ISSN 2723-6471

A Mixed-Methods Data Approach Integrating Importance-Performance Analysis (IPA) and Kaiser-Meyer-Olkin (KMO) in Applied Talent Cultivation

Zhang Zhang[1], Thosporn Sangsawang[2, *], Kitipoom Vipahasna[3], Matee Pigultong[4]

[1] *Vocational Education Division, Faculty of Technical Education, Rajamangala University of Technology Thanyaburi, Pathum Thani, 12110, Thailand*

[2,3,4] *Educational Technology and Communications Division, Faculty of Technical Education, Rajamangala University of Technology Thanyaburi, Pathum Thani, 12110, Thailand*

(Received: October 29, 2023; Revised: November 21, 2023; Accepted: December 23, 2023; Available online: January 29, 2024)

Abstract

This study endeavors to establish an assessment framework for cultivating undergraduate applied talent, specifically emphasizing data science competencies, in alignment with the development of China's regional economy. A mixed-methods approach, integrating focus group interviews and questionnaire surveys conducted over three rounds of data collection, was employed. The collected data underwent rigorous reliability and validity analyses utilizing SPSS software. An Importance-Performance Analysis (IPA) was executed to construct a performance chart, evaluating the effectiveness of a 24-item framework designed to encompass key aspects of data science education. The initial internal consistency α coefficients for Questionnaire 2 and Questionnaire 3 were found to be .892 and .913, respectively, surpassing the 0.7 threshold, indicating a high level of reliability for all items related to data science competencies. The Kaiser-Meyer-Olkin (KMO) measurements approaching approximately 0.9 affirmed the efficiency of the questionnaire, specifically designed to gauge the relevance and effectiveness of data science-related indicators in the context of applied talent cultivation and regional economic development. Furthermore, the study underscores the significance of indicators such as teamwork, regional market research, and business opportunity identification within the domain of data science. It identifies gaps between key indicators and lower-performing indicators, proposing strategic improvement measures to enhance the alignment of applied talent cultivation objectives with the evolving needs of regional economic development, particularly in the data science landscape. The research findings not only contribute to a foundational understanding of data science competencies in applied talent cultivation but also lay the groundwork for innovative reforms in future talent cultivation models. By clarifying objectives and better aligning them with the dynamic demands of regional economic development, this study sets the stage for transformative advancements in the field of applied talent cultivation, particularly within the realm of data science.

Keywords: Applied Talent Cultivation, Data Science Competencies, Regional Economic Development, Importance-Performance Analysis (IPA)

1. Introduction

As China embarks on a new phase of economic development, the flourishing regional economy emerges as a key catalyst for national progress, presenting a unique intersection with the realm of data science. Higher education, a pivotal driver in this trajectory, assumes a critical role not only in advancing regional economic development but also in aligning with the transformative landscape of data-driven insights. Acknowledging the multifaceted challenges faced by higher education in meeting the dynamic demands of regional economic development, particularly within the scope of data science, becomes imperative.

Amidst the backdrop of over 2,500 applied universities in China, constituting 80% of the total, a nuanced approach is warranted to cultivate applied undergraduate talents with a focus on data science capabilities. The existing talent quality assessment system, encompassing general higher education, vocational education, and engineering certification, exhibits strengths and limitations in the context of data science relevance [8]. The liberal arts higher education may emphasize theoretical understanding but could potentially overlook practical skills essential for data science. On the

***Corresponding author: Thosporn Sangsawang (sthosporn@rmutt.ac.th)**
DOI: https://doi.org/10.47738/jads.v5i1.170

other hand, vocational education, prioritizing practical skills, may neglect broader academic knowledge integral to data science proficiency.

In this evolving landscape, where data science skills are increasingly vital, this study seeks to establish a comprehensive and scientifically grounded evaluation indicator framework. The framework aims to assess the quality and effectiveness of applied undergraduate talent cultivation in the context of regional economic development, with a specific emphasis on data science competencies. Existing evaluation methods often fall short in capturing the nuances of data science education, overlooking practical skills, innovation capacity, and entrepreneurial mindset, all of which are pivotal in this domain.

Moreover, the research endeavors to bridge the gap in empirical understanding by exploring the correlation between applied undergraduate education in data science and regional economic development. By doing so, the study aspires to contribute to the broader goal of enhancing universities' capabilities to serve regional economic and social development, while simultaneously fostering innovation-driven progress in the dynamic field of data science [10].

In conclusion, this paper aims to construct an evaluation indicator framework specifically tailored to the cultivation of applied undergraduate talents in data science within the context of China's regional economic development. The intention is to offer valuable insights for higher education reform and innovation, ultimately ensuring that educational practices are aligned with the contemporary requirements of the data science landscape.

2. Literature Review

Regional economic development remains a cornerstone in driving overall economic growth at the local level, with an increasing intersection with the realm of data science [18]. The strategies and initiatives undertaken to enhance a specific region's economic potential and competitiveness are now intertwined with the evolving landscape of data-driven insights. Researchers emphasize the pivotal role of regional economic development not only in creating job opportunities and elevating living standards but also in fostering an environment conducive to data science innovations and investments.

In tandem, the cultivation of applied undergraduate students has become a focal point in academia and industry, now extending its purview to include the burgeoning field of data science [1][12]. Acknowledging the paramount importance of practical skills in today's data-centric job market, educational institutions are increasingly integrating applied skill and knowledge development into undergraduate programs. This evolution involves providing students with hands-on experiences, internships, and practical training specifically tailored to the demands of the data science industry [2][15].

