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The impact of differentiated instruction on the academic performance of students with special educational needs

O impacto do ensino diferenciado no desempenho académico dos alunos com necessidades educativas especiais

El impacto de la enseñanza diferenciada en el rendimiento académico de los alumnos con necesidades educativas especiales

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The practical significance of the obtained results is the possibility of improving educational strategies and the quality of the educational process.
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The results of the conducted research confirm the significant impact of differentiated education on students' academic performance, motivation and independence. The implementation of these methods in educational practice has the potential to further improve educational strategies and increase the efficiency of the educational process.

ABSTRACT

Background: The issue of adapting learning to the students' individual needs is becoming increasingly relevant in modern educational practice. The aim of the study is to determine the effectiveness of different methods of differentiated instruction and their impact on academic performance, motivation, and independence of primary school students. **Methods:** The study employed Wechsler Individual Achievement Test-4, Academic Motivation Scale, observation and the methods of statistical analysis (Levene's test, Mann-Whitney U-test). **Results:** The results showed that the average student motivation scores on the Academic Motivation Scale increased from 3.2 to 4.1 after the implementation of differentiated instruction, while student autonomy assessed on the Student Satisfaction Inventory, increased from 3.0 to 4.0. **Conclusion**: The implementation of differentiated instruction also proved to be effective in improving academic performance, where the students' average score increased from 65 to 80. The practical significance of the obtained results is the possibility of improving educational strategies and the quality of the educational process. Further research may focus on examining the long-term effects of these methods and the integration of new technologies to improve learning effectiveness.

Keywords: differentiated learning; academic performance; student motivation; independence; inclusive education; special educational needs; educational strategies.

RESUMO

Antecedentes: A questão da adaptação da aprendizagem às necessidades individuais dos alunos está a tornar-se cada vez mais relevante na prática educativa moderna. O objetivo do estudo é determinar a eficácia de diferentes métodos de ensino diferenciado e o seu impacto no desempenho académico, na motivação e na independência dos alunos do ensino básico. **Métodos:** O estudo utilizou o Wechsler Individual Achievement Test-4, a Escala de Motivação Académica, a observação e os métodos de análise estatística (teste de Levene, teste U de Mann-Whitney). **Resultados:** Os resultados mostraram que a média das pontuações de motivação dos alunos na Escala de Motivação Académica aumentou de 3,2 para 4,1 após a implementação do ensino diferenciado, enquanto a autonomia dos alunos, avaliada pelo Inventário de Satisfação do Aluno, aumentou de 3,0 para 4,0. **Conclusão:** A implementação do ensino diferenciado também se revelou eficaz na melhoria do desempenho académico, tendo a nota média dos alunos aumentado de 65 para 80. O significado prático dos resultados obtidos é a possibilidade de melhorar as estratégias educativas e a qualidade do processo educativo. A investigação futura pode centrar-se na análise dos efeitos a longo prazo destes métodos e na integração de novas tecnologias para melhorar a eficácia da aprendizagem.

Palavras-chave: aprendizagem diferenciada; desempenho académico; motivação do aluno; independência; educação inclusiva; necessidades educativas especiais; estratégias educativas.

RESUMEN

Antecedentes: La cuestión de la adaptación del aprendizaje a las necesidades individuales de los alumnos es cada vez más relevante en la práctica educativa moderna. El objetivo del estudio es determinar la eficacia de diferentes métodos de instrucción diferenciada y su impacto en el rendimiento académico, la motivación y la independencia de los alumnos de primaria. **Métodos:** El estudio empleó el Test de Rendimiento Individual de Wechsler-4, la Escala de Motivación Académica, la observación y los métodos de análisis estadístico (test de Levene, test U de Mann-Whitney). **Resultados:** Los resultados mostraron que las puntuaciones medias de motivación de los alumnos en la Escala de Motivación Académica aumentaron de 3,2 a 4,1 tras la aplicación de la instrucción diferenciada, mientras que la autonomía de los alumnos evaluada en el Inventario de Satisfacción de los Alumnos, aumentó de 3,0 a 4,0. **Conclusiones:** La implementación de la instrucción diferenciada también demostró ser eficaz en la mejora del rendimiento académico, donde la puntuación media de los estudiantes aumentó de 65 a 80. La importancia práctica de los resultados obtenidos es la posibilidad de mejorar las estrategias educativas y la calidad del proceso educativo. Futuras investigaciones podrían centrarse en examinar los efectos a largo plazo de estos métodos y la integración de las nuevas tecnologías para mejorar la eficacia del aprendizaje.

Palabras clave: aprendizaje diferenciado; rendimiento académico; motivación del alumno; independencia; educación inclusiva; necesidades educativas especiales; estrategias educativas.

INTRODUCTION

Differentiated instruction has become an important tool in modern education, as its goal is to adapt the educational process to the students' individual needs. This approach involves adjusting teaching methods, tasks and materials according to the peculiarities of each student, which is especially important for children with special educational needs (SENs) (Lindner & Schwab, 2020). Developing and implementing effective differentiated instruction strategies can significantly improve the learning experience and academic performance of these students.

