Scientific Research Publishing

Open Journal of Social Sciences, 2023, 11, 455-468
https://www.scirp.org/journal/jss
ISSN Online: 2327-5960
ISSN Print: 2327-5952

Analysis on the Impact of Novel Coronavirus Pneumonia Epidemic on Scientific Research in Universities

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How to cite this paper: Sheng, N., Zhang, X. H., & Luan, W. D. (2023). Analysis on the Impact of Novel Coronavirus Pneumonia Epidemic on Scientific Research in Universities. *Open Journal of Social Sciences, 11,* 455-468.
https://doi.org/10.4236/jss.2023.114032

Received: March 15, 2023
Accepted: April 24, 2023
Published: April 27, 2023

Abstract

Objective: To understand the progress of scientific research during the pandemic, and to analyze comprehensively the factors, in order to better carry out targeted work, and further strengthen the planning of scientific research organizations. **Method:** We issue questionnaires on mobile phones to colleges and research institutes in the natural sciences. According to the situation of their scientific research teams, each unit selects 5 - 10 faculty members of different research fields, different professional qualifications, different levels and different ages to complete online questionnaires. Being problem-oriented, we select professors, scholars, young instructors and scientific research managers from 6 colleges with different departments and different scientific research scales to conduct the research and discussions. We extract data from scientific research system for macro analysis. The above three methods are complemented and cross-referenced with each other. **Results:** The scientific research works in colleges and universities are affected widely by the epidemic. The result shows that the experimental process was slow (accounting for 65.78%). The postgraduates were not on duty (accounting for 61.16%), and the limited data of thesis writing appeared detached (accounting for 27.18%). Compared with the same period of the previous two years, the individual applications for government-sponsored research are considered to be basically equal (accounting for 51.46%). Due to the reduction of government financial investments, some major scientific research projects undertaken by enterprises. **Conclusion:** According to the requirements for epidemic prevention and control, the deployment and planning of the work should be adjusted timely, in order to respond to the actual needs. We must strike a balance between epidemic prevention and control, and scientific research, promote both of them, and grasp development opportunities.

Keywords

Novel Coronavirus Pneumonia, Scientific Research, Universities

1. Introduction

Since December 2019, Wuhan has successively found several cases of pneumonia of unknown cause (Li et al., 2020), causing the virus of pneumonia of unknown cause to spread rapidly to Hubei and even the whole country in the following month. 31 provinces, regions and cities have launched the first-level response to major public health emergencies (Zhang, Chen, & Zhao, 2020). Universities and scientific research institutes have also responded positively by taking preventive and control measures to postpone the resumption of classes and study. The sudden epidemic has brought unprecedented impacts and challenges to the way and progress of scientific research, and the scientific research organization will change after the normalization of epidemic prevention and control.

Scientific research is a complex progression which often requires the knowledge of multiple disciplines. While one person's knowledge structure and ability cannot take into account multiple disciplines, the research team with complementary expertise is particularly important (Jones, 2009). In the early stage of COVID-19 in 2020, under the strict control requirements of outdoor activities, a series of scientific research activities such as outbound research, test experiments, technical seminars, and academic conferences were restricted. Some tasks had been postponed, some scientific research had been stalled, and scientific research activities had gradually entered a "slow pace" state (Deng, 2021). In the context of the COVID-19 epidemic, a questionnaire about scientific research of medical undergraduates in a medical university was distributed (**Table 1**). Anonymous method and stratified cluster sampling survey were adopted, and students from the third, fourth, fifth grade and undergraduate of 12 majors in medical college were investigated (Bian et al., 2022).

However, there is no systematic analysis and research on the extent and breadth of the impact; under the normalization of epidemic prevention and control, the working mode of scientific researchers has changed. This paper analyzes the progress and extent of scientific research under the impact of the epidemic through a large-scale mapping study in a university, sorts out the difficulties and problems in the scientific research process of university researchers, studies the influencing factors, and proposes countermeasures and development suggestions.

2. Research Technique

1) Questionnaire Survey

a) Design Principles

The questionnaire topics were selected to reflect the research situation of

Table 1. The situation of medical undergraduates participating in scientific research activities[1].

