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ANALYSIS OF DATA MINING METHODS IN ELECTRONIC EDUCATION

Abstract: *The relevance of using data mining methods to support management in the electronic education process is substantiated in the article. The main methods of data mining within the framework of e-education are described in detail, and an overview of the main scientific works devoted to this area is presented. These methods may be useful in decision support systems at all levels of management of the educational process.*
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Introduction

Varieties of data mining techniques are used in different educational contexts. The main goal of these methods is to transform data into information that would be relevant to the educational process and to search for patterns to make the best decisions in a given area. The process of data analysis includes the following stages: pre-processing the data, identifying patterns using various data analysis methods, testing the found patterns, applying these patterns to predict future events in the field of education, and using the resulting forecasts in decision-making and formation of education policy.

Publications that contain evidence and experimental bases on the most pressing issues related to the use of the application of mining methods in the e-learning system were analyzed in this article.

The study in [1] proves the relevance of using data mining methods in the educational process to support decision-making on its management. The article proposes a software application that provides data analysis using complex classification algorithms.

In [2], the authors proposed several educational data mining methods to assess the learning behavior of students in an e-learning system. These methods include cluster analysis aimed at determining the most popular time threshold for completing a task in one session, data analysis and visualization to highlight the main parameters that contribute to the effective completion of courses, and V-fold cross-validation using statistical processing, which makes it possible to group students by main indices of their activity to determine the relationship between a high percentage of activity and academic performance. The analysis showed that it was possible to optimize course navigation and time spent on assignments if information about important e-learning tools was available.

Methods for analyzing educational data and their differences from data mining methods were discussed in [3]. The areas of application of educational data analysis and the benefits it provides to all participants in the educational process were also analyzed.

In [4], various methods for analyzing data on student performance are discussed. The focus is on predicting the academic achievements of students in undergraduate programs, as well as studying typical student progressions and combining them with prediction results. About 10 classification algorithms were used for prediction.

The goal of the study conducted in [5] is to develop the fundamentals of self-optimization technology for software systems as part of e-learning. It is based on the formulated and formalized principle of reflexive adaptation of software, applicable to a wide class of software systems and based on the identification of new knowledge in the behavioral programming of the system.

In [6], the features of applying data mining and machine learning tools to small data sets are discussed. This article is not a review of popular methods of machine learning and data mining, however, the collected and presented material could help the reader achieve satisfactory results when applying the described computational methods.

According to the study conducted in [10], in modern literature on psychology and pedagogy special attention is paid to identifying factors that influence students' academic success. Statistical methods are used to analyze the influence of the studied parameters on academic performance. However, the conclusions drawn from such analyses often are problematic because the test results from a specific sample of students are not applicable even to individual students in the same sample. This situation requires the identification of possible factors that limit the reliability of the research, the need to pay attention to the specifics of the data to be analyzed and the size of samples from the general population on which this analysis will be performed.

In reference [11], Data Mining technologies are discussed and the main stages of data processing are pointed out. The architecture of Data Mining is presented and the main methods are shown focused on the core tasks of Data Mining. The main tools of Data Mining technologies are assessed.

In this article, the authors analyze data mining methods in an e-learning system. They discuss examples of the application of these methods and the potential benefits they can bring to education.

Analyzing educational data can help identify problems and find solutions to improve performance and learning. This can be used to predict student performance, model and understand their behavior and learning style, and identify groups of students based on the outcomes and process of learning.

Besides, data analytics can help to visualize complex and multidimensional data, allowing us to understand structure and find latent dependencies. This can be useful for organizing educational content, planning and scheduling, and developing personalized recommendations for students.

Social network analysis can also be used to study relationships between students and teachers, as well as between students. This can help create a positive learning environment and identify problems that may be affecting performance.

Finally, educational data analysis can help identify latent problems in academic performance. By analyzing students' behavior when interacting with educational materials, it is possible to identify problems in learning, lack of motivation, and attempts to deceive the educational system.

