Fostering university educators' readiness for Moodle-based differentiated instruction in the context of digital transformation

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Abstract

This study examines educators' readiness for implementing differentiated instruction within Moodle-based digital learning environments in the context of digital transformation in higher education and increasing student diversity. The research addresses the critical need for personalised learning approaches that respond to diverse student needs exacerbated by demographic changes and martial law conditions in Ukraine.

Using a mixed-method case study approach, the research investigated a professional development program at Borys Grinchenko Kyiv Metropolitan University in 2025. A total of 101 university teachers participated in the 15-hour online program, which covered theoretical foundations, Moodle's affordances for differentiation, activity development, and monitoring tools. Despite recognising the need for differentiated approaches (98.8% of respondents), educators face barriers including increased workload and insufficient digital competencies. Of 101 participants, 66 completed successfully, demonstrating improved readiness for digital transformation through practical skill development. The study confirms that targeted professional development enhances educator capacity to meet diverse learner needs in digitally-mediated environments.

Keywords

LMS Moodle, differentated instruction, digital transformation, professional development program, digital competence, universal design for learning, higher education

1. Introduction

In the context of the digitalisation of society, the transformation of higher education is driven by the need to adapt to today's challenges and conditions to remain competitive and ensure the training of modern specialists. The reassessment of the importance of higher education in the context of Ukraine's European integration has led to increased competition among universities for applicants and a need to demonstrate societal value. Trends caused by these changes during martial law include changes in the demographic composition of students, with many leaving Ukraine, particularly the temporarily occupied territories; increased demand for access to educational services regardless of location or time; and a focus on the skills, knowledge, and abilities that students need to work effectively in the modern labour market and the era of artificial intelligence.

While the number of "traditional" students is declining, the number of older learners continues to grow. Accordingly, there is an increasing demand for educational programmes with specific components and multi-programme and interdisciplinary approaches, which are built around the particular work skills and abilities learners require. In light of these trends, higher education institutions must shift their focus towards personalised learning [1]. Differentiated instruction is one of the ways to meet learners' diverse educational needs, interests and goals.

The role of blended and distance learning in transforming higher education has grown significantly during the Covid-19 pandemic and has been further strengthened by the introduction of martial law restrictions in Ukraine. Students continue to favour distance learning and digital resources. Today's

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students are not only learners, but also 'digital consumers' who will eventually become part of the global digital economy. Therefore, effectively using digital tools in the educational process is necessary to ensure accessibility and educational quality, enable flexible learning approaches, and support personalised educational journeys.

Higher education institutions actively use e-learning management systems because they enable centralised management of the educational process, support blended and distance learning, increase accessibility, and allow the educational process to be organised in a digital environment that meets the needs of today's students, who are accustomed to using digital technologies. Moodle is one of the most popular e-learning management systems [2] because educational institutions prefer open-source systems [3, 4] that can be adapted to their needs. Utilisation of e-learning management systems, particularly Moodle, enables the collection and analysis of data, allowing the effectiveness of teaching methods and technologies to be evaluated [5] and differentiated learning to be implemented in higher education institutions. Research [6] has demonstrated the practicality and validity of differentiating content and its presentation methods in Moodle when organising learning according to cognitive learning styles.

Implementing differentiated instruction requires teachers to carefully plan the educational environment, curriculum, assessment, teaching methods and management of student groups, in order to engage learners with different profiles and educational needs [7, 8]. In order to implement differentiated instruction in today's environment, teachers must also possess the necessary tools and strategies to effectively design, implement and evaluate differentiated educational trajectories. The success of the student learning experience using the Moodle LMS depends mainly on the digital competence of the teachers who develop the electronic learning courses (ELC). Unfortunately, many teachers lack the necessary digital skills, such as proficiency in digital analytics tools, pedagogical design, and the ability to create personalised learning paths within an e-learning system. Therefore, improving teachers' digital competence to effectively implement differentiated instruction in a digital environment is a pressing task today.

This study aims to describe a professional development system within a digital module for higher education teachers to implement differentiated instruction in a digital educational environment. By the aim, the following tasks have been formulated: analysing the theoretical foundations of differentiated instruction in a digital educational environment; describing the structure and content of the digital module of the teacher training programme; and analysing teachers' feedback and perceptions of the effectiveness of the digital module for implementing differentiated instruction. The research questions of this study are: What are the theoretical and methodological foundations for implementing differentiated instruction in a digital educational environment? What knowledge and skills must teachers possess to effectively implement differentiated instruction in the Moodle LMS?

2. Literature review

The digital transformation of education and the personalisation of learning pathways for students have been declared in several European regulatory documents. They are a key area of interest for many scholars. The 1999 Bologna Declaration provides for the creation of a European Higher Education Area (EHEA), taking into account student and teacher mobility, as well as personalised learning [9]. By signing the declaration in 2005, Ukraine committed itself to aligning its higher education system with European standards. Following the signing of the Bologna Declaration, a series of conferences were held with European ministers responsible for higher education, resulting in the publication of a communiqué. The Yerevan Communiqué [10] emphasises the importance of transitioning to a student-centred approach to learning. This approach places students at the centre of the educational process, taking into account their individual needs and educational goals. The Paris Communiqué [11] reaffirms participating countries' commitment to modernising higher education through flexible learning pathways, digital tools and innovative approaches. The Rome Communiqué [12] focuses on making higher education more sustainable, adapting to digital technologies, addressing environmental

challenges, and promoting social responsibility. The European Qualifications Framework [13], adopted in 2008 and updated in 2017, provides students with the means to adapt their educational trajectory according to their interests, abilities and goals. Council Resolution on a strategic framework for European cooperation in education and training towards the European Education Area and beyond (2021-2030) focuses on five key areas: ensuring the quality and inclusiveness of education, promoting lifelong learning, improving the motivation and competences of educators, strengthening European higher education, and supporting the green and digital transitions. The resolution promotes the concept of personalised learning journeys by introducing microcredits, flexible learning programmes, and the recognition of non-formal education. Particular emphasis is placed on using digital technologies for adaptive learning to ensure inclusiveness. The importance of digitising educational processes to increase accessibility, adaptability and effectiveness is also emphasised in the 2017 Tallinn Declaration on Digital Education. The declaration calls for introducing digital technologies that can create adaptive learning environments and enable personalised learning approaches and digital platforms for knowledge sharing and collaboration.

