

Navigating Research Productivity and Delayed Graduation Challenges among Graduate Students in China during COVID-19: Findings from a Questionnaire Survey

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Abstract

The study focuses on how COVID-19 has affected the research productivity and degree completion of graduate students in China. A questionnaire survey was conducted with 2298 Chinese graduate students to gauge their perception of COVID-19's impact on their research productivity, delayed graduation, research engagement time and research output. The study found that a majority of Chinese graduate students (64.6%) experienced a temporary reduction in their research productivity due to the COVID-19 pandemic. The study concludes that the pandemic has affected graduate students in different ways and offers recommendations for policies to help them adapt to recent university changes.

Keywords

COVID-19, Graduate Student, Research Productivity, Research Engagement Time, Research Output, Delayed Graduation

1. Introduction

The COVID-19 pandemic has resulted in a significant loss of life worldwide and has posed a threat to recent advancements in global health and development (Onyeaka et al., 2021; Forchette et al., 2021). The closure of university campuses due to the pandemic has affected students worldwide, with face-to-face classes suspended (Tang et al., 2021). A collaborative survey between the United Nations Educational, Scientific, and Cultural Organization (UNESCO), United Nations International Children's Emergency Fund (UNICEF), and the World Bank

revealed that during school closures due to COVID-19, 20% of students in East Asia and the Asia-Pacific subregion, and 38% of students in South Asia did not have access to any form of remote learning (UNESCO, 2022). Meanwhile, almost two-thirds of the 46 countries in the Asia-Pacific region developed online teaching and learning programs in response to the pandemic (UNESCO, 2021). Several previous studies have investigated the COVID-19 pandemic has had its impact on faculties and researchers (McGaughey et al., 2021; Myers et al., 2020; Kwon, 2020; Smith & Johnson, 2022; Malisch et al., 2020), but studies on the impact of the COVID-19 pandemic on early-career researchers remain sparse (Pyhältö et al., 2022).

In January 2020, the COVID-19 outbreak began in mainland China with pandemic-like characteristics, rapidly spreading to numerous cities within a matter of weeks. As a result of the outbreak of COVID-19 in China, many Chinese students turned to online resources for their learning needs (Zhou & Mou, 2022). Multiple rounds of epidemic prevention and control measures have led to intermittent school closures and the shift to online learning, which have disrupted students' academic experiences and research activities. Several studies have focused on the challenges faced by graduate students during the pandemic. Zeng et al. (2021) recently conducted a survey of graduate students in China and found that the pandemic had a significant impact on their academic progress, research activities, and job prospects, and they also found that graduate students faced challenges related to financial difficulties, a lack of access to research resources, and difficulties in communicating with advisors and peers. In response to the pandemic, many universities in China have developed online teaching and learning programs. However, the effectiveness of these programs has been a topic of debate. Su et al. (2021) conducted a study on the effectiveness of online education in China during the pandemic and found that while online learning had some advantages, it also posed challenges such as a lack of interaction and communication among students and instructors. To mitigate the negative effects of the pandemic on graduate education, some universities have implemented measures such as extending the duration of research projects and providing financial support to students. Cao et al. (2020) and Luo et al. (2021) have focused on the psychological impact of the COVID-19 epidemic on college students in China, and they found that the epidemic has brought not only the risk of death from infection but also unbearable psychological pressure. Wang et al. (2022) proposed a framework for supporting graduate students during the pandemic, which includes measures such as enhancing online learning platforms, providing psychological counseling services, and improving communication and collaboration among students and advisors.

Overall, the COVID-19 pandemic has had a significant impact on higher education and graduate education in China. While universities have implemented measures to mitigate the negative effects, there is still a need for further research and initiatives to address the challenges faced by graduate students

during the pandemic. Therefore, the current study focuses on graduate students, including both master's and doctoral students, to investigate how the pandemic has affected the research productivity and degree completion of graduate students in China.

2. Literature Review

2.1. Graduate Education under the Epidemic

The COVID-19 pandemic caused a significant shift in graduate activities from face-to-face teaching to virtual modes, posing a major challenge to postgraduate students and affecting their engagement with the material. Goldstone and Zhang (2022) utilized a national online survey to explore the graduate research experience and potential policy solutions of the pandemic through multi-level modeling, including mental wellbeing, loneliness, access to research resources, social connection, and training availability, and finally, the need is demonstrated for generalized and specific support combining financial assistance, mental health and pastoral support, communication, and academic study support. Goble et al. (2022) investigated the implementation of the foundation interim year 1 and the impact of pandemic-related changes to course structure on self-reported work preparation among UK medical school graduates, and they found that graduates who had taken modified practical and written examinations reported feeling more prepared and experiencing a greater sense of “legitimacy” compared to those who did not take the exams. Oliveira et al. (2022) have examined the effects of COVID-19 on graduate students in Brazil, and also found that even though the students reported good quality of life and self-perceived health, they experienced moderate levels of anxiety during social distancing. Additionally, the study also revealed a decreased level of academic motivation and productivity among the students. Daud et al. (2020) investigated the impact of the COVID-19 pandemic on the mental health of university graduates in Malaysia. The study examined how factors such as the spread of the virus, isolation measures, online learning, and delays in the start of the new semester affected the graduates' mental health. According to reports from university counselors in Malaysia, there was an increase in the number of graduates seeking counseling during the Movement Control Order period.

2.2. Impact of COVID-19 on Graduate Education Research Productivity

The halt of academic operations, and closure of public recreational areas, and fitness centers pose a significant risk to the physical, mental, and social health of students of all levels. Postgraduate students, in particular, may face a challenge in pursuing their daily experiments, which could negatively impact their research outcomes. According to Aydemir & Ulusu (2020), graduate students could be among the groups that are most affected by these circumstances. Anwer et al. (2021) conducted a study to assess how the COVID-19 pandemic has af-

affected the research output of postgraduate students in Hong Kong, their findings identified the main worries that postgraduate students have during this pandemic. According to the respondents, the six primary concerns during the COVID-19 pandemic are related to the lack of available participants for research experiments, the fear of potential exposure to the virus from research participants, concerns about community transmission, cancellations of international trips that could impact their attachment programs, challenges in meeting with their supervisors frequently, and the inability to attend scientific conferences. Gupta et al. (2022) noted that COVID-19 has placed a significant strain on education programs, specifically postgraduate medical education across all fields. This has resulted in notable impacts on various aspects of these programs, including their teaching, curriculum, examinations, training, and ongoing thesis research. The authors also examined the main effects of these disruptions on academic pursuits, such as extensions, changes to plans for studying abroad, reduced job opportunities, challenges with publishing, loss of skills, and increased risk of COVID-19 infection

3. Method

3.1. Research Questions and Hypothesis

This study aimed to identify and understand how the Pandemic impacted the postgraduate students' research productivity in China. The research was conducted nationwide to obtain a comprehensive view of the situation. In this study, we have narrowed our focus to two pivotal research questions, aiming to delve deeper into the impact of the COVID-19 pandemic and its associated measures on postgraduate students. Firstly, we examine how the pandemic and its measures have affected students' research productivity, graduation delays, changes in research engagement time, and overall research output, all from the perspective of the graduate students themselves. The rationale for choosing these aspects lies in their centrality to postgraduate education and the notable disruption caused by the pandemic, which has significant implications for students' academic development and future career trajectories.

Furthermore, we delve into how specific demographic factors, such as gender, age, level and form of study, year of enrollment, and discipline affiliation, potentially moderate the relationship between COVID-19-related measures and these key outcomes. By unpacking these factors, we aim to gain a more nuanced understanding of how the pandemic has differentially affected postgraduate students from diverse backgrounds, thereby informing more targeted policy and intervention efforts.

In sum, our focus on these specific aspects is grounded in their significance to the research question at hand and the need to provide a comprehensive analysis of the pandemic's impact on postgraduate students. Therefore, the study was guided by two primary research questions:

R.Q.1: To what extent have the COVID-19 pandemic and its associated meas-

ures influenced postgraduate students' research productivity, graduation delays, shifts in research engagement time, and overall research output, as perceived by the students themselves?

R.Q.2: Which demographic variables, including gender, age, study level and format, enrollment year, and discipline membership, might serve as moderators in the relationship between COVID-19 measures and postgraduate students' research productivity, graduation postponements, research engagement time, and overall research output? e defined.

Based on the research purpose and research questions, this study sets the following 2 research hypotheses:

Null Hypothesis 1: There was no association between COVID-19 and students' perceptions of research productivity, delayed graduation, research engagement time, and research output.

Null Hypothesis 2: There were no significant variations in students' perceptions of research productivity, delayed graduation, research engagement time, and research output based on their demographic information, which includes gender, age, level of the study program, form and type of study, year of enrollment, and discipline affiliation.

