

Factors Affecting Scientific Research Outcomes among Chinese Higher Vocational Institutions: A Study Based on Guizhou

Yongcheng Long

Panjanat Vorawattanachai

Wannaporn Siripala

Department of Management Science,
Institute of Science Innovation and
Culture, Rajamangala University of
Technology Krungthep, Bangkok,
Thailand

panjanat.v@mail.rmuth.ac.th

Abstract—This study investigates institutional, human resource, and external factors affecting scientific research outcomes in Chinese higher vocational institutions, focusing on Guizhou province. A sequential explanatory mixed-methods approach was adopted, involving surveys from 480 vocational educators and semi-structured interviews with 10 top-performing researchers. Using Structural Equation Modelling (SEM), findings revealed that human resources play the most significant role ($\beta = 0.87$), followed by institutional ($\beta = 0.72$) and external factors ($\beta = 0.65$). Research experience, professional development, faculty qualifications, institutional funding, access to international journals, industry partnerships, and external grants are all significant contributors. The significance of regulatory support, targeted funding, and collaborative research in enhancing research quality and productivity was emphasized by the interview results. The study concludes that enhancing human capital, strengthening institutional research infrastructure, and fostering academic-industry linkages are essential for advancing research performance. Policy recommendations include optimizing funding allocation, streamlining research policies, and promoting faculty development programs to support sustainable scientific innovation in vocational education institutions.

Keywords— *Research experience, Institutional funding, Industry collaboration, Faculty Development, Vocational research performance.*

I. INTRODUCTION

The outcomes of scientific research in higher educational institutions, whether they are from vocational education or non-vocational education, are commonly influenced by

various contributing factors such as individual factor (researcher's capability, skills, experience, and motivation) (Lischewski et al, 2020), institutional context (such as accessibility to research funding, policy, facilities resources, skillful faculty members and teachers, and accessibility to modern technology and laboratory in the institution) (Abugre, 2018;; Muriithi et al., 2018 Kosmützky, 2020), collaboration between internal and external institutions, human resources that can support to the implementation of comprehensive and innovative research in vocational education (Al-Kurdi et al, 2018; Rybnicek & Königsgruber, 2019), availability of modern technology dan new research approaches to accelerate and boost the accuracy of scientific research (Wu & Liu, 2021), dissemination of research outcomes (Al-Kurdi et al., 2018; Findler et al, 2019), supporting facilities such as library and laboratory, and conducive research atmosphere or environment. Understanding those crucial elements can enhance the quality and performance of scientific research in vocational higher education.

However, most previously available studies tend to identify those crucial factors separately (Abugre, 2018; Muriithi et al., 2018; Kosmützky, 2020; Lischewski et al, 2020). Many of them commonly investigate a single factor within the context of non-vocational education institutions. So, they cannot provide a clear overview and identify which factors among the comprehensive factors play a crucial role in impacting the scientific research outcome in vocational higher education institutions. The existence and mission of universities and vocational institutions are different. University is recognized

for its research and teaching, but vocational emphasizes preparing graduates for the job market and industry, teaching improvement, and research. In this case, the university only has two challenges: teaching and research. Still, vocational education has triple roles and challenges: preparing skillful graduates suitable for job market demands, curriculum relevant to industry demands, including teaching and learning strategies, and research.

There has been a dearth of significant research gaps among available studies that have already explored potential factors contributing to scientific research performance in vocational higher education institutions. Specifically, there is a lack of comprehensive understanding of how those factors impact the quality and performance of research in their institution. For example, previous research often focuses on individual factors such as institutional support (Le & Lei, 2019) or individual teacher capabilities and faculty reputation (Cadez et al, 2017), the role of leadership in supporting research quality (Reb et al, 2019), collaborative research (Muriithi et al, 2018; Wine et al, 2022; Cantner et al., 2024) without considering how these interacting factors influence the quality and productivity of research wholistically. Finally, available literature studies often overlook the discrepancy between regional and institutional perspectives that potentially influence the results of existing research findings. Understanding this issue can provide a better understanding of the demand for enhancing the quality of research through how a specific institutional policy can enhance the research performance and outcomes, and how technological advancement and new trends can impact the dynamic of research in vocational higher education. Filling this gap can provide a more comprehensive understanding of the issues regarding potential factors affecting the quality and outcome of scientific research in vocational higher education institutions and strategies for fostering scientific research in Guizhou, China, and beyond.

Finally, the role of scientific research in vocational higher education in China is crucial to bridging the discrepancy between education and industrial demand. With a firm focus on practical application and collaboration with industries, scientific research can convince that vocational education in China produces knowledgeable, skilled, and ready graduates who can contribute directly to the country's economic development.

Scientific Research Performance in Chinese Vocational Higher Education

At present, China has entered a new era of development, with the acceleration and upgrading of industry and economic restructuring as the priority, which has an impact on the market demand for professional workers with technical talents from all walks of life becoming increasingly urgent (Jiang & Gu, 2023). This has made vocational education in China important, and it will become increasingly prominent. To improve the quality of vocational education in China, the

Ministry of Vocational Education has drafted a plan to optimize the quality of vocational education from 2020 to 2035. The strategy plan is in line with China's national economic and social development goals, which are to set strong goals to improve quality, increase efficiency, and innovate in the development of vocational education. In order to improve the degree of matching between local professional skills training and the needs of local enterprises and ultimately promote the process of "going out" of China's standard-run vocational education schools and technical industry standards, in the past ten years, teachers in various colleges and universities have conducted comprehensive and three-dimensional research and inspection in the field of overseas study in China while exploring teaching methods and organizing student management. This study aims to sort out the existing research results in this field, summarize the current research situation on overseas study in higher vocational colleges, and provide basic ideas for future research directions.

