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# Experience in forming entrepreneurial education in Kazakhstan universities in the conditions of information and digital development

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Information and digital technologies can help in shaping the experience of using online courses for student entrepreneurs. This study constitutes an original investigation dedicated to the cultivation of entrepreneurial education experience within Kazakhstani universities, situated within the context of informational and digital development and the contemporary challenges encountered by all nations in the global arena. The main objective of this research was to determine how the academic performance of students studying entrepreneurship through online courses changed over time. The study enrolled 282 second-year and third-year students of the faculty of public administration, business, and law from one Kazakh university. In this study, an experimental design was employed to ascertain the effectiveness of integrating MOOC through the amalgamation of statistical data analysis and paired *t*-tests. The primary mode of assessment was testing, encompassing closed-end assessments comprising one hundred questions based on the outcomes of a specific course. Each question held a point value of one, with the maximum achievable score being one hundred points. The authors juxtaposed mean scores across different time intervals to ascertain the intervention's impact on student performance. The Student's *t*-test was utilized to compare the mean values by identifying significant disparities at the 0.05 level. The academic achievements of second-year students in some disciplines improved after the MOOC implementation compared to Point 1. According to the calculations, there was a significant difference in student performance before and after learning with MOOC; the mean score difference and *t*-value with the paired value are higher than the *t*-value in the tests of the first and last assessments. Thus, online courses have shown their effectiveness in improving student performance in all ten subjects of the entrepreneurial course. This contributed to improved efficiency of the educational process and the implementation of information and digital technology in the online environment without losing its productivity. This research is of practical value as it indicates the need to integrate information and digital technologies into entrepreneurial education. Educational institutions, curricula, and scientific research may use these findings.

## KEYWORDS

digitalization, education, entrepreneurship, formation experience, information and digital development, learning

## 1. Introduction

In the twenty-first century, technology is an integral part of everyday life. People massively use for example phones, tablets, and computers to search for information, navigate, pay bills, study, and communicate (Secundo et al., 2021). Technologies have been acknowledged as playing a pivotal role in the realm of international development and in shaping the educational landscape within universities across the global spectrum (Fiore et al., 2019). Today, the number of digital tools used by humankind is endless. They offer a whole range of new ways to communicate, learn, and collaborate (Secundo et al., 2020a). When used wisely, technology can offer new ways to solve the problems students face in learning, make work more efficient and transparent through digital data collection and analytics, and improve performance and quality (Cho and Lee, 2018). The use of digital technologies can be critical in creating effective, cost-effective, and flexible solutions aimed at developing the education sector and entrepreneurial competencies, promoting continuous learning, and informing universities about global technological, economic, and social issues (Rippa and Secundo, 2019).

Distance learning in higher education has grown rapidly over the past decade (Yuan and Kim, 2014). The development of information technology and the introduction of online tools have significantly affected the entire educational system (Secundo et al., 2019). In recent years, the widespread use of digital technologies has also been encouraged in entrepreneurship education where providers of online courses and distance curricula could provide an educational process (Vorbach et al., 2019). Various educational platforms, digital content, and the integration of additional technologies digitalize entrepreneurship teaching (Vinogradova et al., 2019). To date, in Kazakhstan, the educational system conceptually has three main areas: educational process digitalization, the digital educational content of education, and digitalization of education management. In general, education digitalization in Kazakhstan is one of the main directions within its reform (Zhailaubayeva, 2019). The vision of future educational institutions is often associated with the gradual transition of all subjects to the cloud education system. It includes online tutorials and virtual laboratories, open educational content, and a flexible and individual approach to each participant (Zhailaubayeva, 2019).

This paper is original research on the formation of entrepreneurial education experience in Kazakhstan universities in the context of information and digital development and current challenges that all countries of the global world face. The principal objective of this research endeavor resided in the endeavor to discern the temporal evolution of academic attainment among students engaged in the study of entrepreneurship through the medium of online courses. Researchers elucidated the trajectory of students' academic performance alterations, spanning from the commencement of remote instruction to the culmination of this instructional modality. Given the range of benefits highlighted in previous studies (Secundo et al., 2021) that information and digital technologies can provide in the study of entrepreneurship and a look at the possibilities for improving curricula and approaches, the authors can conclude that the chosen topic is relevant for the current research. The research is also relevant because the students, who study entrepreneurship, need not only the development of

their specific competencies but also an interactive approach to increase their interest and speed of learning. This paper presents an original and reflective study of how digital technologies can improve education quality in the entrepreneurial sector. This paper is of practical importance for world science in the field of entrepreneurship teaching.

