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Assessing the effectiveness and potential of modular education in higher learning institutions

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Abstract

The global health crisis in early 2020 disrupted conventional teaching methods, prompting a rapid shift toward alternative instructional models. This study investigates the effectiveness of the modular learning approach introduced during the pandemic and seeks to identify an optimal methodological framework for its implementation in higher education. The research employed theoretical and comparative analysis, observation, survey methods, and didactic design to explore how modular learning influenced student training quality. Findings indicate that the modular approach contributed positively to the organization and delivery of academic content, supporting student engagement and learning continuity during a period of crisis. Furthermore, the study highlights critical elements for structuring this methodology effectively, emphasizing the importance of flexibility, autonomy, and coherence in learning design. These insights offer practical value for university educators and education planners aiming to refine instructional strategies in both emergency and long-term contexts.

Keywords: Active learning; higher education; instructional design; modular teaching; pandemic pedagogy

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1. INTRODUCTION

In the first quarter of the year 2020, governments worldwide imposed quarantines and social distancing practices as health measures to cope with the COVID-19 spread. These worldwide restrictions affected higher education all over the world, and Kazakhstan is no exception. At that moment, Kazakhstan universities were moving from traditional face-to-face education to online modality, and the unexpected challenge faced during the pandemic made universities search for new applicable effective methods to rationally organize and manage the educational process without any quality loss. All these required universities and students to rapidly master the use of learning management systems such as Moodle, Blackboard, Brightspace and Google Education among others, and distance learning communication software products like Zoom, Adobe Connect, Skype and Teams to name a few (Qi, 2025; Palanci et al., 2024).

Among successful online teaching strategies, the modular-based approach has been identified as an effective way of organizing the learning process. This approach presents content in a block-modular format, where the information is structured in distinct modules. According to Asrorova (2016), the essence of modular learning lies in its structure, which consists of methodological blocks or modules. The content and scope of these modules can vary based on didactic objectives, the training level of the students, and their interests and needs. These variables constitute an individualized trajectory within the coursework, making modular learning particularly advantageous in the context of the pandemic.

At the university level, modular technology became popular in the United States, Germany, the United Kingdom, and other countries during the early 1960s. Pioneers of modular learning (Ramsden, 2003; Russell & Lube, 1974; Stewart & Wilkerson, 1999) emphasize its significance in activating cognitive activity by offering students a degree of academic freedom. This freedom includes choices of topics, learning pace, and tools. Consequently, the components of the modular learning system can be characterized by content, time flexibility, and the individualization of the learning process, with advantages such as flexibility and variability.

The autonomy provided by modular learning, in terms of content and tools, allows teachers to highlight its advantages over traditional methods. This autonomy fosters responsibility and awareness, both in students' academic and personal development. Jayasree (2004) notes that the principles of modular learning are not in opposition to general didactic principles but represent new facets that emerge with the reorganization of the learning process. Therefore, it can be concluded that the modular approach is a natural progression in the evolution of pedagogical theory, driven by societal advancements in scientific and technological progress.

However, in many cases, the application of modular technology is often carried out on an empirical basis, based on teachers' experience and the theory of simulation modelling. There is a theoretical gap in the development of modular learning within engineering education. As a result, this educational approach is often implemented in an unrefined and theoretical form, leading to certain challenges and errors. These shortcomings may diminish or distort the overall effectiveness of the technology itself (Ambayon & Millenes, 2020). This highlights the need for the development of a conceptual framework for modular learning. Creating appropriate didactic tools grounded in scientific theory would enhance the effectiveness of modular learning across various educational fields. The potential of modular learning is evident in its ability to differentiate teaching methods and tools, stimulate students' cognitive activity, offer flexibility, promote an individualized pace of work, foster creative development, and encourage personal responsibility in professional development.

Given these facts, there is a clear, practical need to implement the modular learning approach in university education. This study seeks to address the following questions: What teaching and learning conditions are necessary to effectively apply the modular approach in virtual educational environments? How can modular learning be used most effectively in virtual classrooms? What variables influence the development and success of the modular approach?

The study is based on the hypothesis that learning effectiveness, in terms of motivation and learning outcomes, will improve when interdisciplinary courses are structured using modular learning technology. This technology emphasizes academic freedom, variability in working methods, and individualized pacing for

assignments. This hypothesis will be tested in the course of the research.

The paper focuses on the case of West Kazakhstan University named after Makhambet Utemisov, Faculty of Education, which serves as the experimental base for this study. The research aims to: (a) analyze the effectiveness of the modular approach for teaching and learning during the pandemic, and (b) identify the optimal methodological model for organizing the study process to adequately implement this teaching approach. To achieve these goals, the conditions of the educational process will be examined in detail, with the design of educational course content organized in a modular learning format. Surveys of both teachers and students will be used to assess learning outcomes and draw conclusions about the success of modular learning in addressing didactic tasks.

The research findings will contribute to solving key educational challenges, improving teaching and learning methods, and enhancing the online education process by leveraging technology during the pandemic.

1.1. Literature review

1.1.1. Pandemic challenges in higher education

The higher education crisis triggered by the pandemic has led to the largest global shift to online education in human history. This abrupt transition from traditional classroom settings in numerous regions around the world has forced universities to adopt virtual and digital learning modes. This shift has become a significant topic of discussion among scholars in recent times.

Currently, QS, Educations.com, and StudyPortals (DAAD, 2020) are conducting three international surveys of university staff and students on the impact of COVID-19 on their study or mobility plans. The findings of these surveys are being presented through web talks and blogs. However, there is a limited number of empirical academic studies published on this phenomenon. Research dedicated to understanding how online distance learning during the COVID-19 lockdown has impacted academic practices in higher education is still sparse.