Items	Frequency	Percentage
Are you willing to participate in scientific research activities		
Yes	364	95.79
No	16	4.21
Is it necessary to participate in scientific research activities		
Yes	370	97.37
No	10	2.63
The Impact of Novel Coronavirus Pneumonia Epidemic on Scientific Research willing		
Greatly affected	138	36.32
Relatively affected	93	24.47
Less affected	85	22.37
No affected	64	16.84

universities, the indicators of research activity and the heart of researchers. The design of the questionnaire is based on the guidelines of "convenient for respondents to fill in, simple content and hierarchical questions". First, the questions were designed according to the relationship between the research process, the main reasons and the secondary reasons. This method can study the major and minor contradictions that affect the development of things, and provide a basis for decision makers to grasp the general direction (Zhang, 2020). Secondly, for subjectivity, attitudinal questions, the evaluation scale and numerical allocation scale are adopted to reasonably classify and quantify the subjective factors. The respondents' attitudinal tendencies are measured through scale-based questions, which indicate the direction for the management measures of the managers (Zhang, 2020). Third, for correlated and multi-factor questions, matrix-type questions are designed, where one question follows multiple questions, which is more hierarchical and allows analysis of correlated factors and information. Fourth, for the content that is not covered by the questionnaire options and cannot be specified, open-ended questions are designed to give the respondents more room for free expression.

b) Data Sources

Give full play to the advantages of efficient and convenient new media, rapid distribution and recovery, and quantifiable analysis of data, we used the Questionnaire Star software to create a cell phone applet questionnaire. After several

[1]Note: A total of 400 questionnaires were distributed in the survey, and 380 valid questionnaires were collected. The effective rate was 95%. After questionnaire was collected, data entry was performed with Excel 2019, and frequency analysis with SPSS 17.0 (Bian et al., 2022).

rounds of discussion, repeated demonstration, and inviting some teachers to test and fill in the questionnaire, the research team continuously optimized the content and level settings of the questionnaire. The questionnaire finally determines the issues covering research fields, research status, factors restricting the development of scientific research, and the use of instruments and equipment. After the questionnaire was designed and distributed to all secondary units in the field of natural sciences in the whole school. Each unit selected 5 - 10 faculty members of different research directions, professional title levels and age groups to fill out the questionnaire online according to the research team. 412 valid questionnaires were collected.

The survey questionnaire consists of four parts. The first part is the basic information of the investigators with 6 questions, mainly including the department, research direction, types of scientific researchers, structure of scientific researchers, number of graduate students, etc. The second part is the situation of scientific research with 10 questions, including the degree and factors affected by the epidemic, the impact of the epidemic on the status of the project application and research funds given by the government, the situation of cooperative scientific research, etc. The third part is the scientific research output with 5 questions, including the publication of papers, academic conferences, declaration of patents, etc. The fourth part is the scientific research situation of graduate students with 4 questions, mainly including the degree of experimental process, the situation of scientific research output, etc.

2) On-site interview

According to the doubtful contents in the questionnaire, 6 colleges of different departments and different research scales were selected for research and interview, including the College of Control Science and Engineering, the College of Microelectronics, the College of Physics, the College of Basic Medical Sciences, the College of Life Sciences and the College of Space Science. The interviewees included professors and scholars, young teachers, vice deans in charge of research, and research secretaries, etc.

3) Data Analysis

The designed questionnaire was given to the personnel related to the research topic in a feasible way, and then the results were compiled and statistically analyzed (Luo & Zhang, 2017). In-depth analysis of the additional information obtained from the interviews and research, and the typical initiatives taken by each secondary unit to effectively respond to the impact of the epidemic, as well as the data from the research system and the management system of the Ministry of Information and Industry were extracted for macro analysis. The three data items were cross-referenced and complemented each other.