To comprehensively assess the effectiveness of both regional economic development and the cultivation of applied undergraduate students in the context of data science, a robust evaluation index framework is imperative [4]. This framework becomes the linchpin for policymakers and researchers, offering a systematic approach to gauge the impact and outcomes of initiatives and programs. It provides a structured means for measuring and analyzing achievements, strengths, and areas requiring improvement in both regional economic development and the development of data science competencies among undergraduate students.

Furthermore, the integration of regional economic development with applied undergraduate student cultivation, particularly in the domain of data science, holds promise for mutually beneficial outcomes. Aligning educational programs with local industry needs ensures that students acquire relevant data science skills tailored to regional job market demands. This alignment effectively bridges the gap between academia and the data science industry, equipping graduates with the expertise needed to contribute meaningfully to their region's economic development through data-driven insights [5].

In the realm of research methodologies, the focus group interview method [9] emerges as a potent tool for gaining a nuanced understanding of the perceptions, experiences, and viewpoints of stakeholders involved in regional economic development and applied undergraduate student cultivation within the data science domain. This qualitative research approach enables researchers to gather valuable insights from various perspectives, including policymakers, educators,

 ISSN 2723-6471

industry professionals, and students, contributing to a holistic understanding of the symbiotic relationship between regional economic development and data science education.

3. Method

3.1. Population and Sample

The research employed a mixed-method approach, integrating the Focus Group Interview Method and questionnaires across three rounds of data collection, with a specific focus on data science considerations. The application of the Focus Group Interview Method involved the following steps:

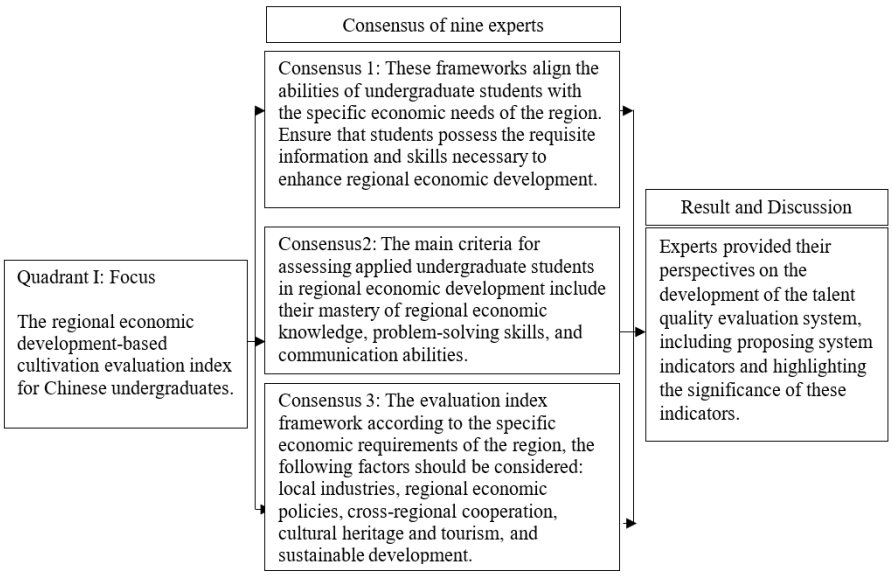
In Round 1, semi-structured interviews were conducted with nine experts forming focus groups through video conferencing. The researcher, serving as the host, guided experts in brainstorming the construction of the evaluation index framework for cultivating applied undergraduate students with an emphasis on data science, aligned with regional economic development in China. The details of these interviews can be found in Questionnaire I, emphasizing data science competencies and their relevance to regional economic growth. The consolidated opinions of the experts were utilized to shape the content of Questionnaire II.

