EAI Endorsed Transactions
on Scalable Information Systems
Research Article EAI.EU

The Quality Evaluation of Innovation and Entrepreneurship Education in Colleges and Universities in the Context of Big Data

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Abstract

INTRODUCTION: The advancement of appropriate instructional procedures and data techniques had already facilitated the development of a virtual evolutional innovation and entrepreneurship education process.
OBJECTIVES: The adoption of big data has also tended to result in academic revolutionary movements for businesses. To address the limitations of current university instructional setups and to broaden the scope of Big Data's (BDC) application, this study presents an optimization technique for evaluating the quality of innovation and entrepreneurship education.
METHODS: This paper presents an optimization technique for measuring the quality of education in innovation and entrepreneurship. This technique should help us move beyond the constraints of our existing approaches to higher education's pedagogical infrastructure into the domain of big data.
RESULTS: The proposed optimization algorithm differs from conventional university quality evaluation instructional practices as it integrates big data that dramatically improves the college Entrepreneurship class interaction. This article proposed a Convolution neural network algorithm with BDC for training virtualization representation and employs a standard correlation analysis method in data analysis to retrieve the correlation relationship between the information content enclosed in huge entrepreneurship education and online students.
CONCLUSION: Simulation results revealed that the proposed model has provided an accuracy of 98%. The proposed method provides a platform for sharing instructional materials that function more efficiently under heavy load. Up to 98% and 94% security are achieved under heavy and light loads, respectively. The use of cloud computing in this scenario led to improvements of 7% and 8%, respectively, yielding results of 89% and 86%.

Keywords: Big Data (BDC), Cloud Computing, Convolution Neural Network (CNN), Correlation Analysis, Data Techniques, Entrepreneurship Education, Instructional Procedures, Optimization Technique, Pedagogical Infrastructure, Security Metrics, Simulation Results

Received on 20 August 2024, accepted on 16 April 2025, published on 14 May 2025

doi: 10.4108/eetsis.7015

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1. Introduction

Innovation and entrepreneurship programs at universities are crucial in providing students with the skills they need to succeed in their chosen industries and beyond [1]. The emergence of big data brings obstacles and opportunities for improving university education. Big data personalizes learning, informs curriculum creation, and improves assessments, resulting in individualized educational experiences, identifying market trends, and providing insights into student performance for improved support. It fosters collaboration, facilitates networking, predicts at-risk students for timely interventions, enhances real-world simulations and drives research into new teaching methods, ultimately preparing students for success in a globalized market.
Capsule Networks (CapsNet) offer a neural network architecture adept at capturing spatial relationships in

data, making them highly effective for analyzing complex datasets. This study leverages CapsNet to evaluate innovation and entrepreneurship education, providing insights into student performance and program effectiveness. By integrating big data analytics with CapsNet (BDC), this research aims to optimize educational quality through data-driven improvements. Big data also empowers business-minded college students to identify emerging markets and address challenges arising from new business models, such as reconfiguring value networks and restoring industrial supply chains [2, 3]. Despite its potential, many students lack foundational knowledge in innovation and entrepreneurship, sparking debates about effectively communicating these concepts [4]. Gender differences in perspectives reveal that male students often see entrepreneurial thinking as a strategic approach to market opportunities, while female students emphasize resource efficiency for goal achievement [5]. Complex problems, such as those encountered in industrial processes, are often governed by discrete event dynamic systems (DEDS), which are motivated by sequences of events occurring in specific orders [6]. DEDS have broad applications, including manufacturing, aviation, communications, and the military, and have become integral to university programs promoting innovation and entrepreneurship [7, 8]. China's shift from a traditional economic model to one driven by innovation highlights the importance of concepts like cloud computing, big data, and artificial intelligence across various societal domains [9]. For example, Gudivaka (2021) demonstrated how integrating AI and big data in music education creates engaging and personalized learning experiences through interactive features and real-time feedback [10]. Modern graduates must navigate increasingly nuanced social environments, making creative and entrepreneurial skills highly sought after by employers. Governments and private institutions are thus investing heavily in fostering originality and risk-taking among students [11, 12]. This research focuses on enhancing the quality of innovation and entrepreneurship education for college students in the context of cloud computing through big data applications. For instance, Gattupalli (2024) illustrated how AI-driven CRM systems using Natural Language Processing (NLP) enhance customer interactions, security, and personalization, achieving measurable improvements in retention and engagement. Similarly, applying big data and AI to education can provide actionable insights for program optimization, fostering creative thinking and entrepreneurial skills [13].

1.1 Education for Entrepreneurship and Innovation

Education fosters pioneering personalities by teaching entrepreneurial spirit, initiative, curiosity, and good management skills. These traits are complemented by technological proficiency, social awareness, and independent work capabilities. Modern education evolves by aligning the university's core needs with societal demands, creating mutual benefits between students and employers while optimizing the education system to foster innovation and entrepreneurship at research universities. Collaboration among academic institutions, students, and society is critical for meeting shared objectives. Higher education underscores this relationship by nurturing creative and entrepreneurial talent to address evolving societal and economic needs. Universities, especially research-oriented institutions, play a vital role in preparing students for the complexities of the modern world through initiatives that integrate creativity with technical and managerial skills [14]. "Internet Plus education" model highlights the need for innovative approaches to nurturing students' imagination and initiative. This paradigm accelerates knowledge dissemination, improves organizational efficiency, and fosters classroom creativity, driving systemic educational reforms [15]. However, challenges persist, such as shortages of trained faculty, inconsistent teaching methodologies, and a disconnect between academic learning and real-world applications, particularly in U.S. institutions [16]. Countries such as China, on the other hand, are attempting to restructure their educational institutions to match global competition standards. The emphasis is on fostering students' creativity and entrepreneurial skills, particularly in STEM fields.

By integrating global practices, Chinese education is gradually aligning itself with the comprehensive curricula of Western nations, which emphasize independent thought, critical analysis, and entrepreneurial values. These efforts are crucial, as only about 1% of Chinese graduates engage in entrepreneurial activity, compared to the global average, due to policy and developmental barriers [17-19]. Achieving the goal of fostering entrepreneurial and innovative talent requires reforms that promote creativity, align with employment strategies, and encourage youth entrepreneurship. China's central committee has prioritized policies supporting social incentives, government backing, and entrepreneurship courage to drive these efforts forward. Educational institutions are adopting data-driven approaches, such as queueing theory and discrete event dynamic systems (DEDS), to assess and improve teaching methodologies [20]. DEDS, originating in the 1980s with advancements in computer technology, offer robust frameworks for analyzing dynamic systems, including educational settings. These systems address coordination and network modeling challenges in manufacturing, communication, and defense.