3. Findings

1) Type and Structure of the Scientific Research Personnel

The statistics come from the multiple choices of the researched personnel. As Figure 1 shows, 216 university researchers are engaged in basic research,

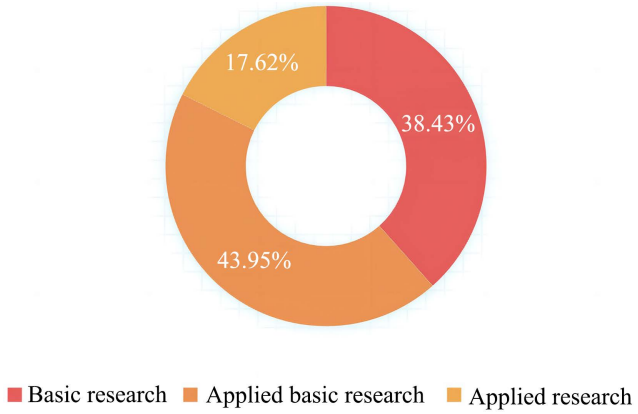

Figure 1. Research types of scientific researchers in the university.

accounting for 38.43% of the total, 247 in applied basic research, accounting for 43.95% of the total, and 99 in applied research, accounting for 17.62%, which reflects the gradual transformation of universities into research and teaching universities. Professors account for 38.65%, associate professors account for 30.19%, associate researchers account for 11.11%, lecturers account for 6.52%, and researchers account for 3.38%, and senior titles become the main force of scientific research among faculty members (Figure 2).

2) The Impact of the Epidemic on the Overall Situation of Scientific Research

In 2020, scientific research was widely affected by the epidemic. As shown in Figure 3, 44.42% of the researchers thought that scientific research was relatively affected by the epidemic, 22.33% thought that scientific research was less affected by the epidemic, 16.02% thought that scientific research was greatly affected by the epidemic, and 11.89% thought that it was generally affected, etc.

3) The Impact of the Epidemic on the Status of the Project Application

Compared with the same period of the previous two years, the percentage of individual researchers applying for vertical projects in 2020 was considered basically the same at 51.46%, decreased at 34.95%, increased at 7.52%, and significantly decreased at 6.07% (the results are shown in Figure 4). The vertical projects mainly come from the government planning, and the policy plan is relatively stable and generally has little change. The first half of the year is the project application period, and the project results will be announced in the second half of the year. The scientific research management department has done a lot of work in the previous period, and tapped the strength of the National Fund, national major projects and other declarations, and the number of declared projects has increased. However, scientific research projects are facing the impact of reduced government financial investment, reduced guidelines for some vertical projects in the last year of the 13th Five-Year Plan, and the tendency of some major scientific research projects to be led by enterprises, etc. It is expected that the project initiation and competitive scientific research funds in 2020 will be affected accordingly.

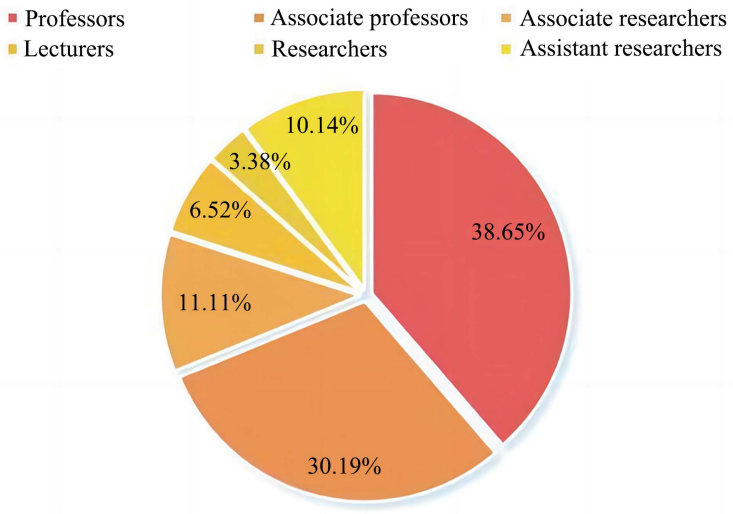

Figure 2. Structure of scientific researchers in the university.

