenting the following properties:

i) Reactivity

ii) Adaptability

iii) Pro-activity Autonomy and Sociability

6. Architecture of Intelligent Agents

To build characters with affective characteristics, techniques were employed agents intelligent. According to Wooldridge [2002] Agents are computer systems located at some environment where they are able to independently carry out activities to achieve their goals, it must exist within an environment, act independently and make their own decisions. Also according to the author on an intelligent agent is considered "*beyond the features previously denied* ", it must be reactive, proactive and possess social skills. It is reactive when it perceives, processes and responds (in a timely fashion) with environmental changes, and pro-active if it exhibits a behavior motivated by their goals and ally, and when social interacts with other agents in the environment.

Traditionally, agents are specified by means of a diagram where the rectangles indicate the modules and the arrows use of data between parties. This representation takes the architecture name of the agent. "*Wooldridge* [2002] *the fine architecture of an agent*" as a particular methodology for the construction of agents that specify how it can be decomposed in modules and how these modules interact, in addition to a mapping that relates the perceptions received with the actions to be performed.

The architectures of intelligent agents in (1) can be abstract (representations) or concrete are effectively implemented in a programming language. According to Weiss [2001] there are basically four different types of architectures for intelligent agents: Agent-based Logic Reactive Agents, Agents, BDI (Beliefs, Desires and Intentions) and Agents with Layered Architecture. Each of the four types of architecture are explained below.

Figure 1. Functional Architecture

Agents based on logic: also known as Symbolic Artificial Intelligence, this classical approach suggests that the agent's intelligent behavior can be achieved with a system of symbolic representation of both the desired behavior of the agent and the environment where it belongs and to a set of rules for manipulating these symbols. This symbolic representation is composed of logic formulas and their manipulation corresponds to logical deduction.

Reactive agents: development of reactive agents, and conducted a direct mapping possible information relating the input (perception) that the agent may have to each action that he can perform in the environment. These agents select actions based on current perception, ignoring the rest of historical perceptions. Although simple, economical and robust, this approach presents problems because it is not designed to learn from experience and thus improve its performance over time.

BDI agents: created by the philosopher Michael Bratman, this type of architecture is to describe the practical process of human reasoning. BDI agents implement and manipulate a structure that divides the architecture into three main modules: beliefs, desires and intentions. Initially the information from the external environment are captured by the perception, and knowledge base and updated. The processing architecture decides which goal you want to achieve and in light of that decision, choose a plan to run the library.

Agents with Layered Architecture: This approach divides the decision-making process of an agent in several layers. This separates idea how different types of behavior are generated (eg behaviors pro-active and reactive). Agents that implement this approach may choose a structure of horizontal layers or vertical, where horizontal layers in the structure of all the data they handle input and output and vertical handles only the first input data and handles only the last output data .

7. Software Architecture for Virtual-Taneb Performance Assessment of Student

Virtual-TANEB is a software that belongs to Dimension Management School of Education Outcomes. According to [9] point to this dimension as indicators of earnings management: assessment and continuous improvement of the school's pedagogical project, analysis, dissemination and use of results, identifying the level of satisfaction of the school community, with the work of its management and transparency of results, as in (2).