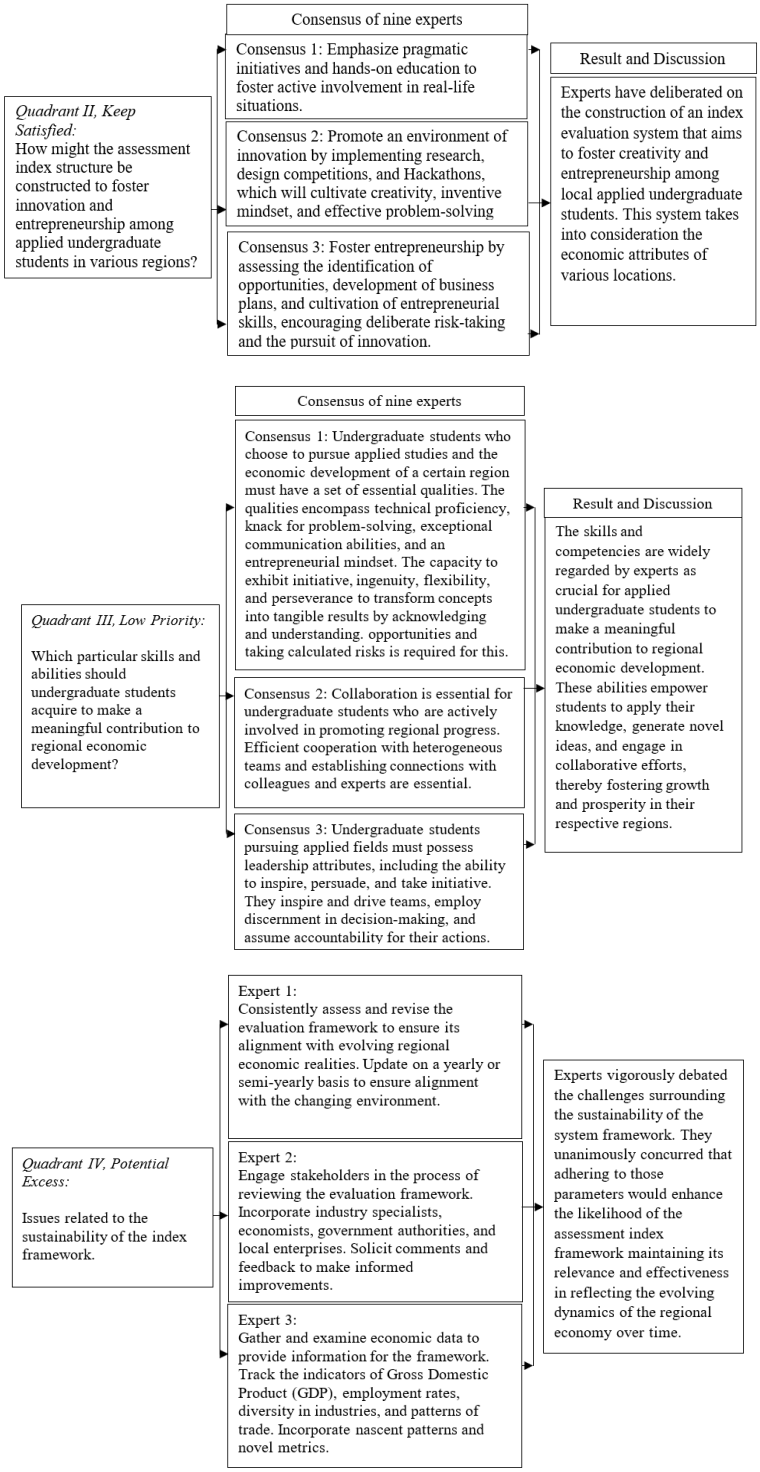
In Round 2, experts engaged in a comprehensive evaluation of the overall structure and design of Questionnaire II, specifically focusing on aspects such as refinement, accuracy, sequencing, and logical coherence, with a heightened awareness of data science considerations. Subsequently, necessary revisions were made to the relevant statements, ensuring that the questionnaire adequately addressed the intricacies of cultivating applied undergraduate students in the data science domain within the context of regional economic development. This iterative process led to the retention of 4 first-level indicators and 24 second-level indicators, forming Questionnaire III.

In Round 3, the third questionnaire (Questionnaire III) underwent transformation into a Likert scale format. Respondents were tasked with evaluating both the importance and performance of each indicator included in the questionnaire, with a particular emphasis on data science competencies. This structured approach aimed to gather nuanced insights into the perceived significance and effectiveness of various indicators in the realm of data science education for applied undergraduate students within the specific context of regional economic development in China.

4. Result and Discussion

A total of 9 experts participated in the focus groups, and the results represent a consensus of their opinions. We intentionally included divergent views to underscore the range of experiences and perceptions among both individuals and groups. During the focus group interviews, 14 questions were discussed, and these discussion topics can be categorized into four parts (Box 1 to 4).





Following the experts' discussion, the conventional content analysis method was employed to organize and analyze the collected data. This process resulted in the development of the preliminary evaluation index framework for cultivating applied undergraduate students based on regional economic development in China (Refer to Table 1). Subsequently, the experts' opinions were evaluated through a questionnaire survey (Questionnaire II).

Table 1. The Preliminary Evaluation Index Framework for Cultivating Applied Undergraduate Students Based on Regional Economic Development in China

Primary Indicators	Secondary Indicators	M	Expert's Opinion	SD	IQR	Consensus
P1 Knowledge structure	X1 General education	4.78	Strongly agree	.12	1	Congruence

 ISSN 2723-6471

Primary Indicators	Secondary Indicators	M	Expert's Opinion	SD	IQR	Consensus
	X2 Professional knowledge	4.81	Strongly agree	.15	1	Congruence
	X3 Local knowledge	4.85	Strongly agree	.13	1	Congruence
P2 Professional theoretical application and practical ability	X4 Theoretical understanding and analysis	4.73	Strongly agree	.21	1	Congruence
	X5 Ability of Expression	1.42	Strongly disagree	.16	1	Congruence
	X6 Problem-oriented learning	4.78	Strongly agree	.14	1	Congruence
	X7 Practical problem solving	4.69	Strongly agree	.23	1	Congruence
	X8 Interdisciplinary integration	4.73	Strongly agree	.18	1	Congruence
P3 Employability	X9 Self-adaptation and management ability	4.75	Strongly agree	.16	1	Congruence
	X10 Team cooperation ability	4.81	Strongly agree	.21	1	Congruence
	X11 Interpersonal ability	4.85	Strongly agree	.17	1	Congruence
	X12 Stress tolerance	4.76	Strongly agree	.12	1	Congruence
P4 Entrepreneurship ability	X13 Innovation and creative ability	4.73	Strongly agree	.14	1	Congruence
	X14 Business planning and strategy making ability	4.75	Strongly agree	.17	1	Congruence
	X15 Market research and analysis ability	4.81	Strongly agree	.13	1	Congruence
	X16 Risk management and entrepreneurial adaptability	4.73	Strongly agree	.14	1	Congruence
	X17 Entrepreneurship and persistence:	4.84	Strongly agree	.16	1	Congruence
	X18 Marketing and sales ability	4.80	Strongly agree	.15	1	Congruence
P5 Quality of regional economic services	X19 Values	4.77	Strongly agree	.24	1	Congruence
	X20 Sense of rootedness in the local community	4.78	Strongly agree	.20	1	Congruence
	X21 Regional economic understanding and analysis ability:	4.68	Strongly agree	.21	1	Congruence
	X22 Regional development planning and policy analysis ability	4.65	Strongly agree	.16	1	Congruence
	X23 Regional market research and business opportunity identification ability	4.72	Strongly agree	.14	1	Congruence