### 1.1. Literature review

Entrepreneurship refers to the concept of developing and managing a business enterprise for making a profit by taking on multiple risks in the corporate world (Hoang et al., 2020). Entrepreneurs usually create a business plan, hire a workforce, obtain resources and funding, and provide leadership and management of the business, which requires specific skills (Ferreira, 2020). In recent years, some scientific papers highlighted the issues of entrepreneurship in the context of Kazakhstan (Bika et al., 2022; Doszhan et al., 2022). Adding the fundamentals of entrepreneurship to the learning process is partly due to difficult pedagogical practice. Therefore, questions arise about the role of universities, teachers, and students in this process (Hameed and Irfan, 2019). Digitalization in entrepreneurial education constitutes the process of employing digital technologies and tools to enhance the quality of education within this domain (Neeley and Leonardi, 2022). It encompasses a spectrum of pedagogical facets, spanning from the conception and delivery of online courses to the utilization of interactive learning platforms, virtual classrooms, and simulations of business scenarios.

In recent years, scientific research around the world actively presents and develops models of educational approaches to entrepreneurship that can provide additional analytical frameworks for better studying, accepting, and comprehending the role of entrepreneurship in higher education (Hoppe et al., 2017). Due to the unprecedented impact of the COVID-19 pandemic, many educational institutions around the world forced to take various measures including social distancing, home quarantine, school closures, and moving classes online (Yoo and Managi, 2020). Universities had to deal with the restructuring of traditional curricula using digital technologies. Thus, the pandemic has become an important trigger for the reflection, development, and implementation of new educational processes that use the potential of digital technologies (Holzmann et al., 2018). MOOC has been widely implemented around the world in various fields due to the coronavirus pandemic (Vorbach et al., 2019; Li, 2022). All course resources and information are open and distributed via the Internet. Students conduct discussions on a certain topic, group classes in the field of knowledge, and collective practices, hand over projects, develop business plans, ideas, and start-ups, and communicate (Lu, 2015).

The digitalization of educational institutions means the creation of convenient and effective tools for all participants: students, their parents, teachers, and the administration of the educational system as a whole (Rippa and Secundo, 2019). In addition, learning digitalization should be a kind of synthesis of the real and digital world in a virtual environment and the optimal balance of human-machine interaction (OECD/European Union, 2019). Having focused on some aspects of education

digitalization, in particular on the implementation of the general education system, it can be noted that recently the process of creating and using Internet resources of open general education, general development, from individual tasks to full courses and modules, actively forms entrepreneurial competencies (Maas and Jones, 2017). A single online course platform allows everyone to quickly adapt to information flows, evaluate information, make decisions in special situations, and master twenty-first-century skills (Lamine et al., 2018). Typical features of digital education using network technologies are flexibility, mobility, productivity, dialogue and interactivity, and orientation toward receiving media streams (Zhailaubayeva, 2019). The main task of digitalization in education is to improve the education quality, that is, to train the country's youth and increase the competitiveness of graduates in various fields (Olokundun et al., 2017).

Digital information development is just one dimension of the broader impact of digital technologies on entrepreneurial education. It brings significant changes both at the individual and organizational, as well as at the cultural and professional levels (Facer, 2011). The synergy of information and digital development and entrepreneurship is that their symbiosis can provide an opportunity for entrepreneurs to participate in curricula development. They can pool the resources of companies and universities to carry out research and entrepreneurial projects and provide an opportunity for universities to involve businesses in their advisory or governing bodies (Frolova et al., 2019; Vinogradova et al., 2019).

The introduction of digital technologies can lead to corresponding changes in the experience of students in terms of online collaboration, online interaction, and teamwork satisfaction (Wolverton, 2018). Moreover, digital technologies increase engagement and allow efficient management and implementation of synchronous discussions in online education (Klotz and Wright, 2017). The success of online collaborative learning depends on the team dynamics and cohesion, and the instructor's support. Moreover, in online collaborative learning, the instructor's role changes and turns into a fellow student, supporter, and designer of learning processes (Secundo et al., 2021). Despite the general global trend toward digital educational technologies, integration of online technologies into educational institutions is not always easy. It meets resistance since not everyone is ready to implement new methods and approaches (Masterson, 2020). Issues such as low curricular adaptability, outdated technological equipment, and teachers' inexperience in using online courses contribute to institutions failing to capitalize on the new twenty-first-century opportunities (Sun, 2020).

The role of universities, educators, and students in the process of entrepreneurial education through digital technologies unfolds as follows: Universities cultivate and implement digital educational platforms and learning management systems, facilitating students' accessible engagement with entrepreneurship subjects and courses in an online format. Additionally, universities orchestrate instructional courses and workshops for instructors, enabling their adept utilization of digital technologies in teaching entrepreneurial disciplines. Modern and interactive educational materials, including video lectures, simulations, virtual laboratories, and other digital resources for entrepreneurial education, are developed by universities (Neumeyer and Liu, 2021).