3.2. Participants

This cross-sectional survey aims to assess the impact of the COVID-19 pandemic on the research productivity and delayed graduation of graduate students in China, and to investigate how graduate students view changes in their research engagement time and output during the epidemic. The survey spanned from June 1 to June 30, 2022 and was distributed to universities nationwide through various channels including the WeChat and Enterprise WeChat platforms. Graduate students were invited to participate in the survey and complete electronic questionnaires in Chinese WeChat and a web questionnaire was utilized as communication tools for gathering responses from graduate students. Out of the 2,854 questionnaires initially collected, 2,298 were deemed valid after data cleaning. Moreover, the data analysis in the study was carried out using SPSS version 26, with Chi-Square Test being utilized as the primary tool for analyzing the collected data. In addition, the Post Hoc Pairwise Comparison Test was applied to determine the significant differences between groups.

3.3. Variables

3.3.1. Dependent Variables

The dependent variable, research productivity, can have a significant impact on graduate students, as it is often a key factor in their success in academic programs and future careers. High research productivity can lead to greater opportunities for grants, scholarships, and publishing in prestigious academic journals. It can also enhance a student's reputation in their field and increase their chances of securing employment in their desired career path. On the other hand,

low research productivity can be detrimental to a student's academic progress and future prospects (Belavy et al., 2020; Forero & Moore, 2016; Kwon et al., 2015).

In the current study, the research productivity was defined as research engagement time and research output. In this survey, the progress and achievements of research and development are defined as research production, and the efficiency of producing research production is defined as "research productivity." And the research engagement time is measured in terms of hours spent on research per day or per week. The research output includes completed research projects, published papers or articles, completing a thesis identifying a research topic, conducting a literature review, collecting and analyzing data, and presenting your findings.

3.3.2. Independent Variables

Given the complex and multifaceted nature of postgraduate research, there is a need to examine how different demographic factors interact with COVID-19-related measures to influence students' research productivity, time to graduation, research output and overall research engagement. The survey includes multiple-choice questions on the general impact of coping with COVID-19 on research productivity, delayed graduation, research output and overall research engagement categories, which will provide valuable insights into the challenges researchers face during a pandemic and the ways in which they adapt to continue their important work. By doing so, this study can provide a more nuanced understanding of the challenges and opportunities facing postgraduate students in the current context and develop evidence-based policies and strategies to promote equitable and inclusive access to research opportunities and outcomes.

The demographic characteristics could include a student's gender, age, level, form and type of study program, year of enrollment, and discipline affiliation. The survey includes 7 items in the demographic category, which are multiple-choice questions aimed at better understanding the background and characteristics of the participants. By taking these factors into consideration, it may be possible to better understand the potential effects of COVID-19 measures on the research outcomes of postgraduate students and to develop targeted interventions and support strategies that address the needs of different groups of students. Therefore, it's important to consider these factors as potential moderators when analyzing the relationship between COVID-19-related measures and postgraduate students' academic outcomes.

3.4. Reliability and Validity

Reliability and validity are important and fundamental aspects of assessing any measurement method used for data collection in a good research project (Ahmed & Ishtiaq, 2021), reliability being the consistency of a measurement instrument across time and situations, and validity being the accuracy of a mea-

surement instrument in measuring what it is intended to measure. In this case, the Cronbach's alpha coefficient of the questionnaire was measured using SPSS software and yielded a score of 0.908, indicating a high level of internal consistency in the measurement tool used in the study. This means that the items or questions used in the study are closely related to each other and consistently measure the same construct.

The KMO and Bartlett tests are commonly used to evaluate the effectiveness of factor analysis. The KMO value of the questionnaire was measured using SPSS software and yielded a score of 0.708, indicating that the sample size is sufficient for factor analysis. Additionally, the P-value of the Bartlett's test was less than 0.05, indicating that the correlations between the items in the measurement tool have statistical significance, and that the tool is measuring what it is intended to measure. Overall, the measurement tool has high reliability and validity, which is crucial in ensuring the accuracy and consistency of research results.

3.5. Ethical Consideration

Ethical considerations were carefully considered throughout this study. Prior to the commencement of the study, ethical approval was obtained from the institutional review board. Informed consent was obtained from all participants prior to their participation in the study. Participants were informed that they could withdraw from the study at any time without penalty. The study involved sensitive information about the participants, so strict confidentiality measures were implemented. All identifying information was removed from the data and access to the data was restricted to authorized personnel only. The data was stored on a secure server and password-protected. To minimize any potential risks to participants, the study was designed to follow strict guidelines regarding data collection and analysis. Each participant was assigned a unique identifier to protect their identity. Data was kept confidential and was only used for research purposes. Any results that were published did not contain any identifying information.

4. Results

4.1. Demographic Characteristics

The total sample size of the study is 2298 individuals (**Table 1**). The sample consists of 44% males and 56% females, with the majority falling in the age range of 21 - 25 years (68.4%). A large portion of the sample consists of individuals pursuing a Master's degree (95.5%), with the remaining 4.5% pursuing a PH.D. degree. Most of the individuals are enrolled full-time (80.5%) and pursuing professional studies (59.2%). The majority of individuals enrolled after 2017, with the largest enrollment in 2021 (36.7%). In terms of disciplines, the sample is primarily made up of individuals pursuing studies in engineering (41.5%), followed by social sciences (32.7%) and humanities and arts (17.4%). a) Selection: Highlight all author and affiliation lines.

Table 1. Demographic characteristics.

		n	%
Sample Size		2298	100
Gender	Male	1011	44
	Female	1287	56
Age (years)	<21	12	0.5
	21 - 25	1572	68.4
	26 - 30	524	22.8
Levels	>30	190	8.3
	Master	2195	95.5
	PH.D.	103	4.5
Study Forms	Full-time	1850	80.5
	Part-time	448	19.5
Study Types	Academic	937	40.80
	Professional	1361	59.2
Enrollment Years	Before 2017	43	1.9
	2018	77	3.4
	2019	501	21.8
	2020	833	36.2
	2021	844	36.7
Disciplines	Humanities & Arts	401	17.4
	Social Science	752	32.7
	Nature Science	77	3.4
	Engineering	953	41.5
	Medicine & Nursing	115	5

4.2. Impact on Graduate Students' Research Productivity

4.2.1. Overall Impact of the Pandemic on Research Productivity among Graduate Students

In this survey, the impact of response to COVID-19 on research productivity was measured by a single item asking respondents: From the end of 2019 to now, how have COVID-19 and its response affected your research productivity as a whole? (Question 1) The 5-point response was then reversely grouped into 1) Even now, there is still an unacceptable impact on research productivity. 2) Though there was a temporary impact, the impact on research productivity is acceptable now. 3) Though there was a temporary impact, the impact on research productivity disappears now. 4) There has been little impact on research productivity from this factor since January 2020. 5) My research productivity has been improved by reducing commuting time, online tools, etc.

Based on the information in **Table 2**, it can be inferred that most of the participants (80.1%) have had some level of negative effect on their research productivity due to COVID-19 and the measures taken in response to it. Nonetheless,

Table 2. Impact of the pandemic on research productivity among graduate students.

Survey Items	n	%
1) Even now, there is still an unacceptable impact on research productivity.	298	13%
2) Though there was a temporary impact, the impact on research productivity is acceptable now.	1485	64.6%
3) Though there was a temporary impact, the impact on research productivity disappears now.	126	5.5%
4) There has been little impact on research productivity from this factor since January 2020.	354	15.4%
5) My research productivity has been improved by reducing commuting time, online tools, etc.	35	1.5%

a considerable number of respondents (16.9%) indicated that the impact on their research productivity was manageable or minor. A smaller portion of respondents (13%) stated that the impact of COVID-19 on their research productivity continues to be unacceptable. According to the survey results, 64.6% of participants reported that while there was a temporary impact, the negative effects on their research productivity are now manageable. Additionally, 5.5% of respondents stated that while there was a temporary impact, the negative effects on their research productivity are now completely gone. Another 15.4% of respondents reported that there has been minimal impact on their research productivity since January 2020. On the other hand, a small percentage of respondents (1.5%) reported that their research productivity has actually improved due to reduced commuting time by working online.

4.2.2. Different Impacts on Graduate Students' Research Productivity Based on Their Demographic Characteristics: Gender, Age, Level and Form of Study, Year of Enrollment, Discipline Affiliation

In order to explore how demographic characteristics and academic variables relate to the dependent variable of interest, a Chi-square test was carried out. The results of the test are presented in **Table 3** below. The results of the Chi-Square Test indicate that there is a significant association between all of the independent variables and the research productivity interest ($p < 0.05$), with the exception of the variable "Type of study program" ($p = 0.047$). their gender (0.000), age (0.020), level and form of the study program (0.002 and 0.000, respectively), enrollment year (0.000), and discipline (0.000) ($p < 0.001$). These findings indicate that these factors can have a significant impact on the study outcomes and therefore should be taken into consideration while analyzing and interpreting the results.