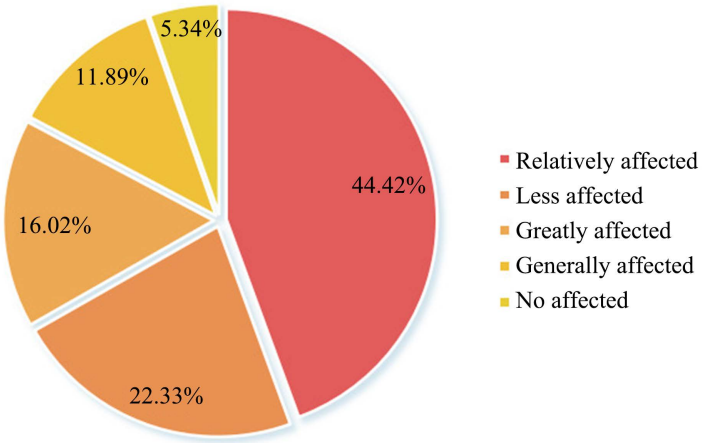

Figure 3. The extent to which the scientific research was affected by the epidemic in 2020.

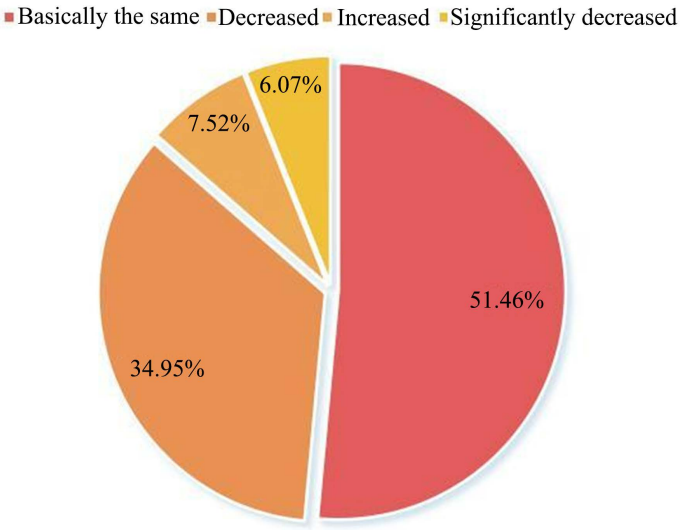

Figure 4. The vertical projects applied for in 2020 compared to the same period in the previous two years.

4) The Impact of the Epidemic on Scientific and Technological Cooperation and Technology Transformation

The analysis of data from the research management service system shows that from January to May 2020, the contract amount of newly established horizontal projects increased greatly year-on-year, but the number of newly established projects plummeted to 95, a decrease of 61.07% year-on-year; the increase in funding is mainly due to the large projects of 10 million started in the pre-epidemic period. In 2020, the researchers engaged in scientific and technological cooperation and technology transformation compared with the same period of the previous two years is shown in Figure 5. The number of researchers engaged in scientific and technological cooperation and technology transformation in 2020 compared to the same period of the previous two years is shown in Figure 5. 49.76% of the respondents filled in this option, and the decrease in cooperation projects with enterprises (38.59% + 6.55%) accounted for 77.55% of the respondents. Scientific and technological cooperation and technology transformation are most obviously affected by the epidemic.

5) The Impact of the Epidemic on Scientific Research Output

As shown in Figure 6, 65.62% of those surveyed thought that the epidemic had an impact on research output. Among them, 58.11% (48.91% + 9.2%) believed that the output of scientific research slowed down, with an increase of 7.51%. It was flat at 34.38%.

By analyzing the experimental progress and the publication of related academic research results affected by the epidemic, as shown in Figure 7, the publication of papers was most affected by the epidemic, 222 people believe they have been affected, accounting for 53.88%. And academic conferences were significantly reduced, with the inconvenience of inter-provincial mobility, restricted international air traffic, and the limitation of the number of conference participants, leading to the failure to hold conferences as scheduled, accounting for 32.04%; the declaration of patents and the declaration of awards decreased, accounting for 17.47% and 11.17% respectively.