A search of the Scopus scientometric database for scientific publications using the keywords 'differentiated instruction' and 'higher education' reveals the following main areas: flipped classroom technology, inclusive education, student-centred learning, English language teaching, online learning and adaptive learning. Boelens et al. [14] consider differentiated instruction in the context of blended learning implementation. Differentiated instruction is seen as a way to improve the quality of blended learning through personalisation by considering learners' diversity. The positive impact of differentiated instruction on student learning outcomes and teacher-student interaction is noted by Chiang and Wu [15]. Liou et al. [16] also refers to differentiated instruction as a solution that can provide students with diverse learning opportunities and meet the educational needs of students with different academic abilities and strengths. Hernandez et al. [17] note a decline in the quality of differentiated instruction when transitioning online due to a lack of readiness to use online tools to implement such instruction. However, students positively evaluate online practices for implementing differentiated instruction, such as formative assessment, differentiated tasks, and the organisation of group work [18]. Research by Moallemi [19] notes the positive impact of differentiated instruction on student engagement in the educational process at university. Students positively perceive diversity and choice of content. At the same time, the role of the teacher remains key, as students are not always able to choose what is best for them. Kohnke and Moorhouse [20], describing their experience of implementing differentiated instruction, note that one of the obstacles to implementing differentiated instruction is the high workload of teachers. Elyas et al. [21] recommend that higher education institutions consider using differentiated instruction when planning teacher and instructor training programs, professional development programs and courses, and when establishing criteria for evaluating teachers'/instructors' work with classes/groups. The issue of training teachers and future teachers in differentiated instruction is raised in the works of Bi et al. [22] and Nketsia et al. [23]. The study results show that each of the principles of differentiated instruction (content, process, educational environment, readiness, interest, and learning profile) is important in training future teachers and practising teachers' professional development. The impact of technology-oriented differentiated instruction on student motivation was studied by Krishan and Al-rsa'i [24]. Their experiment showed that technology-oriented differentiated learning significantly increased student motivation to study science compared to traditional methods. A technological approach to responding to student diversity in groups is also considered by Balchin and Bouzaki [25]. The wide range of technological tools currently available can take into account individual differences among students, allowing for changes in lesson content, tasks, learning modes, teaching and learning strategies, assessment strategies, and level of difficulty, which in turn improves student engagement in the educational process and their learning outcomes. The utilisation of LMS Moodle for differentiated, personalised learning is also the focus of attention of contemporary researchers. Mardiyah et al. [6] demonstrates the practicality and validity of implementing content differentiation and means of its presentation in Moodle when organising differentiated learning according to cognitive learning styles. Terletska et al. [26] describes the utilisation of LMS Moodle to implement differentiated instruction in heterogeneous groups. Ismail et al. [27] explores the possibility of implementing differen-

tiated instruction in the LMS Moodle in the context of blended learning. Papanikolaou and Boubouka [28] explores the possibilities of creating personalised training courses in Moodle.

An analysis of scientific sources reveals a significant number of studies devoted to the digital transformation of education, the functional capabilities of the Moodle LMS, and the theoretical foundations of differentiated instruction. However, insufficient attention has been given to the cross-disciplinary study of these areas in the context of teacher training. In particular, there is limited experience of integrating the principles of differentiated instruction into the digital educational environment of the Moodle LMS, considering the specifics of higher education. Furthermore, there is a lack of research into how teachers acquire digital differentiation skills during professional development programmes and which knowledge and skills are essential for successfully implementing a differentiated approach in Moodle.

3. Methodology

This study employed a mixed-method case study approach to examine the implementation and outcomes of a professional development program to enhance university instructors' readiness to apply differentiated instruction in a digital learning environment based on the LMS Moodle. The selected case focused on the course "LMS Moodle as a Means of Implementing Differentiated Instruction", developed and delivered at Borys Grinchenko Kyiv Metropolitan University in 2025. The training program was conducted entirely online and consisted of synchronous sessions (via Zoom) and asynchronous activities within a Moodle-based course. Its total workload amounted to 15 academic hours (0.5 ECTS credits). The course content was structured around four thematic units:

1. An introduction to the theoretical foundations and current approaches to differentiated instruction,
2. The affordances of Moodle for supporting differentiation,
3. The development and management of differentiated activities and resources, and
4. Tools for monitoring student activity and providing formative feedback.

Tools for monitoring student activity and providing formative feedback. Participants completed practical tasks, including designing adaptive lectures and configuring access restrictions based on student progress. Upon successful completion, participants received digital badges within the course and official certification under University Order No. 196 dated March 27, 2025.

101 university instructors representing various faculties of Borys Grinchenko Kyiv Metropolitan University voluntarily enrolled in the program. Of these, 73 participants provided post-training feedback, and 66 completed the course successfully.

The primary instrument for data collection was a Moodle-integrated questionnaire administered at the end of the course. The questionnaire consisted of 14 items, including one open-ended question. The collected data were analysed using basic descriptive statistical techniques and qualitative thematic analysis of narrative responses. No additional software tools were employed for data processing.

Additionally, the findings of a 2023 institutional survey conducted during the training session "Designing Differentiated Instruction in Digital Courses" – attended by 83 instructors – were incorporated into the analysis. These earlier results informed the design of the 2025 training program and provided a comparative basis for assessing instructors' evolving perceptions and readiness to implement differentiated instruction in Moodle-based environments.

4. Theoretical background

Differentiated instruction as an approach to learning and teaching recognises a wide range of readiness levels, interests and learning styles among students, using proactive, flexible, diverse strategies focused on knowledge and the learner's needs [29]. Tomlinson and McTighe [30] suggest using a variety of teaching approaches based on learners' learning styles (learning preferences), interests and background knowledge (level of readiness). Adapting the educational process to the individual educational needs

of learners is achieved through the differentiation of goals, educational content, learning format and terms. Researchers describe many strategies that can be used to implement differentiated instruction [31, 32, 33]. The most commonly used differentiation strategies are supporting students with low levels of knowledge by providing additional materials and assistance in completing tasks, and using different formats for grouping students.

Differentiated instruction strategies can be categorised as content-, process- or product-related. Content-related strategies include differentiating learning materials according to their level of complexity, adapting tasks to suit learners' different learning styles, and using assessments to differentiate between learners. Process-related strategies include grouping students according to various principles, using project-based and problem-based learning, setting individual tasks and delegating responsibility. Product differentiation involves variability in how learners present their learning outcomes. This includes various forms of result presentation, results at different levels, and creative differentiation. Conducting different types of assessment – initial, formative and summative – is considered one of the strategies for successfully implementing differentiated instruction. Entrance or preliminary assessments determine the level of knowledge, readiness, skills, needs, interests and learning preferences. Differentiating the learning process involves ensuring flexibility in the choice of working methods, topics, and levels of interaction.

The effective implementation of differentiated instruction in a digital educational environment requires a conceptual foundation that ensures both technological and pedagogical feasibility of adapting the learning process to the diversity of the student audience. Universal Design for Learning (UDL) is a suitable basis for this, as it focuses on designing an educational environment to consider learners' differences in advance. UDL is a scientific concept that is used to organise the educational process. It provides flexibility in the ways information is presented, knowledge and skills are demonstrated, and students are engaged. The aim is to remove barriers to learning, provide appropriate conditions and support, and maintain high expectations for the academic achievement of all learners, including those with disabilities and those with limited proficiency in the language of instruction [34]. The UDL approach involves creating conditions for inclusivity, ensuring content accessibility, and building flexible educational trajectories, allowing each student to interact with the material most comfortably and effectively for them. This conceptual framework is critical for systematically implementing differentiation in a digital environment based on the Moodle LMS. Universal design for learning and differentiated instruction have different origins and conceptual foundations, but their goals and principles largely coincide [35]. UDL is seen as a proactive concept aimed at designing a learning environment that provides a variety of ways to access knowledge, engage students, and express learning outcomes. At the heart of UDL is the idea of reducing barriers to learning by taking individual needs into account at the course design stage. In contrast, differentiated instruction focuses on adapting the learning process to each learner's personal characteristics and current results. Differentiated instruction is a reactive tool that the teacher implements in response to the real needs of students that emerge during the educational process (table 1).