Educators, in turn, conceive and devise curricula aligned with contemporary trends and digital tools for entrepreneurial education. They integrate digital technologies into pedagogical practices, further enriching the instructional process (Neumeyer et al., 2021).

Meanwhile, students actively engage in the educational process through the deployment of digital resources and technologies, facilitating self-directed learning and explorations into entrepreneurial topics. Their participation encompasses online discussions, forums, collaborative projects, and online assessments via digital platforms. These endeavors foster the exchange of experiences and knowledge among students and instructors alike (Solberg et al., 2020).

The overarching goal of digitization within entrepreneurial education is to enhance educational accessibility, thereby expanding students' opportunities for learning at their convenience and from any global location. Furthermore, this approach permits learners to flexibly tailor the pace and format of their education, thereby potentially optimizing comprehension (Solberg et al., 2020; Neumeyer and Liu, 2021).

The interplay and mutual engagement of universities, educators, and students with digital technologies contribute to a more effective and flexible paradigm of entrepreneurial education, augmenting course accessibility and elevating the quality of education within this domain.

In line with contemporary teaching processes, there is a rapid growth of online course platforms around the world including entrepreneurship education (Hodges et al., 2020). Digital technologies can offer better support for energy efficiency through the ability to access an online community where potential business ideas can develop and become customized. Emerging digital technologies support innovative entrepreneurship learning experiences (Secundo et al., 2020b). It is interesting to study such systems of information and digital development in the context of Kazakhstan.

## 1.2. Problem statement

The main motivation for writing this paper was the desire to obtain new experimental data on the use of information and digital technology in entrepreneurial education. Focusing on this topic can provide much-needed insights into developing entrepreneurial competencies while adapting to the transition to an online educational environment that can enable learning from anywhere in the world. The main objective of this research was to determine how the performance of students studying entrepreneurship through online courses changed over time. In other words, the goal was to establish the dynamics of changes in student academic performance from the moment they started distance learning until the end of this form. It was the dominant type of education after the decline in pandemic risks. Before starting the research, the authors formed the following tasks:

1. Reveal the dynamics of the academic performance of students, who study entrepreneurship through MOOC-based online courses, depending on the year of their studies.

- Determine if there is a significant difference between student academic achievements before and after MOOC implementation for entrepreneurship education.
- Reveal the percentage increase in student academic performance in specific subjects at Toraighyrov University depending on the year of study.

## 2. Materials and methods

### 2.1. Participants

The study took place from September 2021 to June 2022 and enrolled 282 second-year and third-year students of the Faculty of Public Administration, Business, and Law from Toraighyrov University (Pavlodar, Kazakhstan). To study the dynamics of knowledge and therefore the effectiveness of the online platform and online courses, the research has enrolled students, who met the selection criteria and voluntarily agreed to participate. They received the invitation via the administration-provided e-mail. The researchers did not force any student to take part in the study; participation was voluntary. The participants received information about the research methodology and objectives before initiation as well as guarantees of anonymity and secure data storage. **Table 1** presents detailed information about the number of participants.

The authors chose the participants voluntarily through an oral proposal in the classroom. A student, who showed interest in research and a desire to participate, became involved. Participants were aged 19 to 21 years; the mean age was 20.2 years, 51.4% females and 48.6% males.

### 2.2. Procedure

Within the scope of this study, Massive Open Online Courses (MOOCs) were examined as contemporary technological innovations and illustrative instances of integration within the higher education system. These courses encompass recorded video lectures, readings, curated problem sets, online assessments, interactive educational modules, as well as opportunities for student engagement through forums. MOOCs exhibit a comprehensive structure akin to that of a structured curriculum, featuring a coordinator, thematic coherence, a defined schedule, and associated assignments.

TABLE 1 Number of study participants.

Year	Sex	Number of respondents	Percentage
Second	Females	84	29.8
	Males	58	20.6
Third	Females	61	21.6
	Males	79	28.0
Total		282	100.0

Educators, who diligently aimed to furnish a broad spectrum of profound knowledge, crafted all online lessons. Researchers meticulously prepared and orchestrated all activities within the MOOC framework, anchoring their conceptualizations in their professional expertise. They curated materials and uploaded them onto the MOOC online platform specifically for this investigation. The research design entailed student instruction utilizing MOOCs and the development of interactive sessions, with content generation undertaken by nineteen instructors affiliated with the represented university. Additionally, the research incorporated the participation of four educators.