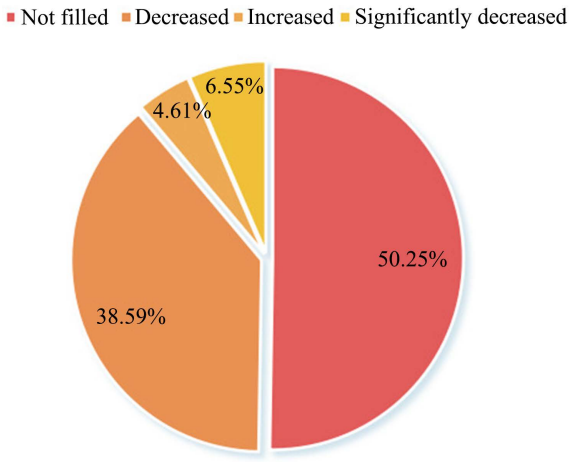

Figure 5. Factors affecting the conduct of scientific research during the epidemic.

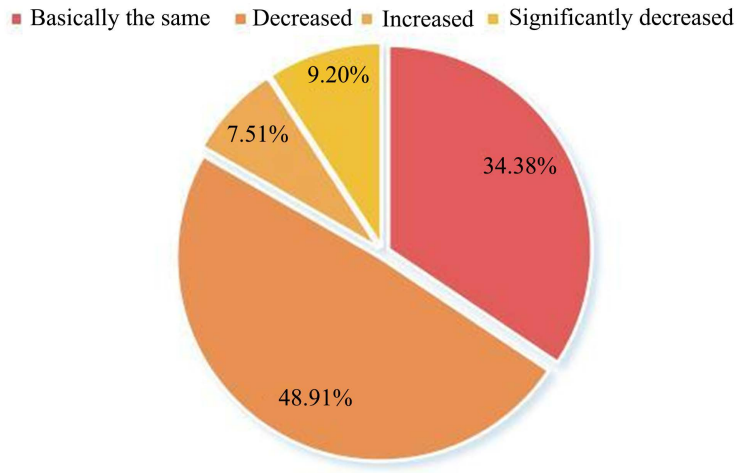

Figure 6. The impact of the epidemic on scientific research output in 2020.

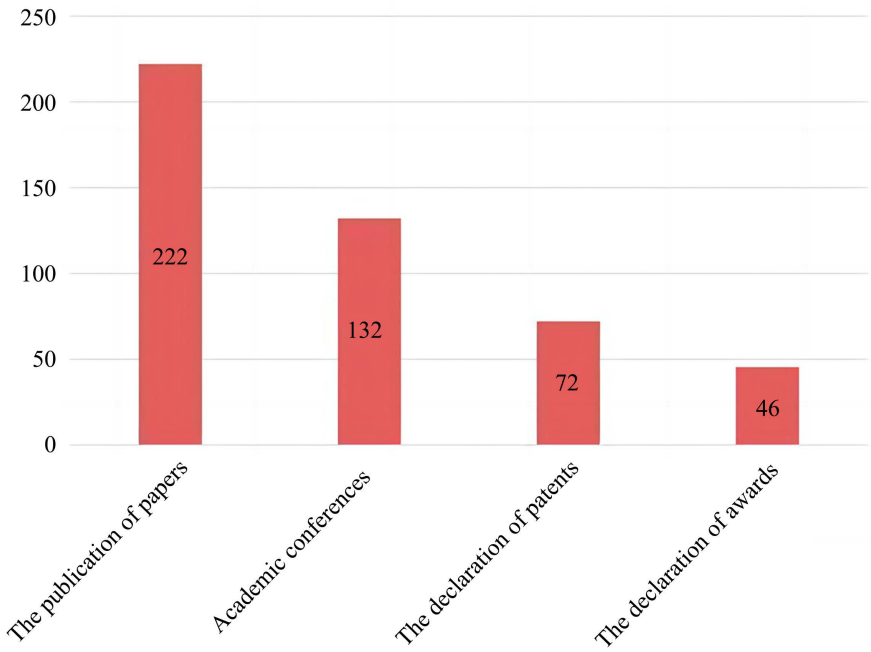

Figure 7. The main impact of the epidemic on scientific research output.

6) Internal Factors of the Epidemic Affecting the Delayed Progress of Scientific Research

The experimental process was slow (69.49%), master's students did not arrive (64.62%), thesis writing was restricted and data was broken (28.72%), the accumulation of foundation for declared projects was restricted (24.87%), doctoral students did not arrive (23.59%), and horizontal projects could not be undertaken (22.31%) (see Figure 8 for details).