Differentiation occurs within the established universal course structure, which is underpinned by the principles of UDL. Differentiated instruction can seamlessly integrate into the UDL system, enhancing its adaptability and flexibility. Concurrently, factors such as formative assessment, flexible grouping and a growth mindset [36] among teachers strengthen the connection between the two approaches. These components are essential for ensuring that universal learning design is not just a declarative principle but becomes a practical method of supporting the educational process. When implementing learning in a digital environment based on the Moodle LMS, combining UDL with differentiated instruction ensures the course organisation is both effective and intact. The LMS provides tools for implementing UDL principles during the course design stage, particularly through resource variability, interaction formats, and individual learning trajectories. During implementation, teachers can use flexible task settings, student grouping, content adaptation, and assessment and feedback based on up-to-date student performance and learning profiles to deliver differentiated instruction. Thus, universal learning design provides the architectural foundation of the course, while differentiated instruction provides its pedagogical flexibility. Their interaction creates an adaptive, student-centred electronic learning

Table 1
Comparison of universal design for learning and differentiated instruction.

Criterion	Universal design for learning	Differentiated instruction
Focus	Eliminating barriers in the learning environment for everyone	Adapting learning to the needs of specific groups or individual students
Approach	Proactive – anticipates needs in advance	Reactive/individualised – responds to existing needs
Application	Integrated into the course structure	Implemented during teaching through adaptations
Target group	All students, including those with special needs	Groups or individual students with different levels, styles, and interests
Tools	For example: alternative formats for materials, flexible modes of interaction	For instance: level-based tasks, flexible grouping, variable assessment

environment capable of maintaining a high level of engagement and effectiveness in higher education.

The advantages of LMS Moodle for organising differentiated instruction include flexible options for content and methodological differentiation, automated assessment and monitoring of student performance, and functions for creating individual learning paths. The capabilities of LMS Moodle for implementing differentiated instruction can be classified according to the principles of differentiation: content, process, outcome, educational environment, readiness level, interests, and learning profile (figure 1).

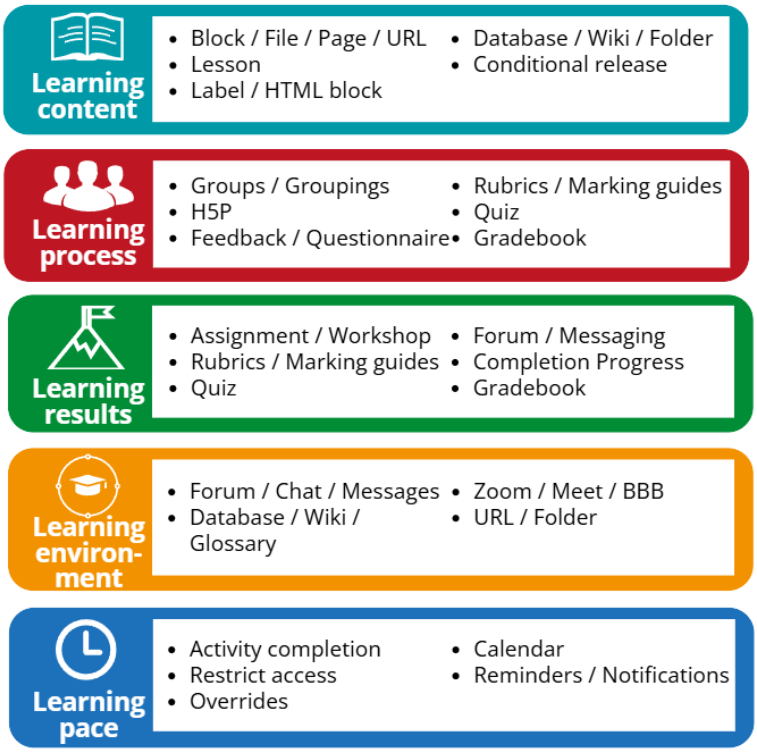

Figure 1: Moodle LMS features for differentiated instruction.

To differentiate learning content, LMS Moodle offers tools for adding materials in various formats (text, video, audio, presentations, SCORM packages) and configuring access conditions. This ensures that content is adapted to the level of training, learning styles and interests of learners. The 'Book' resource is used for step-by-step study of topics and forming a clear structure that facilitates convenient

navigation. The ‘Page’, ‘File’, ‘URL’, ’Mindmap’, and ‘External tool’ resources allow information to be presented in various formats. The ‘Lesson’ activity allows you to create adaptive content with a variable learning path depending on the student’s answers. This allows you to complicate or simplify the material according to the level of knowledge. The ‘Database’, ‘Wiki’, and ‘Folder’ resources are used to select sources and support self-study. Students with a higher level of autonomy can work with open resources. The ‘Restrict access’ feature controls the access sequence to content, considering previous actions or group membership.

In the Moodle LMS environment, differentiation of the learning process is implemented through flexible configuration of learning methods, pace, difficulty level and interaction. The ‘Feedback’, ‘Choice’ and ‘Questionnaire’ tools allow you to collect data on students’ learning needs, which serves as the basis for designing a course that considers their levels of preparation, styles and interests. They also provide the dynamic feedback necessary to adapt the learning content. The functionality of groups and groupings makes it possible to form both homogeneous groups to reduce psychological stress and increase support, and mixed groups to develop peer interaction. This approach promotes not only the assimilation of content but also the formation of social and communication skills. The interactive tools H5P and SCORM support individualised work at a comfortable pace. H5P allows you to create adaptive tasks with feedback, and SCORM provides a conditional transition between activities depending on the student’s progress. The ‘Workshop’ activity develops critical thinking and independence through students evaluating each other’s work according to precise criteria. Differentiation occurs through the variability of formats, roles, and levels of participation. The ‘Q and A forum’ promotes individual reflection, as students leave answers independently, without the influence of others. This enhances the depth of reasoning and equality of participation in joint discussions.