MAIN PART

Educational data analytics is a powerful tool that can help teachers and students improve their learning and achieve better results. There are many data mining methods and algorithms. Let us consider the features and application of these methods.

1. Artificial neural networks

Features: Imitate the functioning of the human brain, consisting of neurons that process input data and transmit signals.

Application: Solving problems of classification and forecasting.

2. Decision tree

Features: Classify, predict, and describe important features.

Application: Question-based data separation and decision-making.

3. Nearest neighbor method and k-nearest neighbor method

Features: It is based on proximity between data objects.

Application: Classification and clustering based on the proximity of objects.

4. Support Vector Machine

Features: Find a separating hyperplane of maximum width between two data classes.

Application: Classification and regression.

5. Bayesian networks

Features: Model probabilistic relationships between variables.

Application: Forecasting and identifying relationships.

6. Linear regression

Features: Predict the dependence of one variable on another or several other variables.

Application: Forecasting and analysis of regression problems.

7. Correlation and regression analysis

Features: Explore relationships between variables.

Application: Analysis and forecasting.

8. Hierarchical and non-hierarchical methods of cluster analysis:

Features: Group data objects according to their similarities.

Application: Classification and identification of data structure.

9. Methods to search for association rules

Features: Find relationships between variables or data objects.

Application: Finding associations in data, for example, using the Apriori algorithm.

10. Evolutionary programming and genetic algorithms

Features: Model evolution and selection processes in nature.

Application: Optimization and search for the best solutions.

11. Limited search method

Features: Solve combinatorial optimization problems.

Application: Selecting the best option from a finite set of possible options.

12. Data visualization methods

Features: Presentation of data in graphical format for easy understanding and analysis.

Application: Data visualization to identify patterns and understand data structure.

Let us consider the features of using some methods for educational purposes in electronic education.

Artificial neural networks. The use of neural networks in learning opens up broad opportunities for innovative methods of information processing. Here are a few ways neural networks can be used for educational purposes:

processing of text information:

• automatic assessment of essays and answers to questions.

• generation of automatic feedback and recommendations for improving writing skills.

• recognition and analysis of text data to provide personalized learning materials.

processing of audio information:

• speech recognition for automatic assessment of the level of oral communication skills.

• creation of personalized audio tasks or training programs, considering individual pronunciation features.

processing of graphic information:

• automatic evaluation of drawings and graphic works.

• pattern recognition for creating interactive educational materials.

processing of video information:

• analysis of student behavior during training.

• providing feedback based on visual analysis while completing tasks.

• creation of personalized training programs:

• using training data to create customized courses or lessons.

• adapting the pace of learning depending on the student's level of understanding.

analysis of individual student problems:

• using training data to identify weaknesses and provide additional resources if needed.

• creation of special tasks:

• automatic generation of individual tasks aimed at solving specific student problems.

These approaches allow teachers and educational programs to provide more effective and personalized teaching methods, which can lead to better student learning.

Forecasting. Forecasting, in the context of machine learning, is the process of creating a model from training data to predict the values of a target variable for new data. Different methods are used depending on the type of target variable.

Regression is used when the target variable is a continuous numeric value. For example, using data on the number of hours spent studying; the final grade can be predicted using regression models such as linear regression.

Classification. Classification is used when the target variable is categorical, i.e., it accepts a limited number of classes or labels. The process of training a model includes selecting an algorithm, identifying features (independent variables), preparing data, training the model, and evaluating its performance on new data. Once trained, the model can be used to predict values of the target variable for new data that were not part of the training set.

Detecting structure in data. Algorithms for detecting structure in data aim to identify patterns, groups, or clusters in data without prior knowledge of the structure.

CONCLUSIONS

Data mining approaches demonstrate effectiveness and efficiency in existing e-learning systems. The distinctive feature of traditional e-learning systems is that they are query-based without the use of data mining or heuristics. Therefore, robust data mining approaches need to be included in the developed e-learning system to find clusters in educational data. Data mining methods work effectively with large volumes of data, making education systems reliable and capable of solving interdisciplinary problems related to emotional learning and e-learning. For future research, data mining approaches can be improved by making them more sensitive to knowledge generation and providing assistance that is more objective to students. Large and real data sets can be created to analyze the behavior of the data mining approaches developed.