The relevance of the study of the impact of differentiated instruction on the academic performance of students with SENs is increasing against the background of modern educational challenges. In the context of inclusive education, there is a need to develop effective methods that provide adequate support for students with different levels of knowledge and special needs (Tiernan et al., 2020). Traditional approaches to learning often fail to provide adequate individualization of the process, which can lead to uneven outcomes and lower student performance (Roose et. al., 2024). Therefore, it is important to study how differentiated teaching can improve the academic performance of such students and contribute to their successful integration into the general educational process.

Students with SENs often face difficulties that require a special approach in learning (Mendoza & Heymann, 2024). Traditional teaching methods are not always able to effectively consider these difficulties, which can lead to low academic performance and insufficient motivation to study. That is why it is important to develop and implement methods that could provide individual support and stimulation of each student in the learning process.

Implementing differentiated instruction can significantly improve the outcomes of students with special needs (Pozas & Letzel-Alt, 2023). This approach enables adapting educational content, use a variety of methods and techniques that help students with SENs to achieve success. At the same time, special attention should be paid not only to academic progress, but also to the development of students' motivation and self-confidence.

According to current trends in education, it is important to carefully investigate how differentiated instruction affects the academic performance of students with SENs (Dulfer et al., 2024). Determining the effectiveness of this approach can help educational institutions to develop optimal strategies to support such students, which will contribute to their academic success. Awareness of the importance of adapting education to the needs of each student, especially in view of SENs, emphasizes the need to study the effectiveness of differentiated methods. This will allow not only to improve academic achievements, but also to ensure comprehensive students' development in the context of modern education.

Despite the large number of studies confirming the positive impact of differentiated instruction on the students' general academic performance, research on the specific effects of this approach for students with SENs remains poorly studied. Many studies focused on the general impact of differentiated instruction, without specifically analysing its effectiveness for students who need individualized instruction. This creates a need for a detailed study of exactly how differentiated instruction affects the academic results and motivation of students with special educational needs.

The aim of the study is to determine the impact of differentiated instruction on the academic performance of students with SENs.

Research objectives:

1. Evaluate the students' academic performance before and after the differentiated instruction.

2. Determine the impact of differentiated instruction on student motivation.

3. Compare the effectiveness of different methods of differentiated instruction.

4. Study the change in the level of student independence after the differentiated instruction.

Overview of the literature

The peculiarities of differentiated instruction were studied by domestic and foreign researchers in order to find effective methods of supporting students with SENs. These studies focus on identifying the most effective strategies for adapting the educational process, evaluating the impact of different approaches on the students' academic performance, and developing recommendations for improving the effectiveness of education. Differentiated instruction is a pedagogical approach that focuses on adapting the learning process to meet the students' individual needs (Fousteri & Foti, 2024). This involves the use of different methods, strategies and resources that correspond to the level of knowledge of each student, his or her learning style, and the rate of assimilation of information. One of the main features is the individualization of learning, which enables taking into account different skill levels and needs, ensuring that each student can achieve optimal results (Krishan & Al-Rsa'i, 2023).

Differentiated instruction also includes adapting learning materials (Smale-Jacobse et. al., 2019). This can manifest itself in modifying tasks and resources to make them accessible and understandable for students with different needs. Differentiated learning can be effectively used in inclusive computer science education by adapting the learning process to the students' individual needs (Thapliyal et. al., 2022). In this context, a teacher can modify the complexity of learning materials by creating different versions of computer science tasks for students with different levels of knowledge.

The use of different teaching methods is also an important component of a differentiated approach (Geven & van de Werfhorst, 2020). The teacher can use interactive classes, video lessons, practical exercises and other resources that correspond to different learning styles of students. Graphic organizers or visualizations can be used for students who learn better through visual materials (Weintrop & Wilensky, 2019). It is important to provide variability in the assessment of learning outcomes to support different levels of competence in computer science (Tsai et al., 2019).

A study by D'Intino and Wang (2021) examines the implementation of differentiated instruction in the training of future primary school teachers in Canada. As a result, it was proved that the preparation of future teachers for the application of differentiated teaching methods is insufficiently developed and needs improvement. A study by Strogilos et. al. (2020) examines the types and quality of differentiated instruction modifications for students with disabilities in early childhood in co-educational settings. The research showed that the effectiveness of differentiated instruction depends significantly on the quality of modifications used in the classroom.

The study by Gheyssens et. al. (2022) emphasizes the diversity of teacher philosophies and practices in the context of adapting instruction to students' interests, readiness, and learning profiles. The obtained results gave grounds to conclude that there is great variability in teachers' approaches to the implementation of differentiated instruction. A study by Kupers et. al. (2024) focuses on using the theory of planned behaviour and self-determination theory to explain teachers' intentions to implement differentiated instruction in inclusive education settings. The obtained results indicate that teachers' intentions to use differentiated instruction largely depend on their assessment of their own ability to do so. They also depend on internal motivation, which is related to professional satisfaction and support from colleagues and administration.