DEDS applications and methodologies in education have enabled virtual transformations, particularly through integrating big data [21-24]. This research proposes an optimization approach using CapsNet (Capsule Networks) combined with Convolutional Neural Networks (CNNs) to evaluate the effectiveness of innovation and entrepreneurship education programs. CapsNet enhances data processing by preserving spatial relationships through capsule structures, enabling precise analysis of extensive datasets. Unlike traditional CNNs, CapsNet uses dynamic routing to identify feature hierarchies and relationships better, making it resilient to transformations like rotation and scaling. Studies demonstrate CapsNet's superior accuracy (98%) in predicting educational outcomes, outperforming conventional models and improving program optimization. By merging CNN and CapsNet, this study provides an effective tool for assessing educational programs, offering insights into student performance, teaching methodologies, and program efficiency. The findings aim to aid institutions in strengthening innovation and entrepreneurship education through advanced big data analytics. The remainder of this paper is organized as follows: Section 2 reviews related works, Section 3 outlines the proposed methodology, Section 4 presents the results, and Section 5 concludes the study.

2. Related Works

It is crucial to evaluate how well students are taught to think creatively and entrepreneurially in higher education. Zhou's work from 2022 builds an evaluation index system for how well students are taught about innovation and entrepreneurship in higher education [25]. The five components that make up the evaluation index are as follows: self-innovation and entrepreneurship, educational conditions, educational channels, and the curriculum and activities for teaching innovation and entrepreneurship. This assessment index system is grounded in a literature review on measuring the effectiveness of training in innovation and entrepreneurship.

The widespread use of big data is made possible by advances in IT, which also drives the ongoing transformation of educational practices at institutions. As students attempt to equip themselves for a volatile labor market, the efficacy of courses emphasising innovation and entrepreneurship has come under criticism. Examine the current state of entrepreneurship and innovation education using large datasets. The effectiveness of the CapsNet-Convolution neural network model in analyzing big data for entrepreneurship education heavily depends on the quality and characteristics of the datasets used for training. These datasets, sourced from institutional records, surveys, questionnaires, and online learning platforms, often span multiple academic years to understand student experiences and outcomes comprehensively. They encompass demographic information, academic performance, engagement metrics, and a target variable representing success in entrepreneurship education, typically defined as a composite score based on grades, project outcomes, or self-reported competencies. Given the imbalance in many educational datasets, with more successful students than unsuccessful ones, balancing techniques such as oversampling, undersampling, or class weighting are employed to ensure fair model training. Preprocessing methods further enhance the model's learning process, including normalization to scale features, outlier removal to reduce skewness, and feature engineering to create new predictive variables. The datasets are then split into training, validation, and test sets to evaluate model performance effectively. Careful dataset curation and preparation enable CapsNet to make accurate and reliable predictions, ultimately supporting improved educational outcomes in entrepreneurship education. Wang's (2020) essay delves into topics such as professional ethics, a job-seeker mentality, cultivating innovation and practice abilities, creative thinking, psychological bearing capacity, entrepreneurial core competitiveness, innovation and entrepreneurship comprehensive quality, etc [26]. To better prepare tomorrow's innovators and entrepreneurs, we look at the current condition of innovation and entrepreneurship education in universities and institutes of higher learning. This study suggests reforms and mitigation strategies in light of the unfavorable influences. The society, including the government, schools, teachers, and students, compiled the innovation and entrepreneurship education model to create a collection of ever-evolving innovation and entrepreneurship curricula. That way, we can foster the growth of creative and entrepreneurial minds and create a training program that can keep up with the trends. A real-world case study or experiment that demonstrates how CapsNet is used to assess the quality of schooling. In a mid-sized U.S. school district, educators faced challenges in evaluating the quality of their innovation and entrepreneurship programs due to limited technology infrastructure. To overcome this, the district collaborated with a local university to pilot using CapsNet (Capsule Networks) for educational outcome assessment. Data was collected from multiple sources, including student performance, attendance records, and feedback on the entrepreneurship curriculum. The university's data science team trained the CapsNet model to identify patterns and correlations between teaching methods, student engagement, and program effectiveness. The model found that hands-on projects led to higher student engagement and success rates than traditional lectures and highlighted effective teaching strategies. The pilot demonstrated scalability by leveraging existing data and cloud-based solutions, allowing teachers to conduct analyses without requiring advanced local computing resources. Future research could include longitudinal studies, exploration of diverse educational contexts, integration with other technologies, and user experience assessments. Although the model shows promise, challenges such as data quality, technical expertise, and resistance to new methods must be addressed. Overall, the case study highlights how CapsNet can improve educational assessments in settings with limited resources and provides insights for future research to enhance its application.

Developments in teaching about entrepreneurship in universities are increasingly seen as crucial. The study aims to ascertain how satisfied participants are with their educational experience regarding entrepreneurship. Using the C- Context, I- Input, P- Process and P- Product (CIPP) model, Xinqiao Fan et al.'s (2022) study first theoretically analyzes the factors affecting the quality of entrepreneurship education in universities and colleges and then elucidates how this quality might be raised [27]. The analytic hierarchy process (AHP) and the fuzzy comprehensive evaluation (FCE) method are then used to construct an evaluation index system and a fuzzy evaluation model for entrepreneurship education. According to the findings, student engagement is the most crucial element in determining the success of entrepreneurship programs. According to the data, pupils are most satisfied with their teachers and least satisfied with the entrepreneurial atmosphere. The suggested methodology allows for a simple and accurate assessment of entrepreneurship education and serves as a valuable guide for enhancing the standard of entrepreneurship instruction in academic institutions.

There has never been a more important time for China to experience national rejuvenation and economic growth. The ability to innovate is the lifeblood of any country and a never-ending source of economic development. The youth of a country are its best hope for its future success. College students now have a far greater opportunity to integrate into society and understand their place in the world. This is because the capacity to be entrepreneurial and have a creative spirit is crucial to advancing the new era. It has drawn the attention of everyone because of its vital role in the progress of both individuals and China. As Internet technology evolves and application space expands in the cloud computing era, the focus of universities, society, and the country has shifted to enhancing the quality of innovation and entrepreneurship education for college students based on big data analysis. The system's core is a technology for modelling complex systems in discrete dynamical terms. In this paper, Wenhui Zhang (2022) discusses how to improve the quality of innovation and entrepreneurship education in the context of big data and cloud computing by introducing the development and principle of complex system discrete dynamic modeling technology, analyzing the deficiencies and problems of college students' innovation and entrepreneurship, and then offering suggestions for doing so [28]. Wang (2023) investigates how big data technology can enhance the innovation and entrepreneurship education model in vocational colleges, improving teaching effectiveness, innovation, and employability. The new model boosted students' knowledge, research, innovation, and practical skills, with an average score of 90 in innovative practice—27 points higher than traditional methods. Additionally, it positively impacted students' moral character, motivation, and learning behaviors, supporting education reform and talent development [29].