Vocational education in China has also undergone rapid transformation in recent decades, with scientific research being an important component in improving the quality and relevance of curriculum and teaching methods and meeting the needs of society and industry (Winterton, 2017; Li, 2018; Dahalan et al, 2024). Research in vocational education in China focuses on developing students' practical skills to equip them with work skills that meet industry needs, improve the effectiveness of teaching and learning, and strengthen the relationship between educational institutions and the world of work (Li & Pilz, 2023). Research in vocational education in China is crucial for improving the quality and relevance of vocational education. This research is strategically positioned to develop curricula that meet industry needs, introduce innovative teaching methods, and strengthen collaboration between educational institutions and the world of work. Thus, research in vocational education aims not only to improve the quality of education but also to ensure that graduates are ready to enter the job market with the skills they need.

The main research objectives in vocational education in China include several important aspects. First, curricula relevant to industry needs and adaptive to technological developments should be developed. Second, the competence and skills of teachers should be improved through continuous training and professional development. Third, integrating technology into the learning process to prepare students for the challenges of Industry 4.0 and 5.0 and the advancement of robotic technology. Fourth, the alignment of the skills taught with those required in the workplace is guaranteed by the enhancement of the relationship between vocational education institutions and industry. In China, vocational education research encompasses a variety of formats, including case studies, industry surveys, the development of novel teaching models, and teacher training and workshops.

Many vocational education institutions work with companies to conduct research projects to improve operational efficiency and develop new technologies. In addition, there are also collaborations with international universities and research institutions to improve the quality and impact of research. The quality of research in vocational education in China is measured by publications in leading scientific journals, awards received, and the practical impact of the research results. The international reputation of Chinese vocational education has improved, primarily through collaborations with global universities and research institutions. Many vocational education institutions in China have received international accreditation and awards for their innovative educational programs and training. This ongoing research contributes to sustainable economic and social development and enhances the country's global competitiveness in various industrial sectors.

II. LITERATURE REVIEW

A. Determinant factors affecting research outcome: *Theoretical basis*

In the American context, the determining factors that affect the outcomes of scientific research in higher educational institutions have been formulated since 1998 under the work of Dundar & Lewis (1998), which highlights some regression models to probe the indicators of research performance at the university level, especially the quality of doctoral research programs. Dundar & Lewis (1998) criticize previous studies concerned with only two factors: program size and research productivity. These two factors are the most commonly used variables in assessing the quality of doctoral research programs worldwide. They also deliver their idea that actual research outcomes at the institutional level are multidimensional and relate to knowledge production and dissemination using different forms of research, outreach activities, research productivity, managerial environment, funding, and the availability of modern technology to support the performance of research outcomes.

He further mentioned that research outcomes and productivity of an institution or higher educational institution cannot be separated from individual, institutional, departmental, and external factors. Table 1 below underlines Dundar & Lewis's (1998) idea regarding institutional factors that affect the quality of research outcomes for doctoral programs in the American context. Since the table does not aim to identify comprehensive factors contributing to the outcome of research at the vocational level, the present study tries to review the dimensions and indicators from different perspectives to come up with more valid and reliable dimensions and indicators applied for assessing the outcomes of research in vocational higher educational institutions.

This part still elaborates on the dimensions and indicators for higher education regarding research outcomes in a university

context. Some indicators will be introduced before they are modified for vocational education contexts (to assess the outcomes of research at vocational higher education).

Table 1. Factors affecting research outcome or productivity (Dundar & Lewis, 1998).

TABLE I. GROWTH MINDSET AND STUDENT SATISFACTION

No	Category and indicators
1	Individual Factors
	The factor of innate abilities of individual faculty members (i.e., personality, IQ, gender, and age)
	Personal environmental factors (i.e., quality and culture of graduate training and culture of employing department)
2	Departmental and Institutional Factors
	Institutional and leadership structure
	The size of the program and faculty
	Control by the private sector
	Availability of internal research funding
	Availability of technology and computing facilities
	Number of books and journals in the library
	Culture and working environment factors
	Organizational culture
	Research Policies
	Number of students on research support
	Availability of experienced faculty
	Availability of nongovernmental research funds

1. Research Questions

- 1) *What institutional, human resource, and external factors significantly influence the scientific research outcomes among higher vocational institutions in Guizhou?*
- 2) *How do these factors impact the quality and quantity of scientific research outputs among higher vocational institutions in Guizhou?*

2. Research Objectives

1. To identify the specific institutional, human resource, and external factors that significantly influence the quality and quantity of scientific research outcomes in higher vocational institutions in Guizhou.
2. To evaluate the impact of institutional, human resource, and external factors on the quality and quantity of scientific research outputs among higher vocational institutions in Guizhou.

III. RESEARCH METHODS

The current study aims to explore specific factors within institutions, among human resources, and from external environments that play a crucial role in shaping the scientific research outcomes of higher vocational institutions in Guizhou and to provide a detailed understanding of the impact of the identified factors on the quality and quantity of scientific research outputs among higher vocational institutions in Guizhou. In this research, a cross-sectional survey is applied to the research design. Creswell & Hirose (2019) define a cross-sectional survey as a research method involving data collection from many participants simultaneously. This design is commonly employed to

identify population characteristics, prevalence, or patterns. In a cross-sectional survey, the data are collected using a questionnaire. In this case, an interview may be implemented to support the statistical analysis results, which will explain the relationship among variables without considering the changes in time (Creswell & Hirose, 2019). By combining a cross-sectional survey and interview, this study refers to a sequential explanatory research design. The sequence involves administering the questionnaire to the research sample, in this case, the vocational high school teachers with experience conducting research in their institutions. The interview is continued to verify the results of the questionnaire.

Participants and contexts

The research participants comprised 480 teachers of vocational higher educational institutions in Guizhou province. Guizhou province became one of the centers of excellence for its vocational higher education because of the high quality of research and contribution to highly skilled graduates that support industry and job market demand, compared to other provinces in China. The number of vocational higher educational institutions was 48. The present study used purposive random sampling of 48 vocational higher educational institutions. In employing purposive random sampling, this present study set up specific criteria for the participants, such as experience in conducting research, publication, educational background, and academic position.

