It does not mean changing the Annual Programs, but their innovation and adaptation in certain teaching subjects, through the organization of activities in regular teaching and extracurricular subjects. The following are highlighted as benefits that teachers, students and all stakeholders will gain:

- improvement of motivation due to the introduction of quality competencies based on learning and teaching
- encouraging cooperation by creating a common point of interest that provides an opportunity to exchange experiences and work methods
- strengthening of self-confidence, self-esteem, competencies and valued for the labor market. Other aspects related to this way of working are the development of innovative and creative learning experiences; consistency between education provided in schools and student competencies expected by industry, and promotion of collaboration between schools and industry.

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THE IMPACT OF INTELLIGENT LEARNING MANAGEMENT SYSTEMS IN IMPROVING EDUCATIONAL PROCESSES

Abstract: The aim of this paper is to promote ideas for involving a wider use of intelligent e-learning systems in educational processes and highlight their benefits. We analyze the use of current most popular Learning Management Systems, in particular amplified due to the impact of Covid-19 global pandemic. We discuss on their advantages and disadvantages, accompanied by conclusions upon the topic. The main objective is to provide recommendations for overcoming the detected weaknesses in order to benefit the learning processes. We suggest a use of intelligent e-learning systems that include item response theory within. That would personalize the learning process deeper and adjust the content material to the students' personal abilities and their current level of knowledge. Such systems – when carefully created and designed, provide specific personalized student feedback and support the functional knowledge that students gain throughout the learning process. Additional outcome is the adaptation of the corresponding ideas for students with special needs, which would improve their integration into educational processes. The last conclusion is that intelligent e-learning systems can be used for multilevel purposes. The gathered data can be very useful for analyses on various parameters (common students' gaps in acquired knowledge, time management in mastering topics, etc.). All this would lead to curriculum improvements as well as proof oriented based education reforms.

Keywords: E-learning systems, Item response theory, Testing, Educational reforms

E-learning Systems

Nowadays, the usage of e-learning software in educational processes increases exponentially worldwide, due to innovations in teaching caused by the rapid development of web technologies and also the influence that COVID-19 pandemic had made at all the levels of education on the globe. As a consequence, the mode of delivering education have been transformed revolutionary: the traditional concept of formal face-to-face teaching and learning is no more complete nor enough. E-learning systems are educational platforms that enable the use of technology and multimedia to deliver a learning experience electronically – usually through a network. The common technologies that facilitate the provision of courses online are broadly termed “Learning Management Systems” or “LMSs.” Learning management systems are web-based software platforms that provide an interactive online learning environment and automate the administration, organization, delivery, and reporting of educational content and learner outcomes (Tumbull et al, 2019). Originally, they have been developed and designed to facilitate the learning processes in higher education as licensed software like Blackboard and Canvas or an open source solution like Moodle. The open-source systems were initially used by universities and colleges, since they could easily download the source code, adapt it to their own needs, and build their own LMS solution, according to their environment and circumstances. The most popular open-source LMS that is used today globally is Moodle, with almost 100,000 registered sites in 229 countries (Tumbull et al, 2019), not counting the last couple of COVID 19 pandemic years, that had significantly increased the statistics above. Consequently, the usage of LMSs has widely expanded at all the levels of education, primary, high and higher, making them an essential tool for the success of any (online or on site) delivered course. They facilitate greatly learning activities allowing rapid creation and distribution of course content. The features of LMSs are numerous, starting from Course Management that enables timely relevant deliver course material to the students enrolled, including features for content management, delivery control and class scheduling. Furthermore, they include completely designed tools for Assessments, Tracking Progress. Gradebook, Communication Tools, Multimedia, etc.

Due to expansion of new technologies and also the need of evolving more student-focused teaching methods, the LMS of the near future is becoming more than a helpful administrative tool, having much more essential role than a facilitator in the learning process. In that light, our work is focused on we might say, the most critical function of LMSs, that is – assignments and testing, i.e. students’ feedback on the acquired knowledge. A standard LMS supports the collection and storage of various assessment tasks for students, accompanied by teachers’ grades and feedback for each student. Such tasks include assignments, tests, projects, etc., while the LMS provides to students with real-time information on their progress in a course along with relevant feedback usually generated by the teacher.