Students at all levels of education have a high propensity for creative problem-solving and business initiative. A structured approach is crucial for effectively implementing big data technologies in entrepreneurship education. Institutions should start by assessing readiness through needs assessments and engaging stakeholders such as faculty, students, and industry partners to identify gaps and challenges. A clear strategic plan with defined objectives and a phased timeline should guide the process, focusing on investing in user-friendly tools like Tableau or Power BI and providing students with access to relevant datasets. Updating curricula to incorporate big data concepts and introducing specialized courses on predictive analytics, data ethics, and similar topics are essential. Educators should receive workshops and peer learning training to ensure they can effectively integrate these technologies into their teaching. Pilot programs in specific courses or departments provide an opportunity for initial testing, with experiential learning through capstone projects and industry partnerships enhancing practical application. Feedback from these programs should drive continuous improvement, supported by student performance and satisfaction metrics. Successful initiatives can be expanded across departments and documented to showcase their benefits. Addressing resource constraints, faculty buy-in, and data privacy concerns is critical. Starting with manageable steps and gradually scaling ensures improved educational quality, better preparation of students for the evolving job market, and promotion of innovation in entrepreneurship education. Because of the importance of teaching students, the scientific perspective on development and encouraging them to start their own businesses, it is imperative that educational institutions implement programs to teach students about innovation and entrepreneurship. This is an important tactic for advancing the reform of teaching in higher education and fostering the growth of students' imaginative capacities and practical competence. It's also a practical application of the idea of encouraging business ownership to create new jobs. A crucial step in ensuring that all college grads find gainful employment. Universities and colleges, as vital nodes in the country's overall innovation system, are tasked with developing a workforce equipped to thrive in the current environment by providing cutting-edge education. Xiaohang Wen (2022) merges the theoretical knowledge and practical experience of "Innovation, Invention, and Intellectual Property Practice" and "Foundation of Innovation and Entrepreneurship Education" to propose a meteorological big data service for college students' innovation and entrepreneurship projects [30]. With the ultimate goal of building a dynamic, three-dimensional training model geared toward meteorological service, research and practice will center on teaching college students to innovate and become entrepreneurs utilizing meteorological big data. Students will gain an understanding of the value of big data in meteorology, which will aid in their capacity for creative problem-solving and entrepreneurial initiative. It is possible to foster high-level inventive and entrepreneurial abilities to satisfy the needs of the construction of an innovative country by directing students to participate in initiatives centered on innovation and entrepreneurship.

Yin (2024) explores how big data analytics and digital sharing technologies can enhance innovation and entrepreneurship education in the digital economy. It aims to improve teaching methods and prepare students for entrepreneurial roles by integrating these tools, focusing on market trends, consumer behavior, and collaborative learning. The goal is to provide recommendations for incorporating these technologies into curricula, helping students develop essential skills for the digital economy [31].

This study by Yufei Xie (2021) analyzes and deconstructs the key concepts of AI knowledge-based crowdsourcing based on literature research. Additionally, this study analyzes the objective fitting needs of combining AI knowledge-based crowdsourcing with college students' innovation and entrepreneurship education practice through a survey and research of an r [32]. Based on the practical process of innovation and entrepreneurship education for college students in the author's university, this study analyzes and deconstructs the key concepts in addition to this, the study provides evidence that college students are aware of and make use of AI knowledge-based crowdsourcing knowledge in the process of acquiring and applying the skills necessary for innovation and entrepreneurship. Pan (2024) proposed the role of education in social entrepreneurship for college students, focusing on adaptive hybrid learning systems and their impact on skill development. It examines how social entrepreneurs address global challenges and uses Data Envelopment Analysis (DEA) and Convolutional Neural Networks (CNN) to evaluate early-stage education's effect on career growth. The goal is to enhance learning systems, assess competencies, and emphasize practical action in social entrepreneurship [33].

Education in innovation and entrepreneurship is expanding rapidly in China, although the quality of instruction differs significantly. As a result, it is of the utmost importance to methodically create an assessment index system for educational programs about innovation and entrepreneurialism. Interdisciplinary approaches are typical of the specialization environments that comprehensive universities provide. The Jinan University Shenzhen Campus was selected as a case study for this investigation. Undergraduate students majoring in multidisciplinary arts and sciences can benefit from the assessment index method developed by Dan Yao et al., (2022). This evaluation index system is made up of four primary indexes and nineteen secondary indexes. The research was based on a review of the existing literature [34]. In total, 234 people filled out the survey, and Importance-performance Analysis modeling was used to assess the current condition of innovation and entrepreneurship education in the field of study. The research indicates that the novel service platform should be given top billing in terms of evaluation priorities. The outcomes of this study could be helpful to the creation of education programs in innovation and entrepreneurship at other universities similar to those studied here. A case study that illustrates how the proposed approaches are applied and validated in a real-world setting by considering the following suggestions: The Changzhou Institute of Technology in China created a big data framework for evaluating the efficacy of entrepreneurship programs by incorporating data analytics into the curriculum, with a focus on market analysis and customer behavior prediction. Using indicators such as patents, publications, and contest participation, they enhanced student engagement and the formation of student-run enterprises. Similarly, UC Berkeley's Sutardja Center for Entrepreneurship & Technology (SCET) integrated entrepreneurship education and big data analytics, providing hands-on experience through projects and industry collaborations. Students used massive databases to find market opportunities, resulting in successful enterprises and venture capital funding. A comprehensive program at the University of Michigan included a big data analytics course and capstone projects in which students used data-driven methodologies to solve real-world business problems, resulting in a large increase in student-led businesses. Furthermore, using a CapsNet-Convolutional Neural Network model to evaluate student ideas revealed insights into project strengths and shortcomings, allowing for more targeted support and greater commercialization success. These examples demonstrate the usefulness of incorporating big data into school, encouraging practical learning, and employing advanced analytics to generate entrepreneurial skills and a strong ecosystem that benefits society.