The questionnaire is then distributed to the 48 vocational higher institutions through the research center in each institution (480 teachers). Some were sent to their email as a distance issue and for convenience. Then, after obtaining the approval, the head of the research center and their staff distribute the questionnaire to the teachers in each institution. The questionnaire is administered using online platforms, including WeChat and email. In this case, the participants who fulfill the predetermined criteria are selected, and those without research experience will not be included in the study. Then, the participant's selection for the interview will be based on random sampling and their availability to attend the interview sessions.

Ten top vocational higher educational institutions were selected based on their research rankings, and then one experienced lecturer from each institution was selected for the interview based on availability. The number of interviewed teachers was 10, as recommended by the institutions with the set criteria. The interviews were conducted face-to-face with the teachers conveniently from the present study venue. Meanwhile, teachers who are from inconvenient distances are administered using telephone calls. All the participants are selected voluntarily, and they can withdraw anytime if they wish to withdraw. This present study keeps all participants' identities anonymous to ensure their confidentiality.

Research Instruments

The research instrument in this study was developed based on the main research questions formulated previously. To answer the first question, researchers designed a questionnaire to identify and measure various factors that influence the outcome of scientific research in high vocational education institutions in Guizhou. This instrument includes three main dimensions: institutional, human resource, and external factors. These three dimensions are compiled by referring to theories developed by Dundar & Lewis (1998) and Wang & Fu (2023) to guarantee the theoretical basis and strong empirical relevance.

- Institutional factors include research infrastructure, facilities, funding, and institutional policies. Eight indicators illustrate the adequacy of institutional support in providing library facilities, scientific journals, internet access, laboratories, and research policies that encourage the quality and quantity of outputs.
- Human resource factors assess aspects of lecturers' professional qualifications, research experiences, and professional development. This dimension comprises nine indicators: track records, training participation, and research roadmap ownership.
- External factors include collaboration with industry, external funding, and the influence of government regulations. This dimension, consisting of nine indicators, evaluates institutional support for research partnerships, the frequency of acquisition of external funds, and the extent to which regulations facilitate or inhibit research activities.

In addition to the questionnaire, this study also uses semi-structured interviews to answer the second question, namely the extent to which the three factors impact the quality and quantity of research output. The interview protocol was prepared based on indicators in the questionnaire and was validated by three vocational education experts. The interview includes three main questions that lead to an in-depth exploration of the influence of each dimension. The inter-coder reliability test shows a kappa coefficient of 0.90 to 0.92, which shows a very high consistency.

To ensure content and construct validity, researchers involve three experts (two doctors and one professor) in validating the questionnaire. After a revision based on expert input, the questionnaire was tested on 25 respondents from institutions similar to the main sample. The validity test through Exploratory Factor Analysis (EFA) shows that the three dimensions have KMO values above 0.90, and the significance of Bartlett is below 0.000, which means it is feasible to be analyzed further. The reliability test using SPSS 32.0 shows the Cronbach's Alpha value of 0.92 for institutional factors, 0.94 for human resource factors, and 0.90

for external factors. The entire value is above the threshold of 0.7, indicating that the instrument has high internal reliability and is suitable for collecting primary data.

Data Analysis

Data analysis in this study was carried out quantitatively and qualitatively using the triangulation approach. For quantitative data, SPSS 32.0 software presents descriptive statistics, while Lisrel 9.2 analyzes exploratory factors and models structural equations (SEM). The SEM model evaluates the relative effects of three main dimensions - institutional, human resource, and external factors - on the quality and quantity of scientific research outputs in high vocational education institutions. Meanwhile, qualitative data from interviews were analyzed using a thematic analysis approach consisting of three stages: data reduction, data presentation, and conclusion. Interview transcripts are classified based on predetermined themes: institutional factors, human resources, and external factors. Two independent experts with doctorates are involved in data reduction, presentation, validation, and interpretation. Cross-checking is carried out systematically to ensure accuracy, and each discrepancy is resolved through team discussions. This approach provides a validated interpretation of the most influential factor to support research success in vocational institutions.

IV. RESULT AND DISCUSSION

RQ1. What institutional, human resource, and external factors significantly influence the scientific research outcomes among higher vocational institutions in Guizhou?

A total of 480 participants filled out a questionnaire consisting of three leading indicators, namely Institutional Factors (Research infrastructure, research facilities, funding, and policies), Human Resource Factors (Faculty qualifications, research experience, and professional development), and External Factors (Industry partnerships, external grants, and regulatory impacts), each of which is measured by eight sub-indicators. Each indicator is designed to explore factors influencing the quality of research output in a vocational school environment. Institutional Factors evaluate the extent to which research infrastructure, facilities, funding, and institutional policies support research activities. Human Resource Factors assess the quality of human resources through faculty qualifications, research experience, and ongoing professional development. Meanwhile, External Factors measure the impact of partnerships with industry, external grants, and regulatory influences on research activities. The contribution of each sub-indicator of the three factors is presented in Figures 1, 2, and 3

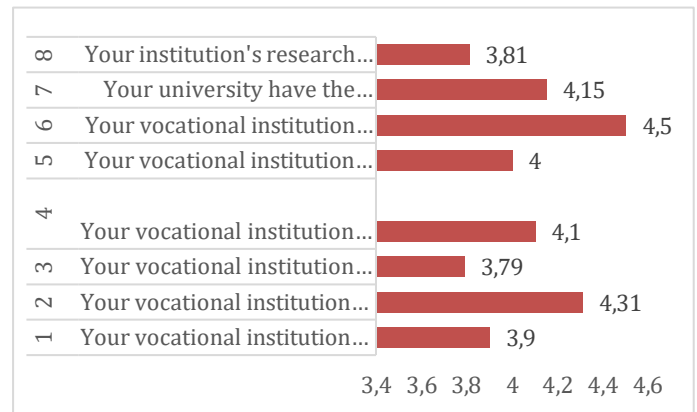


Figure 1 Institutional factor

Figure 1 shows the score of each sub-indicator of the Institutional factor. Of the eight sub-indicators representing the institutional factor, the sub-indicator "provides and supports funding for your research" has the highest mean score of 4.5, followed by "provides adequate resources such as international scholarly journals to support research programs," with a mean score of 4.31. This shows that the participants consider funding support for research in vocational schools very significant, reflecting the importance of access to adequate funds to carry out research projects. The high mean score on this sub-indicator confirms that researchers may have difficulty obtaining materials, tools, and other resources needed to produce quality research without sufficient financial support. In addition, the availability of resources such as international scientific journals is also highly valued by researchers, as shown by the mean score of 4.31 on this sub-indicator. A robust theoretical framework is established through access to the most recent and dependable scientific literature. It assists researchers in maintaining awareness of the most recent advancements in their discipline, thereby enhancing the quality of their research findings.