One of the earliest studies by Bozkurt et al. (2020) reported the impact of the educational disruption caused by the COVID-19 pandemic in 31 countries. The study highlighted major recurring themes, including the inequities and digital divides exacerbated by the pandemic, the need for alternative assessment and evaluation methods, the transition to formative assessment through synchronous and asynchronous means, and the adoption of online proctoring services to combat academic dishonesty.

Furthermore, Hjelsvold et al. (2020) conducted one of the first studies investigating educators' feedback on distance learning during the COVID-19 lockdown. The survey, which included 303 university students and 56 educators in Norway, identified several pressing challenges: the lack of preparation time and readily available resources, teachers' inexperience with online education, curricula that were slow to adapt to online formats, students' inadequate preparation for online study, and the need for the development of new formative and summative assessment methods.

Consequently, the pandemic has starkly exposed the fragility of educational systems worldwide, even in countries considered relatively stable. Traditional classroom settings have disappeared, disrupting the daily routines of all those involved in the educational process. Teachers' adaptability has been tested beyond reasonable expectations as they worked to create conducive learning environments for all students, while simultaneously striving to maintain academic progress. Therefore, the innovation and digitalization catalyzed by this crisis must be leveraged to make educational systems more just, inclusive, and resilient (Aflalo et al., 2024). The need for more flexible and content-responsive curricula has become an urgent concern among educators. Additionally, strategies to maintain, engage, and motivate students to continue learning have emerged as priorities for teachers.

Daniel (2020) affirms that, in increasing their capacity to teach remotely, institutions should maximize the use of asynchronous learning, which is well-suited to digital formats. However, digital formats must be integrated into a comprehensive educational system that includes remote teaching platforms, such as Zoom.

Daniel (2020) also analyzed the challenges faced by higher education institutions during the COVID-19 crisis. Key preparation measures identified included: (a) ensuring students have access to the necessary study materials at home, (b) preparing curriculum content as mobile and flexible learning resources, (c) providing all students with access to learning materials, (d) developing teaching methods and materials focused on skill-building rather than content delivery, (e) selecting manageable learning modalities, (f) fostering student interaction in groups, and (g) ensuring ongoing staff training and support mechanisms for teachers.

Although many institutions had plans to incorporate technology more extensively in teaching, the outbreak of COVID-19 forced these changes to be implemented within a matter of months rather than over several years. As a result, the modular-based learning model was proposed as a hybrid approach, combining traditional (face-to-face) and distance education. This model allows students to follow an individualized study trajectory at their own pace, with supervision and guidance from a teacher.

1.1.2. Background history of modular technology

Over the last two decades, the idea of modular learning has been a fairly frequent topic of discussion in educational research (Ambayon & Millenes 2020; Bennett, 2011; Cheng et al., 2017; Sadiq & Zamir, 2014; Stewart & Wilkerson, 1999). However, as early as the end of the last century, 'module' –as a component of an educational program– began to appear in the terminology of educational institutions.

The ideas of modular teaching originated from Skinner´s work and were theoretically justified and developed in Russell's (1987) and Owens' (1970) research. The impetus for using modular technology started at the UNESCO conference held in Paris in 1989. The conference pioneered the idea of 'open and flexible structures for education and training, which can adapt to the changing production needs of science and local conditions. Modular learning technology was proposed as a tool and became the object of study and experimentation for the next 50 years. The notion of 'open and flexible learning structures' takes on particular relevance at a forced isolation around the world due to COVID-19.

Retrospective analysis has shown that researchers' interest in modular learning was due to different objectives at different times, considering a modular organization of learning material, to enable students to work at a pace that suits them, which would ensure a better level of knowledge acquisition. Thus, Russell (1987) defines the module as an instructional package dealing with a single conceptual unit of the learning material and actions prescribed to the students. Modular learning is an opportunity to develop students' independence and responsibility, to develop the qualities that allow them to analyze their own experience and assess their strengths and weaknesses, and to take corrective action by studying supportive or corrective modules.

Other researchers sought to integrate different learning methods and forms into a design flexible problem-modular instructional systems aimed at achieving a high level of student readiness for professional activities, and characterized the module as a 'functional unit' which is a complete block of information (Jutsjavichene,1990). Interdisciplinary links and found solutions were identified by special departments in higher education.

On the other hand, Lopukhova (2017) explains that modular technology is a way of assembling individual subject knowledge blocks. This creates a more comfortable environment for incremental knowledge building. A module is seen as a set of learning opportunities organized around a clearly defined topic or block that contains specific objectives, learning activities, and assessment using criterion-based measurement.

The main difference between the modular learning system and the traditional one is the independent analytical approach to the study of a particular professional discipline, in which the design of the knowledge and skills accumulation process is based on the assessment of one's own resources and, importantly, personal interest. If we refer to the format of traditional learning, it looks as follows (Figure 1).

Figure 1

Traditional classroom model

Traditional classroom model	Lecture
	I-R-E discussion (Initiate-Response-Evaluation)
	Individual study
	Textbook reading
	Laboratory (practice)
	Laboratory report
	Test (assessment)

However, an alternative modular learning model focused on the development of analytical skills that implies critical thinking, autonomy and responsibility has as its main didactic objective the creation of conditions for student-centered learning. This model would look like this (Figure 2).

Figure 2

Modular-based model

Modular-based model	Setting a task (subject knowledge unit)	Teacher's guidance
	Providing access to relevant materials and resources	
	Data mining	
	Data evaluation	
	Engaging in argument from evidence	
	Collaborative learning in groups	
	Sense-making solutions	
	Questions-answers part	
	Embedded assessment	

Based on these stages of learning organization, there is a clear shift from the teacher's active role to the student's active work, which is consistent with the principles of individualization and differentiation. These principles are becoming increasingly relevant in today's higher education world, especially in pandemic times.