Due to global economic trends and the winds of technological change, China has made it a national strategic aim better to integrate industry and education for innovation and entrepreneurship. But for a long time prior to that, the many differences between the educational and industrial systems were the cause of a rift between education for innovation and entrepreneurship and professional education, a profound disconnect between professional education and the local industries, and a lack of interest on the part of entrepreneurial mentors. To assess the current innovation and entrepreneurship education conditions in China's technical universities, Min Lv (2022) wrote the following article. It has been proposed that technical institutions increase the integration between industry and education for innovation and entrepreneurship to reduce the gap between the supply side (higher education talent training) and the demand side (industrial development). This action would be taken to lessen the impact of the imbalance [35]. To foster national and regional economic development and social progress, it is recommended that technical universities revamp their talent training paradigm by updating their organizational structure and curricular system. They should also adjust the innovation ecosystem by reorganizing incubation platforms and teacher-student teams. To further national and regional economic development and social advancement, it is recommended that technical universities shift their talent training paradigm. This article provides a framework for assessing the impact of innovation and entrepreneurship programs in China's technical universities. Patents, publications, awards at contests, and funding all play a role in the technique, as do fewer concrete measures like organizational structure and customer satisfaction. We then tailor this process to the needs of the Changzhou Institute of Technology. Stanford University's d.school uses big data analytics in its curriculum to assess student projects and outcomes. This data-driven strategy refines teaching methods and increases student engagement, with many students creating firms based on their projects. Similarly, MIT's Martin Trust Center for MIT Entrepreneurship uses big data to track the success rates of student and alumni firms, evaluating trends to influence curriculum and mentorship programs, resulting in increased funding opportunities for student enterprises. Big data is used by the University of California, Berkeley's SkyDeck accelerator to evaluate company performance, including measures like investment raised and market traction. This targeted guidance has led to great success rates and significant funding for several firms. Babson College, well-known for its emphasis on entrepreneurship education, uses big data to evaluate student performance and alumni achievement. It constantly modifies its programs to maintain its top ranking in entrepreneurship education. Finally, Nanyang Technological University (NTU) in Singapore uses big data analytics to evaluate the effectiveness of its entrepreneurship programs, collecting data on student projects, industry partnerships, and startup outcomes, thereby contributing to Singapore's stronger entrepreneurial ecosystem. These case studies provide useful insights into how big data and new evaluation approaches are used in real-world educational contexts, confirming their inclusion into entrepreneurship education.

3. Materials and Method

Figure 1 provides a plausible framework for the layout of a big data approach for entrepreneurship education with a mobile phone as a terminal that also helps to add practical implementation scenarios for mobile observational learning as well as resolve the issue of a lack of context specific big data through conventional entrepreneurship education as well as learning period and location constraints. The guidance mentioned above is provided by sequential training with the help of the CapsNet neural network. During the same time period, it explains and anticipates the potential use and expansion of big data across various industries. Since it is beginning to study with the mobile phone, quality evaluation of innovation remains an advanced way of learning. In recent years, big data analytics has gained traction in educational evaluation, but significant gaps remain in assessing the quality of innovation and entrepreneurship education. Traditional methods often rely on subjective assessments, leading to incomplete insights, while current big data systems lack the analytical frameworks needed for complex educational datasets. Many institutions struggle to implement data-driven approaches that accurately measure outcomes and guide curriculum development. This study proposes a novel optimization technique that integrates CapsNet with big data analytics, aiming to provide more accurate and comprehensive assessments of educational quality, improve student success, and bridge the gap between traditional evaluation practices and advanced data-driven strategies. At the time, the entrepreneurial education teaching technique is still in its early stages, and there is no completely developed teaching approach utilizing Big Data with CapsNet. The instructional technique of certain themes should be incorporated and examined throughout future professional practice. College students' comprehensive entrepreneurial education is assessed by putting several capsules in the training venue to identify distinct student groups. Following the gathering of data on students of various categories by the CapsNet capsules, training for the pupils is supplied based on their status. The structure of multiple capsule layers in a Capsule Network (CapsNet) enhances the model's ability to capture spatial hierarchies and relationships between features.

Capsules, groups of neurons that output vectors, encode the presence of features (via vector length) and their properties (via orientation). CapsNets typically start with a Primary Capsule Layer, which extracts low-level features using 8 to 32 capsules, each outputting fixed-length vectors (e.g., 4D or 16D). Higher-Level Capsule Layers capture more abstract features, using 16 to 64 capsules with larger output vectors (e.g., 16D or 32D). The dynamic routing mechanism is a key component that refines connections between layers based on "routing by agreement." Capsules initially connect to all higher-layer capsules, and iterative updates based on the agreement between lower-layer outputs and higher-layer predictions adjust connection strengths, using techniques like weighted summation, softmax activation, and dot product agreement measurements. This architecture supports hierarchical feature learning, with lower-level capsules capturing basic features (e.g., edges) and higher-level capsules encoding complex ones (e.g., shapes and objects). The vector representation in CapsNets includes spatial relationships, improving robustness to transformations like rotations and translations, which is crucial for tasks such as image recognition.

We begin by compiling information on how colleges and institutions teach about innovation and entrepreneurship. Then, there are the massive troves of observational data. The collegiate innovation curriculum should be compiled in Innovate with the support of CapsNet. Make entrprenu the repository for academic programmes that teach entrepreneurship. Karl Person's coefficient $\mathrm{Innovate}$ and $\mathrm{entrprenu}$ is defined as in Equation (1).

$$\gamma_{IE} = \frac{\sum \begin{array}{c}(Innovate_j - \overline{Innovate}) \\ (Entrprenu_j - \overline{Entrprenu})\end{array}}{n\ \sigma_{Innovate}\sigma_{Entrprenu}} \qquad (1)$$

In Equation (1), $\overline{\text{Innovate}}$ and σ_{Innovate} are the mean and variance of the observations of innovation education in colleges and universities respectively using CapsNet. Also

$\overline{\text{Entrprenu}}$ and $\sigma_{\text{Entrprenu}}$ (2)

are the mean and variance of the observations of entrepreneurship education in colleges and universities respectively using CapsNet, as defined in Equation (2).

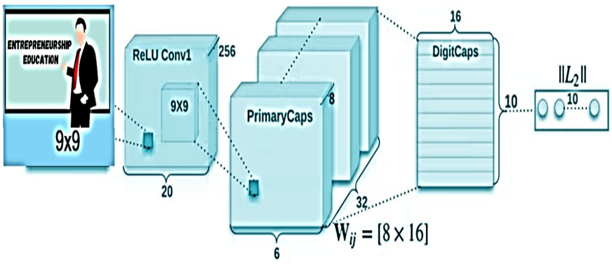

Figure 1. Proposed workflow in entrepreneurship Education

Where n is the total number of times college and university entrepreneurship and innovation courses have been observed. $\sum_j \text{Innovate}_j$ is the sum of all the n observations of innovation education in colleges and universities. The mean of n observation of entrepreneurship education in colleges and universities using CapsNet is defined as in Equation (3).

$$\overline{Entrprenu} = \frac{\sum_j Entrprenu_j}{n} \qquad (3)$$

$\sum_j \text{Entrprenu}_j$ is the sum of all the n observation of entrepreneurship education in the colleges and universities The standard deviation of n observation of innovation education in colleges and universities with CapsNet is defined as in Equation (4).

$$\sigma_{Innovate} = \left[\frac{1}{n}\sum (Innovate_j - \overline{Innovate})^2\right]^{\frac{1}{2}} \qquad (4)$$

The standard deviation of observation for entrepreneurship education in colleges and universities through CapsNet defined as in Equation (5).

$$\sigma_{Entrprenu} = \left[\frac{1}{n}\sum (Entrprenu_j - \overline{Entrprenu})^2\right]^{\frac{1}{2}} \qquad (5)$$