Figure 2 Human resources factor

Figure 2 represents the scores of each sub-indicator of the Human Resources factor, which is measured by eight sub-indicators. Of these eight sub-indicators, the sub-indicator "engaged in research activities collaboration" has the highest mean score of 4.6; another sub-indicator that also has a high mean score is "published many scientific papers in the last five

years," with a mean score of 4.2. This shows that participants consider collaboration in research activities critical in improving the quality of research output. The highest mean score for the sub-indicator "engaged in research activities collaboration" of 4.6 confirms that collaboration with colleagues and external partners, such as industry or other research institutions, can enrich research by sharing ideas, resources, and expertise. This collaboration increases opportunities for innovation and expands academic and professional networks, which are essential in developing broader and more impactful research. The sub-indicator "published many scientific papers in the last five years," with a mean score of 4.2, also shows the importance of publication productivity as an indicator of success in research. Many publications in the last five years reflect the level of productivity and recognition from the academic community, which directly measures the quality and relevance of the research conducted.

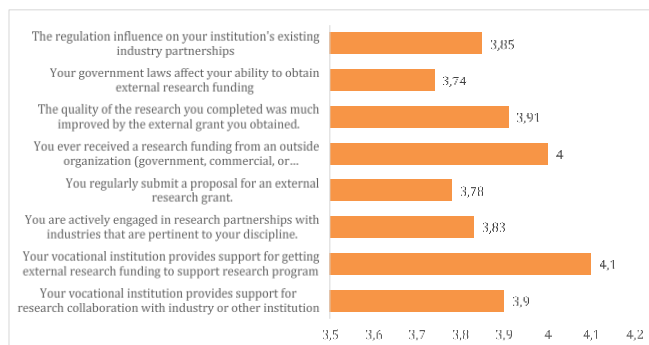


Figure 3 External factor

Figure 3 shows each sub-indicator's score measuring external factors, including the components of industry partnerships, external grants, and regulatory impacts, which are detailed in 8 sub-indicators. These eight sub-indicators overall have a mean score above 3. However, the two sub-indicators with the highest mean scores are "provide support for getting external research funding to support research programs," with a mean score of 4.1. Furthermore, the sub-indicator with the second highest mean score is "received research funding from an outside organization (government, commercial, or international)," with a mean score of 4. This finding shows that external support, especially funding-related, plays a crucial role in the success of research programs in vocational schools. The sub-indicator "provides support for getting external research funding to support research programs," with a mean score of 4.1, shows that researchers highly appreciate the assistance provided by institutions in accessing external funding. The sub-indicator "received research funding from an outside organization (government, commercial, or international)" with a mean score of 4 reflects that direct experience receiving funding from external organizations is also very important. Funding from outside the

institution allows researchers to carry out more complex projects on a larger scale and with more comprehensive resources, which can improve the quality of research output. In addition, external funding is often considered to be a recognition of the quality and potential of the proposed research.

Descriptively, the three components influence the quality of research results, but the magnitude of the contribution of each factor and sub-indicator cannot be determined. To understand the significance and magnitude of each sub-indicator's influence, and to identify valid factors that affect research quality, researchers use SEM (Structural Equation Modelling). The SEM method was chosen because of its ability to analyze complex relationships between latent and observed variables simultaneously. Through SEM, researchers can identify causal relationships between sub-indicators and measure the strength of the influence of each factor.

Research data must be homogeneous and typically distributed in order to qualify for the SEM test. The results of the data normality and homogeneity tests are summarised in Tables 2 and 3

TABLE II. THE RESULTS OF THE ONE-SAMPLE KOLMOGOROV-SMIRNOV TEST FOR DATA NORMALITY

		X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12
N		480	480	480	480	480	480	480	480	480	480	480	480
Normal	Mean	3.90	4.31	3.79	4.1	4	4.5	4.15	3.81	3.70	3.65	3.5	4.2
Parameters	Std.	1.40	1.06	1.46	1.40	1.36	1.03	1.42	1.27	1.29	1.47	1.27	1.12
a,b	Deviation	2	5	7	6	3	1	0	3	3	1	1	2
Most	Absolute	.205	.301	.200	.213	.202	.236	.225	.223	.281	.209	.246	.262
Extreme													
Differences	Positive	.195	.183	.200	.188	.136	.135	.163	.158	.138	.194	.180	.151
	Negative	-	-	-	-	-	-	-	-	-	-	-	-
		.205	.301	.193	.213	.202	.236	.225	.223	.281	.209	.246	.262
Test Statistic		.205	.301	.200	.213	.202	.236	.225	.223	.281	.209	.246	.262
Asymp. Sig. (2-tailed)		.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
		c	c	c	c	c	c	c	c	c	c	c	c

		X13	X14	X15	X16	X17	X18	X19	X20	X21	X22	X23	X24
N		480	480	480	480	480	480	480	480	480	480	480	480
Normal	Mean	4	4.6	3.00	4	4	3.9	4.1	3.83	3.78	4	3.91	3.85
Parameters	Std.	1.28		1.40	1.42	1.46	1.14	1.31	1.32	1.21	1.193		1.25
a,b	Deviation	3	.961	2	6	7	7	0	4	0	1.446		1
Most	Absolute	.278	.257	.205	.196	.200	.297	.209	.225	.277	.288		.252
Extreme											.208		
Differences	Positive	.170	.179	.195	.196	.200	.165	.119	.144	.128	.151		.177
	Negative	-	-	-	-	-	-	-	-	-	.288		--
		.278	.257	.205	.184	.193	.297	.209	.225	.277	.208		.252