Thus, the module, as a reproducible learning cycle, has a design consisting of three structural parts: introductory (theoretical), active (practical) and final (evaluative). Modular learning is a set of pedagogical conditions determining the selection and arrangement on a modular basis of content, forms, methods and means of learning, providing comfortable teacher-student relations in the achieving educational goals process when mastering knowledge, to form professional and personal qualities in future professionals for successful careers (Golchevskiy, 2010).

Thus, the essence of modular learning is that learning is structured into organizational and methodological blocks or modules, the content and scope may vary depending on didactic objectives, profile and level differentiation, as well as the wishes of students, taking into account the choice of individual trajectory of the course.

In its turn, the didactic system of modular training is based on the integration of the principles of individualization, differentiation, self-organization, and contextuality, which allows ensuring the formation of a certain professional level of the future specialist's competence. This quality of professional competence, which has a development potential based on independent learning and continuous professional development, can have an effective impact on the specialist's new formation training, which consists of the ability to create and operate new technology generations to maintain and independently develop the professional knowledge level. Hence, the new paradigm of university education is based on pedagogical technologies that focus on the formation of practical skills and abilities, which allow specialists to be competitive in the intellectual labor market.

The notion of competitiveness in modern technological society trends goes beyond standard subject knowledge and professionalism, and requires a new competencies format from graduates, including flexible

skills and adaptability to changes and unstable conditions, multitasking skills, and strategic planning, in addition to subject competencies. For pedagogical knowledge and university education management, Cheng & Bakar (2017) and Ambayon & Millenes (2020) believe that varied learning based on informed choice of content and tools can move beyond the traditional professional knowledge system, which corresponds to the idea of modular learning.

1.1.3. Modular learning

A module is a training unit that consists of a standardized set designed to facilitate effective learning. It includes learning objectives, in this case, intermediate-level objectives that guide the learning process. The module also outlines a list of necessary equipment, materials, and tools required to carry out the module, as well as the training material that helps students understand the subject matter. Guidelines for practical and laboratory exercises are provided to help students practice the relevant skills and competencies associated with the module, along with tests and quizzes to evaluate their understanding and mastery of the content.

The components of modular learning are not rigidly fixed and may vary depending on several factors. These factors include the specific discipline being taught, the level of education, the preparedness of students, and the personal and professional experience of the teacher. Despite these variations, the unchangeable components of modular learning are the modular program itself, which consists of individual modules. This program is designed to develop students' independent cognitive activity and is structured in alignment with the logic of acquiring new knowledge. The modules are connected logically according to the specific knowledge and skills required for the subject being taught.

The overall structure of a modular program is shown in Figure 3. In this structure, each discipline, as chosen by the developers, is divided into blocks or modules. Each block serves as a complete element that meets intermediate learning objectives and achieves specific learning outcomes, as further illustrated in Figure 4.

Figure 3

General structure of the modular program

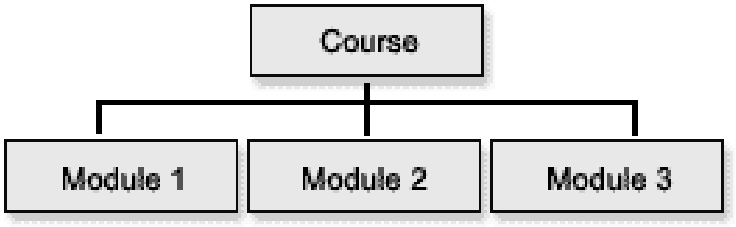
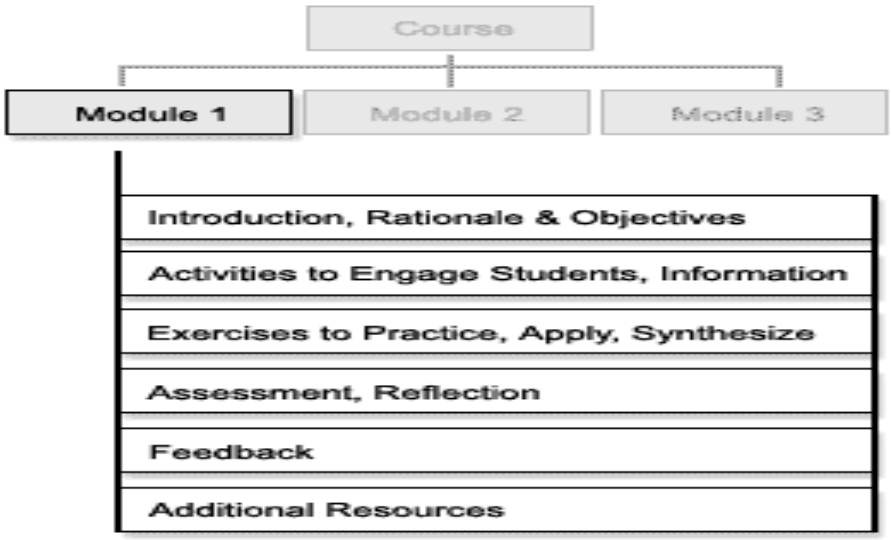


