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# Premises of Improving the Quality of the Didactic Process in Pre-university Education in the Context of Education 4.0

Diana-Elena CHIVU[1]

## Abstract

*Pre-university education is in a dynamic process of continuous transformation, and the impact of the restrictions imposed by the COVID-19 pandemic have generated major transformations. If until then only some teachers were motivated to go through training programs for the development of digital skills, to use applications, platforms, and digital resources in teaching, and students occasionally learned using digital resources, during the pandemic they had to adapt to the new context, to quickly adopt and immediately apply in the classroom, with students, digital solutions for both teaching and assessment. After the removal of the restrictions imposed during the pandemic, both teachers and students benefited from the experience gained during the restrictions and continued to use open educational resources, learning platforms, forms for evaluation and feedback, groups for quick communication. A large volume of open educational resources has been created, with various facilities, useful for supporting the teaching process and facilitating learning, which are expected to lead to improved school performance.*

*This study presents the results of a research carried out by applying an online questionnaire, distributed by email, to a number of 91 teachers from pre-university education in Romania. Its purpose was to identify the most important aspects that positively influence the school performance of students. The determining factors influencing student results were identified as follows: teaching adapted to students' learning pace supported by applications; the involvement of parents, leading teachers to reduce absenteeism; student participation in remedial activities.*

**Keywords:** adaptive learning, improving student performance, continuous training, online learning.

**JEL Classification:** C88, I21.

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[1] Bucharest University of Economic Studies, Bucharest, Romania, chivudiana22@stud.ase.ro.

## 1. Introduction

Improving student performance and preparing them for the digital society can be achieved through the use of digital technology and new learning methods such as adapted learning. Education 4.0 can be addressed by: integrating technology into the learning process, adapted learning, project-based and collaborative learning, competency-based assessment, developing digital skills.

The integration of digital solutions in the learning process is materialised through the use of mobile devices, tablets, computers, and specialised software dedicated to online learning, to facilitate and improve the educational process.

Adapted learning involves the use of technology, which allows teachers to create personalised learning programs adapted to the needs and learning pace of each individual student. Depending on the students' progress, their learning path is personalised so that each student can learn at a different pace.

"Teachers are no longer transmitters of knowledge, but activators of cognitive activities, managers of teaching activities, and supporters of learning activities" (Xin, et al., 2022). In the Romanian pre-university education system, school performance is based on uniformity and standardisation. All teachers must plan their teaching based on a nationally established curriculum, carry out standardised teaching and assessment, and act to remedy problems identified through assessment. When teachers act to improve school results, they put students at the center of attention, motivate them to learn, effectively lead teaching, use educational technologies and resources for adapted learning and performance, use assessments, and feedback to continuously improve teaching.

"The school must quickly find possibilities to achieve a balance of great accuracy between its traditional role and the new roles that the digitisation of the world in which we live tend to attribute to it" (Pânișoară, 2022).

Learning improvement can be facilitated through continuous monitoring and adaptive learning solutions. Monitoring can be done using data collection systems regarding the evolution of test scores, and adapted learning through the use of solutions based on artificial intelligence and specific algorithms allow predicting the course of the subjects or contents to be studied.

The system of collecting test results can be used with objective results when the assessment is standardised and unitary at the level of a school unit or a group of school units. Both teaching and assessment must be student-centered to increase the quality and outcome of learning, implicitly to increase student achievement.

Standardised assessment must also be carried out on teachers, using a series of items based on which a score is established annually followed by improvement measures to increase the score at the next assessment.

In terms of monitoring student performance, collecting and analysing performance data can help identify learning gaps and identify students who need extra help. This allows for the development of personalised learning strategies and programs tailored to the needs of each student.

Another important dimension is the evaluation of teachers' performances. Following the evaluation, it is possible to identify those teaching staff who need

improvement, in terms of teaching, learning, assessment and the use of technology in the teaching activity. The improvement can be carried out through continuous training programs, which allow the identification of solutions adapted to the needs of teachers, directions that can be obtained after the data analysis stage.

The development of personalised teaching programs can be achieved by processing data related to the progress and performance of students, thus helping to develop personalised teaching programs adapted to the needs of each student. This can improve student performance and increase their satisfaction with the learning process.

The digitisation of continuing education, achieved through technologically enhanced educational environments, leads to the transformation of the optics of teachers, who, when they use online resources, will more easily find the way to motivate students to learn.