From **Table 4**, it is apparent that there exists a difference in attitudes towards the impact of epidemics on research productivity among male and female postgraduate students in China. Specifically, the data suggests that female postgraduate students tend to hold more positive attitudes towards the impact of epidemics on research productivity when compared to their male counterparts. These findings imply that gender may have a significant influence on how individuals perceive and react to epidemics with regard to research productivity. **Table 4** also illustrates that among postgraduate students in China, those who are part-time hold more positive attitudes towards the impact of epidemics on

research productivity compared to full-time students. Additionally, it indicates that master's students generally exhibit more positive attitudes toward this impact than doctoral students. Furthermore, the study revealed significant differences in attitudes toward the impact of epidemics on research productivity among students studying engineering, humanities, and social sciences. Specifically, it was found that engineering students tended to hold a more negative view of the impact of the epidemic on research productivity in comparison to humanities and social science students.

Table 3. Chi-square test of differences in research productivity among graduate students with different characteristics during the COVID-19 pandemic.

Variable	Chi-Square Test		
	Value	df	Asymptotic Significance (2-sided)
Gender	31.094a	4	0.000
Age	24.095a	12	0.020
Level	16.929a	4	0.002
Form	30.315a	4	0.000
Type	9.646a	4	0.047
Enrollment Year	43.880a	16	0.000
Discipline	65.169a	16	0.000

Table 4. Demographic characteristics* research productivity crosstabulation.

			1	2	3	4	5	Total
Gender	Male	n	169 _a	650 _b	47 _b	136 _b	9 _b	1011
		%	56.7%	43.8%	37.3%	38.4%	25.7%	44.0%
	Female	n	129 _a	835 _b	79 _b	218 _b	26 _b	1287
		%	43.3%	56.2%	62.7%	61.6%	74.3%	56.0%
Age	<21	n	2 _a	6 _a	1 _a	2 _a	1 _a	12
		%	0.7%	0.4%	0.8%	0.6%	2.9%	0.5%
	21 - 25	n	193 _a	1042 _a	75 _a	245 _a	17 _a	1572
		%	64.8%	70.2%	59.5%	69.2%	48.6%	68.4%
	26 - 30	n	76 _{a,b,c}	318 _c	43 _b	75 _{a,c}	12 _{a,b,c}	524
		%	25.5%	21.4%	34.1%	21.2%	34.3%	22.8%
	>30	n	27 _a	119 _a	7 _a	32 _a	5 _a	190
		%	9.1%	8.0%	5.6%	9.0%	14.3%	8.3%
Level	Master	n	273 _a	1433 _b	118 _{a,b}	336 _{a,b}	35 _{a,b}	2195
		%	91.6%	96.5%	93.7%	94.9%	100.0%	95.5%
	PH.D.	n	25 _a	52 _b	8 _{a,b}	18 _{a,b}	0 _{a,b}	103
		%	8.4%	3.5%	6.3%	5.1%	0.0%	4.5%
Form	Full-time	n	252 _a	1181 _a	101 _a	299 _a	17 _b	1850
		%	84.6%	79.5%	80.2%	84.5%	48.6%	80.5%
	Part-time	n	46 _a	304 _a	25 _a	55 _a	18 _b	448
		%	15.4%	20.5%	19.8%	15.5%	51.4%	19.5%

Continued

Type	Academic	n	129 _a	587 _a	52 _a	161 _a	8 _a	937	
		%	43.3%	39.5%	41.3%	45.5%	22.9%	40.8%	
	Professional	n	169 _a	898 _a	74 _a	193 _a	27 _a	1361	
		%	56.7%	60.5%	58.7%	54.5%	77.1%	59.2%	
Enrollment year	Before 2017	n	10 _a	22 _a	5 _a	5 _a	1 _a	43	
		%	3.4%	1.5%	4.0%	1.4%	2.9%	1.9%	
	2018	n	15 _a	42 _a	7 _a	10 _a	3 _a	77	
		%	5.0%	2.8%	5.6%	2.8%	8.6%	3.4%	
	2019	n	63 _a	320 _a	38 _a	69 _a	11 _a	501	
		%	21.1%	21.5%	30.2%	19.5%	31.4%	21.8%	
	2020	n	116 _a	533 _a	36 _a	146 _a	2 _b	833	
		%	38.9%	35.9%	28.6%	41.2%	5.7%	36.2%	
	2021	n	94 _a	568 _a	40 _a	124 _a	18 _a	844	
		%	31.5%	38.2%	31.7%	35.0%	51.4%	36.7%	
	Discipline	Humanities & Arts	n	52 _a	249 _a	21 _a	65 _a	14 _b	401
			%	17.4%	16.8%	16.7%	18.4%	40.0%	17.4%
Social Science		n	68 _a	479 _b	38 _{a,b,c}	153 _c	14 _{a,b,c}	752	
		%	22.8%	32.3%	30.2%	43.2%	40.0%	32.7%	
Nature Science		n	9 _a	50 _a	4 _a	13 _a	1 _a	77	
		%	3.0%	3.4%	3.2%	3.7%	2.9%	3.4%	
Engineering		n	157 _a	622 _b	53 _{a,b,c}	115 _c	6 _c	953	
		%	52.7%	41.9%	42.1%	32.5%	17.1%	41.5%	
Medicine & Nursing		n	12 _{a,b}	85 _{a,b}	10 _b	8 _a	0 _{a,b}	115	
		%	4.0%	5.7%	7.9%	2.3%	0.0%	5.0%	

4.3. Impact on Graduate Students' Delayed Graduation

4.3.1. Overall Impact on Graduate Students' Delayed Graduation

The impact of response to COVID-19 on research productivity was measured by a single item asking respondents: Do you think that there is a possibility that the COVID-19 epidemics and its responses will delay your completion of your degree? (Question 2) The responses on a 5-point scale were categorized into two levels that pertain to the possibility of delays in completing a degree. These two levels are: 1) an almost negligible possibility of delay, with an expected probability of less than 20%; and 2) A low likelihood, with a probability of 20% or 3) a moderate likelihood, with a probability of 50%. 4) a high likelihood of delay, which has a probability of 80%, And 5) the expectation of being late or already being late, which has a probability of over 80%.

Table 5 shows the percentage of respondents who reported the possibility of delays in their research work due to the COVID-19 epidemic and response, categorized into five options: 35.6% (819) respondents reported that there was almost no possibility of delay, and 21.8% (502) respondents believed that there was a low possibility of delay. However, 22.9% (526) of respondents believed that

Table 5. The overall impact of the pandemic on the possibility of delayed graduation among graduate students.

Survey Items	n	%
1) There is almost no possibility of delay (expected to be less than 20%).	819	35.6%
2) There is a low possibility of delay (20%).	502	21.8%
3) There is half the possibility of delay (50%).	526	22.9%
4) There is a high possibility of delay (80%)	215	9.4%
5) Expected to be late or already late (more than 80%)	200	8.7%

there was a half possibility of delay during the epidemic, 9.4% (215) respondents believed that there was a high possibility of delay, and 8.7% (200) respondents that they would delay graduation or have already delayed.

4.3.2. Different Impacts on Graduate Students' Delayed Graduation Based on Their Demographic Characteristics

The Chi-Square Test was utilized to investigate the relationship between several demographics and the delayed graduation of interest. Based on **Table 6**, the research indicated that factors such as age ($p = 0.000$), level of academic study ($p = 0.003$), form of study program ($p = 0.000$), type of study program ($p = 0.007$), and enrollment year ($p = 0.000$) played a significant role in distinguishing the participants from one another. Nevertheless, gender ($p = 0.0828$) and academic discipline ($p = 0.050$) did not appear to have a substantial impact on the study's results.

Based on **Figure 1**, it appears that graduate students who are over 30 years old (>30 age group) hold a more pessimistic perspective regarding the effect of the epidemic on their ability to graduate compared to those who are between the ages of 21 and 30. In other words, the study suggests that older graduate students are more likely to view the pandemic as a potential obstacle to completing their degree. Specifically, the chart shows the percentage breakdown of the different age groups based on the different likelihoods of delayed graduation. The age groups included in the chart are <21 years, 21 - 25 years, 26 - 30 years, and >30 years. Based on **Figure 1**, the percentages for the different age groups appear to vary depending on the level of likelihood of delayed graduation. For example, at the "less than 20%" likelihood level, the highest percentages were found in the 21 - 25 and 26 - 30 age groups, at 36.6% and 36.5% respectively. However, at the "80%" level, the >30 age group had the highest percentage at 14.7%.

In **Figure 2**, the distribution of various categories is displayed based on different scenarios of delayed graduation levels. These categories encompass the level of study (Ph.D. & Master), form of study (full-time, part-time), and type of study (academic, professional). Notably, the proportion of each category varies depending on the specific possibility of delay in graduation. For instance, doctoral students were less likely to have a probability of delayed graduation of "less than 20%" and more likely to have a probability of "more than 80%" compared to Master's students. Full-time graduates were more likely to fall into the cate-

gory of “less than 20%” and less likely to have a probability of “80%” and “more than 80%” compared to part-time graduates. The delayed graduation’s probability of being in the category of “less than 20%” was higher for full-time graduates than for part-time graduates, while the delayed graduation’s probability of being in the category of “80%” and “above 80%” was lower. Academic graduate students are more likely to have a probability of “less than 20%” and less likely to have a probability of “more than 80%” compared to professional graduate students.