Through the discussion, it was learned that the limited writing of papers, the limited accumulation of applied projects, and the inability to undertake horizontal projects were mainly due to the lack of scientific research force, which led to the failure of the experiment to be carried out as scheduled, and the fault of

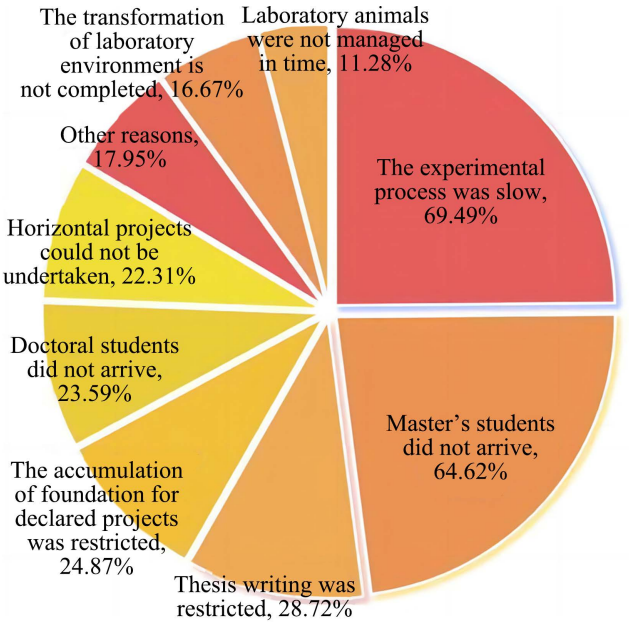

Figure 8. Main aspects affected by the epidemic[2].

data. According to the survey, except for a few individual factors, the arrival rate of scientific research assistants, scientific research financial assistants, and post-doctoral assistants are close to 100%. Some of the research groups appropriately allocate part of their research funds to subsidize the research assistants to stimulate their enthusiasm for research work. Therefore, the auxiliary personnel of scientific research is not the main factor causing the shortage of scientific research force. The shortage of scientific research personnel is mainly caused by the delayed arrival of graduate students, who started to return to school at the end of May. As of now, the average number of doctoral and postgraduate students on duty is 84.81% and 46.52% respectively. Except for those who are abroad and in areas with serious epidemics, doctoral students are basically on duty. The majority of master's students who returned to school were second-year students and first-year students who applied to return to school. Due to the promotion of anti-epidemic research policy, the return rate of graduate students in medical and life fields was the highest, with 77.4% in basic medical school. With the increasing scale of graduate students returning to school, the above phenomenon will be gradually alleviated. However, the research capacity is still unable to meet the scientific research progress. It will take some time to restart the scientific research, to debug the equipment, to re-cultivate the samples, and to adapt the students to the research and get into the working condition.

7) External Factors of the Epidemic Affecting the Delayed Progress of Scientific Research

The research questionnaire was designed to analyze the factors affecting scientific research work. As shown in **Figure 9**, 335 people believe restriction of

[2]Note: This is a multiple choice, the percentage of multiple choice = the number of times the choice is selected ÷ number of valid copies of the answer paper.

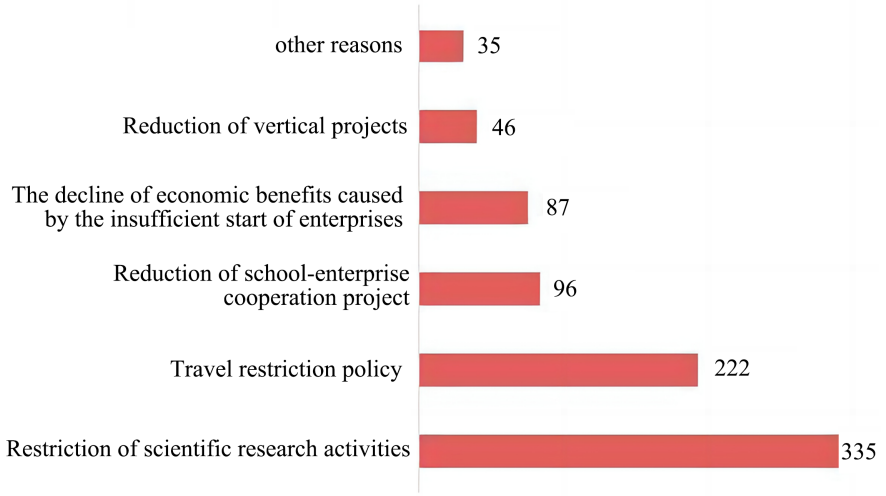

Figure 9. External factors of the epidemic.