## 2. Challenges of Pre-university Education in Romania and Education 4.0

Pre-university education is impressive by the order of magnitude and by the implications that decisions made at the national level bring. In all school units in Romania, the same curriculum is used, and the teaching, learning, and evaluation process follows the same rules and is measured with the same instruments. We have national evaluation systems for the 2nd, 4th, and 6th grades, evaluation at the end of the 8th grade that ranks the students, and after finishing high school the Baccalaureate exam. Students pass nationally unique subject assessments, the results of which can be compared and ranked. Any action aimed at improving the process and implicitly the results of students, applied at the national level, has profound implications for all generations of students.

Technologies evolve rapidly and people must constantly adapt to these changes. The educational system is conservative and difficult to change. However, both the improvement of learning and the evaluation of teaching activity should be addressed.

*Big data* and Education 4.0 are two concepts that complement and influence each other. Big data facilitates access to relevant data in adapting and personalising the educational process by collecting, storing, and analysing large volumes of data, while Education 4.0 integrates technologies to improve the learning process.

Education 4.0 promotes project-based and collaborative learning, giving students the opportunity to work together to solve problems and apply the knowledge gained in a practical way.

Competency-based assessment focuses more on what students can do than what they know. This can include project-based assessment, portfolio-based assessment, and self-reflection-based assessment.

Developing students' digital skills, including skills such as programming, graphic design, data management, and algorithms, are essential elements of Education 4.0.

For the implementation of Education 4.0 in Romania, it is essential that teachers and students have access to modern technology and adequate resources. In addition, it is important that teachers are trained and motivated to use new technologies and be able to create personalised and effective learning programs.

However, the implementation of solutions based on *Big data* in the educational system is a complex process, which is based on the development of a plan built around precise objectives, goals, and expected benefits in the various stages of the educational process. Data sources and tools for data collection and analysis are supporting elements designed to provide valuable information that can help improve the outcomes of pupils, students, teachers, and the education system in general. The data used in this process are students' grades, their results in school and extracurricular competitions, attendance, data retrieved and dynamically updated. Other useful and relevant information is specific to teachers in pre-university education, such as: teaching degree, number of transferable professional credits accumulated in the last closed five-year period, starting from finalisation, interest in professional development manifested through research, publication, participation with students in school competitions.

Yong Cui et al. (2021) argue that by using data on students' academic performance, teachers can better analyse and monitor progress and guide students to success.

**Figure 1. The resulting diagram after processing the data collected from teachers about Teachers' views on how monitoring and evaluating student progress is important in raising student achievement**



*Source*: https://forms.gle/vz78nT5cXR1oJrqL9.
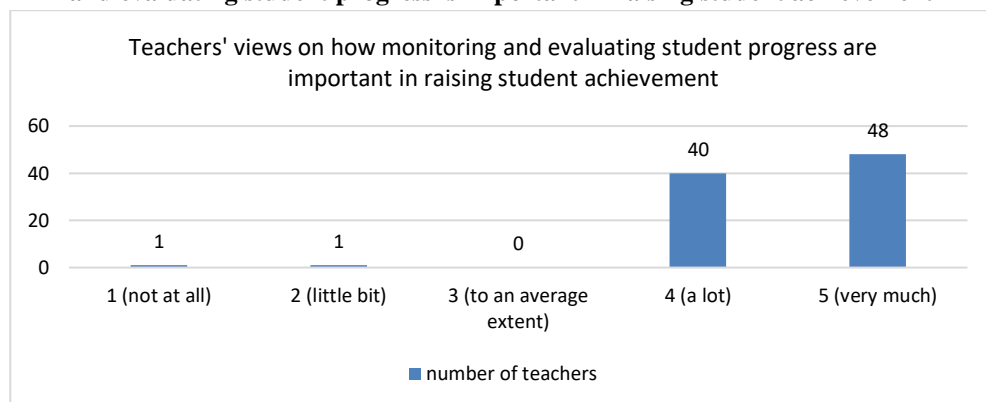
In order to identify ways to improve the results of students in pre-university education, we created a questionnaire that was presented to teachers from Dâmbovița and Teleorman counties. The questionnaire was completed between 19-25 April 2023 by 91 teachers who teach students from ISCED 0 to ISCED 5. In the first part of the questionnaire, questions were formulated regarding the highest level of teachers' studies, the level at which teachers teach, gender, teaching degree. In the second part, questions were asked about the continuous training of teachers. The first question aimed to identify the number of transferable professional credits accumulated by the teachers, in order to detect the interest in their own professional development. Among teachers, 82.4 % have accumulated at least 90 CPT. The next two questions addressed teachers' beliefs about the importance of accredited in-