Test Statistic	.278	.257	.205	.196	.200	.297	.209	.225	.277	.288	.208	.252
Asymp. Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	c	c	c	c	c	c	c	c	c	c	c	c

TABLE III. THE RESULTS OF THE ONE-SAMPLE KOLMOGOROV-SMIRNOV TEST FOR DATA NORMALITY

According to the results from Table 2 and Table 3, the collected data have a normal distribution and are homogeneous because the total significance value is below 0.05. Therefore, conducting factor analysis using structural equation modeling (SEM) is appropriate. SEM analysis was performed using Lisrel 9.2 software. The SEM test results are displayed in Figure 4 below.

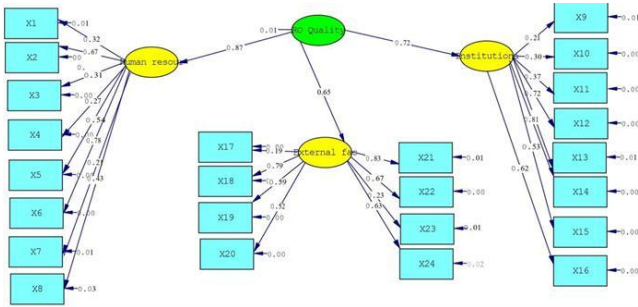


Figure 4 Standard Model of Factors Influencing the Quality of Research Outcome

Figure 4 identifies three components: institutional, human resources, and external factors. All three of these factors have a favorable impact on defining the quality of research outcomes. The institutional factor component accounted for 0.72, the human resources component for 0.87, and the external factor component for 0.65. The findings of this study enhance the findings of the descriptive analysis and interviews presented in the preceding section. The findings of this SEM study also uncover aspects that considerably impact the quality of research outcomes. The Institutional factor component, comprising indicators X9 to X16, has a beneficial impact on institutional factors and the quality of research outcomes. The X9 indicator has a contribution of 0.21, the X10 indicator has a contribution of 0.30, the X11 indicator has a contribution of 0.37, the X12 indicator has a contribution of 0.72, the X13 indicator has a contribution of 0.67, the X14 indicator has a contribution of 0.81, the X15 indicator has a contribution of 0.53, and the X16 indicator has a contribution of 0.62. The primary contributor is X14, which represents financial support from institutions.

In addition, the Human Resources component, which includes eight variables (X1 to X8), favors institutional elements and the quality of research outcomes. The X1 indicator has a contribution of 0.32, X2 has a contribution of 0.67, X3 has a contribution of 0.31, X4 has a contribution of 0.27, X5 has a contribution of 0.54, X6 has a contribution of

0.78, X7 has a contribution of 0.21, and X8 has a contribution of 0.43. The variable with the most significant impact is X6, which represents research experience through publications. Moreover, the External factor component, comprising eight variables (X17 to X24), has a beneficial impact on both institutional aspects and the quality of research outcomes. The X17 indicator has a contribution of 0.19, while X18 has a contribution of 0.79. X19 provides 0.59, X20 contributes 0.52, X21 contributes 0.83, X22 contributes 0.67, X23 contributes 0.23, and X24 contributes 0.63. The primary contributing factor is X21, which represents external financing obtained from the government, business, or other institutions.

RQ2. How do these factors impact the quality and quantity of scientific research outputs among higher vocational institutions in Guizhou?

This second question was answered through interviews conducted by researchers with 10 respondents (Table 4) from the top ten vocational institutions. This section analyzes the interview results to answer how these factors impact the quality and quantity of scientific research outputs among higher vocational institutions in Guizhou

TABLE IV. INTERVIEW SUBJECT

No	The initial name of the participant	Research performance
1	IM	Get external funding more than 3 times
2	SF	Have publications in more than five reputable journals
3	XJ	Have publications in more than five reputable journals
4	YP	Get external funding more than 3 times
5	NS	Get external funding more than 3 times
6	LJ	Have publications in more than five reputable journals
7	DM	Have publications in more than five reputable journals
8	CN	Get external funding more than 3 times
9	NM	Get external funding more than 3 times
10	PN	Have publications in more than five reputable journals

First, the human resource factor is the dominant factor affecting the quality of the research output. Respondents (CN, NM, LM, SF, and XJ) asserted that the research experience became a key element in producing meaningful research. As revealed by Respondent XJ, "Experience provides confidence and skills that cannot be obtained only through academic qualifications." CN reinforced this by saying, "Researchers are more sensitive to the field's challenges and know how to

handle them." In addition, DM and NM consider academic qualifications important. According to them, lecturers with a doctorate tend to produce more in-depth and original research; even without experience, the potential quality of research is not optimal. The third element of this factor, professional development, is seen as a catalyst that maintains the sustainability of the quality of research. PN respondents stressed, "Without adequate training, the ability to research can be stagnant and not develop."

Second, institutional factors also significantly influence, primarily through funding support and access to international scientific journals. Most respondents recognize infrastructure and research facilities as being adequate. However, funding limitations are often an obstacle. Respondent XJ revealed, "Without sufficient funding support, we often have to limit the scale and scope of research." Even a lengthy administrative process slows research implementation, as NS stated. On the other hand, SF refers to access to international scientific journals as "important sources for renewing library reviews and maintaining research relevance." This shows that the quality of research not only depends on the expertise of researchers but also on institutional infrastructure that supports the enrichment of global academic knowledge and collaboration.