Upon our personal experience based on the usage of Moodle, and the research we have made on the assignment tasks in the testing part, we conclude that a common LMS supports various kinds of tests (mostly organized as quizzes), where the teacher can include different types of questions (multiple choice, true/false, fill in the blank, essay questions, etc.) The teacher chooses the topics included in each test, and also creates the grading and the scoring part, that can be made automatically (by linear scoring), and/or by the teacher, via the system. No matter the question or category level, each test can be set up to provide real-time feedback for the student upon his answer. The feedback output is usually given in the form correct/incorrect answer, providing to students the correct final answer, or as a personalized feedback that the teacher shall made by his own and assign it on the system. In our opinion, this kind of classical testing does not include a deeper personal feedback upon students’ ability in general. and moreover, does not indicate it interactively, in a continuous manner. Without minimizing the great impact of classical testing theory included in the LMSs assignment features, we might say that, even a high rated LMS is not designed to be automatically personalized according to students' current level of knowledge and needs, nor to profoundly detect their common gaps.

In order to reach more specific goals on students' personal feedback and get more accurate information on students' level of understanding as well as on the time needed for mastering various topics within the curricula, we might consider the option to include a use of so called intelligent e-learning systems in the learning process. An amount of resent research in e-learning is related to the use of intelligent e-learning systems, which have the ability to automatically adjust to students' capabilities (Jando et al., 2017). For example, intelligent tutoring systems (ITS) are specialized e-learning systems that incorporate forms of adaptive learning, customized content, and/or personalized feedback, using factors such as: student's style, current level of knowledge and skills, emotional stage, etc. Such systems can generate personalized learning suggestions, tasks or help/feedback dynamically, based on the needs of each student, even without an intervention from a teacher. Most e-learning systems offer tutorials, videos, quizzes or tasks with automated grading, and contain useful information about the student's activity. This data can be collected, processed, analyzed, and visualized in order to help students, teachers or administrators to handle the learning process more effectively, or to trigger warnings in case of lack of activity or progress. In continuation, we mention some programs of this type, developed in Macedonia.

MENDO (Kostadinov et al., 2010). is an e-learning system (a kind of an ITS) which is used for teaching programming and organizing competitions in informatics. In Macedonia, the system has been used during the organization of all national competitions in informatics since 2010, as well as several (Junior) Balkan Olympiads in Informatics. As of 2022, the system has more than 16000 registered users who have submitted more than 530000 solutions (both during competitions, and in the learning processes) on 1000+ tasks. More than 40 specialized learning materials are available on the system, containing text, images, animations and interactive tools. In addition, the system contains several other modules, including a forum, wiki, user management section, and more. One of the main features of the system is its ability to automatically grade solutions and to offer appropriate feedback. In most cases, the system is able to catch common mistakes and to present them to the user. The system allows several modes of grading the output, including testing for exact matches, equality (2 = 2.000), special/custom graders, interactivity, etc., and also executing custom tests where the users can provide their own input. The system is developed with Java, and currently runs on a Linux machine (note: previously, the system was running on Windows) – therefore, in practice, it supports both.

Beaver/Bebras (Kostadinov et al., 2015) is a popular international challenge which aims to promote Computer Science and computational thinking among school pupils from both primary and secondary schools. In Macedonia, a custom system is developed specifically for the Beaver challenge and it used to organize and participate in the event. During the Beaver week, students connect to the system by simply typing an url pointing to the website where the system is running, and by entering their name and a school code (obtained previously via their teachers). The system handles everything else, including presenting their tasks, grading, sending certificate to both schools, teachers and students, and more. The Macedonian system for organizing the Beaver event supports two languages (Macedonian and Albanian), as well as several different types of tasks. For several years, Macedonia was one of the top countries by number of participants (relative to the size of the population).

The *Hero app* (Kostadinov et al., 2018) is a software application that monitors, stores and visualizes data from other e-learning systems, and which is currently used by several organizers and contestants in Macedonia to prepare for competitions, as well as to monitor homework progress by several teachers that use the MENDO system with their students.