The purpose of differentiating learning outcomes is to ensure flexibility in assessment by individual progress and task performance styles. LMS Moodle supports various types of assessment (initial, formative, summative), which allows for the creation of individual educational trajectories, process control, and feedback. The ‘Assignment’ activity will enable you to vary the types of tasks and apply rubrics with different criteria and difficulty levels, ensuring fair assessment of varying levels of preparation. Rubrics can be different for different student groups and help plan and self-assess work. The teacher comments on individual elements, indicating areas for growth. The ‘Quiz’ activity supports an adaptive mode with different progression paths and feedback, while the ‘Lesson’ activity supports conditional navigation between difficulty levels. Categories in the question bank and random question selection allow each student to receive an individual test version. The ability to override deadlines and attempts increases flexibility. The ‘Gradebook’ enables you to configure weights, scales, and grade categories, supporting different educational trajectories and personalisation of learning. The ‘Database’ activity provides various forms of presentation of results, choice of difficulty level, and peer assessment, supporting individual learning styles and group work with differentiated assessment.

Differentiation of the educational environment involves creating conditions that consider the individual needs, level of autonomy, and interaction styles of students. In LMS Moodle, this is achieved through various communication channels and customisation of the pace and format of communication. The platform’s tools support group and individual communication in synchronous and asynchronous formats, using BigBlueButton, Zoom, and Google Meet resources. The ‘Chat’ resource is used for question-and-answer sessions, reflection, group discussions, and evaluating students’ contributions to joint projects. The “Messages” resource is available for individual communication. Teamwork is supported through the “Forum”, “Database”, “Wiki” and “Glossary”. Settings for different groups and the choice of communication channels create a personalised educational environment that considers each student’s pace, level and style of communication.

Differentiating the pace of learning allows students to learn at a comfortable pace, taking into account their characteristics. LMS Moodle supports this through anytime access to materials, flexible deadlines, additional attempts on tests, and adaptive course elements. The “Completion Progress” block allows students to track their progress and teachers to set different conditions for different groups and levels. Access restrictions control access to materials by date or task completion, which helps to organise learning at your own pace, with support for students who need supervision. The ability to set individual

deadlines and use the 'Calendar' provides a personalised learning schedule. At the same time, automatic notifications remind students of important events and support the organisation of the learning process. Time restrictions in "Lessons" and "Quizzes" help to teach self-control and track task completion.

Teachers must be proficient in modern digital tools to ensure flexibility in content delivery, customise individual educational trajectories, implement adaptive assessment, and organise personalised interaction. Only with the right level of digital competence can university teachers design differentiated courses that cater for different learning styles, speeds and needs. Digital competence also enables the effective collection and analysis of feedback, progress monitoring tools, and real-time adjustments to the educational process. Therefore, improving teachers' digital skills is essential for the successful digital transformation of education and implementing differentiated learning principles in the university's electronic learning environment.

5. Results and discussion

Scientific research [37, 38, 39] shows that teachers often encounter difficulties when it comes to understanding and implementing differentiated instruction in practice. In particular, they tend to oversimplify its essence, lack the necessary training to implement it in a digital environment and struggle to adapt their teaching strategies to the different needs of their students. Furthermore, they often lack the motivation to implement differentiated instruction. Differentiation is often perceived solely as content adaptation, ignoring learning processes and products [40], as a need to individualise materials for each learner, or as a strategy aimed at supporting weak students or students with special educational needs [41]. The existence of such misconceptions is also confirmed by a survey of teachers at the Borys Grinchenko Kyiv Metropolitan University, where 42% of respondents chose the answer that differentiated instruction involves the selection of individual materials, forms of work, and control for each student, and 22% of respondents chose the answer that it is a method designed for teaching weak students or students with special needs (figure 2).

How do you understand the concept of differentiated instruction?

Response	Average	Total
This approach takes into account the readiness level, learning style and individual needs of students	84%	61
This is an opportunity to use different methods and forms of work for different categories of students	74%	54
This is a method designed for teaching weak students or students with special educational needs	22%	16
This is a course that divides students into level groups	32%	23
This is a method that involves selecting individual materials, forms of work and assessment for each student	42%	31

Figure 2: Teachers' understanding of the concept of differentiated instruction (survey results).

The results of teacher surveys in 2023 (figure 3) and 2025 (figure 4) revealed the following difficulties in implementing differentiated instruction: increased workload for teachers due to the need to develop more materials, ensuring fair assessment of students, lack of time for implementation within the course program, complexity of organising the educational process and knowledge control, insufficient knowledge of the capabilities of the e-learning system for implementing differentiated instruction.

Teachers note that implementing differentiated instruction requires the design of alternative learning resources and tasks adapted to different levels of preparation, learning styles, and educational needs of students. This significantly increases the time required for preparation, especially in the early

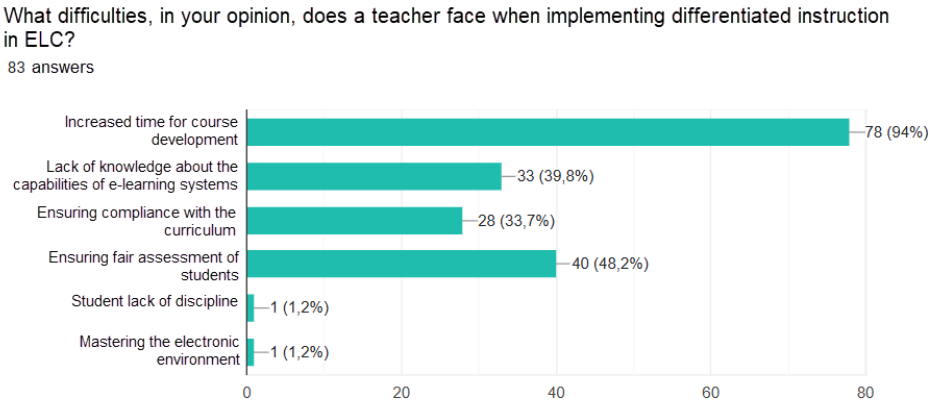

Figure 3: Difficulties in implementing differentiated learning (results of the 2023 survey).

What are the main challenges you see in implementing differentiated instruction? (select up to 5 most significant ones)

Response	Average	Total
High workload for teachers due to the need to prepare materials for different levels	94%	68
The complexity of organising the educational process and monitoring task completion	51%	37
Lack of necessary technical equipment or digital resources	10%	7
Resistance from students accustomed to traditional teaching methods	17%	12
Insufficient support from the administration of the HEI	1%	1
Lack of time to implement a differentiated approach within the course programme	65%	47
Difficulties in assessing learning outcomes across different trajectories	40%	29
Insufficient level of teacher training for the implementation of differentiated instruction	28%	20
Lack of ready-made methodological recommendations or examples of successful implementation	28%	20
Other	1%	1

Figure 4: Challenges in implementing differentiated learning (results of the 2025 survey).

stages of implementation, when there is still no ready-made base of materials. Artificial intelligence opens up new possibilities for implementing differentiated instruction, as it enables the automation and personalisation of creating educational content in line with learners' knowledge levels, learning styles and needs, and tailored to e-learning system activities. AI supports differentiated instruction by enabling the creation of adaptive tasks, the structure of which is dynamically adjusted in response to learners' performance, and by providing personalised feedback tailored to individual strengths and challenges. These technologies reduce instructors' workload through the automated generation of alternative materials, task variations, and assessment rubrics, while maintaining transparency and flexibility in evaluation. AI-driven learning analytics further allow the identification of patterns in student engagement and achievement, offering evidence-based insights for the individualisation of the learning process. However, the effective integration of AI requires careful instructional design and rigorous validation of the reliability and pedagogical value of AI-generated content. In 2025, some respondents noted that using Moodle tools (e.g., restricting access, groupings, and adaptive lectures) partially facilitates the implementation of differentiated instruction. However, the need for additional methodological and technical support remains. In this context, training educators to integrate artificial

intelligence with Moodle to create differentiated instruction materials offers a promising avenue for enhancing instructional design and support.