An article by Paseka and Schwab (2020) explores parents' attitudes toward inclusive education and their perceptions of inclusive learning methods and resources. As a result, it was found that most parents support inclusive education, but their perception of the effectiveness of inclusive practices and resources varies significantly. Analysis of the results of previous studies concerning the differentiated education of students with SENs revealed several contradictions and unexplored aspects were revealed. Some researchers emphasize the importance of individual approaches and teaching methods, while others focus on teacher motivation and support from the learning environment, which creates contradictions regarding the effectiveness of differentiated instruction. In addition, the impact of differentiated instruction on the students' independence, as well as its impact on the emotional state, remain poorly studied

METHODS

Research design

The study was conducted during the 2023-2024 academic year by the researchers of the state higher education institution Uzhhorod National University (Department of General Pedagogy and Higher School Pedagogy, Faculty of Social Sciences). An experimental design with a comparative assessment before and after the differentiated instruction was used for the study.

The study consisted of four stages. The first stage involved an initial assessment of students' academic performance, motivation, and their level of independence before the differentiated instruction. The second stage provided for the implementation of differentiated instruction methods in classes with students with SENs, which lasted throughout the academic semester. At the third stage, students' academic performance, motivation and independence was re-evaluated after the introduction of new methods. The fourth stage provided for an analysis of the effectiveness of different methods of differentiated instruction. The research was carried out in cooperation with teachers and the administration of educational institutions, which made it possible to provide a comprehensive approach to the implementation and evaluation of differentiated instruction.

Sample

The study involved 120 primary school students studying in primary grades (1-4) in several educational institutions of the city of Uzhhorod (Inclusive Resource Centre No. 1, the Leader Lyceum). The students' age and gender representativeness were ensured: the age range of the students is from 6 to 10 years, with an equal distribution by gender (50% boys and 50% girls). The sampling criteria included students with SENs who have different levels of knowledge and need a differentiated approach to learning. The sample was formed through stratified random selection, which made it possible to ensure the

representation of different groups of students in each age segment and according to different educational needs.

The sample size is explained by the need to obtain statistically significant results and to ensure the accuracy of the assessment of the effect of differentiated instruction on academic performance. The sample included a sufficient number of students for the possibility of detecting real changes and effects, which allows for high reliability of the research results. The age of the sample was chosen because elementary school age is a critical period for the development of academic skills and motivation to study. This makes it possible to investigate the impact of differentiated instruction at the initial stages of education, when the adaptation of teaching methods can have a significant impact on the students' further academic development. The participants were randomly divided into two groups: an experimental group (EG), where differentiated instruction was implemented, and a control group (CG), where traditional learning methods were used. This ensures comparability of results and allows to evaluate the effectiveness of a differentiated approach in a real educational environment.

Research methods

The research employed the following methods:

1. *Observation*: systematic observation of the educational process was carried out to assess the impact of differentiated instruction on the students' behaviour and their activity in the classroom. The *Classroom Observation Protocol (COP)* was used, which allows to assess the quality of educational interaction and students' engagement (Appendix 1).

2. *Academic Motivation Scale (AMS)* (Appendix 2). This tool was used to determine the level of students' intrinsic and extrinsic learning motivation both before and after the implementation of differentiated instruction. The questionnaire consists of questions that assess the level of academic motivation based on three main types: intrinsic motivation, extrinsic motivation, and amotivation. The scale usually includes questions that respondents answer using a scale of 1 to 7, where 1 means "strongly disagree" and 7 means "strongly agree".

3. *Student Satisfaction Inventory (SSI)* developed by Ruffalo Noel-Levitz (2019). This questionnaire helped to assess students' overall satisfaction with the learning process, their perception of differentiated learning methods, and the level of emotional comfort in the classroom. The questionnaire contains 72 questions.

4. Student academic performance was measured using the *Wechsler Individual Achievement Test-4 (WIAT-4)* (Wechsler, 2020). This test is used to determine the level of performance in reading, writing, mathematics and general learning skills. Testing was conducted before and after the implementation of differentiated instruction to objectively assess changes in the students' level of knowledge and skills.

5. Questionnaire for teachers: teachers filled out a questionnaire based on the Differentiated Instruction Implementation Questionnaire (DIIQ) (Appendix 3). This questionnaire assessed their views on the effectiveness of differentiated instruction, as well as revealed the difficulties and successes associated with its implementation.

Statistical analysis

Several statistical methods were used to process and analyse the data obtained during the research. The first stage of statistical analysis was the use of Levene's test to check the homogeneity of variances between groups:

$$W = \frac{(N-k)}{(k-1)} \times \frac{\sum_{i=1}^{k} N_i (z_{i\cdot} - z_{\cdot\cdot})^2}{\sum_{i=1}^{k} \sum_{j=1}^{N_i} (z_{ij} - z_{i\cdot})^2}, \quad (1)$$

where:

N – total number of observations

k – the number of groups

N_i – the number of observations in the ith group

Z_{ij} – the transformed distance for the jth element and ith group

$Z_{i\cdot}$ – the average value of Z_{ij} in the ith group

$Z_{\cdot\cdot}$ – the general average value of Z_{ij} for all groups.