The aim of this paper is to promote the idea of considering an opportunity for creating intelligent e-learning system based on Item Response Theory (IRS) that would be gradually involved in educational processes. We discuss its advantages not only for the testing part and the specified personal feedback included, but also for more interactive and individual class delivery, which combined with the teachers' presence, would imply higher level of students' engagement, attention and retention. Consequently, we can expect better performance in studying and understanding the material as well as applying the obtained knowledge. Moreover, the use of such kind of system would provide a profound inside in the possible gaps in students' knowledge, as well as an input for the estimated time needed for students to understand various topics and accordingly apply them, and thus gaining functional knowledge within the curricula provided.

Intelligent E-learning Systems Based on Item Response Theory

Distinguishing between students on their abilities has always been a hard task. The most common method that we are all familiar with is the classical testing method. Unfortunately classical testing methods and measurement procedures have a number of shortcomings. For example, student characteristics and test characteristics cannot be separated. They can only be interpreted in the contexts within. In the classical test theory, ability is expressed by the true score, defining student's ability only in terms of a particular test. When the test is hard, the student will appear to have low ability; when the test is easy, the student will appear to have higher ability. The difficulty of a test item is defined as the proportion of students in a group who answer the item correctly. In other words, we might say that whether an item is hard or easy depends on the ability of the students being measured, and the ability of the students depends on whether the test items are hard or easy. Furthermore, it is difficult to compare students who take different tests, but this is actually true even if the students take the same tests. When the students are of different ability, their test scores contain different amounts of error. As example, consider a student who obtains a score of zero. This will tell us that the students ability is low, but we have no information about exactly how low. Hence, this student can not be compared with another student who obtains a zero score on the same test. Moreover, consider two students who perform at the 50% level on two tests that differ substantially in difficulty. These students cannot be considered equivalent in ability.

In order to overcome the shortcomings above, an alternative more accurate test theory that would be more accurate, shall include:

- item characteristics that are not group-dependent,
- scores describing student proficiency that are not test-dependent.
- a model that is expressed at the item level rather than at the test level,
- a model that does not require strictly parallel tests for assessing reliability,
- a model that provides a measure of precision for each ability score.

A good solution might be a testing model based item response theory (IRT). This theory incorporates two basic principles:

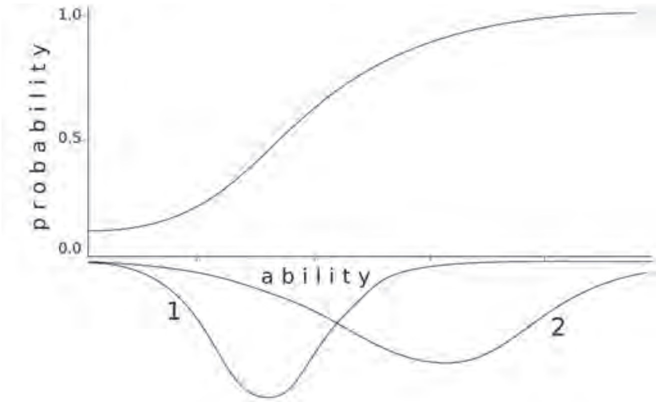
1. The performance of a student on a test item can be explained by a set of factors called abilities.

2. The relationship between students' item performance and the set of abilities underlying item performance can be described by a monotonically increasing function called an item characteristic function or item characteristic curve (ICC). This function specifies that as the level of the trait increases, the probability of a correct response to an item increases.

Figure 1 shows an ICC for the case when only one trait underlines performance on the item, together with distributions of ability for two groups of students. Observe that students with higher values on the trait have higher probabilities of answering the item correctly than do students with lower values on the trait, regardless of group membership.

The IRT model provides several desirable features: Student ability estimates are not test dependent, and item indices are not group-dependent. Ability estimates obtained from different sets of items will be the same, and item parameter estimates obtained in different groups of students

Figure 1



will be the same. In item response theory, item and ability parameters are said to be invariant. The property of invariance of item and ability parameters is obtained by incorporating information about the items into the ability-estimation process and by incorporating information about the students' abilities into the item-parameter-estimation process. The invariance of item parameters is illustrated in Figure 1, which shows distributions of ability for two groups of students (group 1 and group 2). Note that students of the same ability have the same probability of giving a correct response to the item, regardless of the group belonging. Since the probability of success for a student with given ability is determined by the item's parameters, the item parameters must also be the same for both groups. In addition, IRT model provides standard errors for individual ability estimates, rather than a single estimate of error for all students, as is the case in classical test theory.