Table 6. Chi-square test of differences in delayed graduation among graduate students with different characteristics during the COVID-19 pandemic.

Variable	Chi-Square Test		
	Value	df	Asymptotic Significance (2-sided)
Gender	2.151 ^a	5	0.828
Age	46.408 ^a	15	0.000
Level	18.244 ^a	5	0.003
Form	55.090 ^a	5	0.000
Type	16.121 ^a	5	0.007
Enrollment Year	120.225 ^a	2	0.000
Discipline	31.442 ^a	20	0.050

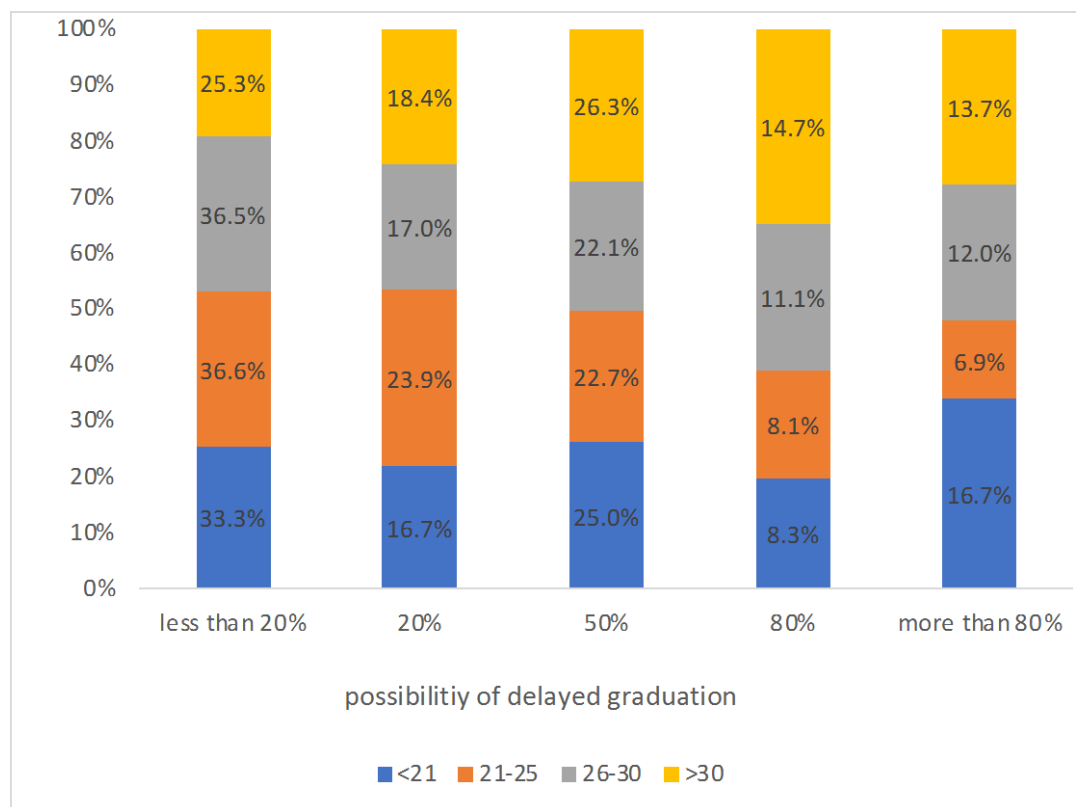


Figure 1. Attitudes toward delayed graduation by age subgroups.

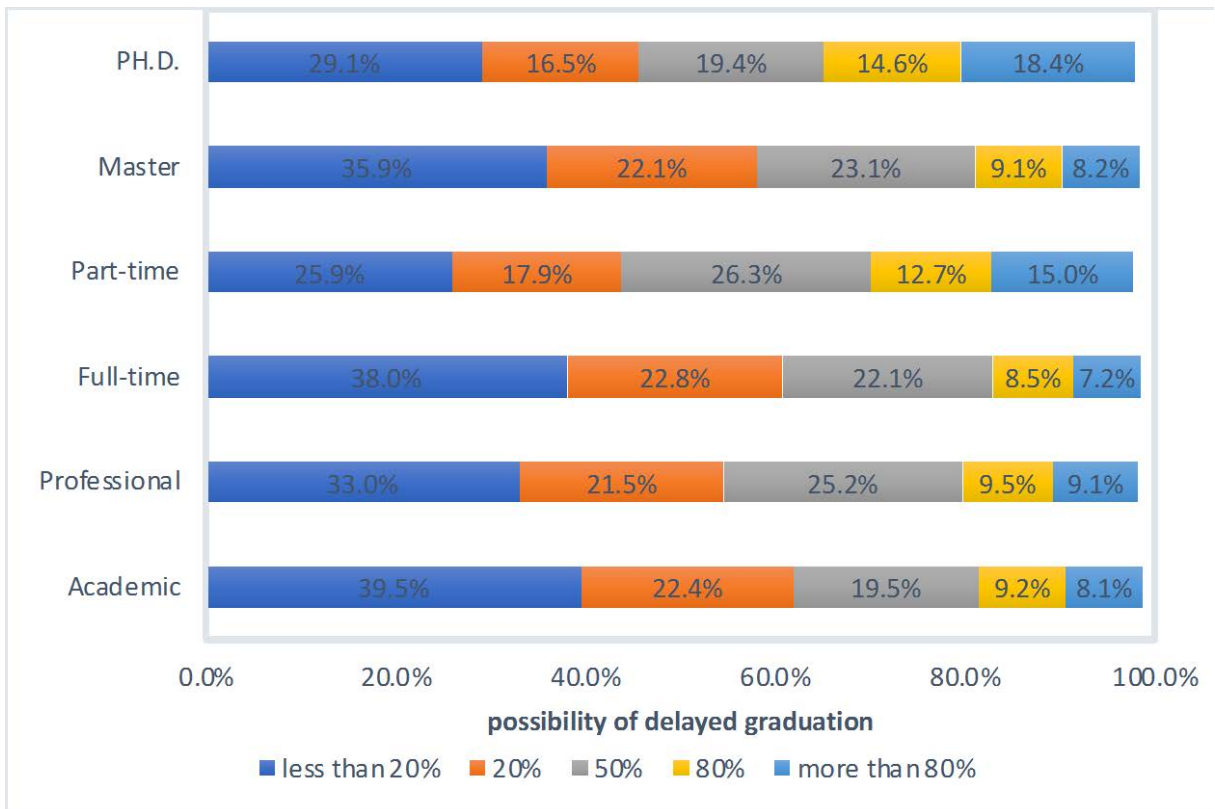


Figure 2. Attitudes toward delayed graduation by level, type, form of study among graduate students.

The study shows that Chinese graduate students who are pursuing a master's degree tend to be more positive about the impact of the epidemic on their graduation, compared to those who are pursuing a PhD. Moreover, full-time students seem to have a more favorable outlook on the pandemic's effect on their degree completion, unlike their part-time counterparts. The data suggests that full-time students have more faith in their capacity to handle academic challenges during a crisis. Additionally, based on the study, students who pursue academic programs are more likely to hold a positive outlook on the pandemic's effects on their graduation than those in professional programs.

Figure 3 shows the percentage breakdown of the probability of delayed graduation levels across different enrollment years. Graduate students who enrolled in 2017 and before, 2018, 2019, 2020, 2021 reveal substantial differences in the likelihood of delayed graduation. Specifically, those who enrolled in 2018, 2017 and before exhibited higher rates of delayed graduation, with over 80% and "more than 80%" being the most frequent categories. In contrast, those who enrolled in 2019, 2020 and 2021 showed higher proportions in the "less than 20%" category. Based on **Figure 3**, it appears that students who enrolled in 2019 generally exhibit a more positive attitude towards completing their graduate degree during the epidemic. More specifically, third-year master's and PhD students seem to display greater confidence in successfully graduating amidst the epidemic.