Using several data mining techniques for educational purposes can significantly improve the learning process and help in making informed decisions based on available information.

The use of data mining methods in e-education provides significant benefits for managing the educational process. The relevance of this approach is due to the growing volume of data generated in e-education and the need to effectively use it to improve

the quality of learning and manage educational programs.

The main data mining methods in e-education include:

• analysis of student attendance and activity data: cluster analysis methods can be used to identify groups of students with similar educational goals;

• classification that can help predict academic success and provide guidance for students facing difficulties;

• the use of machine learning to predict academic performance;

• machine learning models (such as regression and classification) can be applied to predict student success based on their previous performance, activity, and other parameters;

• association analysis methods that can help identify relations between certain teaching methods and student success, these methods can lead to the optimization of educational programs;

• personalized learning: the use of recommender systems and collaborative filtering algorithms to provide personalized content and resources to students;

• feedback monitoring and analysis: the use of natural language analysis and processing to test student-teacher feedback, which can help improve the quality of the educational process.

A review of the main scientific studies in this area allows us to see development trends and determine the most effective methods and approaches. Decision support systems based on these methods can be implemented at all levels of educational management - from decision-making at the curriculum level to adapting approaches to the individual needs of students.

In general, the use of data mining methods in e-education not only improves management efficiency but also contributes to the innovative development of educational systems, making them more adaptive and focused on the needs of students.

References:

1. Gorlushkina, N.N., Kotsyuba, I.Yu., & Khlopotov, M.V. (2015). Tasks and methods of intellectual analysis of educational data to support decision-making. *OTO*. 2015. No. 1.

2. Gushchina, O.M., & Ochepovsky, A.V. (2020). *Data Mining analysis in the study of students' learning behavior in the e-learning system. Virtual modeling, prototyping and industrial design.* Proceedings of the VI International Scientific and Practical Conference. Volume 2, Issue 6 2020, Publisher: Tambov State Technical University.

3. Belonozhko, P.P., Karpenko, A.P., & Khramov, D.A. (2017). Analysis of educational data: directions and prospects for application. *Internet journal "SCIENCE"* Vol. 9, No. 4 (2017).

4. Popova, N. A., & Egorova, E. S. (2023). Data mining of educational data for predicting the performance of university students. *News of the Kabardino-Balkarian Scientific Center of the Russian Academy of Sciences*, 2023, issue 2, 18-29.

5. Bozhday, A.S., Evseeva, Yu.I., & Gudkov, A.A. (2017). Application of data mining methods to implement reflexive adaptation in e-learning systems. *Open education*. 2017; (4):13-20.

6. Anish, H. (2021). Application of machine learning tools and data mining for databases with

a small number of records. *Advanced Engineering Research* (Rostov-on-Don). 2021; 21(4):346-363.

7. Matsebula, F., & Mnkandla,E. (2017*). "A big data architecture for learning analytics in higher education,"* IEEE AFRICON: Science, Technology and Innovation for Africa, pp. 951-956.

8. Barril, J. F. H., & Tan, Q. (2017). *"Integrating privacy in architecture design of student information system for big data analytics,"* IEEE Conference on Cloud Computing and Big Data Analysis, pp. 139-144.

9. Yakubzhanova, D.K., & Akhmedzhonov, A.R. (2016). The role of distance learning in improving the quality of education in universities. *Science Time*. 2016. No. 2 (26). 23).

10. Sosnitsky, V.N., Potanin, N.I., & Sheveleva, L.V. (2013). Problems of statistical analysis of average student performance. *Fundamental research*. 2013. No. 10-2. pp. 316-320.

11. Lee, S. (2023). Models, methods and algorithms of big data and data mining. *Current Research.* 2022. No. 30 (109). pp. 17-20. https://apni.ru/article/4418-modeli-metodi-i-algoritmi-bolshikh-dannikh

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