Figure 4

General structure of the training module

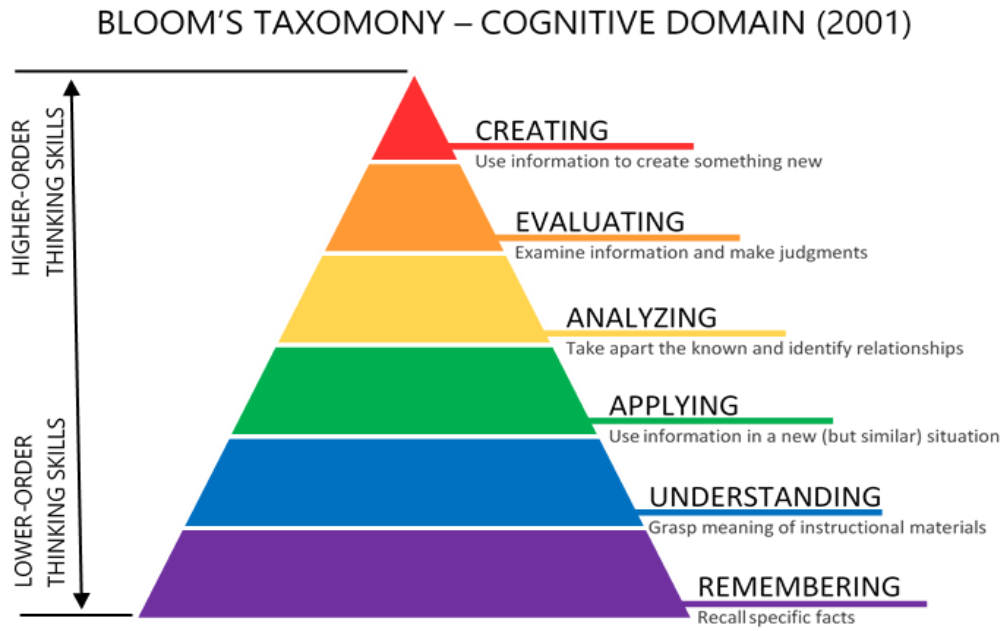


(Typical components of a module.)

The structure of the learning module aligns with Bloom's taxonomy (Figure 5), developed by scholars at the University of Chicago in 1956, which presents a hierarchy of cognitive processes: remembering, understanding, applying, analyzing, synthesizing, evaluating, and creating (Figure 5).
In modular learning, the teacher's role and position within the learning process undergo a fundamental transformation. The teacher's responsibility is to motivate students, manage their learning activities throughout the module, and fulfill the teaching mission through consultation. In the case of a complete transition to modular learning, an essential component is the credit system for knowledge assessment, which utilizes a points-based evaluation to gauge learning effectiveness and student progress. The benefit of credit assessment in modular learning lies in its capacity to foster student independence and responsibility in constructing their own learning path. Within their designated area of responsibility, students understand from the outset the required tasks for successful course completion and the number of credits necessary to successfully conclude the semester.

Figure 5

Bloom's taxonomy



The second most important component determining the high didactic value of modular learning is its flexibility in managing processes, in particular the processes of updating and renewing, and sometimes completely replacing, the learning material. The flexibility of content, which includes professional content, is

very important both during the dynamism of knowledge domains and during 'forced' distance learning (Marasigan, 2021).

The Zoom-era has shown that the time spent on learning material is reduced many times over, mainly due to the individual and synchronous pace of work. The mobility of a module as a unit of an educational course or as a variation of an educational program (when the module is of an applied and extracurricular nature) is achieved by replacing obsolete module units with new ones that contain new and future-oriented information, hence, student learning management is minimal and significantly optimized.

However, despite its obvious advantages, modular learning has several disadvantages (Lysenko & Tokareva, 2021). The main disadvantages are as follows: the introduction of modular training requires significant organizational restructuring of the traditional educational process, in particular, preparation of appropriate teaching and learning facilities; changes in teachers' work planning; and optimal composition (in quantitative terms) of student groups and streams taking into account the capabilities of teaching and learning facilities, development of necessary methodological support, and organization of evaluation procedures.

1.1.4. Description of the modular learning experiment – the case of the university of Kazakhstan

A higher degree of inertia to change exists within educational systems compared to the development of society and its technological advancements. The issue of inertia has been documented by White and Ruth-Sahd (2020), Biesta and Priestley (2013), Jónasson (2016), and Reimers and Chung (2019), among others, who have explored strategies to accelerate modernization and enhance education's responsiveness to market and technological changes. The integration of academic disciplines, alongside theoretical and practical knowledge, has been proposed as a potential solution.

Two distinct lines of integration are identified: 'from education to science' and 'from science to education.' It is acknowledged that university professors predominantly engage in teaching activities, whereas researchers, despite possessing valuable expertise, are less frequently involved in teaching, which could benefit future graduates. Recently, both teachers and academics have concurred on the potential value of establishing 'collaborative centers' to facilitate the integration of scientific and educational efforts. These centers are envisioned as platforms for career guidance, supporting the development of future professionals' ambitions and providing insight into prospective fields of study and production areas. Students with a keen interest in science could participate in ongoing research, positioning themselves to become skilled specialists and contribute to the scientific workforce.

1.2. Purpose of study

As explained before, this study focuses on a modular-based approach at the tertiary level, considering the education and scientific integration in future professionals. The experimental training aims to test the previously proposed hypothesis: learning effectiveness will increase in terms of motivation and learning outcomes if interdisciplinary courses based on modular learning technology, which implies freedom of academic choice, variability of working methods, and individual pace of assignments, are developed.

2. METHOD AND MATERIALS

2.1. Research design

The study is based on: (a) scientific and methodological foundations of modular technology, (b) principles of modular technology considering the following variables: individualization, differentiation, flexibility of methods, variability of materials and time resources, and (c) active teaching methods taking into consideration information search and processing, communication on decision-making, and reflection.

2.2. Data collection instrument

The methodology employed a combination of qualitative and quantitative approaches, including theoretical and comparative analysis, observation, and survey techniques. Data collection was conducted through a self-development survey. Quantitative data were analyzed using the Student's t-test for independent samples, based on the arithmetic mean and standard deviation. An experimental procedure was

implemented, and qualitative data were examined through observation and comparative analysis.