The assessment of all participants' knowledge transpired in September 2021 via closed-form tests. These assessments were designed to encapsulate the depth of knowledge acquired over the preceding year of study. Participants were allotted a 2-h window for the completion of all tests. The authors meticulously analyzed and recorded the ensuing results. Subsequently, students were granted access to the MOOC online platform, installing it on their respective computing devices, and for those opting for convenience, also on their mobile phones. All participants were afforded access to courses that comprehensively aligned with the curriculum. Furthermore, the study encompassed closed-form tests, comprising one hundred questions about the outcomes of specific course comprehension. Each question was appraised at a unitary score, with a maximum attainable score of one hundred units. This scoring system was devised to reflect the students' mastery levels across the course themes and, at a broader level, to ascertain their academic attainment upon semester culmination.

The course was meticulously tailored to the nuances of entrepreneurial education and encompassed a diverse array of instructional materials and interactive assignments, including online lectures, colloquia, seminars, video materials, presentations, and auditory resources, among others (see **Figure 1**). The primary objective of the Massive Open Online Course (MOOC) was to extend accessible and flexible education to a wide-ranging student audience. Within the course framework, MOOC integration functioned in conjunction with traditional instructional modalities, wherein the MOOC served as an auxiliary tool for fostering comprehension of entrepreneurial disciplines. Students engaged with the course material in tandem with their concurrent subjects, thereby facilitating a more comprehensive and diversified educational experience within the entrepreneurship domain.

The course extended over two academic semesters. Comprising a variety of thematic modules, each segment delineated distinct dimensions of entrepreneurship, covering fundamental principles, business strategizing, corporate economics, managerial practices, marketing strategies, financial operations, accounting procedures, labor economics, production arrangement, as well as economic analysis and auditing (refer to **Figure 1**).

The sessions within the MOOC were carried out by the predefined timetable, exclusively in an online setting. In a pedagogical context, educators led sessions within computer laboratories or conventional classrooms equipped with mobile devices. Consequently, the active engagement of 23 instructors was established, including those who contributed to the curricular development for MOOC integration. The platform featured comprehensive subject-specific information necessary for successful course completion, presented in an interactive online format.

<p>Entrepreneurship course uploaded to the MEP database included the following activities:</p> <ul style="list-style-type: none"> <li>- Online lectures</li> <li>- Colloquiums</li> <li>- Seminars</li> <li>- Video materials</li> <li>- Presentations</li> <li>- Audio materials</li> <li>- Interactive practices</li> <li>- Debates</li> <li>- Individual learning activities</li> <li>- Activities in pairs</li> <li>- Group activities</li> <li>- Interactive game activities</li> </ul>	<p>Fundamentals of Entrepreneurship</p> <hr/> <p>Business Planning</p> <hr/> <p>Enterprise Economics</p> <hr/> <p>Management</p> <hr/> <p>Marketing</p> <hr/> <p>Finance</p> <hr/> <p>Accounting</p> <hr/> <p>Labor Economics</p> <hr/> <p>Production Organization</p> <hr/> <p>Economics and Audit</p> <hr/>
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FIGURE 1

Graphic course model in ten specialized MOOC-uploaded subjects for entrepreneurship.

### 2.3. Research design

After approval of the institutional review board, the participants could complete the provided knowledge sheet in the required subjects. The assessments took place at 4 time points: Point 1, the first week of study after the semester began (September 2021); Point 2, the end of the first semester (December 2021); Point 3, the fourth week of study after the new semester beginning (February 2022); and Point 4, end of the study (May 2022). Especially for this research, the MOOC database contained lessons on various courses, which corresponded to the requirements of the curriculum for entrepreneurs. **Figure 1** shows an example of a graphical course model.

### 2.4. Data analysis

This research used an experimental design to determine the effectiveness of implementing MOOCs by integrating statistical data analysis and paired *t*-tests. The authors compared mean scores across different time intervals to determine the effect of the intervention on student performance. A difference test between two mean values taken from the same group has determined significance. Quantitative analysis also included Student's *t*-test. The researchers used the frequency, mean, and standard deviation to describe the statistical data and a *t*-test to compare the mean by detecting significant differences with the 0.05 level. They analyzed the results using SPSS Statistics and used factor analysis validation for data control. Fisher's exact test (*p*) validated the collected data and the results were satisfactory according to comparative analysis criteria. Fisher's test ensured the adequacy and reliability of the results.

### 2.5. Ethical issues

The participating university leaders have professionally planned, properly executed, and approved this research. Before the start of the research activities, the researchers developed a

study protocol; all participants and administrators followed it. The authors carefully agreed to participate in the study with all participants and guaranteed the anonymity of personal data. The research also received the approval of the institutional review board. Additionally, the company that created the MOOC did not act as an interested person in this research and the authors did not have a personal benefit from mentioning the program name.

## 3. Results

To discern the academic performance dynamics of students engaged in entrepreneurship studies through online courses utilizing MOOCs, contingent upon their year of study, **Tables 2, 3** present the mean values and standard deviations of academic achievement for second and third-year students across various specialized subjects within the entrepreneurship curriculum (September 2021–May 2022).