service training programs and approved in-service training programs in developing skills useful for improving student achievement. Responses were on a scale of 1 to 5, where 5 is assigned the highest appreciation. 39.6 % answered with maximum appreciation (5) for accredited programs and 38.5 % for approved programs, and with appreciation 4 42.9 % answered for accredited programs and 41.8 % for approved programs. The conclusion is that teachers attach great importance to continuous training for the development of useful skills in order to improve student performance and value accredited programs more, after which they receive CPT. In the third part of the questionnaire, there were several questions that aim to identify the aspects that teachers consider important for improving school results, such as: 68.1 % consider the number of absences to influence school results. To improve student performance, teachers value the following aspects differently: 95.6 % adapting learning, 68.1 % setting realistic lesson objectives, 69.2 % classroom management, 50.5 % use of technologies and educational resources in digital format, 52.7 % monitoring and evaluating progress (Figure 1), 73.6 % establishing evaluation criteria, informing students, evaluating, and providing relevant feedback on the results obtained. Zhihui Cai et al. support the positive effect of feedback to improve performance (Cai et.al, 2023). In Figure 2 is an analysis of the responses regarding absenteeism, according to the level at which the teachers teach. Simona Sava in „The school of the future or the future of the school emphasises the post-pandemic effects that lead to absenteeism" (Sava, 2022).

Through questioning and analysis, we can identify and take measures where the effects of the pandemic are felt by increasing inequalities between people, as Adriana Reveiu and Daniela Luminita Constantin (2023) „The impact of the COVID-19 pandemic on regional inequalities in Romania" say (Reveiu, Constantin, 2023).

The teachers subject to the study teach high school students (64 %) and secondary school students (25 %).

**Figure 2. The resulting diagram after processing the data collected from teachers about The importance of student absences for school results**



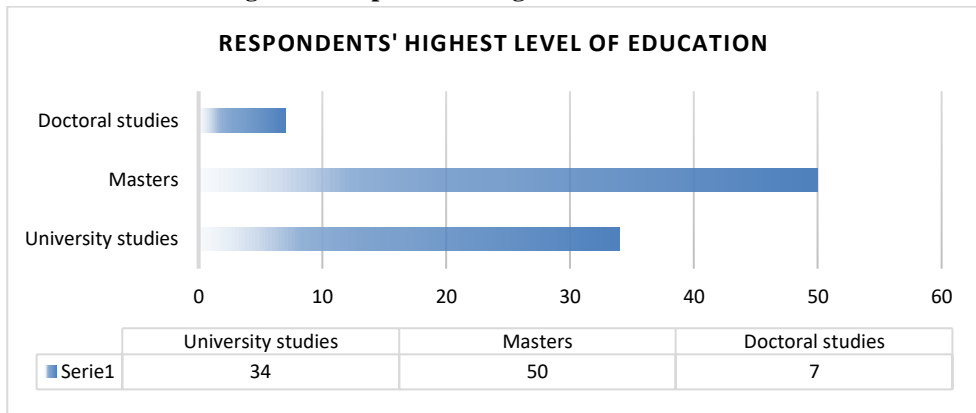*Source:* https://forms.gle/vz78nT5cXR1oJrqL9.
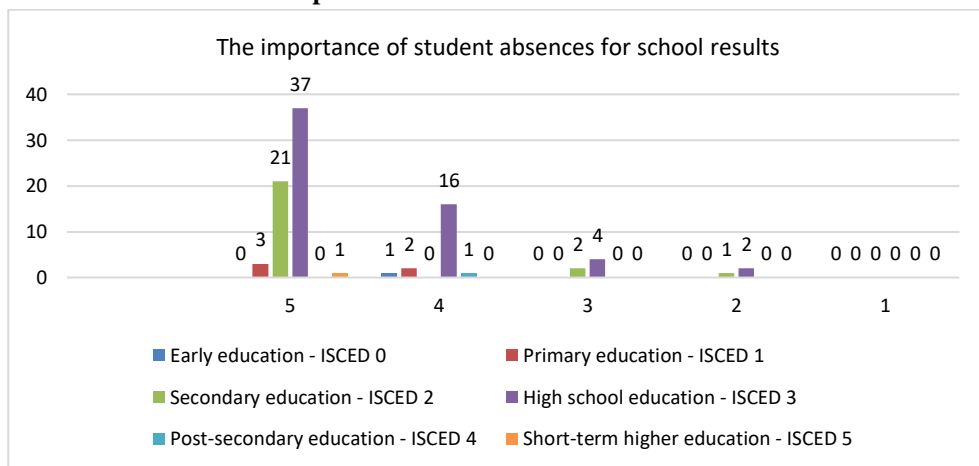
Data collected from students can be used to predict educational performance, but also to provide career choice recommendations, as Xiaomei Bai et al. says in "Educational Big Data: Predictions, Applications and Challenges" (Bai et al., 2021).