 ISSN 2723-6471

Primary Indicators	Secondary Indicators	M	Expert's Opinion	SD	IQR	Consensus
	X24 Regional Cooperation and partner relationship management's Capability	4.78	Strongly agree	.18	1	Congruence
P6 Learning resources	X25 Teaching Staff	2.13	Disagree	.11	1	Congruence
	X26 Curriculum System	1.68	Disagree	.14	1	Congruence
	X27 Internship and Practical training	1.87	Disagree	.13	1	Congruence
	X28 Teaching Facilities	1.89	Disagree	.13	1	Congruence

Based on the experts' opinions, researchers have organized the indicators and enhanced certain indicator descriptions. The refined index framework system can be found in Table 2 and Figure 1.

Table 2. The Optimized Evaluation Index Framework for Cultivating Applied Undergraduate Students Based on Regional Economic Development in China

Primary Indicators	Secondary Indicators	M	Respondent's Opinion	SD	IQR	Consensus
P1 Knowledge structure	X1 General education	4.76	Strongly agree	.15	1	Congruence
	X2 Professional knowledge	4.82	Strongly agree	.16	1	Congruence
	X3 Local knowledge in humanities and 2015 sciences	4.79	Strongly agree	.18	1	Congruence
	X4 Instrumental knowledge	4.78	Strongly agree	.21	1	Congruence
P2 Professional theoretical application and practical ability	X5 Theoretical understanding and analysis	4.81	Strongly agree	.14	1	Congruence
	X6 Problem-oriented learning	4.85	Strongly agree	.15	1	Congruence
	X7 Practical problem solving	4.86	Strongly agree	.18	1	Congruence
	X8 Interdisciplinary integration	4.80	Strongly agree	.23	1	Congruence
P3 Employability	X9 Self-adaptation and management ability	4.79	Strongly agree	.24	1	Congruence
	X10 Team cooperation ability	4.83	Strongly agree	.18	1	Congruence
	X11 Interpersonal ability	4.76	Strongly agree	.19	1	Congruence
	X12 Stress tolerance	4.75	Strongly agree	.18	1	Congruence
P4 Entrepreneurship ability	X13 Innovation and creative ability	4.83	Strongly agree	.16	1	Congruence
	X14 Business planning and strategy making ability	4.69	Strongly agree	.21	1	Congruence
	X15 Market research and analysis ability	4.71	Strongly agree	.22	1	Congruence
	X16 Risk management and entrepreneurial adaptability	4.80	Strongly agree	.23	1	Congruence

 ISSN 2723-6471

Primary Indicators	Secondary Indicators	M	Respondent's Opinion	SD	IQR	Consensus
	X17 Entrepreneurship and persistence:	4.69	Strongly agree	.18	1	Congruence
	X18Marketing and sales ability	4.71	Strongly agree	.19	1	Congruence
P5 Quality of regional economic services	X19 Values	4.67	Strongly agree	.17	1	Congruence
	X20 Local Embeddedness Awareness	4.76	Strongly agree	.16	1	Congruence
	X21 Regional economic understanding and analysis ability:	4.80	Strongly agree	.15	1	Congruence
	X22 Regional development planning and policy analysis ability	4.76	Strongly agree	.17	1	Congruence
	X23 Regional market research and business opportunity identification ability	4.77	Strongly agree	.15	1	Congruence
	X24 Regional Cooperation and partner relationship management's Capability	4.75	Strongly agree	.16	1	Congruence