The academic performance of second-year students in specialized subjects was assessed in September 2021 (point 1) and ranged from 69.14% (for the subject “Management”) to 74.35% (for the subject “Enterprise Economics”) (see **Table 2**). By the end of the first semester, in December 2021 (point 2), after the completion of courses based on MOOCs, an enhancement in academic performance was noted in the specialized subjects, with outcomes diverging from initial values. In February 2022 (point 3), a further increase in performance across all subjects was observed compared to the previous time points. Additionally, in May 2022 (point 4), the academic performance of second-year students improved in all profile subjects relative to the initial benchmarks (point 1). The overall trend indicated a positive shift in performance across all five subjects, and all obtained results were statistically significant. Despite a somewhat gradual growth trajectory in the domain of “Management,” it is noteworthy that this subject demonstrated the lowest performance values among the subjects within this student cohort at point 1.

The implementation of a course based on MOOCs for students has the potential to engender a plethora of varied outcomes and favorable impacts that extend beyond the enhancement of

TABLE 2 Means and standard deviations of academic performance of second-year students in special subjects based on MOOC (September 2021 to May 2022).

Subject	AP-1		AP-2		AP-3		AP-4		P-value
	M	SD	M	SD	M	SD	M	SD	
Fundamentals of entrepreneurship	71.01	24.09	73.10	23.08	80.31	16.17	84.14	15.34	0.019
Business planning	68.10	20.14	73.16	23.14	81.27	20.09	83.19	18.16	0.041
Enterprise economics	74.35	21.12	76.45	25.12	84.23	25.16	86.27	21.08	0.039
Management	69.14	19.46	71.54	24.02	79.14	19.26	80.54	22.13	0.028
Marketing	76.16	18.42	78.10	22.34	82.10	18.46	81.06	17.06	0.037

M, mean; SD, standard deviation; AP, academic performance: the maximum score is 100; AP-1, academic performance at Point 1; AP-2, academic performance at Point 2; AP-3, academic performance at Point 3; AP-4, academic performance at Point 4; p, significance level (significant at  $p < 0.05$ ).

TABLE 3 Means and standard deviations of academic performance of third-year students in special subjects based on MOOC (September 2021 to May 2022).

Subject	AP-1		AP-2		AP-3		AP-4		P-value
	M	SD	M	SD	M	SD	M	SD	
Finance	74.03	17.06	76.19	23.48	81.61	19.16	83.10	17.04	0.027
Accounting	72.13	18.14	79.17	20.07	82.17	20.17	84.01	19.41	0.033
Labor economics	73.41	20.17	76.14	21.10	79.32	23.18	83.15	20.14	0.039
Production organization	70.36	20.39	72.08	23.06	78.40	21.17	82.27	22.03	0.024
Economics and audit	67.15	19.02	71.36	23.44	76.17	20.06	80.36	16.07	0.036

M, mean; SD, standard deviation; AP, academic performance: the maximum score is 100; AP-1, academic performance at Point 1; AP-2, academic performance at Point 2; AP-3, academic performance at Point 3; AP-4, academic performance at Point 4; p, significance level (significant at  $p < 0.05$ ).

accomplishments within the specific domains addressed by the MOOC. Some of these outcomes may encompass Expanded educational accessibility, Cultivation of self-organization and autonomous learning skills, Enhanced technological literacy, Intercultural interaction, Networked opportunities, and Economic efficiency.

Table 3 presents the means and standard deviations of the third-year students' performance in special subjects based on the MOOC from September 2021 to May 2022. As of September 2021 (Point 1), the respondents showed the highest mean performance in Finance and Labor Economics. At Point 2, all five measures of academic performance increased, as in the case of second-year students. In addition, as of February 2022 (Point 3), academic performance increased in all subjects compared to Point 2. Point 4 indicated that academic performance has increased in all subjects. There was a stronger trend toward improving academic performance in Accounting. The data in Figure 2 on all ten studied subjects during the academic year 2021–2022 showed that academic performance improved with the practice time of online entrepreneurship courses in two different years of study.