Belinda Chiera et al. in "How Much Do We Know About Patterns of Student Engagement?" (Chiera et al., 2021) analyse data collected about learner progress to improve learning and teaching. The move of education to the online environment has created the possibility of analysing the behaviour of learners through the number of clicks made weekly on different courses.

Following the study conducted on teaching staff who have university degrees (37. 36 %), master's degrees (54.94 %), doctoral degrees (7.69 %) (Figure 3) it was found that in order to improve the results students need greater involvement in accredited continuing education programs that help them learn and use modern teaching methods, effectively use digital educational technologies and resources. A great deal of importance (96.70 %) is attributed to monitoring and evaluating student progress. With the help of electronic catalogues, data can be collected to help monitor the number of student absences. The involvement of teaching staff is important for creating a teacher-student relationship that helps improve school results (Almăşan et al., 2022).

90.1 % of teachers believe that absenteeism negatively influences student performance, and improved student attendance at school brings improved school results.

**Figure 3. Respondents' highest level of education**



| | University studies | Masters | Doctoral studies |
|---|---|---|---|
| ■ Serie1 | 34 | 50 | 7 |

*Source:* https://forms.gle/vz78nT5cXR1oJrqL9.

After analysing the answers, the teachers believe that the teaching-learning process must be adapted to the level of the students in order to improve their performance (97.8 %). Considering the fact that a large number of students in the class does not allow the teacher to adapt the teaching for each of them, the use of applications for adapted learning by students allows all students to learn at their own pace. Adaptive learning systems have demonstrated a positive impact on learning, says Shuai Wang et al. (2020).

The electronic educational materials that can be found both online and offline are a real help in the didactic process for the preparation of homework, for providing students with useful materials that will help them achieve the proposed objectives. Danial Hooshyar et al. find from the research that adaptive applications improve the attitude toward learning of students (Hooshyar et al., 2021).

Adapted learning is carried out for each subject of study, for each level of education with the aim of improving student results. Depending on the pace of learning, each student can go through theoretical notions and make practical applications using technology and special applications for learning.

The use of electronic educational materials leads to the efficiency of the educational process by changing the way of learning, by accelerating the pace of innovation and research work, by facilitating the exchange of opinions and knowledge, and the real-time evaluation of the information acquired by students.

## 3. Research Questions / Aims of the Research

The purpose of this questionnaire is to identify ways to improve student performance in schools in Romania. The teaching staff who answered the questionnaire were informed about ensuring confidentiality and keeping personal data.

## 4. Research Methods

In order to identify the opinion of teachers in Romania regarding the improvement of student performance and the difficulties they face regarding student absenteeism, adapted learning, continuous training of teaching staff, we conducted a survey -type research, which aimed to apply a questionnaire containing 17 questions to which answered 91 teaching staff from general schools and high schools, from pre-university education in Romania, in April 2023. We considered the application of the questionnaire for teaching staff who obtained the definitive teaching degree (3.2 %), teaching degree II (5, 49 %), didactic degree I (90.1 %). The level at which the teachers teach is: Early childhood education - ISCED 0 (1 %), Primary education - ISCED 1 (5.49 %), Secondary education - ISCED 2 (25.27 %), High school education - ISCED 3 (64, 83 %), Post - secondary education -ISCED 4 (1 %), Short-term higher education - ISCED 5 (1 %).