Then the Equation of the regression line of quality evaluation of Entrprenu on Innovate using CapsNet is defined as in Equation (6).

$$Entrprenu - \overline{Entrprenu} = \gamma \frac{\sigma_{Entrprenu}}{\sigma_{Innovate}} (Innovate - \overline{Innovate}) \qquad (6)$$

Similarly, the Equation of the regression line of quality evaluation by utilizing capsules of CapsNet is defined as Innovate on Entrprenu is in Equation (7).

$$Innovate - \overline{Innovate} = \gamma \frac{\sigma_{Innovate}}{\sigma_{Entrprenu}} (entrprenu - \overline{entrprenu}) \qquad (7)$$

The slope of the regression line Innovate on entrprenu is calculated as in Equation (8).

$$s_{IH} = \gamma \frac{\sigma_{Innovate}}{\sigma_{entrprenu}} \qquad (8)$$

The slope of the regression line entrprenu on Innovate is identified as in Equation (9).

$$s_{HI} = \gamma \frac{\sigma_{entrprenu}}{\sigma_{Innovate}} \qquad (9)$$

The angle between the two regressions is represented as Equation (10).

$$\theta = \tan^{-1}\left[\left(\frac{\gamma^2 - 1}{\gamma}\right)\left(\frac{\sigma_{Innovate}\sigma_{entrprenu}}{\sigma_{Innovate}{}^2 + \sigma_{entrprenu}{}^2}\right)\right] \qquad (10)$$

Consider the Equation (11), and hence the Equation (12) and Equation (13) are obtained.

$$\gamma = 0 \qquad (11)$$

Then, the lines of regression that are perpendicular to each other using CapsNet are denoted as in Equation (12).

$$\gamma = \pm 1 \qquad (12)$$

Then, two lines of regression are parallel. Further two lines have the common point as in Equation (13) and hence they coincident.

$$(\overline{Innovate_1}, \overline{Entrprenu_1}) \qquad (13)$$

Implementing CapsNet-Convolution neural network:

Let $DATA$ be the function of data collection of big data in the construction of entrepreneurship education. Then a 1-D dilation h that convolves the data signal $DATA$ with kernel K size l defined as in the Equation (14).

$$(DATA_{*h}\, K)_l = \sum_{\theta} K_\theta DATA_{l-h\theta} \quad (14)$$

Also, the following Equation is defined by the feature map of big data collection in enhancing entrepreneurship education quality as in Equation (15).

$$FM_{p,q,k} = \max\left(we_k^T IP_{p,q} + b_k, 0\right) \quad (15)$$

In the above Equation, $FM_{p,q,k}$ is activation value of the k^{th} future map of the data analysis at the location (p,q) and $IP_{p,q}$ is the input data centered at the location (p,q) and also we_k is the weight vector and b_k is the bias. The following Equation says that the computation performed by the MLP convolutional layer of CapsNet as in Equation (16).

$$FM_{p,q,k_m}^m = \max\left(we_{k_m}^T FM_{p,q}^{m-1} + b_{k_m}, 0\right) \quad (16)$$

Where $m \epsilon [1, M]$ and M is the number of layers in the mlp convolutional layer. Next, in the pooling layer of the data collection of block chain in the development of high-quality entrepreneurship education, lessen the computational burden by decreasing the number of interlayer connections. Then L_p pooling of the data analysis defined as in Equation (17).

$$output_{p,q,k} = \left[\sum_{(i,j)\in R_{mn}} \left(FM_{i,j,k}\right)^t\right]^{1/t} \quad (17)$$

In the above Equation $output_{p,q,k}$ is the output of the pooling operator at location (p,q) in the k^{th} future map of the data analysis and $FM_{i,j,k}$ is the future value at location (i,j) within the pooling region R_{mn} in the k^{th} future map of CapsNet. The pooling data analysis is average if $t = 1$. Also, if $t = \infty, L_\infty$ reduces to maximum pooling of data analysis. The $ReLU$ activation function of the data analysis defined as in Equation (18).

$$FM_{m,n,k} = \max\left(Z_{m,n,k}, 0\right) \quad (18)$$

In the above Equation the variable $Z_{m,n,k}$ is the input data analysis of the activation function at location (m,n) in the k^{th} channel with capsules of CapsNet. The leaky $ReLU$ activation function of data analysis defined as in Equation (19).

$$FM_{m,n,k} = \max\left(Z_{m,n,k}, 0\right) + \lambda \min\left(Z_{m,n,k}, 0\right) \quad (19)$$

Where λ is a predefined parameter in the range $(0,1)$. Then the above Equation can be written in the following form as in Equation (20).

$$FM_{m,n,k} = \max\left(Z_{m,n,k}, 0\right) + \lambda_k \min\left(Z_{m,n,k}, 0\right) \quad (20)$$

In the above Equation λ_k is the learned parameter of the k^{th} channel of the data analysis.

$$FM_{m,n,k}{}^i = \max\left(Z_{m,n,k}{}^i, 0\right) + \lambda_k{}^i \min\left(Z_{m,n,k}{}^i, 0\right) \quad (21)$$

In Equation (8), $Z_{m,n,k}{}^i$ is the input data analysis of activation function at location (m,n) on the k^{th} channel of i^{th} example, $\lambda_k{}^i$ is the parameter and $FM_{m,n,k}{}^i$ is the output of the data analysis. The function of Exponential Linear Unit (ELU) data analysis of the big data with CapsNetis defined as in Equation (22).

$$FM_{m,n,k} = \max\left(Z_{m,n,k}, 0\right) + \min\left(\lambda\left(e^{Z_{m,n,k}} - 1\right), 0\right) \quad (22)$$

The max out function of the data analysis defined as in the Equation (23).

$$FM_{m,n,k} = \max_{k\epsilon[1,k]} Z_{m,n,k} \quad (23)$$

$Z_{m,n,k}$ is the k^{th} channel data analysis. The softmax loss function of data analysis of big data improves the quality of entrepreneurship education with the implementation of CapsNet to collect information through various capsules defined in Equation (24).

$$L_{softmax} = \frac{1}{M}\left[\sum_{r=1}^{M}\sum_{s=1}^{K} 1.\{x^r = l\} \log p_l^r\right] \quad (24)$$

The contrastive loss function of data analysis of the big data using CapsNet in enhancing the quality of entrepreneurship education is defined as in the Equation (25).

$$L_{softmax} = \frac{1}{2M}\sum_{r=1}^{M}(x)\,d_1^{(r,L)} + (1-x)\max(s - d_1^{(r,L)}, 0) \quad (25)$$

In the above Equation the value of $d_1^{(r,L)}$ defined as in the Equation (26).

$$d_1^{(r,L)} = \left\| z_\alpha^{(r,L)} - z_\beta^{(r,L)} \right\|_2^2 \quad (26)$$