Third, external factors include partnerships with industry, external grant funds, and government regulations. External funds are consistently recognized as the most critical factor in expanding the scope and depth of research. Respondent LJ stated, "Without an external grant, it is difficult to do large-scale research that has a high impact." Partnership with industry allows research to be more applicable. As stated by DM, "The industry presents a real challenge that motivates us to find relevant solutions." In addition, CN said that collaboration with the industrial world opens opportunities for fundamental social contributions through research results. Meanwhile, regulations are considered ambivalent. Some respondents (YP, NM, PN) acknowledge that regulations can ensure research integrity and accountability. However, LJ considers that "regulations that are too bureaucratic slow down the research process, especially in the submission of funding."

Finally, in terms of regulations that influence the quality of research output, rigorous regulations can guarantee that research is conducted in accordance with the highest ethical and quality standards, thereby enhancing the credibility and acceptance of research results at the national and international levels. However, excessive or overly bureaucratic regulations can hinder the research process and reduce researchers' flexibility in exploring new topics.

DISCUSSION

Correlation between support funding and research outcome
The findings from the study, encompassing both surveys and interviews, indicate that financial support is the primary determinant of institutional factors that impact research outcomes. The research outcome is significantly correlated with the financing source. The acquisition of essential resources, such as state-of-the-art technology, top-tier research materials, and instruments, is made possible by the availability of sufficient funding. Furthermore, financing enables academics to engage in conferences and international partnerships, facilitating the expansion of professional networks and creating avenues for other research endeavors. Robust financial backing also enhances researcher motivation, instilling a sense of institutional support and enabling them to delve deeper into their study findings. Conversely, inadequate funding may result in restricted research in terms of its scope and influence, as researchers are obligated to operate within the constraints of the resources at their disposal. The overall quality and quantity of research output are impacted by these limitations, which impede the development of new ideas and originality.

A direct correlation between funding and research achievements offers guidance to institutions to ensure efficient and focused allocation of funds. Organizations offering consistent and enduring financial resources will enjoy a competitive edge in doing high-quality research and can effectively participate in national and international arenas. The correlation between funding and study outcomes has been corroborated by various researchers, such as Mohrman et al. (2008), Bozeman et al. (2013), Cattaneo et al. (2016), Shibayama & Baba (2015), and Tseng et al. (2020). A study by Bozeman et al. (2013) reveals that researchers who receive more substantial financing demonstrate higher quality in their scientific papers than those who receive minimal funding. Furthermore, Mohrman et al. (2008) demonstrate that the quality of research in science and technology is greatly influenced by external funding, particularly from business and international institutions. This is because such funding is given with stipulations for promoting innovation and achieving scientific excellence. Cattaneo et al. (2016) discovered a similar phenomenon in their analysis, indicating that universities operating under a competition-based financing model exhibited more research output than institutions relying on fixed funding. A study conducted by Shibayama & Baba (2015) revealed a direct correlation between the availability of money and research output. Researchers who have better access to funds tend to generate a higher number of high-quality publications. In their study, Tseng et al. (2020) discovered that targeted funding can enhance the efficiency of global research collaborations, resulting in a rise in the production of publications and patents. These findings bolster the assertion

that implementing suitable financing policies enhances productivity and improves the quality of output, hence bolstering the institution's capacity to compete on the global stage.

While our findings establish a positive correlation between funding support and research output, indicating that higher levels of funding support lead to increased research output, it is not feasible to universally apply this relationship to enhance scientific production by simply raising spending. Therefore, designing finance allocations must be executed with meticulous attention. An individual's record of published works can be considered while establishing this funding policy. Our research findings further validate that having research expertise, including experience with publishing, is a factor that influences research output. This will be thoroughly covered in the following section of this session. Researchers who have consistently published papers show their proficiency in efficiently using finances, indicating that they have the potential to achieve greater results if they receive sufficient financial assistance. Hence, while formulating funding rules, it is imperative to consider not only the amount of funding allocated but also to ensure that the distribution of these funds is contingent upon the researcher's credentials and track record of publications. By adopting this approach, institutions may guarantee that their funding effectively enhances the quality and quantity of research output.

Correlation between research experience (publication and research collaboration), professional development, and research outcome

The findings of this study validate that the three primary components in Human resources that significantly impact the quality of research outcomes are publishing experience, research cooperation, and professional growth. A solid publication track record is crucial as it showcases the researcher's capability to provide comprehensive and top-notch research. This publication experience demonstrates a profound comprehension of the research process, encompassing all stages from planning to publication and the capacity to adjust to the requirements of global standards. Furthermore, research collaboration has a significant role in determining the quality of research output. This joint endeavor facilitates the exchange of knowledge, resources, and technology among research teams from various universities and fields. By engaging in collaboration, researchers have the opportunity to enhance their viewpoints and methodologies, leading to the production of more complete findings. Moreover, engaging in professional development activities such as attending training sessions, seminars, or workshops is a crucial element in enhancing the capabilities of researchers. Professional development enables researchers to acquire up-to-date information and advancements in their respective sectors, enhancing the quality of their research endeavors.

The results of this research align with multiple prior studies, including Leahey et al. (2017), Houari & Fakhreddine (2024), and Lee (2024), thereby confirming the association between publication experience and the quality of research outcomes. The findings of Leahey et al.'s (2017) research further corroborate these results, indicating that academics with greater publication experience tend to create papers with greater influence and significance within their respective field. This study demonstrates that expertise in publishing is not solely correlated with the number of publications but also with the caliber and widespread recognition within the scientific community. Moreover, a study conducted by Houari & Fakhreddine (2024) demonstrates that the level of publication experience is frequently correlated with the researcher's proficiency in a specific domain, leading to enhanced research outcomes. Lee (2024) discovered that researchers with a robust publishing history tend to receive more citations, indicating their study's caliber and influence. Additionally, professional development is another research discovery concerning the human resources aspect that influences the quality of research output. This finding aligns with the studies conducted by Knight et al. (2006), Jirotko et al. (2013), and Hirsh-Pasek et al. (2015). A study conducted by Knight et al. (2006) demonstrates that researchers who engage in training programs significantly enhance their expertise and understanding, directly enhancing the quality of their research outcomes. Researchers enhance their comprehension of cutting-edge procedures and approaches and their capacity to implement such knowledge in research by participating in training sessions. This enhances the quality of research outcomes by enabling researchers to have access to a broader range of information and generate more comprehensive findings.