An item characteristic function or item characteristic curve (lCC) is a mathematical expression that relates the probability of giving a correct response on an item to the ability measured by the test and the characteristics of the item. Technically, it is possible to construct an infinite number or IRT models, but only few models are useful. The three most popular uni-dimensional IRT models are the one, two, and three parameter logistic models. The one-parameter logistic model is one of the most widely used IRT models. Item characteristic curves for the one-parameter logistic model are given by the following equation

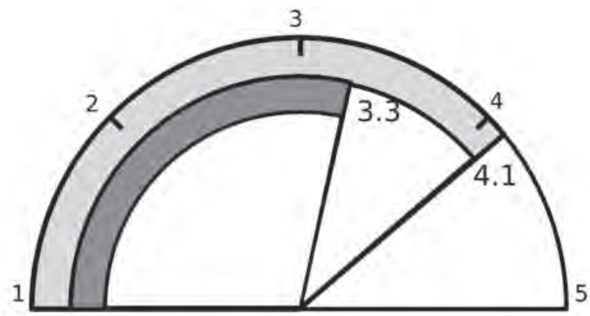
$$P_i(\sigma) = \frac{1}{1 + e^{-(\sigma - b_i)}}$$

where: $P_i(\sigma)$ is the probability that a randomly chosen student with ability σ, answers the item *i* correctly; and b_i is the item *i* difficulty parameter. The b_i parameter for an item is the point on the ability scale where the probability of a correct response is 0.5. This parameter is a location parameter, indicating the position of the ICC in relation to the ability scale. The greater the value of the parameter, the greater the ability that is required for a student to have a 50% chance of getting the item right; hence, the harder the item. Difficult items are located to the right or the higher end of the ability scale; easy items are located to the left or the lower end of the ability scale. When the ability values of a group are transformed to 0 and their standard deviation is 1, the values of b_i vary (typically) from about -2.0 to +2.0. Values of b_i near -2.0 correspond to items that are very easy, and values of b_i near 2.0 correspond to items that are very difficult. For deeper reading on IRT models, see (Hambleton et al., 1991).

It is important to note that the property of invariance of item and ability parameters is the cornerstone of IRT and its major distinction from classical test theory: The parameters that characterize an item do not depend on the ability distribution of the students and the parameter that characterizes a student does not depend on the set of test items. We believe that such kind of more accurate and proper method of testing is needed in order to modify deeply the learning process and to improve students' engagement and performances. The use of an intelligent e-learning system based on IRT would be a good option.

We have postulated that an interactive learning platform which requires more activity and detention can improve students' ability. A week-long experiment was carried on a group of 236 students (Kostadinov and Stojmenovska, 2022). The experimental group consisted of 129 students – that were using a newly created e-learning system based on IRT. For more details see (Kostadinov and Stojmenovska, 2022). The control group consisted of 107 students – that were using standard web platform and classical testing methods. Both groups of students were offered a web application with tests and study materials (we have chosen them to be related to mathematics). The outcome is that students that have used the new system spent 31% more time studying. At the end of the survey, a real, regular math test was made to both groups. The experimental group showed better results than the control group, having around of 15% better score. A survey was made in order to find out whether the students would like to use the system with other subjects. The students were asked to give a mark from 1 to 5 indicating strong disagreement to strong agreement. The experimental interactive learning group scored 4.1 compared to the control group that scored 3.3 (Figure 2). The conclusion is that students are more willing to use the new interactive learning platform; They were paying much more attention to the new program and found the whole platform engaging and interesting.

Figure 2



Our next research step is to continue testing the system, upgrade it, amplify its usage, and consequently get accurate feedback. All this would be done in a continuous manner, slowly increasing the complexity and incorporating it gradually.

The main idea is to design a system that would allow students to improve their abilities as much as possible, and learn continuously through each testing process. Since a system based on IRT is a testing platform that can measure this improvements reliably, it can be integrated into a program, and thus we can accurately track the improvements of the students' ability at each step. In order to make the system up to date and inspiring for students, we are now considering an option to present some kind of regard at each step of students' way along the testing. One of the approaches would be to simulate a kind of a gaming process while testing. That would require from students to pass through various levels and then go further. All this might be accompanied with a reward obtained – once a student passes the corresponding level. Rewards can be of different kinds: Starting from students' favorite virtual character jumping out in a pop-up window and congratulating the completed level (for younger pupils), via some badge scoring or other multimedia rewards (for older pupils). Basically, we believe that any carefully designed reward system common for gaming, but paying a huge attention to be suitable for the learning process, could be simulated and/or implemented accordingly. This approach would create an additional interest and motivation for students involved in all the stages of educational processes, since it stays in accordance with their current interests in the modern digital society they live in.