The differentiation of tasks and learning outcomes complicates the assessment process, as students perform work that varies in form and complexity. Teachers emphasised the difficulty of ensuring uniform criteria, considering individual educational trajectories. In 2023, this issue was identified as one of the main problems (48.2% of respondents), and in 2025, the issue of difficulties in assessing differentiated tasks remains relevant (40% of respondents). One of the ways to address these challenges is through differentiated assessment in Moodle, which provides multiple tools for implementing flexible evaluation strategies. These include using rubrics, assessment guides, and advanced gradebook settings, allowing teachers to tailor evaluation criteria to the complexity and type of student work. However, most teachers are not familiar with the full range of Moodle's assessment functionalities, particularly rubrics, detailed grading instructions, and complex gradebook configurations. It should be noted that teachers do not necessarily need to perform the technical setup of e-learning courses themselves; administrators and LMS managers can be involved in these tasks. Nevertheless, having a clear understanding of Moodle's capabilities is crucial for teachers to accurately formulate assessment requirements for technical specialists and ensure that differentiated evaluation is implemented effectively.

The limited number of academic hours within the curriculum is a significant barrier to implementing differentiated instruction. Teachers point out that working on topics that consider students' individual needs requires more time than is allocated by the programme. The training conducted in 2025 aimed to alleviate the problem by using asynchronous activities in Moodle, which allow students to work at their own pace. However, balancing programme requirements and individualisation of learning remains open. Creating conditional logic for access to resources and activities, organising flexible groups, and parallel learning scenarios are time-consuming processes. In addition, managing many parameters in a course requires a high level of technical knowledge and time for constant monitoring. Knowledge assessment in such conditions is also complicated, despite the possibility of using rubrics and adaptive tests, as their development requires significant resources and regular analysis of results. Survey results show that in 2023, a significant proportion of teachers did not understand Moodle tools to implement differentiation (33.7% of respondents). In 2025, the situation improved slightly due to training, in particular through familiarisation with the possibilities of adaptive lectures, groupings, access conditions, rubrics and monitoring tools. Despite the positive dynamics, some respondents (28%) still need further support and practical examples of using the platform to implement differentiated strategies. Similar difficulties have also been confirmed by research [42], which identified the following barriers to implementing differentiated instruction: restrictions imposed by educational programs; heavy workloads for teachers; lack of time; complexity of implementation; and insufficient professional development programs on differentiated instruction. At the same time, teachers also note the need to take into account the diversity of students (figure 5, 6): 98.8% of respondents to the 2023 survey stated the need to at least sometimes adapt teaching materials to the abilities and needs of students; 93% of respondents to the 2025 survey noted the moderate or very high relevance of implementing differentiated instruction.

The digital transformation of modern education, accelerated by the Covid-19 pandemic and the need to ensure quality education during martial law in Ukraine, necessitates implementing online or blended learning. LMS platforms, such as Moodle, create conditions for targeted consideration of individual educational needs, learning styles, knowledge acquisition levels, and student preparation thanks to built-in content adaptation capabilities, flexible access management, assessment variability, and feedback. Accordingly, under the current conditions, in order to implement differentiated instruction, teachers must not only have a comprehensive understanding of the conceptual foundations of differentiated instruction but also master the tools and strategies that allow them to effectively design, implement, and evaluate differentiated educational pathways in the modern digital environment. The experience of teaching students using the Moodle LMS largely depends on the level of digital competence of the teachers who create the ELC. Most teachers use Moodle LMS to post learning materials and announcements, viewing it primarily as a 'centralised repository' for content rather than a full-fledged environment for organising educational activities. Despite the availability of interactive tools in

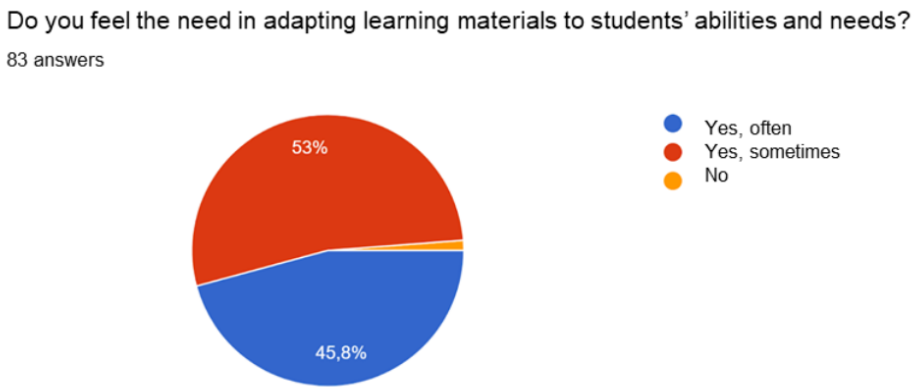

Figure 5: The need to adapt teaching materials to students' needs (results of the 2023 survey).

How relevant do you think the need for differentiated instruction is in your educational practice?

Response	Average	Total
Very high - students have different levels of preparation, and their needs must be taken into account	53%	39
Moderate - there are differences in knowledge levels, but they are not critical	40%	29
Low - most students have a similar level of preparation, so there is no urgent need	4%	3
Not relevant at all - all students work according to a single programme and have the same opportunities	1%	1

Figure 6: Relevance of implementing differentiated learning (results of the 2025 survey).

the system (forum, chat, feedback, etc.), teachers often limit themselves to one-way communication with students and use alternative means of communication. In addition, a common problem is the unstructured placement of educational materials, which complicates navigation and access to resources for students [43].

The effective implementation of differentiated instruction in LMS Moodle requires targeted professional development for teachers, combining the development of digital and pedagogical competencies. When developing a professional development programme for the digital module on implementing differentiated learning in Moodle LMS, it is essential to rely on the theoretical foundations of differentiated learning to avoid incorrect interpretations of this approach, as mentioned above, directions, strategies and methods of implementing differentiation, LMS Moodle tools that can be used to implement differentiated instruction, and the stages of implementing differentiated instruction in LMS Moodle. The professional development programme for scientific and pedagogical workers, 'LMS Moodle as a means of implementing differentiated instruction' [44], developed and approved at the Borys Grinchenko Kyiv Metropolitan University, takes these aspects into account and has the following content:

TOPIC 1. Introduction to differentiated instruction: theoretical foundations and modern approaches

- Overview of the concept of differentiated instruction
- Challenges and benefits of implementing a differentiated approach in the educational process

TOPIC 2. Moodle LMS capabilities for implementing differentiated instruction

- Tools for creating adaptive learning materials in Moodle
- Configuring the course structure for working with differentiated groups of students

TOPIC 3. Creating and managing differentiated learning activities and resources in Moodle

- Using Moodle activities and resources to ensure a differentiated approach
- Organising group projects and forums for students with different learning styles
- Setting up access conditions to resources depending on student achievement and progress

TOPIC 4. Monitoring and analysing student learning activity in Moodle

- Identifying students' educational needs based on Moodle data
- Using feedback tools for effective interaction with students
- Using reports and analytical tools to assess learning outcomes.