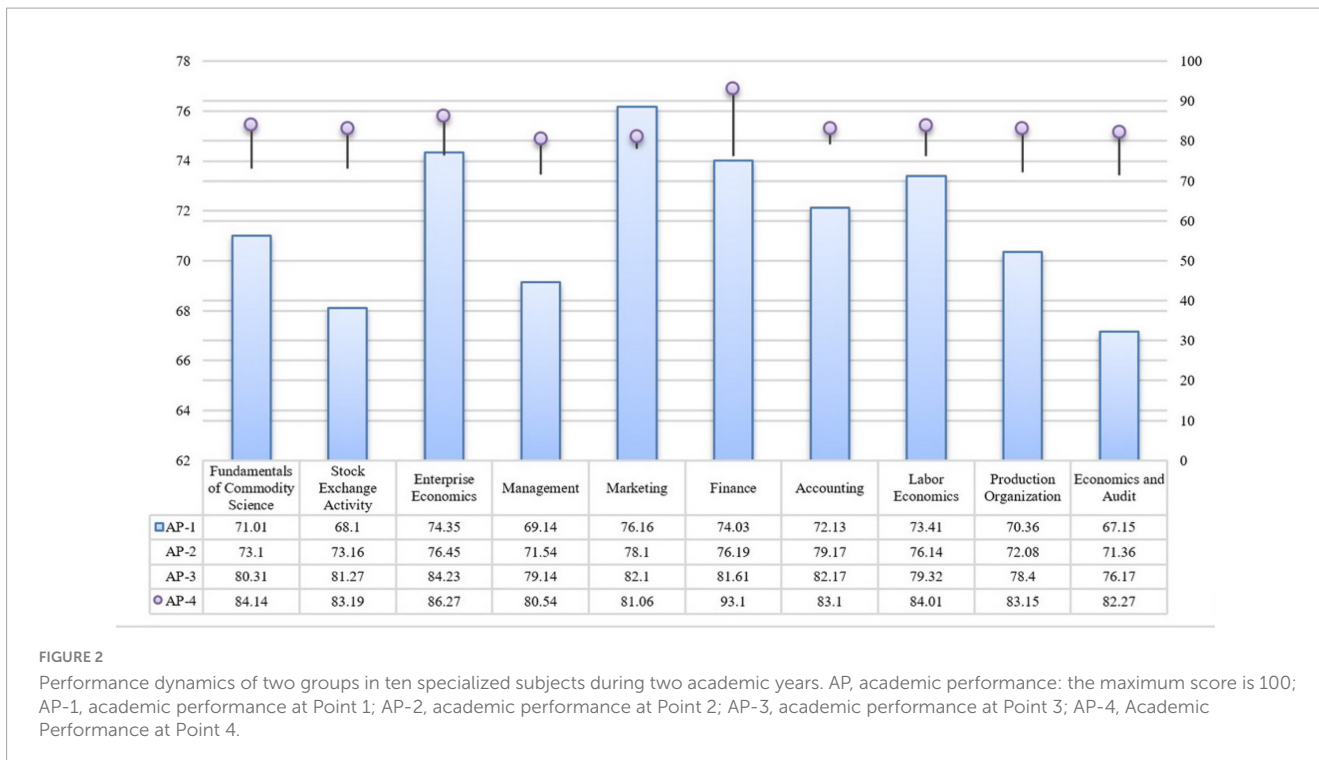
Tables 4, 5 show academic performance at Point 1 and Point 4 in the MOOC-based subjects as well as the standard deviation for the 2 years.

The academic attainment upon the culmination of education after the implementation of MOOCs has not witnessed a diminution, but rather exhibited augmentation, in contrast to the baseline measurements in the domains of foundational entrepreneurship, business planning, enterprise economics, management, and marketing, registering increases of 13.13, 15.09, 11.92, 11.54, and 4.9%, respectively. This outcome

underscores the viability of incorporating MOOCs within the pedagogical framework.

Table 5 illustrates that academic performance after the introduction of MOOCs has not experienced a decline but rather exhibited an increase, in comparison to the baseline measurements, within the disciplines of "Finance," "Accounting," "Labor Economics," "Production Organization," and "Economics and Auditing," manifesting increments of 19.07, 10.97, 10.6, 12.79, and 15.12%, respectively. The resultant data affirm the positive influence of online courses on performance across all five subjects in each academic year, further suggesting that, given their non-diminishing impact on student achievement, their integration within entrepreneurship education is warranted.

To compare the effectiveness of MOOC-based courses and traditional instruction, metrics of student performance from the previous academic year were utilized. Table 6 presents the  $t$ -value and the mean difference in achievement scores between students from the previous year and the current year; the result is statistically significant at  $p < 0.01$ , indicating a substantial disparity in the performance of students before and after the utilization of MOOC-based instruction. Across all subjects in the table, performance indicators demonstrated an improvement following the incorporation of MOOC-based courses. For instance, in the subject of "Foundations of Entrepreneurship," student performance increased from 3.46 to 3.79, and in the subject of "Business Planning," it rose from 3.23 to 3.56, and so forth. In addition, the resulting  $t$ -value for paired value is higher than the  $t$ -value for the tests of the first and last evaluations. Thus, online courses have shown their effectiveness in improving the academic performance of second-year and third-year students in all ten subjects of the entrepreneurial



course. These courses did not diminish the effectiveness of the educational process; rather, they seamlessly integrated information and digital technologies into the online environment, preserving productivity.