Additionally, a study by Jirotko et al. (2013) demonstrated that continuous training and workshops are highly beneficial for researchers to stay updated with the newest scientific advancements. This, in turn, enables them to generate research that is both pertinent and of high quality. Researchers who actively participate in professional growth can incorporate innovative methods and generate research of exceptional quality. This engagement also assists researchers in confronting intricate obstacles and amplifies their capacity to make substantial contributions to scientific and technological advancement. Furthermore, Hirsh-Pasek et al.'s (2015) study revealed that academics who actively engage in professional development exhibit higher levels of innovation and are more proficient in generating superior research than their counterparts who do not participate in such activities. This study discovered that engagement in training, seminars, and conferences provides researchers with opportunities to acquire novel ideas and diverse viewpoints, stimulating creativity and fostering innovative thinking.

Correlation between external funding, industry collaboration, and research outcome

The research findings suggest that external finance and corporate engagement are the most influential factors affecting the quality of research output. External financing is vital in deciding the quality of research findings as it supplies the necessary resources to conduct research activities on a greater scale. Researchers can utilize state-of-the-art laboratory facilities, cutting-edge gear, and software with adequate funding. External financing acts as a stimulus for researchers to engage in innovative research. Researchers who obtain financing from external sources can conduct research activities that are not financed by internal sources. This allows academics to investigate novel concepts and produce breakthroughs in their specialization.

Furthermore, acquiring external financing necessitates adherence to rigorous quality criteria, prompting researchers to uphold the integrity of their research consistently. Moreover, the involvement of the industry is also a vital determinant in assessing the excellence of research outcomes. Engaging in collaborations with industries provides scholars the opportunity to access the practical aspects of the world that are not accessible within their academic setting. This collaboration allows researchers to tackle pragmatic obstacles and enhance the applicability of their study to the industry's requirements and expectations. By partnering with the industry, researchers can design and test products that align with market demands, increasing the likelihood of adopting their research findings in the industry.

The findings of this investigation are consistent with those of other previous investigations, such as Chen et al. (2013), Nguyen & Malik (2022), Lee & Kim (2021), Xia et al. (2022), Nan & Huang (2024), and Cheng et al. (2024). The study conducted by Chen et al. (2013) has provided evidence that the provision of external financing significantly impacts research productivity. In contrast to scholars who exclusively depended on internal funding sources, those with access to external financing were more likely to produce articles of superior quality, according to a study. A study conducted by Nguyen & Malik (2022) yielded comparable findings, indicating that the development of new technologies was significantly influenced by financial support from external sources. Additionally, Lee & Kim (2021) underscored that research collaboration with the industrial sector can substantially enhance the quality of research output. This is accomplished by offering practical insights and opportunities for assessment in real-world settings. Xia et al. (2022) conducted a study that illustrates the potential of industry partnerships to improve the efficacy and relevance of research.

Furthermore, Nan & Huang (2024) asserted that industrial collaboration can accelerate innovation by enabling researchers to connect with the most recent market demands. According to their research, this partnership allows researchers to identify and address practical issues, generating more relevant and applicable responses. In

addition, Cheng et al. (2024) posited that integrating information from academia and industry accelerates the development of innovative products and technologies. They found that this collaboration had the potential to produce research that followed market demands.

CONCLUSION

This study investigates and examines the variables that impact the caliber of research produced within a vocational institution. Institutional factors, human resources, and external influences are the focus of this research. The results indicate that the quality of research output is significantly influenced by these three variables, with the human resources component being the most influential. Subsequently, we conducted tests on the sub-indicators of each variable. Institutional variables are assessed using eight sub-indicators, with financing support being the most influential indicator in determining the quality of research output. Moreover, under the human resources variable, research experience indicators such as publications and research collaborations significantly influence the quality of research output. In addition, professional development indicators substantially contribute to the quality of research output. External financing components, industry engagement, and laws are the primary indicators determining the quality of research output in terms of external factor variables. The results of this study suggest that there is a need to prioritize enhancing the caliber of human resources by emphasizing research experience, publications, research collaborations, and professional growth to get superior research outcomes.

REFERENCES

- [1] Abugre, J. B. (2018). Institutional governance and management systems in Sub-Saharan Africa's higher education: Developments and challenges in a Ghanaian Research University. *Higher Education*, 75, 323-339.
- [2] Al-Kurdi, O., El-Haddadeh, R., & Eldabi, T. (2018). Knowledge sharing in higher education institutions: a systematic review. *Journal of Enterprise Information Management*, 31(2), 226-246.
- [3] Bozeman, B., Fay, D., & Slade, C. P. (2013). Research collaboration in universities and academic entrepreneurship: the state of the art. *The journal of technology transfer*, 38(1), 1-67.
- [4] Cadez, S., Dimovski, V., & Zaman Groff, M. (2017). Research, teaching and performance evaluation in academia: the salience of quality. *Studies in Higher Education*, 42(8), 1455-1473.
- [5] Cantner, U., Kalthaus, M., & Yarullina, I. (2024). Outcomes of science-industry collaboration: factors and interdependencies. *The Journal of Technology Transfer*, 49(2), 542-580.
- [6] Cattaneo, M., Meoli, M., & Signori, A. (2016). Performance-based funding and university research productivity: The moderating effect of university legitimacy. *The Journal of Technology Transfer*, 41, 85-104.
- [7] Chen, S. H., Huang, M. H., & Chen, D. Z. (2013). Driving factors of external funding and funding effects on academic innovation performance in university-industry-government linkages. *Scientometrics*, 94, 1077-1098.