The professional development program, 'LMS Moodle as a means of implementing differentiated instruction', aligns with the key principles of universal learning design. Topic 1 establishes the methodological foundations by promoting an understanding of the principles of differentiation and inclusiveness. These principles form the basis for organising the learning process to consider diverse educational needs. Topics 2 and 3 focus on developing the practical skills needed to design and implement differentiated learning materials, organise flexible groups and configure access conditions. This ensures the learning experience is tailored to different student styles and levels. Topic 4 covers the analysis of educational data, progress monitoring and course adaptation to support a reflective approach and the continuous improvement of the learning process. Thus, the program helps teachers develop the necessary competencies to implement universal design principles for learning in the Moodle LMS e-learning environment.

An ELC was developed based on the professional development program, and training was conducted, which was attended by 101 scientific and pedagogical staff members of Borys Grinchenko Kyiv Metropolitan University. As the program allows training to be adapted to participants' level of digital competence and goals and needs, data from the 'ELC: Basics of Organising Differentiated Instruction' training course survey, conducted in February 2023, was used to develop the ELC. This included useful topics (figure 7), LMS Moodle activities (figure 8) and effective differentiation approaches (figure 9).

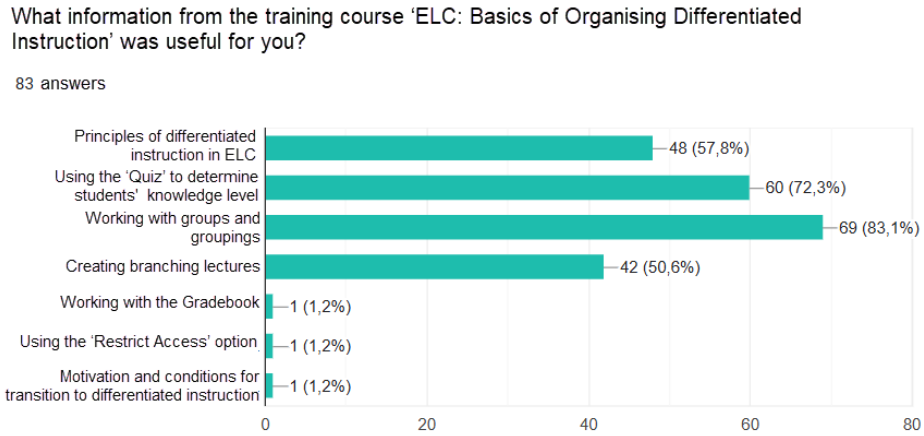

Figure 7: Identification of useful topics for the implementation of differentiated instruction (results of the 2023 survey).

In particular, the most useful topics were identified as working with groups and groupings, using tests to determine students' level of knowledge, the principles of differentiated instruction and the creation of branched lectures. At the same time, the most popular activities and resources were Assignment, Test, Lesson and Forum. Regarding approaches to differentiation, respondents positively assessed the possibility of creating materials of varying levels of complexity, using restricted access to personalise learning trajectories, and organising flexible group tasks that consider students' learning styles.

The course program included online training in Zoom, which combined theoretical and practical material, interactive communication in the ELC created to support the program (figure 10).

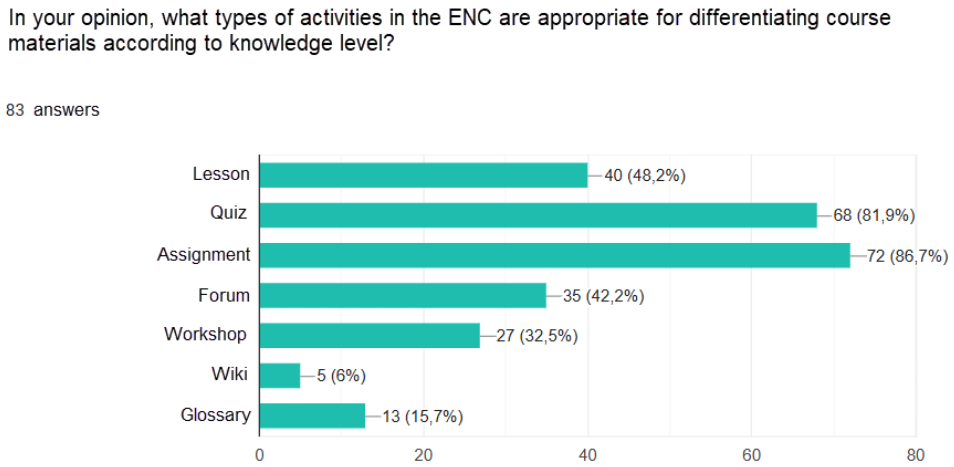

Figure 8: Activities in Moodle LMS that teachers prefer for implementing differentiated instruction (results of a 2023 survey).

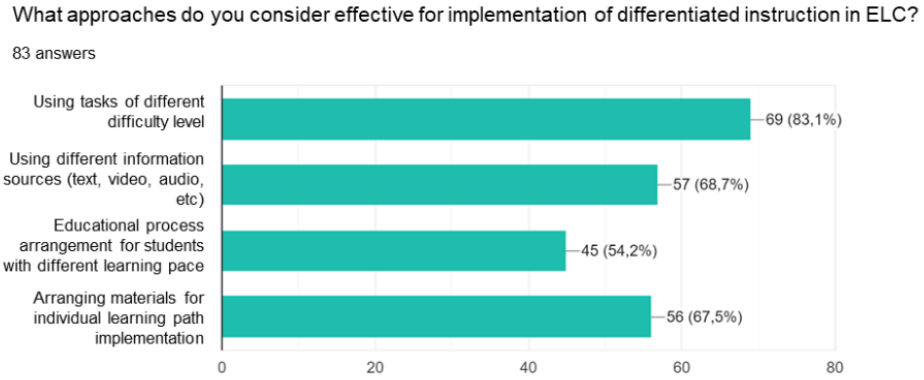

Figure 9: Effective techniques for implementing differentiated instruction (results of the 2023 survey).