2.3. Participants

The experiment was conducted at West Kazakhstan University, Faculty of Education, with senior undergraduate students. A total of 65 persons were selected as the population of this research. Of these, 50 were students and 15 were teachers.

2.4. Procedure

The research utilized the university teacher training curriculum as a foundation for designing selected disciplines in a modular format. The LMS MOODLE platform served as the technological infrastructure. All modules were developed in accordance with the requirements of the Federal State Educational Standard relevant to the corresponding field of study. A conceptual model based on the general structure of training modules was employed (see Fig. 4). The selection of topics within each module was guided by the necessity to develop supplementary skills aligned with contemporary labor market demands. Topics were organized into discrete modules and integrated into a unified modular program with standardized structures and conditions. Each module comprised three components: (a) a theoretical component offering an overview of relevant phenomena, regulations, and principles; (b) a procedural component involving practical tasks; and (c) an evaluative component encompassing various forms of assessment, including cross-assessment, critical evaluation, and reflection (see Fig. 6).

In accordance with the proposed conceptual model, the new paradigm of pedagogical education emphasizes systemic, synthetic, and integrative development, along with the incorporation of professional knowledge in the preparation of future educators through interdisciplinary module distribution. The training process was structured across three levels: (a) the subject-specific and general pedagogical level, addressing the professional knowledge base required by school educators and the development of pedagogical competencies; (b) the psycho-pedagogical level, encompassing studies in pedagogy and psychology along with elective exploration of related fields such as philosophy, history, and testing; and (c) the practical level, which integrates hands-on training and case-based learning.

The criterion applied for assessing acquired knowledge and skills was based on alignment with the three foundational components of any educational process: theoretical understanding, practical application, and summative reflection. The role of the instructor was limited to consultative support and monitoring through interim assessments based on a point-based system for each module.

The effectiveness of modular technology was evaluated using the Student's t-test for independent samples, calculated based on arithmetic mean and standard deviation. This statistical method determines the significance of differences between experimental groups, thereby indicating whether observed differences in means could have occurred by chance. A p-value was computed to assess performance indicators, representing the probability that the results occurred randomly. Values range from 0% to 100% and are typically expressed as decimals (0.05 represents 5%). Lower p-values are interpreted as indicating greater significance. For instance, a p-value of 0.01 suggests a 1% probability of random occurrence. A commonly accepted threshold for statistical validity is 0.05.

The modular training model was implemented across several disciplines within a diverse cycle focused on the cultivation of pedagogical design competencies. Discipline selection was guided by two criteria: (a) practical relevance, promoting engagement and participation within the modular process; and (b) interdisciplinary emphasis, targeting the development of adaptable communication and management competencies.

The study included several interdiscipthe linary modules within the 'Fundamentals of Educational Design' program: (a) Module 1: Introduction to School Pedagogy, (b) Module 2: Trends in Scientific Development in Foreign Pedagogy on the Problems of School Education, (c) Module 3: The Modern Portrait of the School Teacher: Competencies and Prospects for Development, (d) Module 4: Expectations of the Modern School Student, (e) Module 5: Fundamentals of Course Design, and (f) Module 6: Methods for Evaluating the

Effectiveness of a Training Course. A minimum of two modules was required for participation, corresponding to four academic credits. The module content was curated to ensure compatibility, expanding the scope of interaction beyond the primary discipline while preserving the integrity of core educational competencies.

Throughout the modular learning process, increased learner motivation and engagement with thematic content were observed. A heightened sense of individual accountability contributed to enhanced attentional focus and creativity. The practical and functional orientation of acquired knowledge strengthened cognitive development, which, according to Bloom's taxonomy (Figure 5), corresponds to the advancement of higher-order thinking skills, thereby supporting improved and elevated learning outcomes.

3. RESULTS

Upon completion of the pilot training, an initiative group of educators conducted a survey involving 50 students and 15 instructors. A self-constructed instrument was employed, comprising the following evaluative components: (a) the convenience of the MOODLE platform for implementing modular learning, (b) the quality of module content in terms of material relevance and adequacy of didactic tools, and (c) the feasibility and perceived usefulness of modular programs at the university level. Results of the multi-item survey addressing the MOODLE platform's applicability for modular learning (Figures 6a and 6b) indicate a generally positive and consistent evaluation from both student and teacher cohorts. The selected platform was rated as highly usable across groups. Student respondents, however, demonstrated comparatively greater caution in designating the platform as a resource of 'high' or 'maximum' quality, a trend potentially attributable to broader experience with digital technologies and alternative instructional communication tools (Meletiou-Mavrotheris et al., 2021).