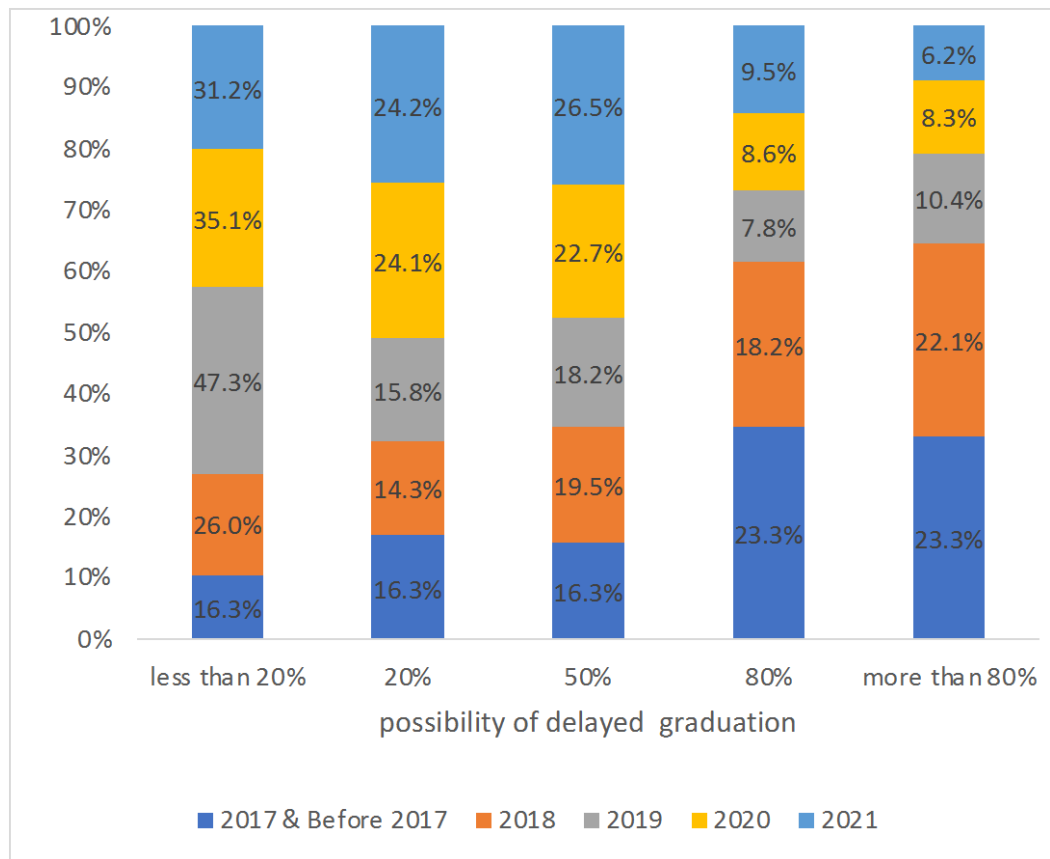


Figure 3. Attitudes toward delayed graduation by enrollment year subgroup.

4.4. Changes in Research Engagement Time during the COVID-19 Epidemics

This section explores how the COVID-19 pandemic affected the time students spent participating in research. Specifically, it examines whether engagement time decreased or increased due to the pandemic. The corresponding questionnaire questions in this study were designed as follows: Assuming that there were no COVID-19 epidemics and their responses, students’ research time would be 0. How much is your research time as an integral number with current COVID-19 epidemics and their response? (Question 3) If your research time decreases due to an increase in administrative work related to the COVID-19 epidemics and their responses, the number will decrease. On the other hand, if your research time increases due to a reduction in commuting time or online efficiency, the number will increase. The 11-point response was then reversely grouped into three levels to operationalize research time change (research time decreases 10%, 20%, 30%, 50%, more than 80%; Not change = 0; research time increases 10%, 20%, 30%, 50%, more than 80%.)

It appears that the COVID-19 pandemic has had a significant impact on the research engagement time of many researchers. According to **Figure 4**, the majority of respondents (34.1%) reported no change in their research work hours, but a large group (one-third) reported a reduction of 10% or more. However,

there were still some who were able to maintain or even increase their research productivity despite the challenges posed by the pandemic. Specifically, 28 respondents (1.2%) reported an 80% or greater reduction in their research time, while 66 (2.9%), 123 (5.4%), 245 (10.7%) and 288 (12.5%) reported reductions of 50%, 30%, 20% and 10% respectively. A total of 783 respondents (34.1%) reported no change in their study time. On the other hand, some respondents indicated that their research time had increased, with 267 (11.6%), 208 (9.1%), 157 (6.8%) and 97 (4.2%) indicating increases of 10%, 20%, 30% and 50% respectively. Thirty-six respondents (1.6%) indicated that their research time had increased by 80% or more.

The results (Table 7) showed that there was no notable distinction based on age, level and form of study, type of study, year of enrollment, or discipline, the results are not statistically significant, suggesting that these variables are not significantly associated with the outcome.

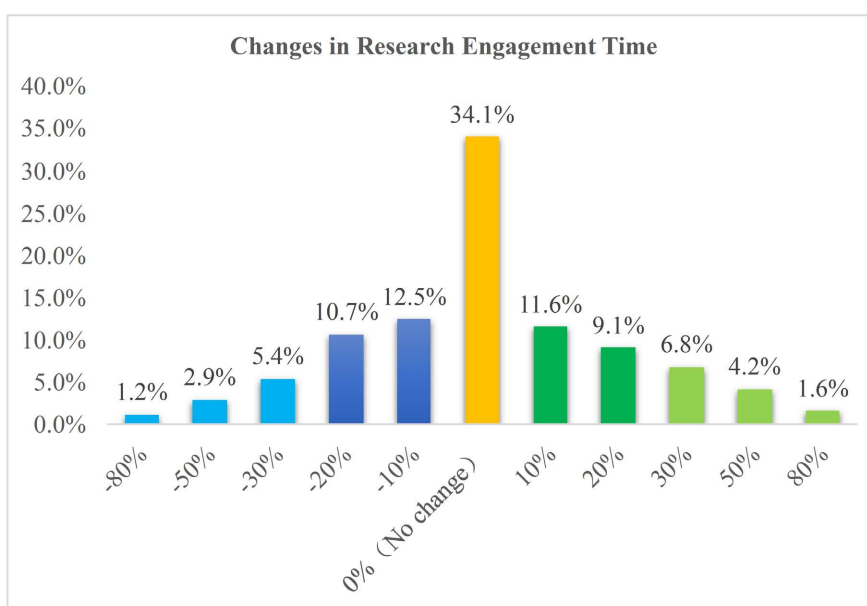


Figure 4. Changes in research engagement time during the COVID-19 epidemics.

Table 7. Chi-square test of differences in research time change among graduate students with different characteristics during the COVID-19 pandemic.

Variable	Chi-Square Test		
	Value	df	Asymptotic Significance (2-sided)
Gender	12.052 ^a	10	0.282
Age	27.939 ^a	30	0.574
Level	15.754 ^a	10	0.107
Form	5.618 ^a	10	0.846
Type	5.019 ^a	10	0.890
Enrollment Year	53.742 ^a	40	0.072
Discipline	52.868 ^a	40	0.084

4.5. Changes in Research Output during the COVID-19 Epidemics

To evaluate how the COVID-19 epidemic has impacted students' research output, as perceived by them, this study structured the questionnaire assuming that their research output would have been zero in the absence of the epidemic. How much is your research output as an integral number with current COVID-19 epidemics and their response? (Question 4) Based on this, knowing the current integral value of the research output during the COVID-19 epidemic and its response. Please note that if students' research output has decreased related to the epidemic, the value will decrease accordingly. Conversely, if the research time has increased due to improved online efficiency or reduced commuting time, the number will reflect an increase accordingly. To operationalize research time change, the 11-point response scale was grouped into three levels by reversing the scale and categorizing the responses as follows: research time decreases by 10%, 20%, 30%, 50%, more than 80%; no change in research time = 0; research time increases by 10%, 20%, 30%, 50%, more than 80%.

According to the survey results (**Figure 5**), the majority of respondents (38.3%) reported no change in their research output, while more than one-third experienced a decrease of 10% or more. However, there are still some who have been able to maintain or even increase their research productivity despite the challenges posed by the pandemic. Of the respondents, 21 individuals (0.90%) reported a decrease in research output by 80% or more, while 71 (3.10%), 116 (5.00%), 255 (11.10%), and 348 (15.10%) reported decreases of 50%, 30%, 20%, and 10%, respectively. A total of 880 respondents (38.30%) reported no change in their research output. On the other hand, some individuals reported an increase in their research output, with 267 (11.60%), 169 (7.40%), 92 (4.00%), and 53 (2.30%) reporting increases of 10%, 20%, 30%, and 50%, respectively. A smaller group of 26 respondents (1.10%) reported an increase in research output by 80% or more. These results suggest that the COVID-19 pandemic has had a mixed impact on research output, with some individuals experiencing significant reductions while others have seen increases.

Based on **Table 8**, we found that there was no notable variation based on demographic factors, such as gender, age, level and form of study, type of study, and enrollment year among others ($p > 0.05$). However, there was a noticeable difference depending on the discipline of the individuals being studied ($p < 0.05$), this suggests that there is a meaningful relationship between these two variables and the research output change being measured. **Table 8** and **Figure 6** indicate that there are statistical differences between various disciplines of study.

Figure 6 indicates that there are statistical differences between various fields of study. For instance, there are significant variations between humanities and natural sciences/medicine, as well as between social sciences and natural sciences/engineering/medicine. Additionally, there are significant differences between natural sciences and engineering/medicine, and between engineering and medicine.

The chart displays the distribution of disciplines (academic fields) in different

levels of research output changes. It includes humanities & arts, social sciences, natural sciences, engineering, and medicine & nursing. Among them, medicine & nursing had the highest percentage change in research output (25.2%) with a 10% decrease. Engineering had a 16.2% share in the same category, compared with 15.5% for humanities & arts and 13% for social sciences. In addition, natural sciences had the largest share (19.5%) of a 20% decrease in research output. In contrast, among the options with a 10% increase in research output, social sciences accounted for 13.3%, whereas natural sciences and humanities shared the same percentage of 11.7%, and engineering and medicine also had the same percentage of 10.4%. As for the category with a 20% increase in research output, engineering had a higher proportion (7.2%), and social sciences were also represented in the same category (8.6%). Overall, the chart reveals that the percentage distribution of research output changes differs across academic disciplines.