In the Equation (27) the variable s is a margin parameter affecting non-match pairs. If (y_α^r, y_β^r) is a matching pair, then $y = 1$ and otherwise the value becomes $y = 0$.
If the loss function of data analysis of big data in the quality of entrepreneurship education is $EINNOV(\psi, P, Q)$, then the regularized loss function of data analysis with the implementation of CapsNet is defined as in Equation (28).

$$E(\psi, P, Q) = EINNOV(\psi, P, Q) + \lambda R(\psi) \quad (28)$$

In the above Equation $R(\psi)$ is the regularization term of the data analysis and also λ is the regularization strength. If we choose randomly picked the pair (P^x, Q^x) in the training set, then the gradients are defined as in Equation (29) with the data collected by CapsNet.

$$\psi'_{x+1} = \psi'_x - \eta_x \nabla_{\psi'} EINNOV(\psi'_x; p^{(x)}, q^{(x)}) \quad (29)$$

The above Equation is the optimization of (P^x, Q^x) and also it is derived by the gradient descent algorithm which is incorporated in CapsNet. The Equation (30) is derived from the Equation (28) and Equation (29).

$$\psi'_{x+1} = \psi'_x - \eta_x \nabla_{\psi'} E[EINNOV(\psi'_x)] \quad (30)$$

4. Experimental results

The existing methods like cloud computing [36], Internet Plus [37], and Internet of Things (IoT) [38] are compared with the proposed Big Data approach using CapsNet (BDC). CapsNet outperforms Internet Plus, IoT, and Cloud Computing techniques regarding scalability, response time, and overall performance. CapsNet exhibits significantly lower response times, with 3 seconds under a 100-user load and 5 seconds under a 200-user load, attributed to its optimized dynamic routing mechanism. In comparison, Internet Plus, IoT, and Cloud Computing have higher response times, ranging from 1.6 to 7.1 seconds, due to the complexity of managing multiple services, network delays, and server communication. CapsNet's architecture allows for efficient data handling and real-time processing, making it highly scalable as it dynamically routes information and adapts to new data patterns. This scalability is limited in Internet Plus, IoT, and Cloud Computing due to bottlenecks, device congestion, and resource-intensive centralized systems. Key factors for CapsNet's superior performance include its dynamic routing by agreement, hierarchical feature learning, robustness to data transformations, and efficient resource utilization. CapsNet achieves high security performance (94% and 98%) under varying load conditions, making it ideal for applications requiring fast, reliable, and secure data processing.

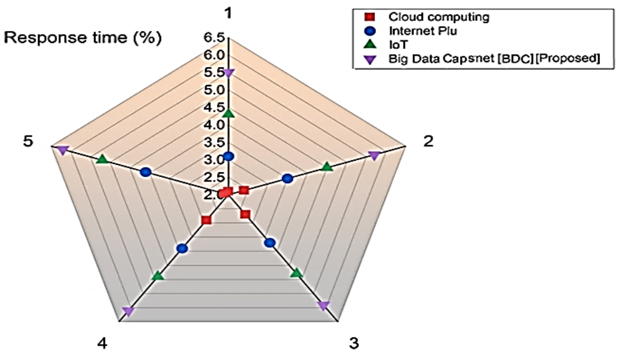

Figure 2. Response time (s)

The performance metrics like response time, safety test analysis, variability analysis, comparison of simulated and actual values, impact of BDC, interest ratio, and comparison of Innovation and Entrepreneurship (IE) are examined for existing and proposed approaches. CapsNet-Convolution combines Capsule Networks (CapsNet) with convolutional operations, offering a significant improvement over traditional Convolutional Neural Networks (CNNs) by capturing spatial hierarchies and relationships in data. Unlike CNNs, which flatten feature representations and lose spatial relationships, CapsNet uses capsules—groups of neurons that detect specific features and preserve their spatial information through vectors. These vectors represent the presence and pose of features, and dynamic routing allows capsules to communicate based on the relevance of their outputs, maintaining spatial hierarchies. This ability to capture complex spatial relationships is particularly valuable in educational datasets, where interactions between factors like student performance, engagement, and teaching methods can reveal critical insights. CapsNet's hierarchical representation and robust dynamic routing make it a more effective tool for analyzing and predicting outcomes in complex datasets than traditional CNNs.

Figure 2 demonstrates that the system can swiftly respond to user actions with a 100-user load, with a response time of nearly 3s, and with a 200-user load, with a response time of nearly 5s using BDC. The system has a much faster response time compared to what is seen in other sources.

Table 1. Comparison of response time and safety test analysis

Methods	Response time (s)	Safety test analysis (%)	
		High load operation	Low load operation
Cloud computing	2.2-6.2	86	89
Internet Plus	1.6-5.2	81	84
IoT	1.3-7.1	73	77
Big Data using CapsNet (BDC) [Proposed]	1.2-4.4	94	98

As shown in Table 1 and Figure 3, while under heavy demand, the security performance of various systems will degrade slightly. This research presents a platform for sharing instructional materials that functions more efficiently under heavy load. Up to 98% and 94% security are achieved under heavy and light load, respectively. When analyzing the CapsNet-Convolution neural network model's effectiveness in big data analysis for entrepreneurship education, it is critical to look at the statistical validation of the reported 98% accuracy, which reflects the model's correct predictions in 98% of the test instances. Confidence intervals and p-values are used to determine the dependability of this accuracy. A 95% confidence interval, for example, may vary from 95% to 99%, determined using the standard error of the accuracy estimate ($SE = \sqrt{(p(1-p)/n)}$), where p is the observed accuracy (0.98), and n is the number of test samples. The confidence interval is calculated as $CI = p \pm Z \times SE$, where Z represents the 95% confidence level. A low p-value (< 0.05) indicates a substantial difference in accuracy compared to a baseline, such as random guessing or a previous model. Statistical tests, such as the binomial or permutation test, can calculate the p-value and determine whether the observed 98% accuracy is sufficient evidence to reject the null hypothesis. If the confidence interval excludes much lower values and the p-value is small, it indicates that the model's performance is both high and statistically validated, which increases the credibility of the findings. This statistical rigor boosts educational institutions' confidence in applying the CapsNet model for big data analysis in entrepreneurship education, encouraging its acceptance and improving academic outcomes.

Cloud Computing in this scenario led to improvements of 7% and 8%, respectively, yielding results of 89% and 86%.

Table 1 illustrates that High and low load conditions are critical for evaluating system performance, particularly in educational settings. High load refers to peak usage periods, such as during exams or project submissions when many users access resources simultaneously. Low load occurs during minimal activity, serving as a baseline for performance comparison. Key performance metrics, such as response time and safety test analysis, are essential for assessing system efficiency, reliability, and security. Faster response times and high safety test percentages under both conditions indicate a robust and user-friendly platform. As shown in Table 1, the results highlight the advantages of the Big Data with CapsNet (BDC) approach over traditional methods like cloud computing, Internet Plus, and IoT. BDC demonstrates significantly lower response times and higher safety test reliability, making it a superior solution for managing educational resources.