Figure 6a

Teachers' perception of MOODLE learning platform usage

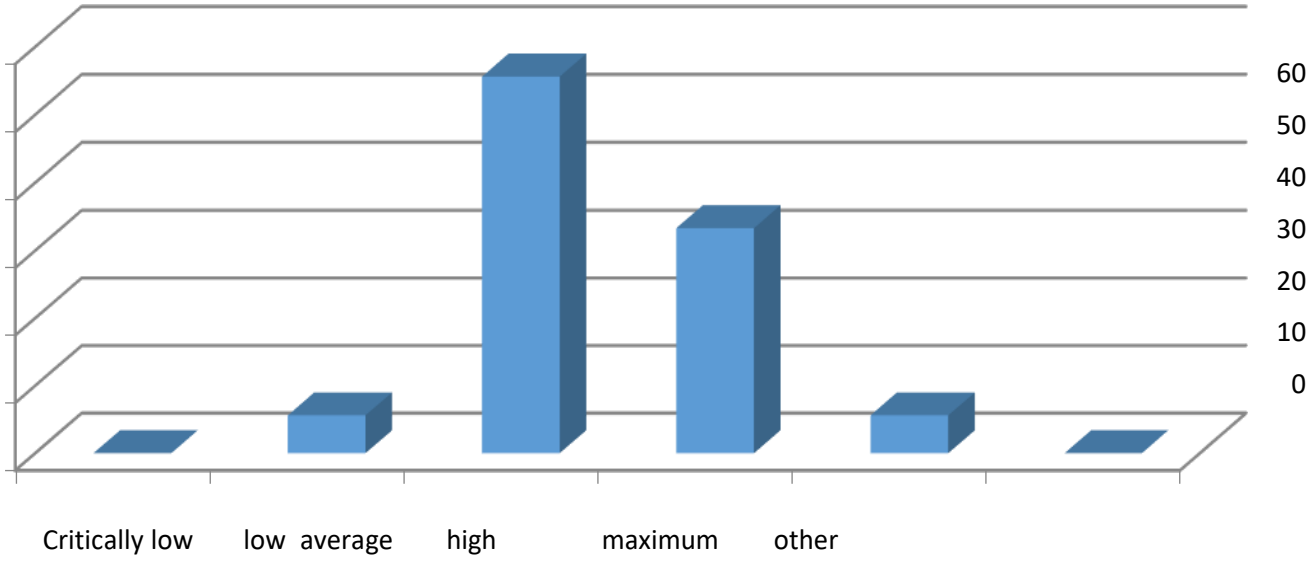
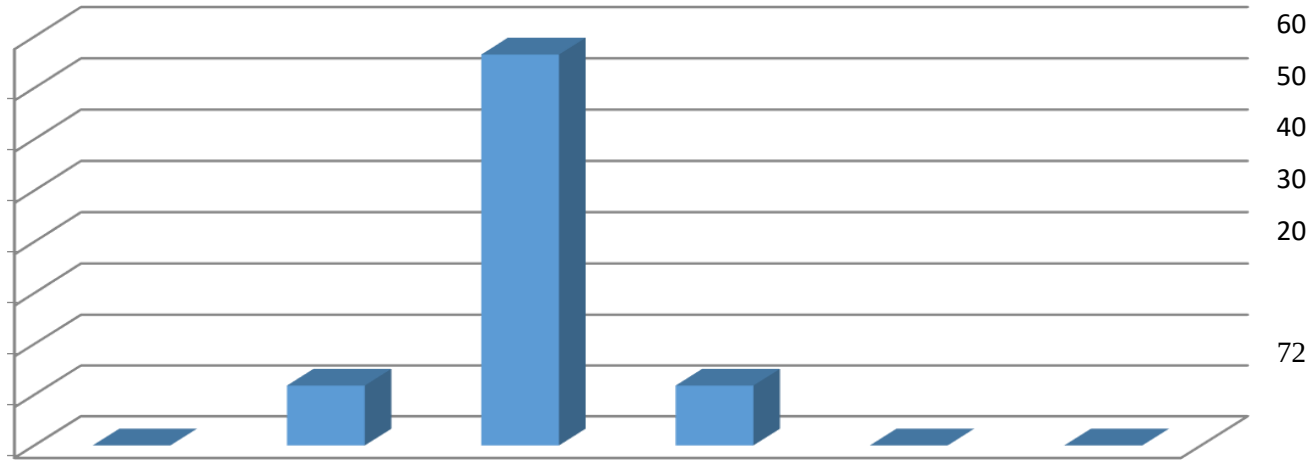


Figure 6b

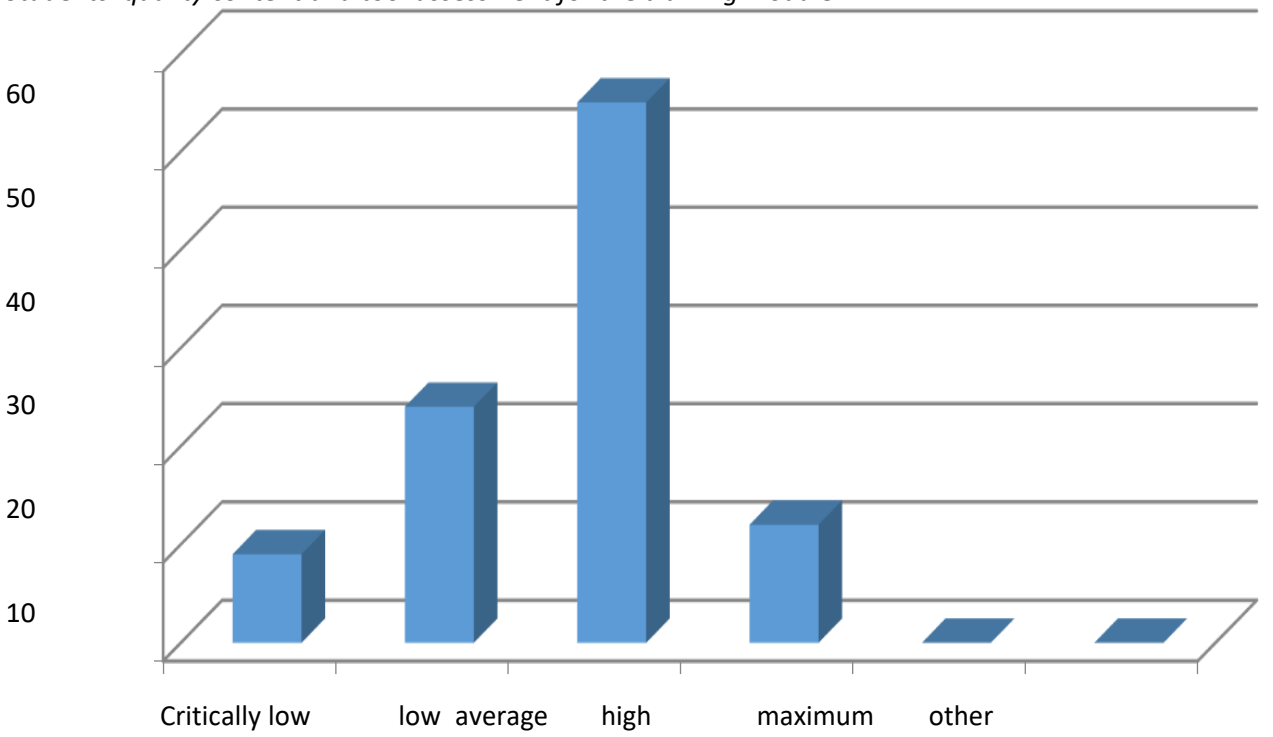
Students' perception of MOODLE learning platform usage