Teaching adapted to the specifics of the student, supported by applications, is a formula that transforms educational resources into pieces, which, distributed specifically to the student's learning pace, lead to an increase in their performance. Prodromou et al. supports adapted learning to improve outcomes (Prodromou, 2021). Among the teachers who participated in the study, 80.21 % believe that continuous training helps them develop skills useful for improving student performance. As Reveiu, A. and Arghir, D.C. say in Mining social media to identify the immediate impact of the COVID-19 pandemic on the Romanian retailers: "early findings, the COVID-19 pandemic has deeply affected people" (Reveiu, Arghir, 2020). The teaching staff who during the pandemic made great efforts for continuous training,

after the pandemic realised that the solution to having better students is for them to be better themselves.

Due to the rapid development of technology, students need competent teachers who know how to use learning applications adapted to their needs. Platforms for adapted teaching, support learning and help the teacher to be able to manage time better and to make teaching more efficient. Shakyani et al. describe the effectiveness of an adapted learning platform (Shakyani, 2023), as well as Kaat Iterbeke et al. (2021). Students can use the adapted platforms both at school and outside of school to be able to go through the curriculum and work tasks at their own pace. People learn using all their senses, and a way to use both hands-on applications and simulators is welcome in the training process. Today's teachers have had no way of benefiting from initial training that uses such tools, therefore offering possibilities to use them in the process of continuous training is more than welcome.

Following the careful analysis of the possible activities that can lead to an increase in student performance, the teaching staff chose: student involvement in projects (49.45 %), student participation in remedial activities (54.94 %), involvement of parents, leading teachers to reduce absenteeism (59.34 %), counseling activities (50.54 %), teaching adapted to the students' learning pace, supported by applications (68.13 %) as shown in Figure 4.

**Figure 4. Teachers' responses regarding: Activities that can lead to increased student performance**



*Source:* https://forms.gle/vz78nT5cXR1oJrqL9.
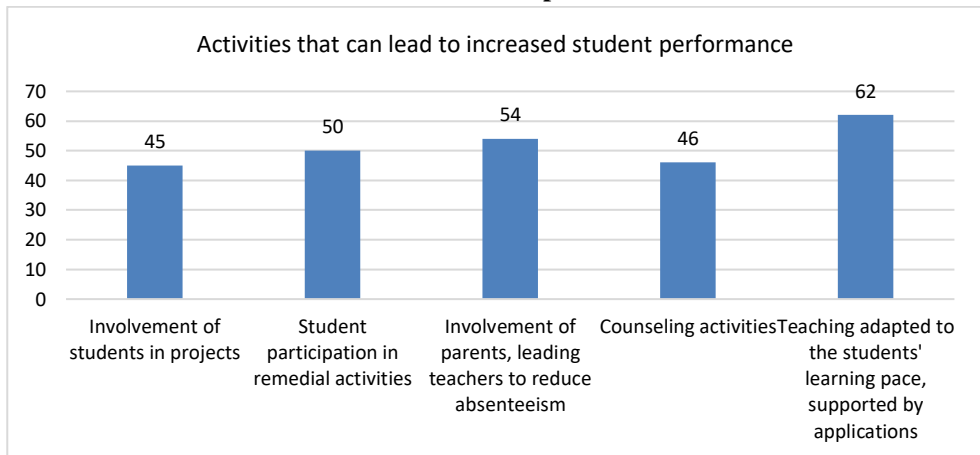
## 5. Conclusions

The transition from traditional education to modern education, in which we use applications, simulators, modern teaching methods, including teaching systems adapted to the students' learning pace, leads to the production of large amounts of data. The key to improving student performance is in processing this big data. Through the electronic catalogue, data such as absences are collected, which are

transmitted daily to parents with the aim of timely intervention and reducing the number of absences in the future. The school situation of the students is recorded in the electronic catalogues and can be transmitted daily to the parents. With the help of the data collected by the electronic catalogue, students' progress sheets can be made, on the basis of which the leading teachers together with the parents can make decisions regarding remedial plans aimed at improving school results. Creating tailored apps with content from the curriculum helps students learn at their own pace, resume whenever they need to, or go through the concepts provided and specified tasks more quickly.

Therefore, the use of solutions based on Big Data technologies in the educational system in Romania can bring many benefits, such as improving the performance of students and the efficiency of the educational system in general. To use Big Data effectively, it is important to collect relevant data and use the right tools to analyse the data and draw effective conclusions.

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