Teachers could work through practical materials in the ELC in a synchronous format tailored to the subjects they teach. This enabled them to implement the teaching materials and work with students immediately. This way, the professional development programme's training was adapted to the real needs of scientific and pedagogical workers and existing disciplines. The ELC "LMS Moodle, as a means of implementing differentiated instruction", used the "Choice" and "Attendance" resources, as well as separate sections for organising the educational process, activities, and resources such as "Zoom meeting", "Forum", and "Board", to ensure communication. It also used the "Lessons" activity, the "URLs" resource, and embedded videos to provide theoretical materials; the "Assignment" activity to ensure the completion of practical tasks; and the "Questionnaire" resource to ensure feedback (figure 11, 12).

The conditions for completing the professional training programme 'LMS Moodle as a means of implementing differentiated instruction' were participation in the online training, completion of practical tasks 'Creating adaptive lectures in LMS Moodle' and 'Setting accessibility restrictions', and completion of a questionnaire based on the course results. To ensure progress tracking in the ELC, a 'Completion Progress' block has been set up. Participants who fully completed the course requirements received awards. Of the 101 participants in the professional training programme, 67 received awards (figure 13) (66 of them within the established time frame), as confirmed by Order No. 196 of 27 March 2025 [45].

Participants in the professional development programme noted that the most helpful part of the training was practising practical skills in using Moodle tools for differentiated instruction (figure 14). In particular, participants noted that they gained experience working with LMS Moodle tools that they had not used before, had the opportunity to evaluate the e-learning system from the students' point of

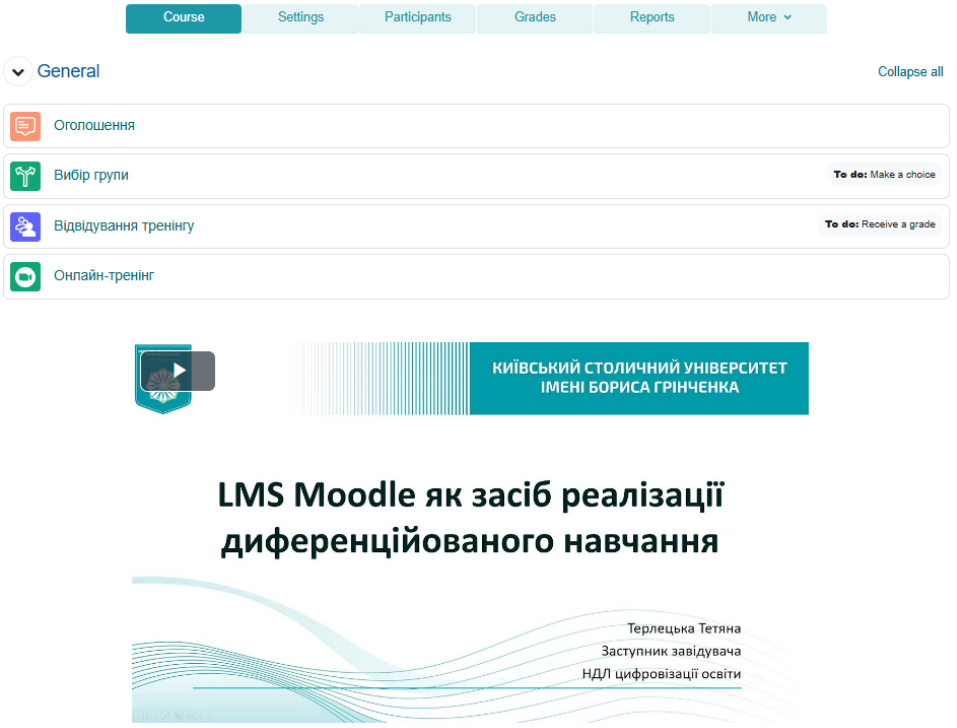

Figure 10: ELC 'LMS Moodle as a means of implementing differentiated instruction'.

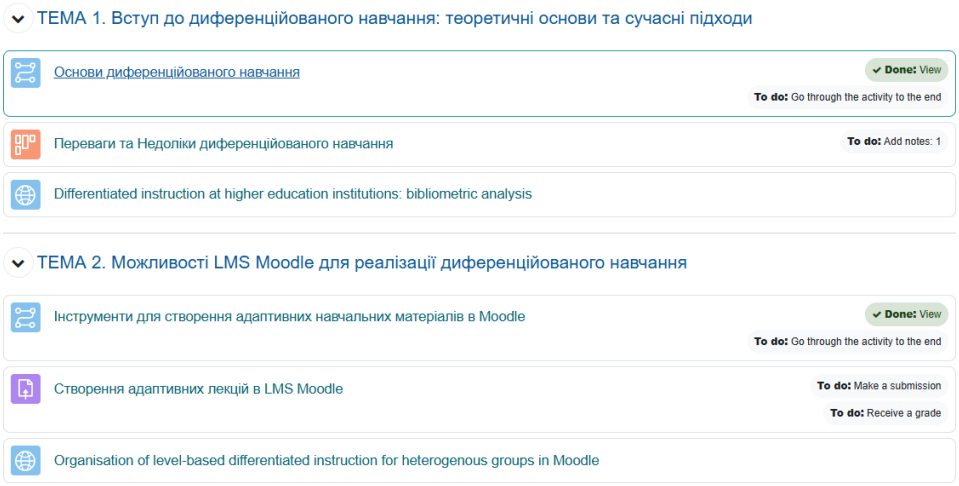

Figure 11: Topic 1 and Topic 2 in the ELC 'LMS Moodle as a means of implementing differentiated instruction'.

view, and discovered new possibilities for using the "Lesson" activity, groups and groupings, etc.

Among the difficulties encountered during the implementation of the professional development programme, it is worth noting the varying levels of digital competence among teachers, particularly in their proficiency in using Moodle tools. Providing additional materials in the ELC in the form of videos, text lectures with graphic elements, and individual and group support in synchronous and asynchronous modes partially ensured differentiation in knowledge levels and learning styles. However, the practical tasks were mostly focused on the basic level of knowledge of the e-learning system, so the authors plan to expand the range of tasks in the future to engage more advanced users better.

Among the topics that participants would like to explore in detail in future training sessions on differentiated instruction, it is worth noting the use of artificial intelligence, advanced Moodle LMS settings, monitoring and evaluating student progress, and methods for effective feedback (figure 15).