The quality of module training material content and tools, as assessed in Question 2, was evaluated exclusively by students (Figure 7). Survey data indicate general satisfaction with material and tool quality; however, approximately 32% of respondents rated this aspect as low, and 16% as critically low. Responses also noted an absence of fundamentally new information and limited practical relevance in the materials. In contrast, only 20% of responses reflected high evaluations. Quantitative indicators highlight issues related to the lack of dynamic content updates, institutional inertia during the transition to innovative pedagogical approaches, and insufficient instructional resources for conducting more frequent content reviews. Annual student surveys, implemented through structured feedback questionnaires addressing alignment between learning objectives, expected outcomes, and actual professional needs, could support content modernization within the discipline.,

Figure 7

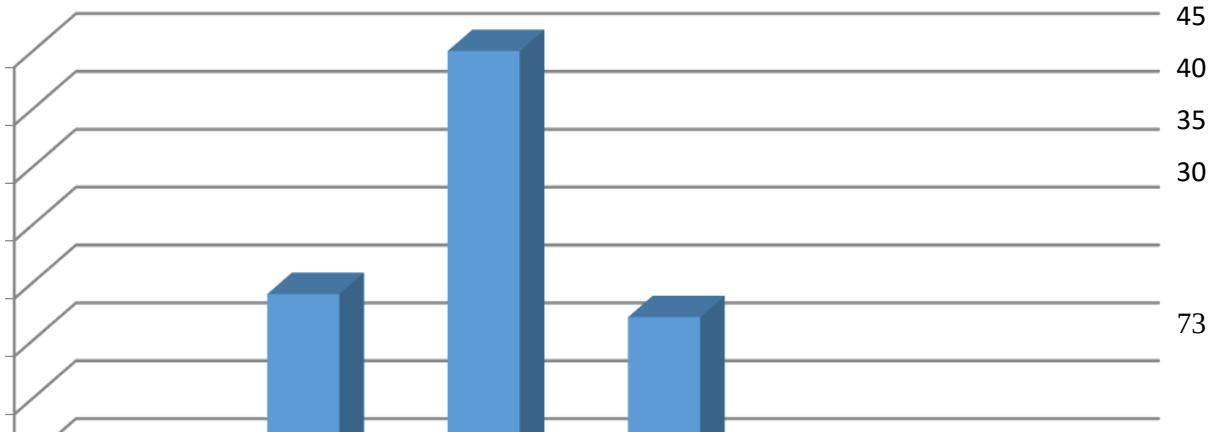
Students' quality content and tool assessment for the training module

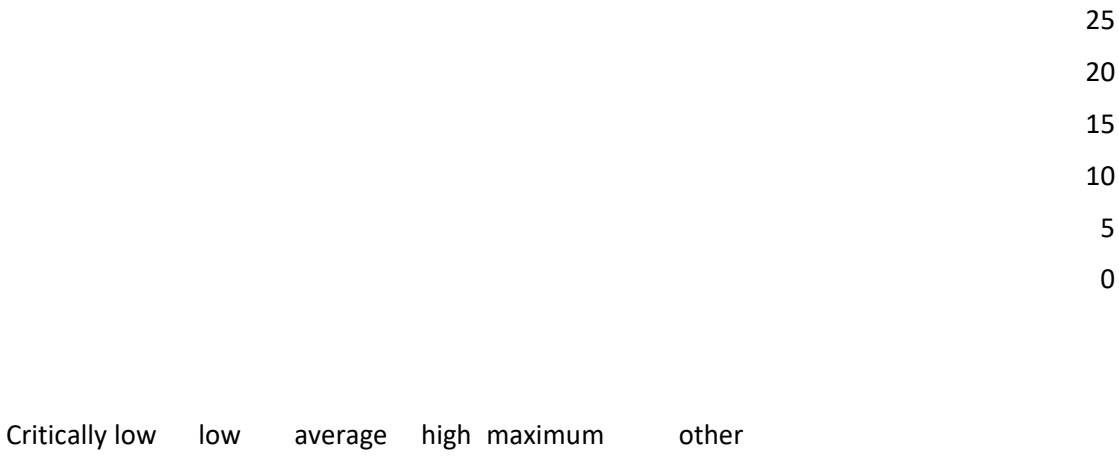


Question 3 contained information regarding students' assessment of modular training usefulness, both in terms of professional growth and development, and in terms of learning process organization comfort (Figure 8).

Figure 8

Students' perception of the modular learning assessment's usefulness at university level





The 'usefulness' results were expected and quite predictable based on the results of the material quality assessment. The level of critically low and low scores increased by about 5% in both cases, and the high score also increased, which in general may indicate a positive perception of modular learning technology among students and the prospects for the development of this technology in universities.