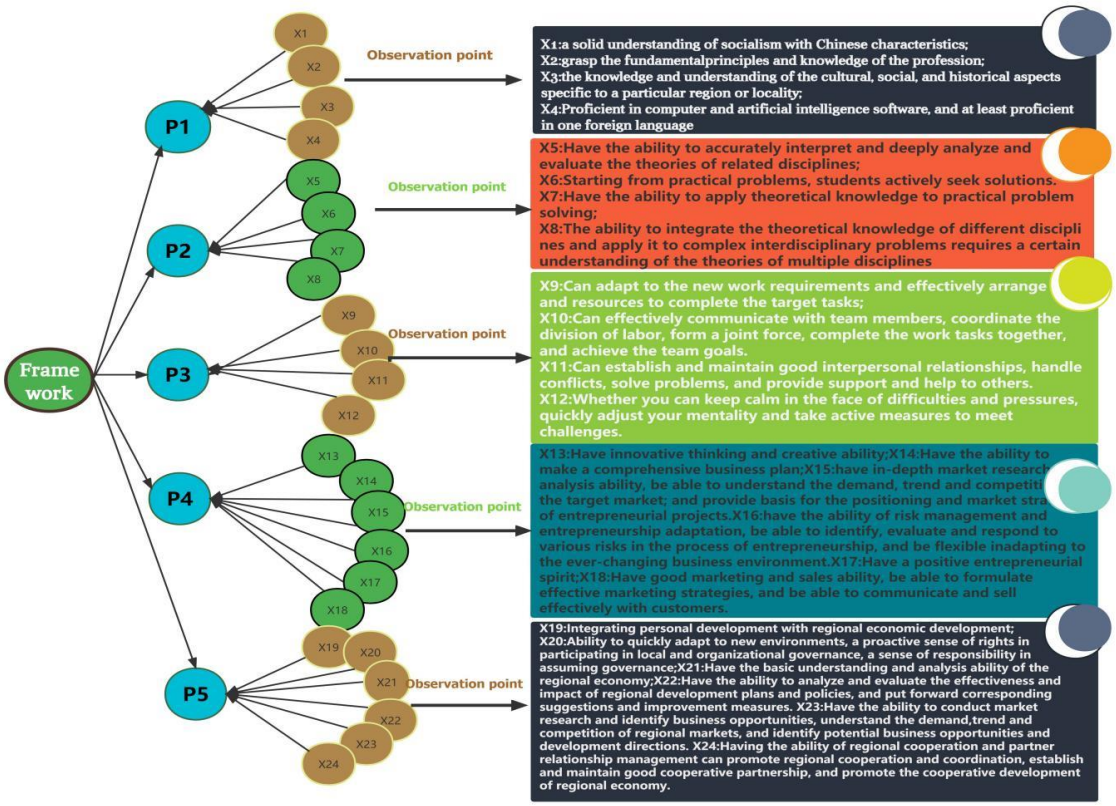


Figure 1. The Framework Diagram of the Evaluation Index for Cultivating Applied Undergraduate Students Based on Regional Economic Development in China

 ISSN 2723-6471

Questionnaire III was administered to assess stakeholders' perspectives on the conceptual framework of Cultivating Applied Undergraduate Students Based on Regional Economic Development. It involved the synthesis of data from the semi-structured interviews, using content validity to develop the questionnaire. The questionnaire was distributed to 250 respondents to evaluate their views on the conceptual framework of Cultivating Applied Undergraduate Students Based on Regional Economic Development, employing a five-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = moderately agree, 5 = strongly agree). The results are presented in Table 2.

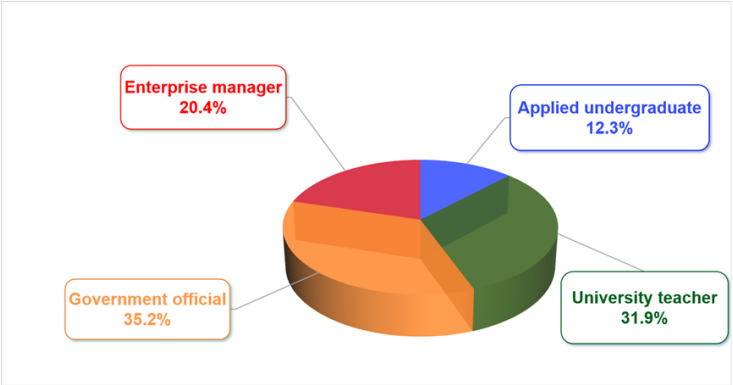


Figure 2. Respondent Type

A total of 250 questionnaires were distributed, and 244 were recovered, yielding a recovery rate of 97.6%. Out of these, 244 questionnaires were deemed valid, resulting in a 100% effective questionnaire recovery rate. The demographic characteristics of the survey sample were obtained through simple descriptive statistical analysis from the respondents to the questionnaire survey, as depicted in Figure 2.

Reliability Analysis: Both Questionnaires II and III demonstrated high reliability, with an initial internal consistency α coefficient of 0.892 and 0.913, exceeding the threshold of 0.5.

Validity Analysis: The validity test, conducted using a five-level Likert scale, demonstrated a high level of validity, with a Kaiser-Meyer-Olkin (KMO) measure approaching 0.9 and a statistically significant Bartlett's spheroid test ($p < .05$). These findings confirm a strong correlation among variables and the successful validation of the questionnaire.

Importance-Performance Analysis: Following the successful completion of reliability and validity analyses on the questionnaire data, the collected data were analyzed using SPSS 24. This analysis yielded importance and performance values for each index, which are presented in Figure 3.