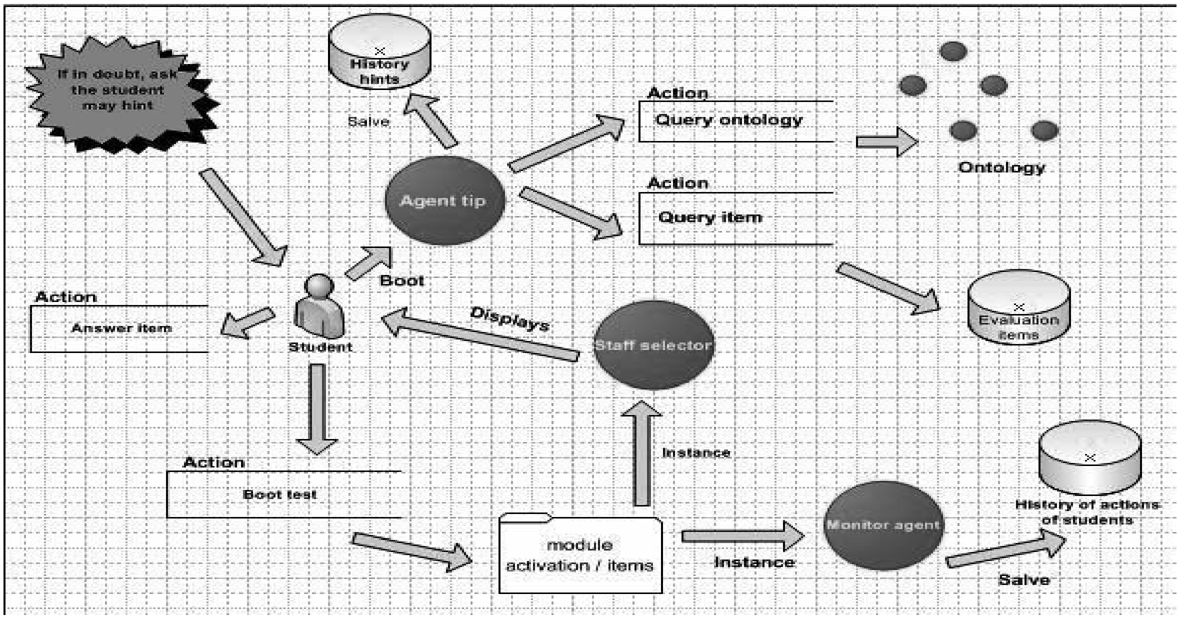

Figure 3. Logo of the Institute for Electrical and Electronics Engineers

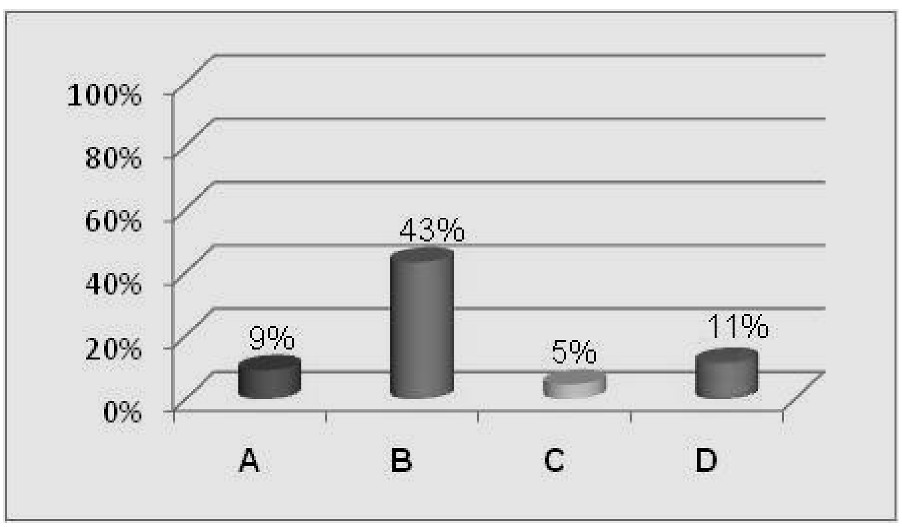

Figure 4. Percentage of Responses to Alternative

This prototype automate such activities as, for example, the application of evidence which are still performed manually and not customized to the student's grade level. This method complicates the diagnosis on the students' learning and consequently cause a costly financial burden to state coffers over the process of creating, implementing and reviewing the evidence. In the early resolution of the test, all students do the same test, taking into account that students have the same level of knowledge.

8. Results

The result shows that 43% of students got the question, i.e. able to perceive the location of the object "*chair* " in the space provided for the audience. In this context, the students could develop the ability provided by the descriptor (D1). The other students have not developed or are still building this skill. Of this group, 9% marked the alternative "*A*", 5% marked the alternative "*C* ", 11% marked the alternative "*D*" and 32% did not score any of the alternatives, as in (4).

9. Conclusion

In our tests, the software presented a virtual-TANEB important contribution to assessment of students in schools, especially primary education, that through software agents, an architecture and a rich graphical environment friendly, we can understand and help develop their skills and detect deficiencies in their classroom. In future work we intend to implementer neural networks for knowledge acquisition in children.

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