The *Mann-Whitney U-test* was used to compare academic performance before and after the introduction of differentiated instruction, as well as to compare between the GE and CG:

$$U = n_1 n_2 + \frac{n_1(n_1+1)}{2} - R_1, U = n_1 n_2 + \frac{n_2(n_2+1)}{2} - R_2 \quad (2)$$

where:

$n_1 n_2$ – sample sizes

R_1 – the sum of ranks for the first sample

R_2 – the sum of ranks for the second sample.

In addition, *descriptive statistics methods* were used to describe and generalize the data. This included the calculation of mean values, medians, standard deviations, and coefficients of variation, which made it possible to describe in detail the distribution of the studied indicators among students. The results were visualized using graphs and charts, which facilitated data interpretation. Particular attention was paid to the correlation analysis, which made it possible to determine the relationship between the change in the students' academic performance and the level of their motivation after the differentiated instruction. This made it possible to assess how much a change in one indicator affects another, which is important for understanding the overall effectiveness of differentiated learning methods.

RESULTS AND DISCSUSSION

The results of testing conducted through the Wechsler Individual Achievement Test (WIAT-4) show significant changes in the students' academic performance after the differentiated instruction. The Mann-Whitney U-test and correlation analysis were used for detailed analysis. Table 1 shows the test results before and after the differentiated instruction.

Table 1. Test results for the Wechsler individual achievement test (wiat-4)

Type of occupation	Before implementation (average score)	After implementation (average score)	Standard deviation before	Standard deviation after	U-value	p-value
Reading	72.5	83.0	9.1	8.7	975.50	< 0.01
Mathematics	68.0	78.5	8.4	7.9	940.00	< 0.01
Writing	65.0	76.5	8.9	8.2	912.00	< 0.01

Source: estimated by the authors based on collected data on the participants of the experiment

Before the implementation of differentiated instruction, the average score of students in reading was 72.5 with a standard deviation of 9.1. Three months after using the new techniques, the average score increased to 83.0, and the standard deviation decreased to 8.7, which indicates stabilization of the results. A Mann-Whitney U-test to assess the statistical significance of these changes showed U = 975.50 at $p < 0.01$, indicating a significant improvement in reading skills after the implementation of the differentiated approach. There was also a marked improvement in mathematics. Before the implementation of the methods, the average score was 68.0 with a standard deviation of 8.4. After the implementation of differentiated instruction, the average score increased to 78.5, and the standard deviation decreased to 7.9, which indicates positive changes in the knowledge of students.

A Mann-Whitney test for mathematics confirmed these results (U = 940.00 at $p < 0.01$), indicating a statistically significant improvement. Regarding written language, the average score before the implementation of the techniques was 65.0 with a standard deviation of 8.9, and after - it increased to 76.5 with a decrease in the standard deviation to 8.2. The Mann-Whitney test for written language showed U = 912.00 at $p < 0.01$, confirming a statistically significant improvement in students' writing skills. Correlation analysis revealed positive correlations between the use of differentiated instruction and improvement in all three academic areas: reading ($r = 0.48$, $p < 0.05$), mathematics ($r = 0.53$, $p < 0.01$), written language ($r = 0.50$, $p < 0.05$). This demonstrates a clear connection between the introduction of new methods and the increased students' academic performance. So, the results confirm the effectiveness of differentiated instruction, which has a positive effect on the students' success in all three areas of education.

The impact of differentiated instruction on student motivation was assessed using the Academic Motivation Scale (AMS). The level of motivation was assessed before and after the implementation of differentiated instruction in the EG, as well as for comparison with the CG. The results were analysed using Levene's test to test for statistical differences (Table 2).

In the EG, there was a significant improvement in the satisfaction with learning scores. Before the introduction of new methods, the average score was 3.2, which increased to 4.1 after three months, indicating a clear increase in positive feelings about the educational process. This is confirmed by the low value of $p = 0.004$ in the Mann-Whitney U-test, which indicates the statistical significance of the changes. The changes were smaller in the CG, indicating no significant effect of traditional

methods. Regarding interest in new knowledge, the EG showed a significant increase from 3.4 to 4.3, which indicates an increase in learning motivation. This is confirmed by the value of p = 0.002, which indicates the statistical significance of the changes. In the CG, the level of interest remained stable, which indicates the insufficient effectiveness of traditional methods in this aspect.

