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ADAPTIVE TESTING AS A TOOL FOR ENHANCING STUDENT MOTIVATION IN THE CONTEXT OF THE EUROPEAN GREEN DEAL

Abstract. This article explores the role of adaptive testing as a tool for enhancing student motivation in the context of studying topics related to the European Green Deal (EGD). The problem statement underscores the importance of adaptive testing for creating a dynamic and personalized learning experience that improves the quality of education. The analysis of recent studies highlights the relevance of implementing digital technologies in education and their impact on the learning process. The main part of the article emphasizes the importance of studying EGD elements for students of various specialties, including economics, engineering, natural sciences, social sciences, and humanities. The development of adaptive tests promotes individualized learning, increases student motivation, and enhances their digital skills. Adaptive testing allows for more precise and effective assessment of student knowledge, supporting the learning process and helping students prepare for future challenges.

An example of adaptive tests in the context of the EGD is provided, demonstrating the approach to assessing student knowledge. The use of artificial intelligence methods in adaptive tests allows for the creation of a personalized learning experience that improves knowledge retention and long-term learning outcomes. The article details how adaptive tests can foster interactivity and individualized learning, enabling students to learn at their own pace while reducing stress levels.

The article summarizes the benefits of adaptive testing and its impact on the learning process in the context of the European Green Deal. The implementation of adaptive tests in university curricula enhances educational accessibility, student engagement, and knowledge retention. The conclusions emphasize the need for further research and practical implementation of adaptive tests to achieve sustainable development and effective learning.

Additionally, the authors note the potential of adaptive testing for preparing future professionals capable of effectively responding to contemporary challenges. This includes not only a deep understanding of the ecological aspects of the EGD but also the development of critical thinking, independent learning, and adaptability to change. The application of adaptive testing contributes to the formation of well-rounded specialists who can implement sustainable development principles in their professional activities.

Keywords: Adaptive testing, European Green Deal (EGD), digital education, personalized learning, sustainable development, student motivation, artificial intelligence, higher education institutions, ecological technologies, knowledge assessment

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АДАПТИВНЕ ТЕСТУВАННЯ ЯК ІНСТРУМЕНТ ПІДВИЩЕННЯ МОТИВАЦІЇ СТУДЕНТІВ У КОНТЕКСТІ ЄВРОПЕЙСЬКОЇ ЗЕЛЕНОЇ УГОДИ

Анотація. У статті досліджується роль адаптивного тестування як інструменту підвищення мотивації студентів у контексті вивчення тем, дотичних до Європейської зеленої угоди (European Green Deal, EGD). Постановка проблеми підкреслює важливість адаптивного тестування для створення динамічного і персоналізованого досвіду навчання, що підвищує якість освіти. Аналіз останніх досліджень вказує на актуальність впровадження цифрових технологій в освіту та їх вплив на

навчальний процес. Основна частина статті висвітлює значення вивчення елементів EGD для студентів різних спеціальностей, включаючи економічні, інженерні, природничі, соціальні та гуманітарні науки. Розробка адаптивних тестів сприяє індивідуалізації навчання, підвищує мотивацію студентів та вдосконалює їхні цифрові навички. Адаптивне тестування дозволяє оцінювати знання студентів більш точно та ефективно, підтримуючи навчальний процес і допомагаючи студентам підготуватися до майбутніх викликів.

Наведено приклад адаптивних тестів у контексті EGD, що демонструє підхід до оцінювання знань студентів. Використання методів штучного інтелекту в адаптивних тестах дозволяє створити персоналізований досвід навчання, що покращує збереження знань і довгострокові результати навчання. У статті детально описано, як адаптивні тести можуть сприяти інтерактивності та індивідуалізації навчання, надаючи студентам можливість вчитися у власному темпі і зменшуючи рівень стресу.

Стаття підсумовує переваги адаптивного тестування та його вплив на навчальний процес у контексті Європейської зеленої угоди. Впровадження адаптивних тестів у навчальні програми університетів сприяє підвищенню доступності освіти, залученню студентів та покращенню збереження знань. Висновки статті підкреслюють необхідність подальших досліджень та практичного впровадження адаптивних тестів для досягнення сталого розвитку та ефективного навчання.

Додатково, автори відзначають потенціал адаптивного тестування для підготовки майбутніх фахівців, здатних ефективно реагувати на виклики сучасного світу. Це включає не тільки глибоке розуміння екологічних аспектів EGD, але й розвиток навичок критичного мислення, самостійного навчання та адаптації до змін. Застосування адаптивного тестування сприяє формуванню всебічно розвинених спеціалістів, які здатні впроваджувати принципи сталого розвитку у своїй професійній діяльності.