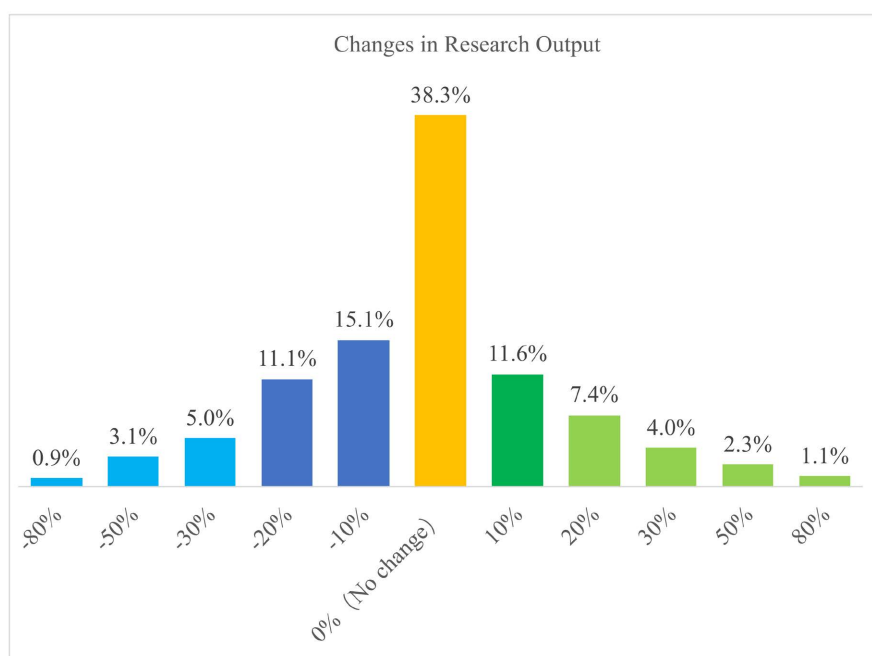


Figure 5. Changes in research output during the COVID-19 epidemic.

Table 8. Chi-square test of differences in research output change among graduate students with different characteristics during the COVID-19 pandemic.

Variable	Chi-Square Test		
	Value	df	Asymptotic Significance (2-sided)
Gender	9.136 ^a	10	0.519
Age	30.678 ^a	30	0.431
Level	15.754 ^a	10	0.107
Form	8.701 ^a	10	0.561
Type	10.463 ^a	10	0.401
Enrollment Year	54.150 ^a	40	0.067
Discipline	70.529 ^a	40	0.002

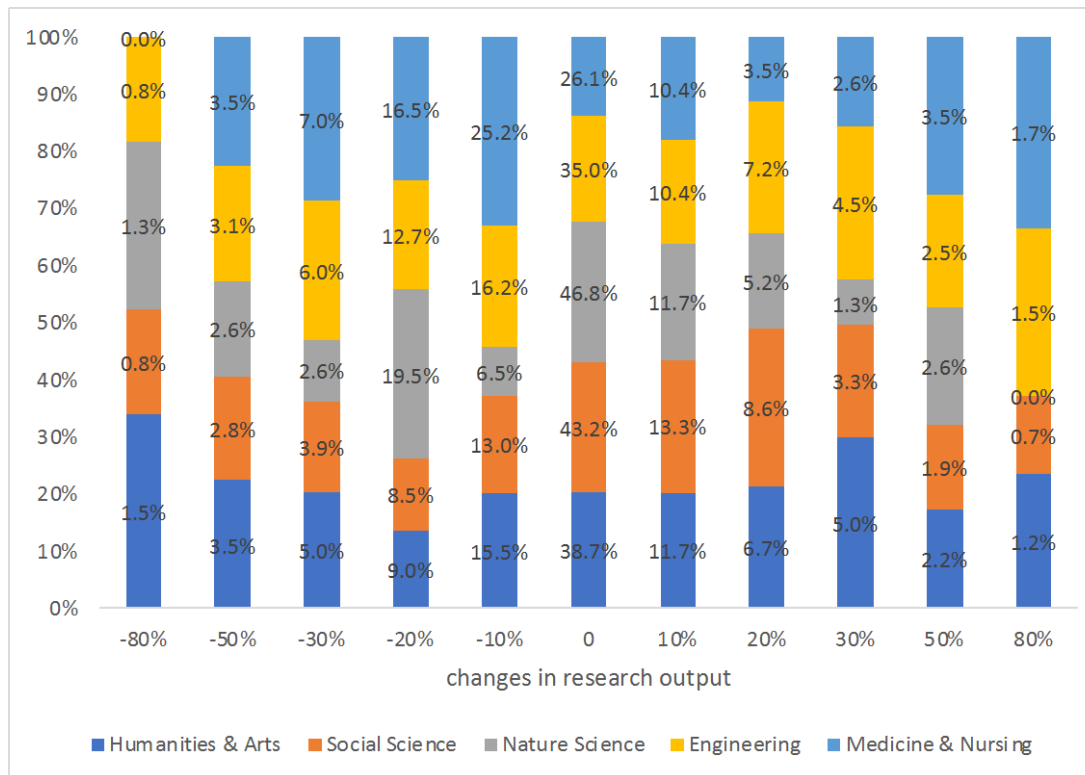


Figure 6. Changes in research output based on different disciplines among graduate students.

5. Discussion

The aim of the present research is to investigate how the pandemic has affected research productivity and delayed the graduation of graduate students in China. Based on the above data and analysis, regarding the response to R.Q.1 and Null Hypothesis 1, the first null hypothesis was rejected. Specifically, the first null hypothesis was rejected, which means that there was an association between COVID-19 and at least one of the variables being studied (students' perceptions of research productivity, delayed graduation, research engagement time, and research output). And the response of this study to R.Q.2 and hypothesis 2 is as follows: the null hypothesis 2 was rejected, it would mean that there were significant variations in students' perceptions of research productivity, delayed graduation, research engagement time, and research output based on their demographic information, which includes gender, age, level of the study program, form and type of study, year of enrollment, and discipline affiliation. In other words, there were differences among the demographic groups being studied, and these differences may be important for understanding the factors that influence students' research experiences and outcomes.

5.1. Varying Experiences and Challenges Faced by Researchers during the COVID-19 Pandemic: A Mix of Positive and Negative Effects

In summary, the COVID-19 pandemic has had a significant impact on the re-

search productivity of the majority of researchers, with negative effects being the norm. However, amidst this adversity, there have been instances of resilience, adaptability, and even unexpected positive outcomes among a subset of researchers. These findings offer a nuanced and comprehensive understanding of the diverse range of experiences and challenges encountered by researchers during this challenging time.

Furthermore, **Table 5** reveals a range of opinions among researchers regarding the likelihood of delays in their work due to the pandemic. Some researchers remain optimistic, while others have expressed concerns and anticipated challenges in maintaining their research momentum.

These findings highlight the mixed impact of the pandemic on researchers' engagement time. Some researchers have experienced significant reductions, while others have demonstrated resilience and even achieved increased research activity.

In conclusion, the impact of the COVID-19 pandemic on research output has been complex, with varying degrees of both negative and positive effects observed across the population of researchers. A significant number of researchers have observed a decline in their scientific output as a result of the pandemic (Myers et al., 2020; Gao et al., 2021; Riccaboni & Verginer 2022). Nevertheless, it is encouraging to note that a few have been successful in sustaining or even enhancing their research productivity despite the challenging circumstances. These results are in line with those of previous studies (Mirahmadizadeh et al., 2020; Fioretti et al., 2020). The results of their study showed that students' sentiments toward school and education were satisfactory during school and institutional closures, and they indicated that students show enthusiasm for learning and school, despite the imposed circumstances. Fioretti et al. (2020) investigated students' positive and negative experiences related to COVID-19, they found that the negative experiences include "Staying at home is a limitation to autonomy" "school is an educational environment, not a relational one" "the impact of new life routines" and "experiencing pain and loss". And the positive experiences, such as "being part of an extraordinary experience", "discovering oneself", "rediscovering family" and "sharing the distance of life".

5.2. Gender-Based Differences in Impacts

The present study has shown that there are different impacts on graduate students' research productivity based on their gender. In contrast to previous research, our study reveals that female graduate students generally exhibit more positive attitudes towards the effects of epidemics on research productivity than male graduate students. Research on past outbreaks, such as COVID-19, suggests that women and girls may experience unique challenges (Viglione, 2020; Vincent-Lamarre et al., 2020; Myers et al., 2020), and in certain regions, may face more adverse effects than men (Riccaboni & Verginer 2022; Correia et al., 2022; Idris et al., 2023). It is important to note that gender-based differences in impacts are not just limited to graduate students. This can also be observed in

other populations and industries. There may be further evidence that the research productivity for women will be reduced by the pandemic, and female academics have fewer research projects than their male peers (Pinho-Gomes et al., 2020; Giurge et al., 2021; Cui et al., 2021; Deryugina et al., 2021; Ginther et al., 2011).