The joy of solving difficult tasks also increased in the EG from 3.1 to 4.0. This indicates an increase in satisfaction with intellectual challenges after the introduction of new methods. A value of p = 0.005 indicates statistical significance of this improvement. The CG does not show similar changes, which confirms the effectiveness of differentiated training. Motivation to receive high grades and praise did not show statistically significant changes in EG (p = 0.220 and p = 0.210, respectively), which may indicate that these aspects of motivation are less influenced by new teaching methods compared to other aspects. Amotivation in the EG decreased from 2.9 to 2.3, which indicates a decreased feeling of the futility of learning. The value of p = 0.006 emphasizes the statistical significance of the decrease in motivation. There was also a decrease in the sense of hopelessness from 2.7 to 2.2 (p = 0.004) and a decrease in the sense of lack of learning value from 2.8 to 2.3 (p = 0.005). This confirms that differentiated learning helps to reduce motivation and increase the students' general learning motivation. In the CG, these indicators changed less significantly, which indicates the effectiveness of new methods in overcoming amotivation. In general, the results of the study demonstrate that differentiated learning has a positive effect on the satisfaction with learning, interest in new knowledge, joy in solving complex tasks and reduction of motivation, which is supported by statistical tests.

These results show that differentiated instruction has a significant positive effect on students' intrinsic motivation and reduces the level of amotivation. Changes in external motivation are not statistically significant, which may indicate that the greatest effect of the introduction of new techniques is manifested in the improvement of internal motivation and reduction of amotivation.

Differentiated Instruction Implementation Questionnaire (DIIQ) was used to compare the effectiveness of different methods of differentiated instruction. Several strategies were evaluated, such as individualizing tasks, group work, and using a variety of resources and learning approaches. The data were collected and analysed to determine which methods were most effective in improving students' academic performance and motivation (Table 3).

Table 3. Test results for the Differentiated Instruction Implementation Questionnaire (DIIQ)

The method of differentiated instruction	Effectiveness rate (average value)	Standard deviation (SD)	Level of student satisfaction (average value)	Standard deviation (SD)	Levene's test (p-value)
Personalized assignments	4.2	0.5	4.4	0.4	0.001
Group work	3.8	0.6	3.9	0.5	0.010
Use of various resources	4.0	0.7	4.1	0.6	0.005
Approaches to learning	3.6	0.8	3.7	0.7	0.020

Source: estimated by the authors based on collected data on the participants of the experiment

Individualization of tasks demonstrated the greatest effectiveness among all the methods used. High average grade and student satisfaction levels indicate that personalized assignments significantly improve academic achievement and promote greater motivation. Levene's test results confirm the statistical significance of these improvements, indicating that assignment personalization is the most successful method among those considered. Group work, although it showed a positive effect, was less effective compared to the assignment personalization. This may indicate that, although group instruction promotes academic performance, its effect is not as significant as that of personalized instruction. Student satisfaction was also lower, which may indicate that group work does not always meet the students' individual needs in the same way that personalization does.

The use of a variety of resources has shown a significant positive impact on academic performance and student satisfaction. This method provides a variety of learning materials that can engage students and enhance their motivation. Statistical results confirm the effectiveness of the use of various resources, although not as significant as in the case of personalized assignments. Learning approaches received the lowest ratings and were less effective compared to other methods. This may indicate that generic approaches that do not consider the students' individual characteristics, have less impact on academic performance and satisfaction. The lowest level of satisfaction also supports this hypothesis, which may indicate the need to implement more personalized or varied teaching methods.

Therefore, the results show that the assignment personalization is the most effective method among those considered, providing the highest level of both academic performance and student satisfaction improvement. The use of a variety of resources also demonstrated high effectiveness, although less pronounced than the assignment personalization. Group work and learning approaches have shown less effectiveness compared to other methods but still have statistically significant results. These findings can help in the further optimization of differentiated learning methods to achieve better results in the educational process.

The Student Satisfaction Inventory (SSI) was used to study changes in the level of student independence after the implementation of differentiated education. Various aspects of students' independence were evaluated before and after the introduction of new methods. The data were collected to analyse whether changes in teaching methods affected students' levels of autonomy and their overall satisfaction with learning (Table 4).

Table 4. Results for the Student Satisfaction Inventory (SSI)

SSI question	Experimental group before implementation	Experimental group after implementation	Control group before implementation	Control group after implementation	Levene's test
1. I can plan my educational activities independently.	3.2 (SD = 0.6)	4.1 (SD = 0.5)	3.3 (SD = 0.7)	3.4 (SD = 0.6)	0.002
2. I feel that I can effectively manage my study time.	3.0 (SD = 0.7)	4.0 (SD = 0.6)	3.1 (SD = 0.8)	3.2 (SD = 0.7)	0.015
3. I feel that I have enough resources for independent study.	3.4 (SD = 0.5)	4.2 (SD = 0.4)	3.5 (SD = 0.6)	3.6 (SD = 0.5)	0.005
4. I am satisfied with my level of independence in learning	3.1 (SD = 0.6)	4.0 (SD = 0.5)	3.2 (SD = 0.7)	3.3 (SD = 0.6)	0.010

Source: developed by the author based on collected data on the participants of the experiment

Prior to the implementation of differentiated instruction methods, the planning of educational activities in the EG showed a medium level of independence, which indicates the limited students' capabilities in this aspect. There was a significant improvement after the introduction of new methods, which indicates an increase in the students' ability to independently organize their studies. This improvement is supported by the statistical significance of the results, which confirms the effectiveness of the implemented changes. Regarding effective time management, the results also show a significant improvement after the implementation of the new techniques. At first, students had problems with organizing their time, but after adapting differentiated approaches they began to better control their schedule, which resulted in the growth of average indicators.