Ключові слова: адаптивне тестування, Європейська зелена угода (EGD), цифрова освіта, персоналізоване навчання, сталий розвиток, мотивація студентів, штучний інтелект, вищі навчальні заклади, екологічні технології, оцінювання знань

Problem Statement. Adaptive testing is a progressive approach to knowledge assessment that utilizes modern digital technologies to create a more dynamic and personalized learning experience. In the context of university education, especially when studying topics related to the European

Green Deal (EGD), adaptive tests can play a crucial role in enhancing the quality of education. This article explores the issue of developing and implementing adaptive tests for students studying EGD, with the aim of creating engaging interactive methods for assessing their understanding of these topics.

Analysis of Recent Research and Publications. The issue of analyzing the impact of digital education elements on the learning process is highly relevant and is highlighted in numerous contemporary scientific studies. Studies [1-3] argue that the digitalization of education is a powerful trend amidst the reform and modernization of the global educational environment. It has been demonstrated that the implementation of digital technologies in education has blurred the boundaries of physical distance and introduced more scientific methods of knowledge transfer from teachers to students. In [4], the challenges of implementing e-learning in higher education are discussed, including the structure and delivery of higher education, the implications for both students and teachers, and the global impact on society. It is substantiated that e-learning can provide students with a model of becoming autonomous independent learners, helping them to learn throughout their lives. Study [5] analyzes the necessity of linking the utility of digital technologies to improve the learning experience and ways to adapt courses to various educational needs and aspirations. The report [6] contains information on media-rich digital learning platforms, personalized or adaptive learning, and social media technologies. Key aspects of digitalization in education include adaptive learning, augmented and mixed reality, gaming, and gamification.

A separate group of studies focuses on the analysis and implementation of adaptive learning in higher education. Studies [7-9] assert that personalized learning on a large scale becomes possible through adaptive learning, which is a promising teaching method that holds great potential to meet the demands of a wide range of students. This method can also help disadvantaged groups and regions gain access to higher education. An essential component of adaptive learning is adaptive knowledge testing systems [10-11]. Various approaches to building computerized adaptive testing systems are proposed in these studies.

Objective. The objective of this article is to analyze the problem of developing and implementing adaptive tests for university students studying topics related to the European Green Deal.

Main Content. The study of topics related to the European Green Deal (EGD) in higher education is of significant importance for students of various specialties. This is due to the comprehensive impact of the EGD on different aspects of the social and economic life of Europe and neighboring countries.

For example, students of economics and business specialties need to understand the impact of the EGD on economic models and business practices.

The agreement entails significant changes in the way businesses operate, including the transition to sustainable development, reduction of greenhouse gas emissions, and implementation of a circular economy. Future economists and business leaders must be prepared for these changes to effectively adapt and capitalize on new opportunities that arise in the context of the green economy.

Students of engineering and technological specialties must grasp the importance of the EGD in promoting the development of new technologies and innovations aimed at reducing environmental impact. Engineers working in fields ranging from energy to transportation must understand the principles of sustainable development and be capable of designing and implementing environmentally friendly technologies.

Students of natural sciences, including ecologists, biologists, and geographers, need to be familiar with the measures provided by the EGD concerning environmental protection and biodiversity conservation. Understanding these measures will enable them to work more effectively in environmental protection, develop conservation strategies, and implement ecologically oriented solutions in various fields.

Students of social sciences and humanities also benefit from knowledge about the EGD, as the agreement influences social aspects of life, including politics, law, and public awareness. Studying the EGD will help them better understand the social challenges associated with climate change and contribute to the development of policies and strategies that support sustainable development.

The importance of studying the EGD also lies in the interdisciplinary approach to education. Students from different specialties can collaborate on solving complex environmental problems by sharing knowledge and experience. This fosters the formation of well-rounded professionals capable of working in conditions of constant change and challenges related to environmental issues.

Knowledge testing plays a crucial role in the learning process by providing students with the opportunity to assess their understanding of the material. In the context of studying topics related to the EGD, testing helps determine how well students have grasped the key principles and provisions of the agreement, particularly in the areas of sustainable development, environmental conservation, and ecological technologies. This allows both educators and students to identify knowledge gaps in a timely manner and take measures to address them.

Adaptive tests enable students to learn at their own pace by adjusting the difficulty of questions to match each student's knowledge level. This

creates a more interactive and personalized learning experience, enhancing student motivation and engagement. The use of adaptive tests also contributes to the improvement of students' digital skills. Digital education methodologies ensure greater accessibility to learning materials and assessments, as students can access them anytime and from anywhere.