Figure 4 represents the variability analysis based on innovation &integration, professional education, dual-innovation education, and innovative sprint towards the innovative and entrepreneurship education have been increased using BDC. Variability analysis in entrepreneurship education examines the differences in student performance, engagement, satisfaction, and the effectiveness of teaching methods, offering insights into how various factors influence learning outcomes. The proposed CapsNet-Convolution system plays a key role in this analysis by capturing and analyzing student interactions with educational resources. By tracking metrics such as grades, participation, and feedback, the system helps identify patterns and trends in student behavior. Increased interaction with the system can enhance engagement, leading to improved performance, while personalized learning experiences reduce variability by addressing individual needs. Additionally, continuous feedback and the influence of social dynamics in collaborative settings further shape student outcomes. The CapsNet-Convolution system provides valuable, data-driven insights that allow educators to adjust their teaching strategies and improve the overall effectiveness of entrepreneurship education. The result also appears that students with a favourable impression of the synergy between their academic and professional training are more likely to show signs of innovative thinking and entrepreneurial aptitude.

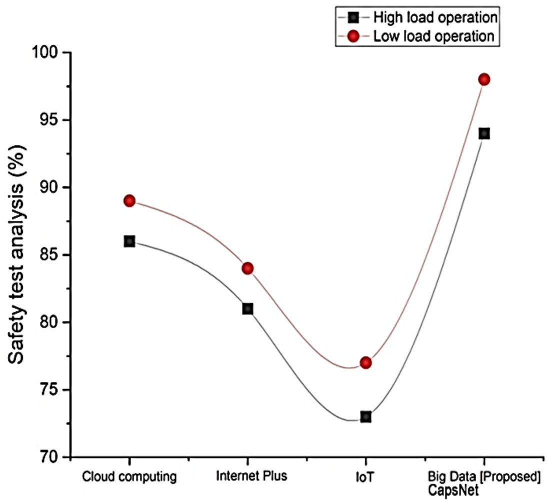

Figure 3. Safety test analysis (%)

Figure 5 depicts the results of comparing the simulated score values and the actual numbers using big data with CapsNet. Figure 5 reveals that the simulated score generated during training follows a trend that is entirely compatible with the actual value and ranges slightly around the actual value.

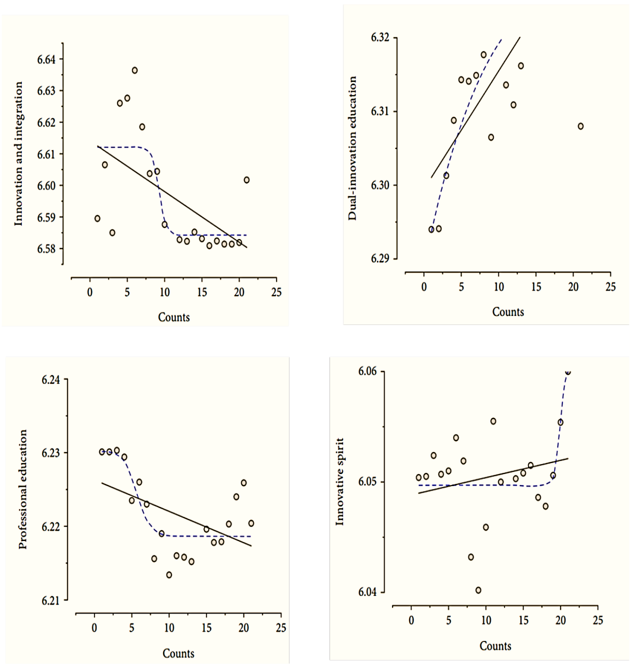

Figure 4. Variability analysis of IE

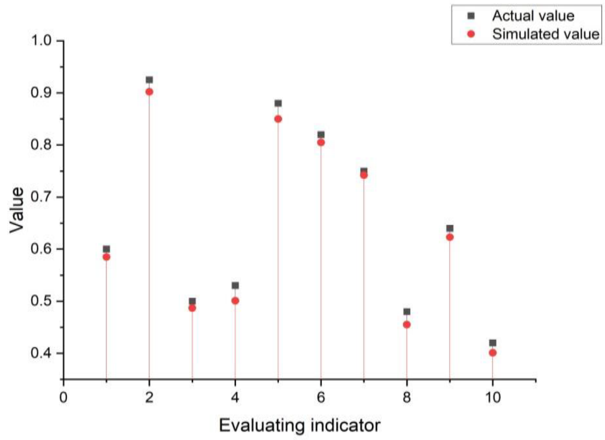

Figure 5. Comparison of simulated and actual values

Table 2 numerically illustrates the simulation and actual values in the entrepreneurship development of college students through CapsNet-based BDC. From the table, it can be observed that the values fluctuate both in the actual and simulated values with an increased number of evaluation indicators.

Table 2. Comparison of simulated and actual values

Evaluating indicator	Actual value	Simulated value
1	0.6	0.585
2	0.925	0.902
3	0.5	0.487
4	0.53	0.501
5	0.88	0.85
6	0.82	0.805
7	0.75	0.742
8	0.48	0.455
9	0.64	0.623
10	0.42	0.401

Figure 6 is a graph depicting Big Data's impact on college students' exposure to entrepreneurial education with the support of CapsNet. The results show that due to the Big Data using CapsNet (BDC), pupils have improved entrepreneurial competence and awareness levels.

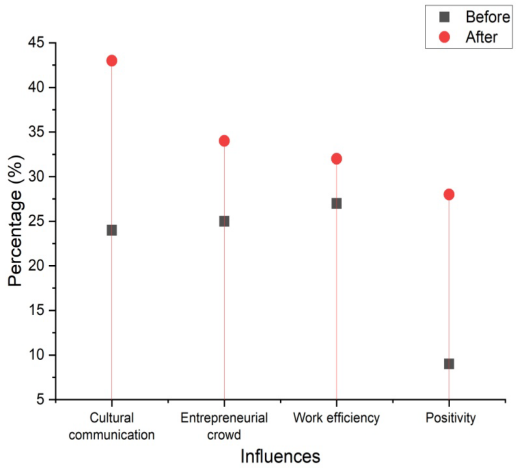

Figure 6. Impact of Big Data with CapsNet

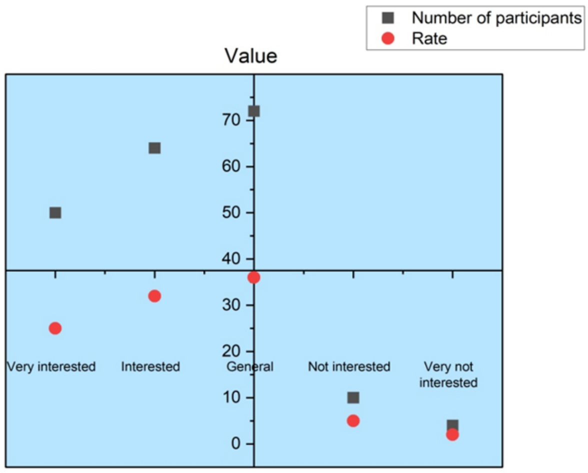

Figure 7. Interest rate (%)