The study found that women tend to be more adaptable and resilient during times of crisis, which could be attributed to their ability to multitask and prioritize effectively. On the other hand, men may struggle more with balancing work and personal life during such times, which could result in decreased productivity. These findings highlight the importance of considering gender when developing policies and strategies for responding to epidemics or other crises.

5.3. Level of Study Program-Based Differences in Impacts

The impact of epidemics on master's and doctoral students is different. The current study found that master's students tend to have a more positive outlook towards the impact of epidemics on various aspects of their academic pursuits than doctoral students. Regarding research productivity, master's students were found to be more optimistic compared to doctoral students. This finding is interesting and may reflect differences in the type of research pursued by master's versus doctoral students, as master's students may be engaged in more coursework and less research than their counterparts. Finally, master's students were also found to have a more positive attitude towards completing their degree despite the challenges posed by epidemics. This may reflect the fact that master's programs are generally shorter in duration than doctoral programs, and thus students may be more motivated to complete their degree in a timely manner.

The previous studies showing the precarious relationship between PhD students and supervisors during the early years of the COVID-19 pandemic and the substantial impact on the successful completion of PhD research and the well-being of PhD students are further highlighted by numerous review and editorial articles exposing the difficulties experienced by PhD students as a result of the pandemic: delayed experiments, missed schedules, depleted funding, changes to online team and supervisor meetings, mandatory work at home, social confinement, and blocked international collaborations (Chan et al., 2020; Cheng & Song 2020; Paula, 2020; Elias et al., 2021).

Overall, these findings provide valuable insights into how different types of graduate students are affected by epidemics and how they respond to such challenges. Future research could delve deeper into the reasons behind these differences and offer more nuanced explanations for the varied impacts of epidemics on different levels of graduate study.

5.4. Type & Form of Study Program-Based Differences in Impacts

Firstly, part-time students tend to have a more favorable view of the influence of epidemics on research productivity than full-time students, while full-time students are more positive about the effect of epidemics on graduation completion

than part-time students. It is interesting to note that part-time students hold a more favorable view towards the influence of epidemics on research productivity compared to full-time students. This may be due to the fact that part-time students are often managing other responsibilities such as work or family, which could make them more adaptable and better equipped to handle disruptions to their research schedules. On the other hand, full-time students may be more focused on finishing their degree requirements and may see epidemics as a hindrance to that goal. It is also not surprising that full-time students are more positive about the effect of epidemics on graduation completion than part-time students, as completing a degree within a set time frame is often a priority for them. These findings suggest that the impact of epidemics on student productivity and completion rates is not uniform, and can vary depending on individual circumstances.

Secondly, there is a difference in attitudes towards the impact of epidemics on research productivity and completion of graduation between professional students and academic students. Specifically, professional students tend to hold more positive attitudes towards the impact of epidemics on research productivity, while academic students tend to hold more positive attitudes towards the impact of epidemics on the completion of graduation. This difference in attitude could be related to the fact that professional students may have more experience in dealing with disruptions in their work, while academic students may be more focused on the impact of the epidemic on their academic progress. Additionally, the nature of the work itself may differ between the two groups, with professionals potentially being able to continue with research remotely while academic students may face more challenges with access to resources and completing coursework. Overall, it is important to understand these differences in attitudes and how they may impact each group's ability to navigate through the challenges presented by epidemics.

5.5. Different Disciplines Are Affected Differently

The current study confirms that the impact of the epidemic on research productivity varies across different disciplines. As previous research has also indicated, we found that there are significant differences in the effect of the epidemic on research productivity in different fields of study (Mossa-Basha et al., 2022; Myers et al., 2020). Specifically, the analysis revealed that research in humanities, social sciences, and medicine has been more adversely affected than research in engineering and natural sciences. While researchers in the latter fields have also faced challenges from the epidemic, the negative impact has been comparatively less severe.

This difference in impact can be attributed to several factors, including the nature of research in different disciplines, the availability of remote working or other alternatives, and the level of government or institutional support provided to researchers. Some studies discussed the various impacts of the pandemic on scientific research and researchers, including funding availability, adaptability to

remote work, and changes in priorities and research topics (Azoulay et al., 2020; Kwon, D, 2020; Pinho-Gomes et al., 2020). Future studies may explore these factors in greater detail to gain a more nuanced understanding of how epidemics can affect different fields of study.

6. Conclusions

In this study, we explored the impact of the pandemic on research productivity and delayed graduation of graduate students in China. The findings showed that there were significant differences in the students' perceptions of research productivity, and delayed graduation based on their demographic information. Moreover, the majority of researchers have reported a decrease in their scientific output due to the pandemic. However, it is encouraging to note that a few have been able to maintain or even increase their research productivity in these challenging times. Understanding these demographic differences in research productivity can help universities and research institutions tailor their support and resources to better meet the needs of different groups of students. Additionally, addressing the underlying factors (Tunzelmann et al. 2003; Kwon et al., 2015; Aulawi, 2021; Bukko & Dhesi, 2021) that contribute to disparities in research productivity can promote greater equity in graduate education and research.

Based on the findings of the study, this study recommends the development of a comprehensive support system for graduate students and researchers to mitigate the adverse effects of the pandemic on their research productivity. This system should focus on providing adequate resources, such as research grants, access to virtual collaborations, and training on effective teleworking methods, for which similar policy recommendations have been made in other studies (Myers et al., 2020; Chavez Villegas et al., 2021). In addition, ongoing support from mentors and academic advisors would be beneficial in helping students and researchers address the challenges posed by the pandemic. In addition, a platform for regular communication and information sharing between students and researchers is desirable to foster a sense of community and to provide a forum for discussing research-related issues. Overall, the implementation of a strong support system will allow graduate students and researchers to maintain their productivity and engagement in research activities during a pandemic. Graduate students have access to support services that provide specific resources and assistance to help them manage their studies and lives during this challenging time. Unlike previous studies, this study specifically suggests that more attention could be given to male, full-time students when providing material and emotional support to graduate students. Specific support is also provided to graduate students in the humanities and social sciences to help them succeed in their studies.

With regard to limitations of the study, it is important to note that the sample used in this study was limited to graduate students in a particular geographic region. Future research could benefit from expanding the sample to include students from a wider range of backgrounds and cultures. It would be interesting to

explore the reasons behind these differing attitudes and to consider how they may impact research productivity in the long term. Understanding these differences can help researchers and policymakers develop strategies and interventions to support and promote research productivity during times of epidemics. In addition, comparative studies in other countries and regions could provide valuable insights into the impact of cultural and environmental factors on the outcomes of similar studies. Further research is therefore recommended to address these limitations and to build upon the findings of this study.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

References

- Ahmed, I., & Ishtiaq, S. (2021). Reliability and Validity: Importance in Medical Research. *JPMMA. The Journal of the Pakistan Medical Association*, 71, 2401-2406.
- Aulawi, H. (2021). The Impact of Knowledge Sharing towards Higher Education Performance in. Research Productivity. *International Journal of Socio technology and Knowledge Development (IJSKD)*, 13, 121-132. <https://doi.org/10.4018/IJSKD.2021010109>
- Aydemir, D., & Ulus, N. N. (2020). Identifying and Solving Scientific Problems in the Medicine: Key to Become a Competent Scientist. *Turkish Journal of Biochemistry*, 45, 225-227. <https://doi.org/10.1515/tjb-2018-0357>
- Azoulay, P., Jones, B. F., & Zivin, J. S. (2020). Covid-19 and the Future of US Industry. *Proceedings of the National Academy of Sciences*, 117, 29817-29824.
- Belavy, D. L., Owen, P. J., & Livingston, P. M. (2020). Do Successful a PhD Outcomes Reflect the Research Environment Rather than Academic Ability? *PLOS ONE*, 15, e0236327. <https://doi.org/10.1371/journal.pone.0236327>
- Bukko, D., & Dhesi, J. (2021). Doctoral Students Living, Leading, and Learning during a Pandemic. *Impacting Education: Journal on Transforming Professional Practice*, 6, 25-33. <https://doi.org/10.5195/ie.2021.167>
- Cao, W., Fang, Z., Hou, G., Han, M., Xu, X., Dong, J., & Zheng, J. (2020). The Psychological Impact of the COVID-19 Epidemic on College Students in China. *Psychiatry Research*, 287, Article ID: 112934. <https://doi.org/10.1016/j.psychres.2020.112934>
- Chan, C., Oey, N. E., & Tan, E. K. (2020). Mental Health of Scientists in the Time of COVID-19. *Brain, Behavior, and Immunity*, 88, 956. <https://doi.org/10.1016/j.bbi.2020.05.039>
- Chavez Villegas, C., Peirola, S., Rocca, M., Ipince, A., & Bakrania, S. (2021). Impacts of Health-Related School Closures on Child Protection Outcomes: A Review of Evidence from Past Pandemics and Epidemics and Lessons Learned for COVID-19. *International Journal of Educational Development*, 84, Article ID: 102431. <https://doi.org/10.1016/j.ijedudev.2021.102431>
- Cheng, C., & Song, S. (2020). How Early-Career Researchers Are Navigating the COVID-19 Pandemic. *Molecular Plant*, 13, 1229-1230. <https://doi.org/10.1016/j.molp.2020.07.018>
- Correia, K. M., Bierma, S. R., Houston, S. D., Nelson, M. T., Pannu, K. S., Tirman, C. M., Cannon, R. L., Clance, L. R., Canterbury, D. N., Google, A. N., Morrison, B. H., & Henning, J. A. (2022). Education Racial and Gender Disparities in COVID-19 Worry,