Artificial intelligence methods used in adaptive tests allow for a personalized learning experience that improves knowledge retention and long-term learning outcomes. The inclusion of interactive elements encourages active participation in the learning process, which positively impacts students' interaction with the material.

The primary goal is to develop and implement effective digital education methodologies for self-assessment and knowledge evaluation on EGD modules. This includes utilizing modern solutions, particularly those based on artificial intelligence, to create adaptive tests. Digital education ensures greater accessibility to education, allowing students to access learning materials and assessments anytime and from anywhere. This is especially important for students who have limited access to traditional educational resources.

Adaptive testing creates a more dynamic and individualized evaluation process, which increases student motivation. Through a personalized approach to testing, where the difficulty of tasks is adjusted to each student's knowledge level, students experience less stress and more interest in learning. This promotes more active participation in the learning process and greater engagement with the material.

The use of digital education methodologies aims to enhance student interaction with the material and encourage them to take an active role in their learning. This is achieved through the creation of engaging and interactive tests that stimulate students to actively study topics related to EGD.

A personalized learning experience provided by adaptive tests improves knowledge retention and long-term learning outcomes. Students who receive material tailored to their needs and knowledge level are better able to assimilate and remember information.

Knowledge testing also supports the learning process by allowing students to regularly check their knowledge and receive feedback. This helps them better understand their strengths and weaknesses and promotes the development of self-assessment and self-regulation skills in learning. For educators, adaptive tests are a tool for monitoring student progress and improving teaching methods based on the data obtained.

Knowledge testing on topics related to EGD helps students prepare for future challenges in their professional activities. Students with a deep

understanding of ecological issues and sustainable development will be better prepared to work in various fields related to the implementation of the principles of the Green Deal. This includes developing and implementing environmentally friendly technologies, formulating ecological policies, and managing natural resources.

Adaptive tests use algorithms that dynamically adjust the difficulty and content of questions to the student's knowledge level in real-time. The main idea behind the construction of adaptive tests includes several key elements.

The process begins with an initial assessment of knowledge level: the test starts with questions of medium difficulty, and the first few questions are used to determine the student's initial knowledge level. Based on the student's answers to these initial questions, the adaptation algorithms determine the difficulty of subsequent questions. If the student answers correctly, the next question becomes more difficult; if the student answers incorrectly, the next question becomes easier.

In constructing adaptive tests, Item Response Theory (IRT) is crucial. This theory is used to model the probability of a correct response to each question based on the student's knowledge level and the question's difficulty. IRT helps in accurately assessing the student's abilities and knowledge.

Next, it is necessary to properly construct the question bank. Questions in the bank usually have varying levels of difficulty and cover different aspects of the studied topic. Each question has parameters that determine its difficulty, discrimination ability, and guessing factor. By following this approach, each student receives a unique set of questions tailored to their knowledge level, ensuring more relevant and effective assessment.

The advantages of adaptive testing include its accuracy in assessment. Adaptive tests provide a more precise evaluation of a student's knowledge with fewer questions compared to traditional tests. The personalized approach of adjusting question difficulty based on the student's performance also enhances student engagement and motivation. Students experience less stress as they are not overwhelmed by questions that are too difficult or too easy.

Implementing adaptive tests in the learning process involves several stages. The first stage is the development of the question bank. At this stage, it is necessary to create a large and diverse question bank with questions of varying difficulty levels. The next stage involves selecting the adaptation algorithm that will build a personalized testing experience, ensuring the algorithm can accurately adjust the difficulty of questions based on student responses.

The third stage is the integration into the Learning Management System (LMS) to provide convenient access for students and instructors, ensuring the

system can handle real-time adjustments and provide immediate feedback. The final stage involves conducting training sessions for instructors and students on using adaptive tests and interpreting their results, providing guidelines and support to help users understand and benefit from the adaptive testing process.

By following these stages, educational institutions can effectively implement adaptive testing, thereby enhancing the learning experience and providing more accurate assessments of student knowledge.

Example of Adaptive Tests in the Context of the European Green Deal

In the course of the research, the following example of adaptive tests was developed.

Introduction. This adaptive test is designed to assess university students' knowledge of the fundamental principles and provisions of the European Green Deal (EGD). The test covers various aspects of the EGD, including sustainability, energy efficiency, biodiversity conservation, and strategies for reducing greenhouse gas emissions. The test will adapt to the student's knowledge level by offering questions of appropriate difficulty.