Results and Discussion

Creating an intelligent e-learning system based on Item Response Theory (IRT) would personalize the learning process deeper and adjust the content material to students' personal abilities and current level of knowledge. These systems include assignments where each student gets questions (items) upon his current knowledge, accompanied by additional interactive instructions after answering. In particular, the use of such systems would lead to the following advantages in the learning process:

- Increased interactivity – instructions can be combined with interactive assessments in order to guide the student towards correct answers and thus continuously evaluate and improve his knowledge;
- Decreased chances for cheating the system and copying – the system might give a different question to each student depending on the previous answer, no matter the eventual matching in the answers;
- There are offered more personalization features for students – each completed level within a topic can benefit the student by earning virtual regard, a badge, or other multimedia reward close to his interests;
- Increased motivation and retention of students – they acquire more knowledge by their own rhythm (but still within a predicted deadline by the teacher);
- Assignment/test scoring does not have to be linear – it can be designed to depend on the particular answer the student has offered;
- The collected data from systems based on IRT provides a deep and accurate picture on the gap of knowledge at various levels within the curricula, and clearly leads to its improvement on different parameters (detects the real-time students' struggle and detention, points out an estimated time management for some topics, and much more).

Based on the experiment presented (Kostadinov and Stojmenovska, 2022), we already got an indication that students have showed improved attention and results of using interactive programs based on IRT. We propose to build on and amplify the idea further on, allowing students to develop their abilities to the upper limits, while learning continuously though each testing process. The IRT testing program can be integrated into platforms, and moreover, these modules can be integrated into a LMS, making its assignment feature much more advanced, interactive, reliable and accurate. A main disadvantage of the systems based on IRT is that the tests creation requires larger database of test items. (Thus could be solved with a team work on the system, for example). Also, as a disadvantage might be considered the fact that the system requires activity from a larger number of students in order to get more valid and accurate results. However, we believe that the common acceptance of these systems in learning processes combined with their wide usage in the future will make it overcome.

Conclusion

Being education one of the main pillars in each society, it needs to be carefully designed and delivered, as well as accepted by pupils and students in the best possible manner. Besides excellent teachers and professors that is an imperative, the individual approach in the course delivery as well as getting the content closer to learners by using modern technologies and up to date media, can significantly facilitate learning processes at all the educational levels, and accordingly provide better learning outcomes. Intelligent e-learning systems can by no means replace the standard face-to-face teaching models, but they can successfully support them at various levels.

Classical teaching methods combined with a usage of an item response theory testing method included within an intelligent e-leaning system would made significant impact on improving the educational processes. When carefully created and designed, the usage of such systems would increase students' motivation, provide specific personalized feedback and support the functional knowledge that all the students are gaining throughout the learning process. These systems might be even incorporated in platforms as LMS, or can be used in a separate mode. E-learning systems based on IRT are focused on the testing process at first look, however, they play a significant role in the course delivery as well – in a deductive individual manner, adjusting to the needs of each student. They can be designed by using various technologies, in a way to be utilized and modified depending within different contents, and thus the positive impact of their usage could have multilevel dimensions: Additional outcome is their possible adaptation for use by students with special needs, which would be a significant booster for their successful integration into educational processes. Furthermore, the gathered data can be very useful for deep analyses on various parameters (common students' gaps in acquired knowledge, time management in mastering topics, etc.). Such reliable outcomes would clearly lead to curriculum improvements and moreover, to proof based oriented education reforms.

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INCLUSIVE CULTURE AS A PEDAGOGICAL DIMENSION OF SUCCESSFUL EDUCATIONAL INCLUSION

Abstract: Educational inclusion, understood as a philosophy, aims to promote access to education for all children, as well as strategies that should contribute to the promotion of an inclusive society. The paper, starting from emphasizing the importance of inclusive pedagogy" and the welfare of the child, points out the importance of inclusive culture as a key dimension in achieving