The statistical significance of this improvement confirms that the methods of differentiated teaching had a positive effect on the organization of students' time. Regarding access to resources for self-directed learning, the significant improvement in this aspect indicates that the new techniques have contributed to a better use of learning materials by students. This improvement indicates that students have become more confident in using available resources for their independent work. The results of statistical tests confirm that these changes are not accidental, but significant.

Changes in the level of students' independence after the differentiated instruction are significant and statistically significant. All aspects of independence assessment (planning learning activities, time management, availability of resources, general satisfaction) showed improvement after the introduction of new methods. This testifies to the positive impact of differentiated instruction on the students' independence level and their overall satisfaction with education.

Discussion

The obtained results confirm the significant positive impact of differentiated instruction on the students' independence level, which is consistent with modern research in this field. Results showed significant improvement in all aspects of independence assessment, including planning learning activities, time management, availability of resources for independent learning, and overall satisfaction with independence. The obtained results correspond to the aim and objectives of the study and testify to the effectiveness of the implementation of differentiated instruction in increasing the student's independence level.

The results of our study support the findings of the study by Pozas et. al. (2020) about the positive impact of differentiated instruction on students' academic performance and motivation. Both studies recognize the significant benefits of differentiated instruction, although the researchers note the difficulties teachers face in implementing it. Our research adds that even under these conditions, differentiated instruction can significantly improve academic performance and increase student motivation with proper teacher support and training.

The results of our study are consistent with the findings of Bondie et. al. (2019). Researchers have also found that moving from a one-size-fits-all approach to differentiated instruction has a positive effect on academic achievement. However, our study focused on younger students and found that differentiated instruction increases not only academic outcomes, but also students' independence level. At the same time, research by Bondie et. al. (2019) focuses more on changes in pedagogical practices and challenges for teachers when implementing a differentiated approach.

Scarparolo and MacKinnon's (2024) research focuses on the role of student voice and their perspectives in differentiated instruction. In contrast, our study focused on objective changes in academic performance. Although both studies demonstrate the positive impact of a differentiated approach, Scarparolo and MacKinnon (2024) emphasize the importance of taking students' opinions into account in the process of adapting instruction.

Compared to Magableh and Abdullah's (2020) study, which evaluated the effects of differentiated instruction on overall performance of Jordanian students, our study found similar results in improving academic performance. However, in addition to the overall performance, we focused on the change in the students' independence level after the implementation of differentiated instruction. Both studies confirm the effectiveness of a differentiated approach, but ours also shows that this approach increases students' independence, which is an important aspect of their development.

Unlike Malacapay's (2019) study, which focused on the relationship of differentiated instruction to students' different learning styles, our study looked more broadly at its impact on academic achievement. Both studies confirm the effectiveness of a differentiated approach, but our results also showed a significant impact on the development of students' independence. Although Malacapay emphasized adapting learning to students' styles, we additionally found positive changes in motivation and academic performance after implementing this approach.

Compared to a study by Noman and Kaur (2020), which explores differentiated assessment as a new paradigm for diverse learners, our research focuses on the impact of differentiated instruction on student academic performance and motivation. Both studies confirm that adapting instruction can improve student outcomes. However, Noman and Kaur (2020) focus on changes in assessment practices, while our study also found positive effects on student autonomy.

Shareefa's (2021) study, which analyses the application of differentiated instruction in multigrade classrooms, shows similar results to our study in terms of improving student academic performance. However, Shareefa (2021) highlights the specific challenges of implementing this approach in small schools. Our results also confirm a positive effect on students' motivation and independence, but in the context of a more homogeneous classroom environment.

The results of our study are like the findings of Brigandi et. al. (2019), who analysed the impact of professional development on differentiated instruction in a gifted children programme. Both studies confirm that differentiated instruction improves students' academic performance.

However, our emphasis on student motivation and autonomy provides an additional dimension that was not the focus of Brigandi, et. al. (2019). While their study focused on the effects of professional development in the context of gifted students, our study covers a broader range of students. Our study also demonstrates the positive impact of a differentiated approach on the students' general motivation and level of independence.

Smets and Struyven's (2020) study focus on the professional development of teachers for the implementation of differentiated instruction in secondary education, which has common results with our study. They found that teachers' professional development has a positive effect on the application of differentiated strategies. Instead, our research not only confirms this effect, but also extends it by showing positive changes in student motivation, achievement, and independence.

A study by Prediger and Buró (2024) examines different approaches to working with students with different abilities in the context of mathematics taught in secondary school. Our results support their findings about the effectiveness of differentiated instruction in improving academic performance. However, in contrast to their emphasis on inclusion practices in mathematics, our study also demonstrates significant effects on student motivation and autonomy in the overall learning process.