The utilization of MOOCs and digital technologies in the educational process can confer significant advantages, not solely confined to the enhancement of students' academic performance, but extending to other dimensions as well. Some of these advantages may encompass:

1. Accessibility: Online courses can cater to a broad spectrum of students, including those who previously lacked opportunities for education due to various reasons (geographical constraints, financial limitations, etc.).
2. Content Upgradation and Relevance: Digital platforms enable swift updates and modifications of educational materials, a crucial attribute in an educational and technological landscape characterized by rapid change.
3. Development of Digital Proficiency: The employment of MOOCs contributes to the cultivation of students' digital proficiency, an attribute increasingly pivotal within the contemporary information society.

**TABLE 4** Mean academic performance of second-year students and standard deviation at Point 1 and Point 4.

Variables	Mean (mean academic performance)	Standard deviation
Point 1: Fundamentals of entrepreneurship	71.01	3.14
Point 4: Fundamentals of entrepreneurship	84.14	2.10
Point 1: Business planning	68.1	3.32
Point 4: Business planning	83.19	2.17
Point 1: Enterprise economics	74.35	3.19
Point 4: Enterprise economics	86.27	2.68
Point 1: Management	69.14	3.27
Point 4: Management	80.54	2.26
Point 1: Marketing	76.16	3.33
Point 4: Marketing	81.06	2.44

**TABLE 5** Mean academic performance of third-year students and standard deviation at Point 1 and Point 4.

Variables	Mean (mean academic performance)	Standard deviation
Point 1: Finance	74.03	3.13
Point 4: Finance	93.10	2.09
Point 1: Accounting	72.13	3.39
Point 4: Accounting	83.10	2.12
Point 1: Labor economics	73.41	3.15
Point 4: Labor economics	84.01	2.27
Point 1: Production organization	70.36	3.35
Point 4: Production organization	83.15	2.10
Point 1: Economics and audit	67.15	3.46
Point 4: Economics and audit	82.27	2.54

TABLE 6 Paired t-test for academic performance indicators between previous and current years of study.

Variables	Previous year of study	Current year of study	t-value	Significance value
Fundamentals of entrepreneurship	3.46	3.79	6.634	2.417
Business planning	3.23	3.56	6.247	2.328
Enterprise economics	3.69	3.92	6.595	2.171
Management	3.14	3.45	6.247	2.268
Marketing	3.25	3.61	6.698	2.254
Financing	3.39	3.72	6.325	2.198
Accounting	3.47	3.82	6.361	2.473
Labor economics	3.57	3.89	6.327	2.652
Production organization	3.12	3.51	6.217	2.391
Economics and auditing	3.29	3.64	6.398	2.351

N = 287;  $P < 0.01$ .

4. Time and Resource Efficiency: MOOCs facilitate the simultaneous dissemination of education to a vast student audience, unbound by temporal or geographical constraints. This capability serves to optimize resource utilization and curtail costs associated with instructional organization and delivery.

Hence, while the enhancement of student academic performance may serve as one indicative measure of MOOC efficacy, these courses possess a breadth of advantages capable of influencing diverse facets of the educational process, thereby enriching learning experiences and augmenting overall instructional quality.

## 4. Discussion

Garcez et al. (2022) found that digital transformation has already become a basic element of academic entrepreneurship and the pandemic has accelerated this process. Previous studies have conclusively proven that the COVID-19 crisis has forced universities around the world to adopt an online environment and online tools have shown their effectiveness (Charrouf and Taha Janan, 2019; Rippa and Secundo, 2019; Kang and Lee, 2020; Secundo et al., 2021). A recent study illustrated the process of redesigning an entrepreneurship education curriculum using digital technologies (Secundo et al., 2021). This scientific paper showed a new approach to entrepreneurial storytelling, pitching, business planning, and development through digital technologies. It highlighted the strengths of online curricula and demonstrated their effectiveness, which is consistent with the current research. Vinogradova et al. (2019) examined the impact of transformational processes in economics on entrepreneurial education under the digitalization influence. The study findings allowed conclusions about the public demand for the introduction of SMART education, which provides for educational activities on the global Internet based on common standards, technologies, and relationships established between the university, entrepreneurs, and students. This conclusion also confirms the need for the implementation of information technologies and digital development in higher

education institutions. Our study has also demonstrated favorable outcomes in the integration of MOOCs into entrepreneurship education: these courses have not diminished the effectiveness of the educational process; rather, they have seamlessly incorporated information and digital technologies into the online environment, without compromising productivity.