Example Test Questions

Initial Questions (Medium Difficulty Level)

1. **What is the European Green Deal?**
- a) An EU program for agricultural development
- b) An EU strategy to achieve climate neutrality by 2050
- c) EU legislation for consumer protection
- d) An investment program for developing digital technologies

2. **What is the primary goal of the European Green Deal?**
- a) Increasing the extraction of natural resources
- b) Achieving climate neutrality by 2050
- c) Increasing employment rates
- d) Developing space technologies

High-Difficulty Questions (After Correct Answers to Initial Questions)

1. **Which sector is the largest source of greenhouse gas emissions in the European Union?**
- a) Industry
- b) Transport

- c) Agriculture
- d) Energy

2. **What measures are included in the European Green Deal to reduce greenhouse gas emissions in the transport sector?**

- a) Banning the use of all types of fossil fuel-powered transport
- b) Introducing a CO2 emissions tax for cars
- c) Subsidies for electric vehicle manufacturers and development of charging infrastructure
- d) Imposing quotas on car imports from countries that do not meet EU standards

Low-Difficulty Questions (After Incorrect Answers to Initial Questions)

1. **Which countries are members of the European Union?**

- a) USA, Canada, Mexico
- b) Germany, France, Italy
- c) China, India, Japan
- d) Australia, New Zealand, South Africa

2. **What is the significance of biodiversity conservation in the context of the European Green Deal?**

- a) Increasing the number of animal species in zoos
- b) Ensuring ecosystem sustainability and reducing negative environmental impacts
- c) Expanding agricultural lands
- d) Developing space programs to explore other planets

Additional Questions (After Reaching a Certain Knowledge Level)

1. **Which of the following principles are key to achieving sustainable development according to the European Green Deal?**

- a) Energy efficiency, renewable energy sources, circular economy
- b) Mass production of fossil fuels, deforestation, increased consumption
- c) Use of nuclear energy, development of the coal industry, reduction of car taxes
- d) Stimulating population migration, developing the military industry, increasing the extraction of natural resources

2. **How does the European Green Deal plan to support sustainable development in agriculture?**

- a) Banning the use of pesticides and chemical fertilizers
- b) Implementing the "Farm to Fork" strategy, which promotes ecological production and consumption
- c) Transitioning to monoculture crops
- d) Increasing food imports from other countries

The test begins with questions of medium difficulty. Based on the student's responses, the system automatically selects the next question, adjusting the difficulty accordingly. If the student answers correctly, the next question becomes more challenging; if the student answers incorrectly, the next question becomes easier.

Adaptive testing determines the results using algorithms that analyze students' answers to questions of varying difficulty levels. The system calculates the student's total score by considering all answers and their weights, using a formula that accounts for the number of correct answers and the difficulty level of the questions. The results may be normalized to ensure comparability between different students.

For example, a student's performance might be evaluated as follows:

Initial questions: The student answers 5 medium-difficulty questions, with correct answers on 3 (each worth 2 points), earning 6 points.

High-difficulty questions: Following correct answers, the system provides 5 harder questions. The student correctly answers 3 (each worth 3 points), earning 9 points.

Low-difficulty questions: After some incorrect answers, the system provides 5 easier questions. The student correctly answers 4 (each worth 1 point), earning 4 points.

Total score: The student's total score is 6 (medium questions) + 9 (hard questions) + 4 (easy questions) = 19 points.

Knowledge level: If the maximum possible score is 30, the student scores 19/30 or approximately 63%, which may correspond to an "average" knowledge level.

Conclusions. Incorporating elements of the European Green Deal (EGD) into university curricula is crucial for preparing students for future challenges and opportunities. The development and implementation of adaptive tests for assessing knowledge about the EGD will not only enhance students' understanding of these important topics but also increase their motivation and engagement in the learning process. This approach ensures the

development of essential digital skills and fosters the creation of an interactive and personalized learning experience.

Knowledge testing plays a vital role in the learning process by providing an assessment and self-assessment of students' knowledge, enhancing their motivation and engagement, supporting the learning process, preparing them for future challenges, and integrating modern technologies. In the context of studying the European Green Deal, adaptive testing becomes an effective tool that facilitates a deeper understanding of important ecological issues and improves the overall quality of education.

The main idea behind constructing adaptive tests is to create a dynamic, personalized assessment process that increases the accuracy of knowledge evaluation, reduces stress, and saves time. By using adaptation algorithms and Item Response Theory (IRT), adaptive tests provide a relevant and effective tool for assessing students' knowledge, contributing to their development and success in learning.

The results of adaptive testing are determined through a comprehensive analysis of student responses, considering the difficulty level of questions and the accuracy of answers. This ensures precise and individualized knowledge assessment, which enhances the learning process and helps students effectively develop their skills and knowledge.

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