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Prediction of the Factors Affecting the Permanence of Knowledge in Mathematics Using Soft Computing †

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Abstract: In this scientific research work, the possibilities of applying artificial intelligence of neural networks, i.e., Adaptive Neuro-Fuzzy Inference System (ANFIS) methodology will be presented and explored as a support in teaching mathematics in predicting the durability of knowledge. The results of the research show that it is through the use of these sophisticated technologies that students' achievements in mathematics can be improved, and that research in this direction is very much needed.

Keywords: mathematics; student; scientific literacy; knowledge; ANFIS methodology

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1. Objectives

In order to learn mathematics, a modern student does not only need a textbook but must also combine other teaching aids, new learning methods, and activities that can raise their level of self-confidence and logical thinking [1]. In this way, they develop basic mathematical skills, such as problem solving, data collection, data evaluation, measurement, etc. The more mathematics is connected to everyday life, the greater the understanding students will have of the need for mathematics in the world. In the modern implementation of the teaching process, information technology is, in a narrower sense, an indispensable teaching tool supporting teachers in the traditional way of learning, and, in a broader sense, it represents a new methodological approach considering different ways of learning and teaching [2]. Thus, the aim of this research is to predict the factors that affect the permanence of the adopted mathematical content. By using the method of artificial intelligence, that is, the Adaptive Neuro-Fuzzy Interference System (ANFIS), we predict factors that affect the continuity of knowledge in mathematics.

2. Methodology

The methodology used in this study is mixed; that is, it performs descriptive and quantitative analysis [1]. In order to predict the factors that affect the permanence of the adopted mathematical content, we use the Adaptive Neuro-Fuzzy Inference System (ANFIS) methodology [2]. A model of the fuzzy inference system formed using neural networks is used to calculate the parameters of the membership function based on the available input–output data [3]. The model is defined on the basis of available knowledge on the process under consideration.

3. Results

Mean error, mean deviation, mean square error, and root mean square error for training data, test data, and all data combined for the input that has the greatest impact on the output size, as well as the reliability coefficient of the model, are presented in this paper.

Input 3 has the lowest Root mean squared errors (RMSE), which means that the degree of use of educational software in learning has the greatest impact on the ratio of the average grade in the previous and current year, which is a measure of the permanence of knowledge. In addition to the individual effects of the inputs on the output, the impact of the two combined inputs on the output is also assessed. Input 1and input 3 in combination are found to have the smallest RMSE, i.e., the greatest influence on the output size. Thus, the applicability of mathematics and the degree of use of educational software in learning have the greatest impact on the ratio of the average grade in the previous and current school year in mathematics [4].

4. Originality Value

One of the biggest problems in teaching mathematics is the permanence of the acquired knowledge [5]. In order for some knowledge to become permanent, it is not enough to adopt certain procedures; the taught content must be understood, and the student must be able to apply this knowledge in unknown situations [6]. For this reason, the factor of permanence of knowledge is considered a crucial factor in the improvement of mathematics teaching [7]. The ratio between the average grade in mathematics at the end of the current year and at the end of the previous school year is chosen as an indicator of the permanence of knowledge [8]. Factors influencing the permanence of knowledge are selected based on personal experience. Factor estimation is carried out using ANFIS methodology [9]. The results of the research present the most influential factors for the permanence of knowledge, namely: the most influential factor, the two most influential factors combined, and the three most influential factors combined. According to the results of the research, the most influential factor in the permanence of knowledge is the degree of use of educational software outside the classroom. Learning with educational software activates many more senses than learning in the traditional way [10]. All these senses enable better adoption of teaching contents, as well as much faster and easier recall of some taught content that has not been used for a long time [11]. Most educational software also has a variety of additional content to help children develop their mathematical thinking [12].

5. Contribution

By introducing educational software into the immediate teaching process, mathematics teaching can be improved and modernized and thus keep pace with the technological achievements of the 21st century. Changes in the teaching of mathematics imply inevitable changes in the methodology of teaching mathematics. This will also require a change in the teacher's personality and their role in teaching. The teacher will guide the student in understanding how to learn and what not to learn. In this way, students will be the creators of their own acquisition of knowledge and will have to take responsibility for their education. Learning mathematics will no longer be something that the student will give in to, but something that he will tackle and get the most out of, being aware of its role in the real and creative environment.

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