The practical use of the obtained results consists in the adaptation of differentiated instruction to increase the students' independence level. The results of the study demonstrate that individualized learning methods improve the management of the learning process and overall satisfaction with learning. The results can be used to develop and improve curricula and strategies that promote a more effective and inclusive learning environment.

Limitations of the study

Limitations of the study include the small sample of students, which may limit the generalizability of the results to a wider population, as well as the possible subjectivity of self-reported assessments of autonomy and motivation. In addition, research focuses on specific methods of differentiated instruction within one instructional system, which may not reflect the effectiveness of other strategies or contexts.

FINAL REMARKS

Research on the effectiveness of differentiated education is extremely important in view of the modern challenges in the educational process. The results of the conducted research confirm the significant impact of differentiated education on students' academic performance, motivation and independence. The implementation of adapted teaching methods demonstrated a significant improvement in all evaluated aspects, including an increase in the level of academic performance, learning motivation, and students' independence. In particular, the use of different strategies of differentiated learning proved to be effective in developing interest in learning and increasing students' independence, which is confirmed by statistical data and correlation analysis. The results also suggest that adapting curricula to the students' individual needs can significantly improve their academic performance and overall satisfaction with the learning process. The implementation of these methods in educational practice has the potential to further improve educational strategies and increase the efficiency of the educational process.

Research prospects

One of the most interesting and promising directions for further research is the study of the long-term impact of differentiated instruction on students' academic performance and personal development. In particular, it is worth studying how the adaptation of teaching methods at different stages of education (for example, in elementary, middle and high school) can affect the students' sustainability of achievements and their level of independence.

Recommendations

It is recommended to actively implement individualized strategies that consider the different needs of students, as well as provide teachers with additional training and support in the implementation of these methods to improve the effectiveness of differentiated instruction. Systematic monitoring and evaluation of learning effectiveness, together with the implementation of modern technologies, such as adaptive learning platforms, can significantly improve the quality of education. Integrating these approaches will ensure a more precise adaptation of instructional strategies and increase the students' overall motivation and academic performance.

REFERENCES

Bondie, R. S., Dahnke, C., & Zusho, A. (2019). How does changing "one-size-fits-all" to differentiated instruction affect teaching? *Review of Research in Education, 43*(1), 336-362. https://doi.org/10.3102/0091732X18821130

Brigandi, C. B., Gilson, C. M., & Miller, M. (2019). Professional development and differentiated instruction in an elementary school pullout program: A gifted education case study. *Journal for the Education of the Gifted, 42*(4), 362-395. https://doi.org/10.1177/0162353219874418

D'Intino, J. S., & Wang, L. (2021). Differentiated instruction: A review of teacher education practices for Canadian pre-service elementary school teachers. *Journal of Education for Teaching, 47*(5), 668-681. https://doi.org/10.1080/02607476.2021.1951603

Dulfer, N., Kriewaldt, J., & McKernan, A. (2024). Using collaborative action research to enhance differentiated instruction. *International Journal of Inclusive Education, 28*(8), 1402-1416. https://doi.org/10.1080/13603116.2021.1992678

Fousteri, M., & Foti, P. (2024). A creative approach of the differentiated teaching and project method in early childhood education. *European Journal of Education and Pedagogy, 5*(2), 64-73. https://doi.org/10.24018/ejedu.2024.5.2.800

Geven, S., & van de Werfhorst, H. G. (2020). The role of intergenerational networks in students' school performance in two differentiated educational systems: A comparison of between-and within-individual estimates. *Sociology of Education, 93*(1), 40-64. https://doi.org/10.1177/0038040719882309

Gheyssens, E., Coubergs, C., Griful-Freixenet, J., Engels, N., & Struyven, K. (2022). Differentiated instruction: The diversity of teachers' philosophy and praxis to adapt teaching to students' interests, readiness and learning profiles. *International Journal of Inclusive Education, 26*(14), 1383-1400. https://doi.org/10.1080/13603116.2020.1812739

Krishan, I. Q., & Al-Rsa'i, M. S. (2023). The effect of technology-oriented differentiated instruction on motivation to learn science. *International Journal of Instruction, 16*(1). https://doi.org/10.29333/iji.2023.16153a

Kupers, E., de Boer, A., Bakker, A., de Jong, F., & Minnaert, A. (2024). Explaining teachers' behavioural intentions towards differentiated instruction for inclusion: Using the theory of planned behavior and the self-determination theory. *European Journal of Special Needs Education, 39*(4), 638-647. https://doi.org/10.1080/08856257.2023.2263717

Lindner, K. T., & Schwab, S. (2020). Differentiation and individualisation in inclusive education: A systematic review and narrative synthesis. *International Journal of Inclusive Education,* 1-21. https://doi.org/10.1080/13603116.2020.1813450

Magableh, I. S. I., & Abdullah, A. (2020). On the effectiveness of differentiated instruction in the enhancement of Jordanian students' overall achievement. *International Journal of Instruction, 13*(2), 533-548. https://doi.org/10.29333/iji.2020.13237a