An analysis of student enthusiasm for entrepreneurship, depicted in Figure 7, reveals that, due to Big Data, college students' enthusiasm for learning has improved by almost 15%, fully igniting their enthusiasm for learning and entrepreneurship through CapsNet. Graphical representations, such as progress charts and performance heatmaps, enhance education by providing clear, actionable insights for students and educators. Progress charts track individual learning journeys, highlighting strengths and areas for improvement, while heatmaps use color gradients to assess proficiency across subjects. These tools offer immediate feedback, motivate students to adjust strategies, and support data-driven decisions. Educators can identify trends, tailor teaching methods, and provide targeted interventions while facilitating communication with students and parents. As a result of empowering informed decisions and fostering collaboration, graphical data representations improve learning outcomes and promote continuous educational improvement.

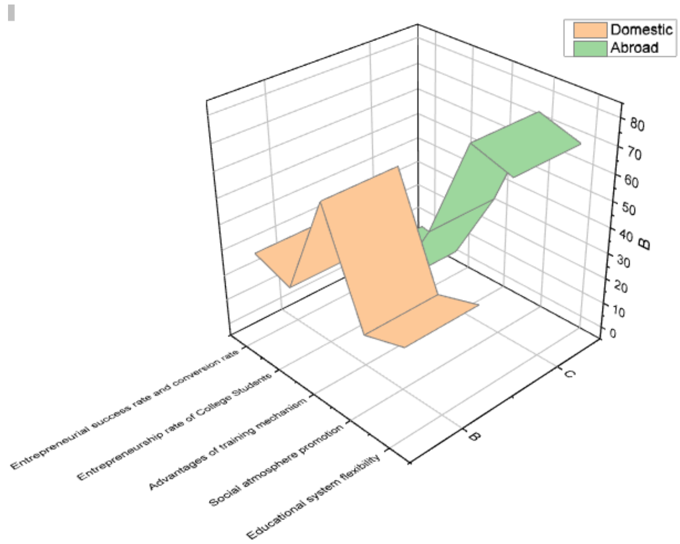

Figure 8. Comparison of IE

Figure 8 shows that international students are far more enthusiastic about IE than their domestic counterparts and that the commercial conversion rate and practical success rate of IE are likewise significantly greater for international students than for domestic students. With the help of big data, this study has analyzed the quality of education using a trending neural model named CapsNet. In this analysis, flexibility in the educational system, support from the social atmosphere, college student's interest in entrepreneurship, and also the level of success conversion rate by the students are projected. The abroad countries also provide higher flexibility in an educational system, which is 40% higher than the domestic one. Additionally, support from the social atmosphere is 50% higher abroad than the domestic educational system. Though the abroad countries satisfy all the student's requirements in choosing their career as an entrepreneur, only a few choose in either case.

5. Conclusion

A simulated evolutionary process of teaching innovation and entrepreneurship has been developed, made possible by the maturation of suitable instructional procedures and data techniques. There has been a trend toward academic revolutions in businesses using big data. In this study, we provide an optimization strategy for assessing the quality of education in innovation and entrepreneurship. This should help us go beyond the limitations of our current approaches to higher education's pedagogical infrastructure and into big data. Exploring big data in innovation and entrepreneurship education offers valuable insights for shaping policies, curricula, and teaching practices. It supports evidence-based decisions, emphasizes skill development, and promotes inclusive education. Institutions can improve program effectiveness, student engagement, and career outcomes by fostering industry collaboration and interdisciplinary approaches. Leveraging big data drives innovation, preparing students for workforce challenges and advancing economic and societal progress. The suggested optimization technique deviates from standard procedures for assessing the quality of university teaching by using big data, which has been shown to significantly enhance student participation in college courses like Entrepreneurship using CapsNet technology. The proposed CapsNet model for evaluating innovation and entrepreneurship education has several limitations, including the risk of overfitting when working with large, complex datasets. Data variability can affect its performance, especially if the training data doesn't represent diverse student experiences. CapsNet is also more complex to implement and requires careful tuning, and its interpretability may be challenging, making it harder for educators to trust and understand the model's decisions. Future research could address the limitations of the proposed model by exploring alternative deep learning architectures like LSTM and GRU, which are effective for time-series analysis of student behavior. A comparative study between CapsNet, LSTM, and GRU could help identify the most suitable model for educational data.

Regularization techniques such as dropout or weight decay could improve CapsNet's generalization. Integrating multiple data sources, like academic performance and attendance, could provide a more comprehensive view of student engagement. Lastly, longitudinal studies could reveal trends and inform strategies to enhance engagement and educational outcomes. Blockchain, AI, learning analytics, VR/AR, IoT, and gamification are integrated into innovation and entrepreneurship education to enhance data security, personalize learning, and improve outcomes. Blockchain ensures privacy, AI enables adaptive learning, and learning analytics provides data-driven insights for curriculum design. VR/AR offers immersive experiences, IoT supports smart classrooms, and gamification boosts engagement and skill development. These technologies create effective, engaging learning environments that prepare students for workforce challenges and foster educational innovation.

The correlation relationship between the information content in huge entrepreneurship education mobile user datasets is determined. This study improves an existing algorithm for big data virtualization. It uses a standard correlation analysis method in data analysis. According to the results, the suggested model has a success rate of 98%. The suggested technique offers a means of disseminating educational resources that are more resilient to congestion. Maximum reliability is 98% under high loads and 94% under mild loads. Cloud computing in this situation resulted in a 7% and 8% increase, producing 89% and 86%, respectively. For future research, it is recommended to analyze the strategies used for enhancing the quality of innovation in entrepreneurship education.

Declarations

Funding:
This work supported by the Jilin Province education science "14th Five-Year plan" in 2024 Year. project title: Research on the mode of serving rural revitalization of agriculture-related colleges in Jilin Province (Project approval number GH24816).

Conflicts of interests: Authors do not have any conflicts.

Data Availability Statement: No datasets were generated or analyzed during the current study.

Code availability: Not applicable.

Authors' Contributions: Xiaoxue Fan and Bingxin Zhang, are responsible for designing the framework, analyzing the performance, validating the results, and writing the article. Ping Zhang, is responsible for collecting the information required for the framework, provision of software, critical review, and administering the process.

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