- [8] Cheng, C., Cheng, S., & Feng, C. (2024). The Triple Helix Model for Industry-Education City Integration in China: A Development Approach. *SAGE Open*, 14(2), 21582440241250111.
- [9] Creswell, J. W., & Hirose, M. (2019). Mixed methods and survey research in family medicine and community health. *Family medicine and community health*, 7(2), e000086
- [10] Dahalan, F., Alias, N., & Shaharom, M. S. N. (2024). Gamification and game-based learning for vocational education and training: A systematic literature review. *Education and Information Technologies*, 29(2), 1279-1317.
- [11] Dundar, H., & Lewis, D. R. (1998). Determinants of research productivity in higher education. *Research in higher education*, 39(6), 607-631
- [12] EL Houari, F., & Idrissi Fakhreddine, M. O. (2024). Determinants of knowledge transfer activities among university researchers: a systematic review. *Journal of Science and Technology Policy Management*.
- [13] Findler, F., Schönherr, N., Lozano, R., Reider, D., & Martinuzzi, A. (2019). The impacts of higher education institutions on sustainable development: A review and conceptualization. *International Journal of Sustainability in Higher Education*, 20(1), 23-38.
- [14] Hirsh-Pasek, K., Zosh, J. M., Golinkoff, R. M., Gray, J. H., Robb, M. B., & Kaufman, J. (2015). Putting education in "educational" apps: Lessons from the science of learning. *Psychological science in the public interest*, 16(1), 3-34.
- [15] Jiang, Y., & Gu, J. (2023). *Technology and industrial transformation of China*. Springer.
- [16] Jirotko, M., Lee, C. P., & Olson, G. M. (2013). Supporting scientific collaboration: Methods, tools, and concepts. *Computer Supported Cooperative Work (CSCW)*, 22, 667-715.
- [17] Knight, P., Tait, J., & Yorke, M. (2006). The professional learning of teachers in higher education. *Studies in higher education*, 31(03), 319-339.
- [18] Kosmützky, A. (2020). Comparative research in higher education. In *The international encyclopedia of higher education systems and institutions* (pp. 217-224). Dordrecht: Springer Netherlands.
- [19] Leahey, E., Beckman, C. M., & Stanko, T. L. (2017). Prominent but less productive: The impact of interdisciplinarity on scientists' research. *Administrative Science Quarterly*, 62(1), 105-139
- [20] Le, P. B., & Lei, H. (2019). Determinants of innovation capability: the roles of transformational leadership, knowledge sharing and perceived organizational support. *Journal of knowledge management*, 23(3), 527-547.
- [21] Lee, D. (2024). Exploring the determinants of research performance for early-career researchers: a literature review. *Scientometrics*, 129(1), 181-235.
- [22] Lee, D., & Kim, K. (2021). A collaborative trans-regional R&D strategy for the South Korea Green New Deal to achieve future mobility. *Sustainability*, 13(15), 8637
- [23] Li, L. (2018). China's manufacturing locus in 2025: With a comparison of "Made-in-China 2025" and "Industry 4.0". *Technological forecasting and social change*, 135, 66-74.
- [24] Li, J., & Pilz, M. (2023). International transfer of vocational education and training: A literature review. *Journal of Vocational Education & Training*, 75(2), 185-218.
- [25] Lischewski, J., Seeber, S., Wuttke, E., & Rosemann, T. (2020). What influences participation in non-formal and informal modes of continuous vocational education and training? An analysis of individual and institutional influencing factors. *Frontiers in psychology*, 11, 534485.
- [26] Mohrman, K., Ma, W., & Baker, D. (2008). The research university in transition: The emerging global model. *Higher education policy*, 21, 5-27
- [27] Muriithi, P., Horner, D., Pemberton, L., & Wao, H. (2018). Factors influencing research collaborations in Kenyan universities. *Research Policy*, 47(1), 88-97.
- [28] Nan, M., & Huang, L. (2024). Innovation Ecosystems: A Cross-Industry Examination of Knowledge Flows and Collaboration Dynamics. *Journal of the Knowledge Economy*, 1-39.
- [29] Nguyen, T. M., & Malik, A. (2022). Impact of knowledge sharing on employees' service quality: the moderating role of artificial intelligence. *International Marketing Review*, 39(3), 482-508.
- [30] Reb, J., Chaturvedi, S., Narayanan, J., & Kudesia, R. S. (2019). Leader mindfulness and employee performance: A sequential mediation model of LMX quality, interpersonal justice, and employee stress. *Journal of Business Ethics*, 160(3), 745-763
- [31] Rybníček, R., & Königsgruber, R. (2019). What makes industry–university collaboration succeed? A systematic review of the literature. *Journal of Business Economics*, 89(2), 221-250.
- [32] Shibayama, S., & Baba, Y. (2015). Impact-oriented science policies and scientific publication practices: The case of life sciences in Japan. *Research Policy*, 44(4), 936-950
- [33] Tseng, F. C., Huang, M. H., & Chen, D. Z. (2020). Factors of university–industry collaboration affecting university innovation performance. *The Journal of Technology Transfer*, 45, 560-577.
- [34] Wine, O., Spiers, J., Burns, K. K., van Manen, M., & Vargas, A. O. (2022). A case study unpacking the collaborative research process: Eight essential components. *Environmental Science & Policy*, 131, 209-220.
- [35] Wang, C., & Fu, B. (2023). A study on the efficiency of allocation and its influencing factors on innovation and entrepreneurship education resources in Chinese universities under the five-in-one model. *The International Journal of Management Education*, 21(1), 100755.
- [36] Winterton, J. (2017). Competence-based vocational and professional education (p. 1). M. Mulder (Ed.). Dordrecht, the Netherlands: Springer
- [37] Wu, N., & Liu, Z. (2021). Higher education development, technological innovation and industrial structure upgrade. *Technological Forecasting and Social Change*, 162, 120400.
- [38] Xia, H., Weng, J., & Zhang, J. (2022). Effectiveness of industry–university–research cooperation in China: impact of innovation input and open innovation environment. *International Journal of Innovation Science*, 14(1), 62-78.