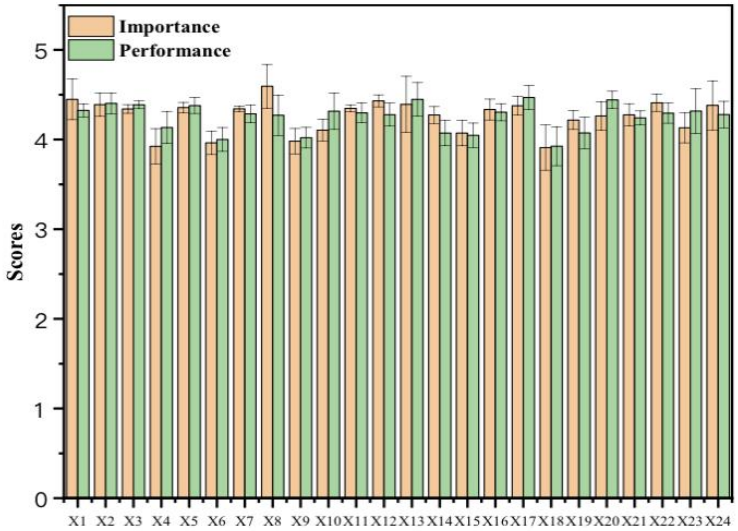


Figure 3. Analysis of the Importance and Performance of the Evaluation Indexes for Cultivating Applied Undergraduate Students Based on Regional Economic Development in China

 ISSN 2723-6471

Based on data analysis, it can be concluded that all respondents have expressed a favorable attitude towards the established evaluation index framework. Utilizing a five-level Likert scale for scoring, the average values of the indexes all exceed 4. An Importance-Performance Analysis (IPA) conducted on this data reveals variations in Importance and Performance values for each index. To effectively depict the specific situation of the 24 evaluation indicators, a materiality-performance chart (see Figure 4) was constructed.

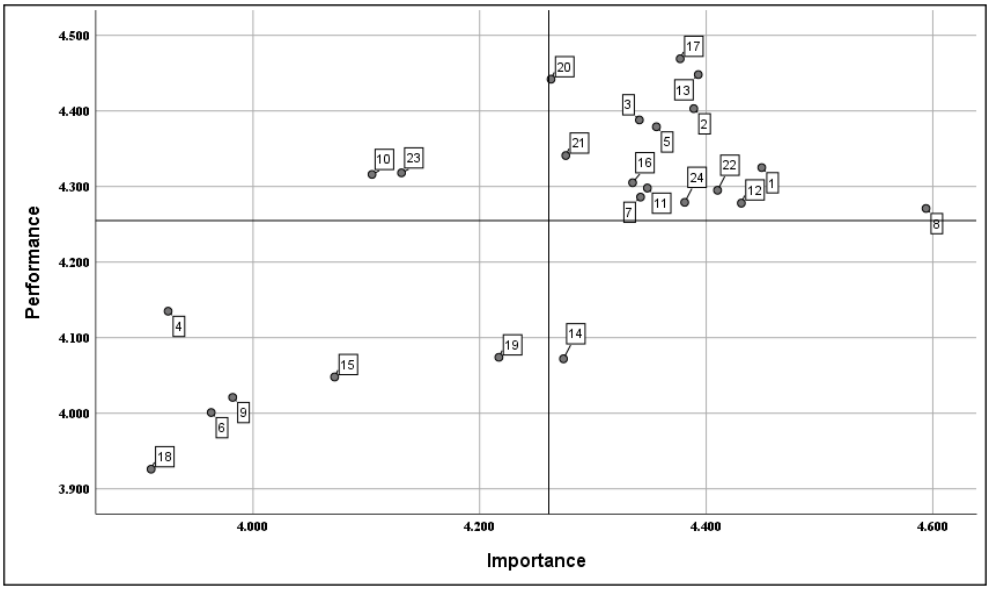


Figure 4. IPA Analysis Quadrant of the Evaluation Indexes for Cultivating Applied Undergraduate Students Based on Regional Economic Development in China (The indicators represented by the numbers in each quadrant of the figure are shown in Table 1)

The First Quadrant: As depicted in Figure 4, the evaluation indicators positioned in the first quadrant encompass general education, professional knowledge, local knowledge in the field of humanities and social sciences, theoretical understanding and analysis, practical problem-solving ability, interdisciplinary integration, interpersonal skills, stress management ability, innovation and creativity, risk management and entrepreneurial adaptability, entrepreneurship and persistence, as well as local embeddedness awareness, understanding and analysis of regional economics, the ability to plan and analyze regional development policies, and regional cooperation and partner relationship management capability. These indicators clearly reflect the respondents' strong emphasis on general education, professional knowledge, and various local knowledge and abilities related to regional economic development. General education serves as a foundational pillar nurturing students' comprehensive literacy and critical thinking skills, equipping them with broad knowledge and holistic humanistic qualities. On the other hand, the acquisition of professional knowledge enables students to gain in-depth understanding and skills in their specific disciplines, providing a solid foundation for their work in relevant fields. Additionally, the cultivation of diverse local knowledge and abilities pertaining to regional economic development equips students with the necessary insights to comprehend and master the practical situation, characteristics, and demands of the local economy. This knowledge serves as a vital resource for enabling them to become effective contributors to regional economic growth.