scientific research activities is the main factor, accounting for 81.31%, and 53.88% of people think travel restriction policy is also an important factor. The proportion of school-enterprise cooperation due to the reduction of cooperation projects and the decline of economic benefits caused by the insufficient start of enterprises reached 23.30% and 21.12% respectively. The percentages of vertical projects and other reasons are 11.17% and 8.50% respectively.

4. Discuss

Insufficient number of scientific researchers makes it impossible for scientific research activities to be carried out properly. As an important part of the research activities, doctoral and master students play an important role in the research activities. Due to the epidemic, postgraduates failed to return to school as scheduled, and some research laboratories and public experimental platforms were shut down, which affected the progress of research activities. As a result, the operation of instruments and equipment, sampling and data analysis could not be fully carried out, resulting in slow progress of scientific research and delaying the arrangement of scientific work throughout the year. A large number of experimental animals and plants died and were destroyed because they could not be taken care of in time; some samples had to be re-cultured because they had exceeded the experimental deadline. Although the results will be alleviated as the graduate students return to school, the order of returning to school and the process of graduate students entering the state will also affect the process of scientific research. The postgraduate and doctoral students who are about to graduate have rich experience, can skillfully operate the instruments and equipment, master the experimental process, and be familiar with the experimental theory. When they leave school, the students of other grades do not return to school, which will result in the inability to pass on the experience and the interruption of the experimental process. At this time, the students of other grades need a certain process and repeated exploration to get familiar with each other,

which will consume scientific research time. Therefore, in the process of returning to school, it is especially necessary to arrange the order of returning to school in accordance with the law of scientific research, and to organize the return of graduate students with scientific tasks scientifically. In order to enable students to enter the experimental state as soon as possible from the interruption of scientific research and to stimulate the inner vitality of scientific research, we can combine participation in the seminar of scientific research projects and the guidance of supervisors to correct their learning attitude and shift their attention from how to graduate to how to improve their own ability (Duan, Shan, & Li, 2016). Through the "passing on, helping and leading" of senior graduate students and doctoral students, they can be introduced to the overall research atmosphere as soon as possible (Duan, Shan, & Li, 2016). Especially when the epidemic has not yet been eliminated and the school has fully resumed classes, the university can provide living conditions for the staff and students to carry out scientific research better, improve the level of living services, extend the meal time, and enrich the variety of daily supplies in the supermarket on campus. The ideological and political work of colleges and universities should adhere to the problem-oriented approach, start from students' ideological and life problems, accurately grasp the special and complex needs and demands of students in the special anti-epidemic period (Liu, 2016), and ensure that they can carry out scientific research and study in a healthy and positive atmosphere.

Scientific research outings are restricted, and effective cooperation and communication cannot be carried out in a timely manner. Restricted by local travel restriction policies, the scientific research cooperation, enterprise negotiation and academic exchange in the original plan were affected. Although the research group adopted online meetings, the effect of online communication was far less than face-to-face, with little effect, especially great impact on international cooperation and exchange. The university is densely populated and access is strictly controlled. Due to the restrictions on access, the purchase and installation of instruments and equipment and the transportation of reagents cannot be carried out normally, and some colleges encounter difficulties in environmental renovation and laboratory relocation. Due to the limited traffic, the company's sequencing and delivery of samples are delayed, the sample delivery in the medium-high risk areas is stopped, and the analytical samples are abandoned. At the same time, the inter-campus and inter-college exchanges are blocked, and the scientific research on campus is affected. Under the normalization of epidemic prevention and control, colleges and universities have formulated strict procedures and systems to prevent the interruption and isolation of the spread of the epidemic, but to a certain extent, the scientific research activities on campus are limited. It is difficult and complicated for graduate students to handle affairs and carry out scientific research activities across campus, and the strength and breadth of interdisciplinary research have become an impact on innovation, especially one of the key factors of source innovation development (Liang, 2017). Even students on one campus are not allowed to enter the laboratories of other