Education for entrepreneurs includes various information and digital technologies, e.g., Startup Compete and IBridgeNetwork (Harms, 2015). Access to cloud computing infrastructure, 3D printing services, tools for both software and hardware prototyping, online software simulations, and online support for building an entrepreneurial team and finding potential investors are all examples of integrating modern technology into entrepreneurship (Secundo et al., 2020a). They aim to develop and disseminate an entrepreneurial mindset and entrepreneurial culture among university students through extra-curricular courses and experiences also supported by digital technologies (Secundo et al., 2020a), which also demonstrates the effectiveness of such synergies.

Previous studies (Li, 2022) have shown that online courses can have a positive effect in various fields; the current research also confirmed the effectiveness of online entrepreneurship courses: the results indicate a significant difference in student performance before and after instruction through MOOCs - across all subjects in the table, performance indicators improved following the implementation of MOOC-based courses. One recent study in Austria (Vorbach et al., 2019) found that Massive Open Online Courses (MOOCs) in entrepreneurship education are one of the strongest trends in online education and influence the content and procedures of teaching and learning. The paper empirically explores the problems and reasons for using MOOCs as a new pedagogical concept. The findings show that the lack of self-discipline to complete courses as well as the lack of interaction with other people are the main obstacles compared to lectures with mandatory attendance at the university (Vorbach et al., 2019). Hoang et al. (2020) confirmed that self-efficacy and learning orientation are important in explaining how entrepreneurial learning relates to entrepreneurial intentions. However, the results showed that MOOCs are flexible in terms of time and place and



can increase the convenience and efficiency of entrepreneurial education (Vorbach et al., 2019), as found in the current research.

Robinson et al. (2016) explored the benefits of using and combining different learning theories and approaches to promote entrepreneurial awareness and thinking. This paper argued for a move away from teacher-led entrepreneurship education toward a more student-centered one and focus on the practical and existential practices of lifelong learning. Such education can use digital development technologies, as found in the current research. Researchers from Saudi Arabia (Hameed and Irfan, 2019) explored the transition from a traditional economy to a knowledge-based one through the BADIR program for technology incubators. Such transition is supposed to increase national innovation capacity and develop an ecosystem for entrepreneurship; it also positively affects the synergy of entrepreneurship and modern technologies, as found in the current research.

## 5. Conclusion

The academic performance of students studying entrepreneurship through MOOC-based online courses depending on their year of study has improved in all ten study subjects and all results were statistically significant. The performance of second-year students at the end of the study increased after MOOC introduction compared to Point 1 in Fundamentals of Entrepreneurship, Business Planning, Enterprise Economics, Management, and Marketing by 13.13, 15.09, 11.92, 11.54, and 4.9%, respectively. The performance of third-year students increased after MOOC introduction compared to Point 1 in Finance, Accounting, Labor Economics, Production Organization, and Economics and Audit by 19.07, 10.97, 10.6, 12.79, and 15.12%, respectively. The resulting *t*-value for paired value is higher than the *t*-value for the tests of the first and last evaluations. Thus, online courses have shown their effectiveness in improving academic performance in all ten subjects of the entrepreneurial course. These courses have increased the educational process efficiency and the implemented information and digital technology in the online environment without losing productivity.

The findings have practical implications as they may integrate information and digital technologies in the study of entrepreneurship to improve education quality. This research is of scientific importance: it brings new knowledge about the use of online courses in Kazakhstan and their effectiveness and applicability in higher education institutions. Moreover, the current research contributes at a theoretical and practical level to the discussion about digital entrepreneurship learning. At the practitioner level, it offers information on redesigning traditional university curricula to adapt them effectively for use in the digital realm.

### 5.1. Limitations

This research had some limitations. As for the sample, students of only one university in Kazakhstan took part in the study. There was no data representative of various educational institutions and regions and the research may not accurately reflect the

effectiveness of online courses in the studied context. In addition, a single sample and number of students limited the possibility of generalizing the results since this research took place on the territory of one educational institution in Kazakhstan. Seasonal variations can exert an influence on the physical and emotional wellbeing of students, as well as impact their motivational levels and concentration during testing. The academic year spans from September to June, encompassing the period during which testing occurs. Students may engage in a greater volume of academic endeavors and educational tasks during this period, potentially affecting their test performance outcomes. The study subjects reflected the curriculum and the required depth of knowledge in each subject; other disciplines may be of interest in future studies.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Author contributions

SA: conceptualization, data curation, and writing—original draft. MK: formal analysis, funding acquisition, and writing—review and editing. GZ: investigation, methodology, and writing—review and editing. GA: project administration, resources, and writing—review and editing. ZI: software, supervision, and writing—original draft. RZ: validation, visualization, and writing—original draft. All authors contributed to the article and approved the submitted version.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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