The Second Quadrant: It is evident from the evaluation indicators located in the second quadrant that two specific areas warrant attention and improvement: team cooperation ability and regional market research and business opportunity identification ability. These indicators hold great significance as they directly influence the success of organizations, particularly in the context of regional economic development. Firstly, team cooperation ability is indispensable for effective collaboration and efficient task execution within an organization. Enhancing the ability to work cohesively as a team enhances productivity and facilitates the sharing of diverse ideas and perspectives [16]. Organizations can promote team cooperation through team-building activities, training programs, and effective leadership, fostering an environment that supports and enhances collaborative efforts. Secondly, the ability to conduct regional market research and identify business opportunities is critical for organizations to maintain competitiveness in a dynamic and evolving market. This ability allows organizations to uncover untapped opportunities, understand market trends, and effectively

respond to changing customer demands. By conducting comprehensive market research, organizations gain valuable insights, anticipate emerging trends, and adjust their strategies accordingly. Additionally, a robust regional market research capability enables organizations to understand the specific needs, preferences, and behaviors of the local customer base, enabling them to tailor their products or services effectively to meet those requirements. Efforts to enhance team cooperation ability and regional market research and business opportunity identification ability should be prioritized in talent cultivation and organizational development. This can be achieved through comprehensive training programs, workshops, and seminars focusing on enhancing teamwork, communication, and problem-solving skills. Furthermore, organizations should encourage employees to actively engage in regional market research, developing practical skills and knowledge related to local economic dynamics and industry-specific trends. By addressing these areas of improvement, organizations can position themselves at the forefront of regional economic development, fostering a thriving business environment and contributing to sustainable growth.

The Third Quadrant: The evaluation indicators provided in this quadrant reveal an interesting observation concerning an area where the importance is relatively low, but the performance is comparatively high. This domain encompasses instrumental knowledge, problem-oriented learning, self-adaptation and management skills, market research and analytical capabilities, marketing and sales skills, and values. Despite their relatively low perceived importance, respondents still consider these indicators crucial for evaluating the quality of talent development. This observation carries several implications. Firstly, it suggests that organizations excel in cultivating instrumental knowledge, referring to the practical skills and expertise necessary for specific tasks. Additionally, the emphasis on problem-oriented learning underscores organizations' ability to equip their talent with problem-solving skills, enabling them to effectively address challenges and drive innovation [13]. Furthermore, the high performance in self-adaptation and management skills reflects the adaptability and leadership qualities demonstrated by the talent, which are essential in an ever-changing business environment where individuals must be responsive to new technologies, market trends, and customer demands. Moreover, the strong market research and analytical capabilities, coupled with marketing and sales skills, indicate that talent possesses the required knowledge and expertise to identify market opportunities, analyze consumer behavior, and develop effective marketing strategies. These skills are crucial for gaining a competitive edge in the market and achieving business objectives. The final indicator, values, plays a significant role in talent development, emphasizing organizations' prioritization of ethics, integrity, and corporate social responsibility in their talent cultivation efforts. These indicators collectively contribute to the overall quality of talent development, underscoring the significance of these skills for organizational success in the long run.

The Fourth Quadrant: The fourth quadrant of the evaluation indicators centers on an area of high importance but low performance, specifically concerning business planning and strategic decision-making skills. This observation indicates a gap in current talent development practices, highlighting the need to emphasize the cultivation and guidance of students' business thinking. By incorporating practical learning experiences, mentorship programs, internships, and fostering a culture of innovation, educational institutions and organizations can effectively address this gap, ensuring the development of well-rounded talent equipped with the requisite skills for effective business planning and strategic decision-making.

5. Conclusion

This study has successfully pioneered a research-driven and practice-oriented evaluation system for cultivating applied undergraduate talents, with a specific emphasis on data science competencies, aligned with the dynamic landscape of China's regional economic development. The methodology employed two main phases:

Phase I: Leveraging the focus group interview method to construct a robust evaluation index framework tailored to the evolving demands of data science education.

Phase II: Implementing the questionnaire survey method to garner stakeholders' perspectives on the constructed index evaluation system, with a focus on assessing the relevance of data science competencies in the context of regional economic development.

The developed evaluation system not only articulates clear objectives and requirements for nurturing applied undergraduate students but also introduces diverse evaluation methods, strategically overcoming the limitations

associated with a singular assessment approach. The findings illuminate critical indicators for evaluating talent quality, specifically emphasizing data science-related aspects such as proficiency in data analytics, practical problem-solving in data-driven scenarios, and interdisciplinary integration within the context of data science.

The Evaluation Index Framework, with its comprehensive set of indicators, provides a systematic means to assess the effectiveness of higher education institutions in preparing students to contribute to regional economic growth, with a particular focus on data science-driven contributions. Integrating this framework into the development model of the Higher Education Cluster in Chengdu and Chongqing allows institutions to align their efforts with regional economic objectives, thereby fostering the cultivation of a data-savvy workforce capable of driving sustained economic development in the region.

In summary, the establishment of this innovative evaluation system ensures that the competencies of applied undergraduate students, especially in the realm of data science, align with the evolving demands of regional economic landscapes. This approach not only enhances educational outcomes in China but also strengthens the employability of applied undergraduate talents, contributing significantly to the prosperity and advancement of regional economies in the era of data-driven progress.

6. Declarations

6.1. Author Contributions

Conceptualization: Z.Z. and T.S.; Methodology: T.S.; Software: Z.Z.; Validation: Z.Z. and T.S.; Formal Analysis: Z.Z. and T.S.; Investigation: K.V.; Resources: M.P.; Data Curation: K.V.; Writing Original Draft Preparation: K.V. and Z.Z.; Writing Review and Editing: K.V. and Z.Z.; Visualization: Z.Z.; All authors have read and agreed to the published version of the manuscript.

6.2. Data Availability Statement

The data presented in this study are available on request from the corresponding author.

6.3. Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

6.4. Institutional Review Board Statement

Not applicable.

6.5. Informed Consent Statement

Not applicable.