faculties to conduct research activities and need to apply and be examined; difficulties are encountered in cooperation within the university and cross-disciplinary research is promoted slowly. The situation of outbound activities varies according to the epidemic situation, but universities can make flexible policies to facilitate cross-campus and cross-college cooperation and exchange among teachers and students, and agree to cross-college experimental research work under the condition of ensuring the safety of epidemic prevention and control. To improve the transportation guarantee ability, adjust the route and departure time of shuttle bus between campuses as needed, so as to facilitate the safe visit and exchange of people on campus without contact with the outside world. To build an "Internet plus" university logistics management service management body (Guan & Zhong, 2010), to ensure that researchers and students can be supported in real time under the normal situation of epidemic prevention and control. Multidisciplinary research is an inevitable trend in the era of contemporary "big science", and more and more research results show that it is also one of the inevitable choices to solve major technical and social problems.

From the demand side to the supply side, the negative impact of the epidemic on China's economy is enormous, and enterprises are undoubtedly facing a crisis of survival, while for the weaker small and medium-sized enterprises, they are facing the risk of bankruptcy (Li, 2020). Enterprises failed to resume work and production on time, and the opportunities for scientific cooperation decreased. "Difficult in starting work, difficult in employing, and difficult in funding" is the common test faced by enterprises. As a result of the epidemic, the production chains of the companies could not function normally and the trade orders could not be completed on time. For some processing industry manufacturers, especially those producing emergency materials related to the epidemic, it is difficult to gather employees to resume production quickly. The lack of cash flow, the lack of revenue, and costs are still accumulating and increasing over time. A series of factors led to a lack of motivation for many companies to collaborate, and thus fewer opportunities to collaborate with schools. Although the epidemic has had some impact on businesses and the economy, it has given rise to online industries such as e-commerce. The university transformation institutions should strengthen the investigation and evaluation of the market prospect of the results, the screening and matching of potential market demand, and the setting and implementation of the benefit distribution of the results among the stakeholders (Tian & Guo, 2019). In the face of the epidemic, to anticipate risk factors in advance, and researchers need to be urged to strengthen the inspection of signed contracts and make risk assessment of new contracts to ensure the smooth performance of horizontal research contracts. In response to the problem of on-site science and technology to accept restrictions, adjust the work methods and explore network cooperation, online science and technology cooperation activities, which requires a more professional and systematic organization and planning. The latest policies issued by national ministries and commissions have put forward new requirements on intellectual property rights and transformation of

achievements in universities. The relevant departments of university management should promptly organize the revision of management methods, continuously improve the policy system and promote the implementation of management as soon as possible. Strengthen the publicity and guidance of relevant policies to ensure that more researchers can grasp and understand the policy vane, and better carry out scientific and technological cooperation.

5. Brief Summary

The impact of epidemic on scientific research work of colleges and universities is objective. According to the requirements of normalized prevention and control of epidemic, colleges and universities should adjust the work deployment and planning in time, regularly study and judge the development of scientific research work under the normalization of epidemic, adjust the work plan in time and enhance the core competitiveness of scientific research of colleges and universities; strengthen the communication with the higher scientific research authorities, adjust the scientific research task objectives, and address the problems such as slow output of scientific research results, discontinuity of scientific research data and failure to meet the original plan. In response to the problems such as slow output of scientific research results, discontinuity of scientific research data, time required to get on the right track, and failure to meet the original plan, we communicate with the competent departments in advance to appropriately relax the standards to solve the worries of scientific researchers; timely adjust the financial budget, as the travel expenses, meeting expenses and equipment purchase expenses in the original financial budget dropped steeply due to the limitation of going out, the inability to carry out meetings, and the obvious slowdown of equipment purchase, the relevant functional departments gave timely guidance to avoid a large balance of funds. Adhere to the normalization of epidemic prevention and control and scientific research work to promote, and seize the development opportunities. Universities should strengthen their planning, cultivate new opportunities in the crisis, and open new innings in the change.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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