Malacapay, M. C. (2019). Differentiated instruction in relation to pupils' learning style. *International Journal of Instruction, 12*(4), 625-638. https://doi.org/10.29333/iji.2019.12440a

Mendoza, M., & Heymann, J. (2024). Implementation of inclusive education: A systematic review of studies of inclusive education interventions in low-and lower-middle-income countries. International *Journal of Disability, Development and Education, 71*(3), 299-316. https://doi.org/10.1080/1034912X.2022.2095359

Noel-Levitz, R. (2019). *Student satisfaction inventory*. https://public-info.dsu.edu/institutional-research/wp-content/uploads/sites/10/2022/09/2019-Student-Satisfaction-Inventory-Executive-Summary.pdf

Noman, M., & Kaur, A. (2020). Differentiated assessment a new paradigm in assessment practices for diverse learners. *International Journal of Education and Cognitive Sciences, 1*(3), 1-7. https://iase-ijeas.com/article_161564.html

Paseka, A., & Schwab, S. (2020). Parents' attitudes towards inclusive education and their perceptions of inclusive teaching practices and resources. *European Journal of Special Needs Education, 3*5(2), 254-272. https://doi.org/10.1080/08856257.2019.1665232

Pozas, M., & Letzel-Alt, V. (2023). Teacher collaboration, inclusive education and differentiated instruction: A matter of exchange, co-construction, or synchronization? *Cogent Education, 10*(2), 2240941. https://doi.org/10.1080/2331186X.2023.2240941

Pozas, M., Letzel, V., & Schneider, C. (2020). Teachers and differentiated instruction: Exploring differentiation practices to address student diversity. *Journal of Research in Special Educational Needs, 20*(3), 217-230. https://doi.org/10.1111/1471-3802.12481

Prediger, S., & Buró, R. (2024). Fifty ways to work with students' diverse abilities? A video study on inclusive teaching practices in secondary mathematics classrooms. *International Journal of Inclusive Education, 28*(2), 124-143. https://doi.org/10.1080/13603116.2021.1925361

Roose, I., Vantieghem, W., Vanderlinde, R., & Van Avermaet, P. (2024). Professional vision as a mediator for inclusive education? Unravelling the interplay between teachers' beliefs, professional vision and reported practice of differentiated instruction. *Educational Review, 76*(3), 483-505. https://doi.org/10.1080/00131911.2022.2054957

Scarparolo, G., & MacKinnon, S. (2024). Student voice as part of differentiated instruction: Students' perspectives. *Educational Review, 76*(4), 774-791. https://doi.org/10.1080/00131911.2022.2047617

Shareefa, M. (2021). Using differentiated instruction in multigrade classes: A case of a small school. *Asia Pacific Journal of Education, 41*(1), 167-181. https://doi.org/10.1080/02188791.2020.1749559

Smale-Jacobse, A. E., Meijer, A., Helms-Lorenz, M., & Maulana, R. (2019). Differentiated instruction in secondary education: A systematic review of research evidence. *Frontiers in psychology, 10*, 2366. https://doi.org/10.3389/fpsyg.2019.02366

Smets, W., & Struyven, K. (2020). A teachers' professional development programme to implement differentiated instruction in secondary education: How far do teachers reach? *Cogent Education, 7*(1), 1742273. https://doi.org/10.1080/2331186X.2020.1742273

Strogilos, V., Avramidis, E., Voulagka, A., & Tragoulia, E. (2020). Differentiated instruction for students with disabilities in early childhood co-taught classrooms: Types and quality of modifications. *International Journal of Inclusive Education, 24*(4), 443-461. https://doi.org/10.1080/13603116.2018.1466928

Thapliyal, M., Ahuja, N. J., Shankar, A., Cheng, X., & Kumar, M. (2022). A differentiated learning environment in domain model for learning disabled learners. *Journal of Computing in Higher Education, 34*(1), 60-82. https://doi.org/10.1007/s12528-021-09278-y

Tiernan, B., Casserly, A. M., & Maguire, G. (2020). Towards inclusive education: Instructional practices to meet the needs of pupils with special educational needs in multi-grade settings. *International Journal of Inclusive Education, 24*(7), 787-807. https://doi.org/10.1080/13603116.2018.1483438

Tsai, M. J., Wang, C. Y., & Hsu, P. F. (2019). Developing the computer programming self-efficacy scale for computer literacy education. *Journal of Educational Computing Research, 56*(8), 1345-1360. https://doi.org/10.1177/0735633117746747

Wechsler, D. (2020). *Wechsler Individual Achievement Test | Fourth Edition (WIAT-4).* https://www.pearsonassessments.com/store/usassessments/en/Store/Professional-Assessments/Academic-Learning/Wechsler-Individual-Achievement-Test-%7C-Fourth-Edition/p/100002039.html?tab=qinteractive

Weintrop, D., & Wilensky, U. (2019). Transitioning from introductory block-based and text-based environments to professional programming languages in high school computer science classrooms. *Computers & Education, 142*, 103646. https://doi.org/10.1016/j.compedu.2019.103646

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