Analysis of the respondents' answers showed that the following algorithm should be followed when planning modular training: (a) divide the course into elements, indicating the logical links between the modules and the recommended sequence of study (if any), (b) determine the topic mastery levels, (c) define the requirements for the mastery levels in each module so that they correlate with the expected course outcomes and the educational program, d) form a logical matrix structure for skills and competencies in the modular course, (e) develop a management system that include control and monitoring processes, and (e) set a time frame. The knowledge demonstration level in student achievement formed the basis for calculating the student's t-test. The t-test is any statistical hypothesis test in which the criterion statistics corresponds to the student's t-distribution under the null hypothesis. To confirm the study hypothesis, there is a need to perform data statistical evaluation, which consists in determining the significance of the differences obtained. The basic formula used for calculating the criterion is the following:

$$t = \frac{M_1 - M_2}{\sqrt{m_1^2 + m_2^2}}$$

where $\mathbf{M_1}$ is the arithmetic mean of the first population (group) being compared, $\mathbf{M_2}$ is the arithmetic mean of the second population (group) being compared, $\mathbf{m_1}$ is the mean error of the first arithmetic mean, and $\mathbf{m_2}$ is the mean error of the second arithmetic mean.

The author calculated the learning assessment in two groups of students: experimental and control, with an equal number of people in each group (25 people). Arithmetic mean and standard deviation were calculated using special SPSS Statistics package (Table 1).

Table 1

T-test indicator calculation

Group	Number of students	Average	Standard deviation	S Standard mean error
Experimental	25	16.3200	2,07605	,41521
Control	25	16.3600	2,49800	,49960

The student's t-test values were interpreted using the number of freedom degrees **f** through the following formula: f = (n1 + n2) - 2 = 48

The student's t-test critical value was determined for the significance required level (e.g., p=0.05) and for a given number of degrees of freedom **f** using a special table. After performing the calculations, the t-criterion

value turned out to be 2.96000. Now for a comparison between the obtained value of the student's t-test 2.96000 and the critical value at p=0.05 given in the table: 2.011. Since the calculated value of the criterion is greater than the critical value, we conclude that the observed differences are statistically significant (significance level p<0.05).

4. DISCUSSION

The theoretical analysis presented on the current state of modular technology development in educational process organization concludes that the module, as a unit of an educational program, possesses significant didactic potential and plays a crucial role, particularly during periods of enforced distance education. In addition to the moral and psychological challenges caused by the pandemic, which have affected both students and educators for various reasons, the management of the learning process has become increasingly relevant. This includes concerns regarding the quality of educational services and the organization and control of learning activities.

Management represents one of the most intricate aspects of any educational institution. To harmonize and streamline management processes, the personal qualities of learners, such as self-awareness and self-organization, can provide substantial support. Therefore, in addition to its primary didactic function of facilitating learning, the modular learning model, based on responsibility, freedom of choice, cognitive engagement, and motivation, also serves a managerial function.

The modular system is sufficiently adaptable to work across all subject areas and can be integrated into virtually all forms of educational communication. However, when developing modular programs and courses, it is essential to recognize that the benefits of this learning model are only achievable under specific conditions, one of which is the use of active and interactive learning methods. A module consists of three components, w theory, practice, and reflection, which define its status as an active unit within an academic discipline and establish the principle of balancing these components appropriately. The dominance of theoretical content in university courses further highlights the low motivation to engage with it, especially for modern students who tend to be visual or kinesthetic learners, those who learn best through seeing and touching. The contemporary graduate expects a clear connection between university education and future professional activity from the outset of their studies (Oleshkov, 2011). In the modern university model, the instructor serves as a consultant, coordinator, or observer, roles that align with the principles of modular learning: autonomy, functionality, flexibility, integration, and efficiency (Kerimbayev et al., 2023).

The organization of modular training and its integration into a cohesive system of university education remains an unresolved issue. The complexity of this challenge arises from the predominance of traditional approaches and the inertia in management and development mechanisms. The managerial aspect is primarily concerned with the distribution of teaching loads across academic years, while modular learning allows students to make individual choices, leading to planning uncertainty and necessitating immediate action to allocate university resources effectively.

A second critical issue in the integration of modular learning is module variability, which influences the possibility and timeframe for developing these modules. The competitive nature of the open educational resources market (MOOCs) offers universities an advantageous opportunity to utilize pre-existing courses with established control and management mechanisms. However, the creation of proprietary educational materials represents a key element of a university's identity, and the uniqueness of its intellectual contributions, including knowledge and technology, enhances its reputation among prospective students and attracts enrollment, which is a critical factor in global university rankings.

5. CONCLUSIONS

In the light of outcomes taken from the findings of the study, the following conclusions are drawn. A modular-based approach is more operative in teaching and learning method as compared to usual teaching approaches because in this format of study, students learn at their own pace. It is an unrestricted self-learning style in which instantaneous reinforcement and comment is provided to practice exercises, which stimulate

the students and build up their motivation and curiosity. The modular approach helps to maximize the chances of teaching and learning management, due to students' involvement in communication and discussion, as well as practical involvement.

For the approach of this research, modular teaching is a more operational approach for teaching university students, particularly during the pandemic. The modular approach is an inimitable way of teaching, so teachers should be provided with adequate training about how to strategize and implement a module in a university setting. Our experimental study has shown that the module as a unit of the university course is able to: (a) optimize the study processes through effective management and monitoring, (b) be a mobile base for course updating, (c) increase course practical values, and (d) give a basis for reflection.

This research has shown the benefits of using a modular-based approach at tertiary level in terms of efficacy and prospects, as a versatile way to work with all subject areas and integrate all learning communication forms for the Faculty of Education of West Kazakhstan University with senior undergraduate students. Further researches in this innovative and useful teaching method must be opened and constantly updated to improve the current educational policies in universities due to the pandemic situation.

Conflict of Interest: The authors declare no conflict of interest.

Ethical Approval: The study adheres to the ethical guidelines for conducting research.The privacy of the participants was protected, and no conflict of interest is anticipated to arise in the research.

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