6.6. Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

[1] Y. J. Bian, L. Xie, dan J. Q. Li, "Research on influencing factors of artificial intelligence multi-cloud scheduling applied talent training based on DEMATEL-TAISM," *Journal of Cloud Computing*, vol. 11, no. 1, pp. 1–17, 2022. DOI: 10.1186/s13677-022-00315-4

[2] M. D. G. D. de Almeida, F. A. S. Marins, A. M. P. Salgado, R. D. C. D. S. M. Bittar, J. M. De Barros, A. H. Junior, N. A. De Souza Sampaio, B. B. Da Fonseca, G. N. D. Baronto, dan A. D. S. Côrtes, "Industrial internship mentoring model for industrial engineering education in public universities," International Journal of Engineering Education, vol. 36, no. 1A, pp. 48–65, 2020.

[3] J. Fu, C. Zang, dan J. Zhang, "Economic and resource and environmental carrying capacity trade-off analysis in the Haihe River basin in China," *Journal of Cleaner Production*, vol. 270, pp. 122271, 2020. DOI: 10.1016/j.jclepro.2020.122271

[4] Q. Han, "Using neural network for the evaluation of physical education teaching in colleges and universities," *Soft Computing*, vol. 26, no. 20, pp. 10699–10705, 2022. DOI: 10.1007/s00500-022-06848-9

[5] Z. Hu, S. Sun, dan L. Cheng, "Exploration and practice of aviation manufacturing talent training mode based on 'practical ability-oriented and industry-education integration,'" *SHS Web of Conferen*, vol. 166, pp. 01034, 2023. DOI:10.1051/shsconf/202316601034

[6] L. Jiang, Q. Zuo, J. Ma, dan Z. Zhang, "Evaluation and prediction of the level of high-quality development: A case study of the Yellow River Basin, China," *Ecological Indicators*, vol. 129, pp. 107994, 2021. DOI:10.1016/j.ecolind.2021.107994

[7] Z. A. Khan, J. Adnan, dan S. A. Raza, "Cognitive Learning Theory and Development: Higher Education Case Study," 2023. DOI:10.5772/intechopen.110629

[8] Y. Li, T. Sangsawang, dan K. Vipahasna, "Utilizing the Delphi Technique to Develop a Self-Regulated Learning Model," *Journal of Applied Data Sciences*, vol. 4, no. 3, pp. 254–263, 2023. DOI:10.47738/jads.v4i3.124

[9] D. L. Morgan, "Focus groups," *Annual Review of Sociology*, vol. 22, no. 1, pp. 129–152, 1996.

[10] S. Qin, X. Duan, A. S. Khandan, dan S. Abdollahi, "An Introduction to Human Resources for Development and Innovation, Science Transformation into Industry Infrastructure by China's New Universities: A Case Study of Green Materials," *Sustainability (Switzerland)*, vol. 15, no. 2, pp. 975, 2023. DOI:10.3390/su15020975

[11] T. Sangsawang, K. Jitgarun, dan P. Kiattikomo, "Students Self Appraisal for online Training," in *ASIA Pacific Educational Research Association International Conference*, vol. 1, no. 1, 2006, pp. 1–5.

[12] T. Sangsawang, K. Jitgarun, dan P. Kiattikomo, "Comparison of Selected Psychology Theories as in Gagne's, Constructivism, and Constructionism," in *The 4th International Conference on Developing Real-life Learning Experiences: Education Reform through Performance-Based Learning*, vol. 1, no. 1, 2006, pp. 327–328.

[13] T. Sangsawang, K. Jitgarun, dan P. Kiattikomo, "A learning strategy suitable for learners' self-discovery," in *EDU-COM 2006 Engagement and Empowerment: New Opportunities for Growth in Higher Education*, 2006.

[14] T. Sangsawang, K. Jitgarun, dan P. Kiattikomo, "A synthesis of Meaningfulness of training theories as in Gagné's Constructivism and ConstuctionismTowards Online Training and Instructional Design," in *The ICAST Asian Symposium*, 2007, pp. 6–9.

[15] T. Sangsawang, K. Jitgarun, dan P. Kiattikomo, "An internet based Instructional Design Framework for vocational education," *International Journal of Soft Computing*, vol. 6, no. 4, pp. 119–127, 2011. DOI:10.3923/ijscomp.2011.119.127

[16] T. Sangsawang, "Instructional Design Framework for Educational Media," *Procedia - Social and Behavioral Sciences*, vol. 176, pp. 65–80, 2015. DOI:10.1016/j.sbspro.2015.01.445

[17] T. Sangsawang, "An instructional design for online learning in vocational education according to a self-regulated learning framework for problem solving during the COVID-19 crisis," *Indonesian Journal of Science and Technology*, vol. 5, no. 2, pp. 283–298 , 2020. DOI:10.17509/ijost.v5i2.24702

[18] Z. Yang, S. Shao, L. Xu, dan L. Yang, "Can regional development plans promote economic growth? City-level evidence from China," *Socio-Economic Planning Sciences*, vol. 83, pp. 101212, 2022. DOI:10.1016/j.seps.2021.101212

[19] G. Zhang, S. Luo, Z. Jing, S. Wei, dan Y. Ma, "Evaluation and forewarning management of regional resources and environment carrying capacity: A case study of hefei city, Anhui province, China," *Sustainability (Switzerland)*, vol. 12, no. 4, pp. 1637, 2020. DOI:10.3390/su12041637