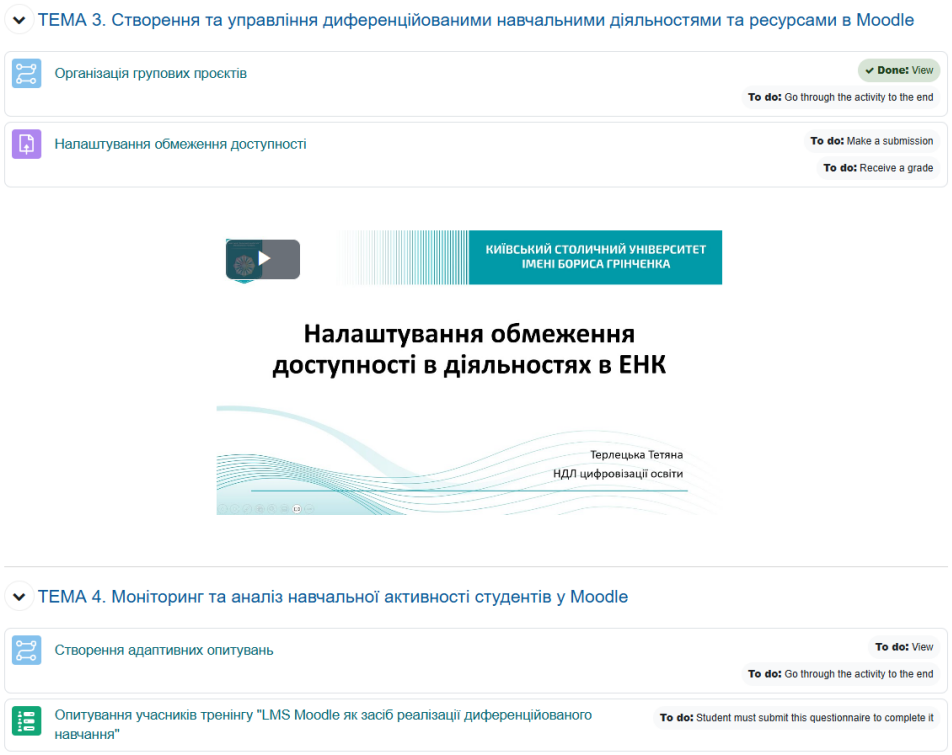

Figure 12: Topic 3 and Topic 4 in the ELC 'LMS Moodle as a means of implementing differentiated instruction'.

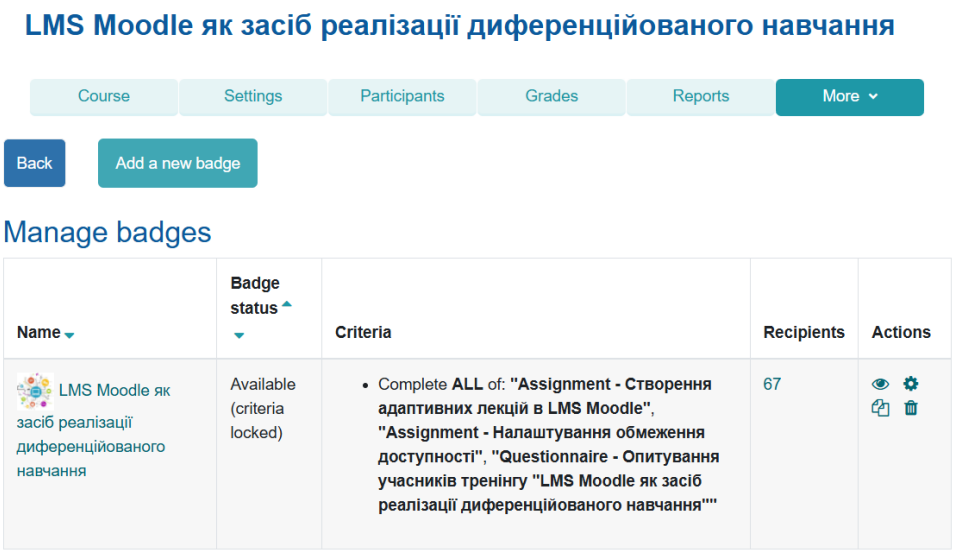

Figure 13: Badge in ELC 'LMS Moodle as a means of implementing differentiated instruction'.

6. Conclusions

This study highlights the crucial theoretical and methodological foundations underpinning the implementation of differentiated instruction within digital educational environments. The analysis confirms that differentiated instruction in LMS Moodle requires a comprehensive understanding of pedagogical principles, universal design for learning, and digital platforms' capabilities to support adaptive, flexible, and personalised educational trajectories.

Furthermore, the findings emphasise that university educators must acquire specific digital skills and pedagogical knowledge to effectively implement differentiated instruction using LMS Moodle. These

What was most valuable for you in this training?		
Response	**Average**	**Total**
Practical skills in using Moodle tools for differentiated instruction	96%	70
Ability to tailor educational resources to student needs	49%	36
Tools for identifying student needs and providing feedback	34%	25
New approaches to the organisation of the educational process	40%	29
Communication and ideas exchange with colleagues	34%	25

Figure 14: Assessment of selected aspects of online training within the framework of the professional development program "LMS Moodle as a means of implementing differentiated instruction".

What topics would you like to explore in more depth in future training sessions?		
Response	**Average**	**Total**
Advanced Moodle settings	58%	42
Using artificial intelligence for differentiated instruction	73%	53
Methods for effective feedback	44%	32
Monitoring and evaluating student progress	48%	35
Not interested in training on similar topics	1%	1

Figure 15: Selection of topics for future training sessions by participants in the professional development program.

competencies include designing and managing adaptive content, organising flexible student groupings, employing varied assessment strategies, and utilising learning analytics for ongoing course adaptation.

The professional development program examined demonstrates the potential to build these essential competencies, thus facilitating educators' readiness to respond to diverse learner needs in a digitally transformed higher education context.

Several limitations of this study should be acknowledged. First, the research was conducted as a single case study within one institution, which restricts the applicability of the findings to other higher education contexts. Second, although the study includes survey data from 2023 and 2025, which provides insights into shifts in teaching practices, the evidence is based primarily on self-reported participant feedback. Such data reflect educators' perceptions and experiences but do not allow for a comprehensive measurement of actual changes in classroom practices or student learning outcomes. Third, the evaluation was limited to the immediate outcomes of the training program, without assessing its long-term impact on educators' professional growth or student learning results. Additionally, the study focused exclusively on using LMS Moodle, which may limit the applicability of the findings to institutions employing other learning management systems.

Future research should address these limitations by conducting longitudinal studies across multiple institutions and integrating objective teaching effectiveness and student achievement indicators. In this regard, exploring the long-term impacts of such training programs on teaching practices and student outcomes is also recommended. Furthermore, investigating the integration of advanced learning analytics and AI-driven adaptive learning systems could deepen the personalisation of differentiated instruction. Finally, examining barriers and enablers to the widespread adoption of differentiated teaching strategies in diverse institutional contexts would provide valuable insights for scaling effective digital transformation initiatives in higher education.

Author contributions

Conceptualization, Nataliia Morze and Tetiana Terletska; methodology, Tetiana Terletska; writing –

original draft preparation, Tetiana Terletska; writing – review and editing, Nataliia Morze; resources, Tetiana Terletska; supervision, Nataliia Morze. All authors have read and agreed to the published version of the manuscript.

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Data availability statement

No new data were created or analysed during this study. Data sharing is not applicable.

Conflicts of interest

The authors declare no conflict of interest.

Declaration on Generative AI

During the preparation of this work, the authors used DeepL Translate for translation purposes, Grammarly for grammar and spelling check, and MyBib for reference formation. After using these tools/services, the authors reviewed and edited the content as needed and take full responsibility for the publication's content.

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