- Stress, and Food Insecurities across Undergraduate Biology Students at a Southeastern University. *Journal of Microbiology & Biology Education*, 23, e00224-21. <https://doi.org/10.1128/jmbe.00224-21>
- Cui, R., Ding, H., & Zhu, F. (2021). Gender Inequality in Research Productivity during the COVID-19 Pandemic. *Manufacturing & Service Operations Management*, 24, 707-726. <https://doi.org/10.1287/msom.2021.0991>
- Daud, S., Wan Hanafi, W. N., Wan Abdullah, W. M. T., Ahmad, N. N., & Toolib, S. N. (2020). Applying Health Belief Model in Assessing Malaysian Graduate's Emotional Wellness Post COVID-19 Outbreak: A Conceptual Paper. *Global Business and Management Research: An International Journal*, 12, 580-588.
- Deryugina, T., Shurchkov, O., & Stearns, J. (2021). *COVID-19 Disruptions Disproportionately Affect Female Academics*. <https://doi.org/10.3386/w28360>
- Elias, S. (2021). Cultivating Mentorship, Cooperation, and Community during COVID-19 and beyond. *Cell Stem Cell*, 28, 802-804. <https://doi.org/10.1016/j.stem.2021.04.016>
- Fioretti, C., Palladino, B. E., Nocentini, A., & Menesini, E. (2020). Positive and Negative Experiences of Living in COVID-19 Pandemic: Analysis of Italian Adolescents' Narratives. *Frontiers in Psychology*, 11, Article ID: 599531. <https://doi.org/10.3389/fpsyg.2020.599531>
- Forchette, L., Sebastian, W., & Liu, T. (2021). A Comprehensive Review of COVID-19 Virology, Vaccines, Variants, and Therapeutics. *Current Medical Science*, 41, 1037-1051. <https://doi.org/10.1007/s11596-021-2395-1>
- Forero, D. A., & Moore, J. H. (2016). Considerations for Higher Efficiency and Productivity in Research Activities. *BioData Mining*, 9, Article No. 35. <https://doi.org/10.1186/s13040-016-0115-3>
- Gao, J., Yin, Y., Myers, K. R., Lakhani, K. R., & Wang, D. (2021). Potentially Long-Lasting Effects of the Pandemic on Scientists. *Nature Communications*, 12, Article No. 6188. <https://doi.org/10.1038/s41467-021-26428-z>
- Ginther, D. K., Schaffer, W. T., Schnell, J., Masimore, B., Liu, F., Haak, L. L., & Kington, R. (2011). Race, Ethnicity, and NIH Research Awards. *Science*, 333, 1015-1019. <https://doi.org/10.1126/science.1196783>
- Giurge, L. M., Whillans, A. V., & Yemiscigil, A. (2021). A Multicountry Perspective on Gender Differences in Time Use during COVID-19. *Proceedings of the National Academy of Sciences of the United States of America*, 118, e2018494118. <https://doi.org/10.1073/pnas.2018494118>
- Goble, M., Whitfield, A., Ogden-Newton, J., & Vivekananda-Schmidt, P. (2022). Curricular Changes and Interim Posts during Covid-19: Graduates' Perspectives. *BMC Medical Education*, 22, Article No. 413. <https://doi.org/10.1186/s12909-022-03477-6>
- Goldstone, R., & Zhang, J. (2022). Postgraduate Research Students' Experiences of the COVID-19 Pandemic and Student-Led Policy Solutions. *Educational Review*, 74, 422-443. <https://doi.org/10.1080/00131911.2021.1974348>
- Gupta, A., Haritha, D., Ramachandran, R., Subramaniam, R., Sai, G. M., Chikoti, G., Gupta, N., Malhotra, R. K., Kaloiya, G. S., & Trikha, A. (2022). Nationwide Impact of COVID-19 Pandemic on Postgraduate Medical Teaching, Research, and Mental Stress: A Cross-Sectional Online Questionnaire-Based Survey. *Journal of Anesthesiology, Clinical Pharmacology*, 38, S34-S45. https://doi.org/10.4103/joacp.JOACP_673_20
- Idris, M., Alkhawaja, L., & Ibrahim, H. (2023). Gender Disparities among Students at Jordanian Universities during COVID-19. *International Journal of Educational Development*, 99, Article ID: 102776. <https://doi.org/10.1016/j.ijedudev.2023.102776>

- Kwon, D. (2020). Science Careers Hit Hard by COVID-19. *Nature*, *581*, 345. <https://doi.org/10.1038/d41586-020-01394-6>
- Kwon, K. S., Kim, S. H., Park, T. S. et al. (2015). The Impact of Graduate Students on Research Productivity in Korea. *Journal of Open Innovation: Technology, Market, and Complexity*, *1*, 1-11. <https://doi.org/10.1186/s40852-015-0024-6>
- Luo, W., Zhong, B., & Chiu, H. (2021). Prevalence of Depressive Symptoms among Chinese University Students amid the COVID-19 Pandemic: A Systematic Review and Meta-Analysis. *Epidemiology and Psychiatric Sciences*, *30*, E31. <https://doi.org/10.1017/S2045796021000202>
- Malisch, J. L., Harris, B. N., Sherrer, S. M., Lewis, K. A., Shepherd, S. L., McCarthy, P. C., Spott, J. L., Karam, E. P., Moustaid-Moussa, N., McCrory Calarco, J., Ramalingam, L., Talley, A. E., Cañas-Carrell, J. E., Ardon-Dryer, K., Weiser, D. A., Bernal, X. E., & Deitloff, J. (2020). Opinion: In the Wake of COVID-19, Academia Needs New Solutions to Ensure Gender Equity. *PNAS*, *117*, 15378-15381. <https://doi.org/10.1073/pnas.2010636117>
- McGaughey, F., Watermeyer, R., Shankar, K., Suri, V. R., Knight, C., Crick, T., Hardman, J., Phelan, D., & Chung, R. (2021). “This Can’t Be the New Norm”: Academics’ Perspectives on the COVID-19 Crisis for the Australian University Sector. *Higher Education Research & Development*, *41*, 2231-2246. <https://doi.org/10.1080/07294360.2021.1973384>
- Mirahmadizadeh, A., Ranjbar, K., Shahriarirad, R. et al. (2020). Evaluation of Students’ Attitude and Emotions towards the Sudden Closure of Schools during the COVID-19 Pandemic: A Cross-Sectional Study. *BMC Psychiatry*, *8*, Article No. 134. <https://doi.org/10.1186/s40359-020-00500-7>
- Mossa-Basha, M., Krupinski, E. A., Filippi, C. G., Sharpe, R. E., & Giger, M. (2022). Report from the RSNA COVID-19 Task Force: COVID-19 Impact on Academic Radiology Research—A Survey of Vice Chairs of Research. *Journal of the American College of Radiology: JACR*, *19*, 304-309. <https://doi.org/10.1016/j.jacr.2021.10.017>
- Myers, K. R., Tham, W. Y., Yin, Y., Cohodes, N., Thursby, J. G., Thursby, M. C., Schiffer, P., Walsh, J. T., Lakhani, K. R., & Wang, D. (2020). Unequal Effects of the COVID-19 Pandemic on Scientists. *Nature Human Behaviour*, *4*, 880-883. <https://doi.org/10.1038/s41562-020-0921-y>
- Oliveira, A. A. de, Silva, L. A. B. da, Nelson Filho, P., Puccinelli, C. M., Silva, C. M. P. C., & Segato, R. A. B. (2022). The Psychological Impact of Social Distancing Related to the Covid-19 Pandemic on Undergraduate and Graduate Students in Brazil. *Brazilian Journal of Oral Sciences*, *21*, e226698. <https://doi.org/10.20396/bjos.v21i00.8666698>
- Onyeaka, H., Anumudu, C. K., Al-Sharify, Z. T., Egele-Godswill, E., & Mbaegbu, P. (2021). COVID-19 Pandemic: A Review of the Global Lockdown and Its Far-Reaching Effects. *Science Progress*, *104*, 1-18. <https://doi.org/10.1177/00368504211019854>
- Paula, J. R. (2020). Lockdowns Due to COVID-19 Threaten PhD Students’ and Early-Career Researchers’ Careers. *Nature Ecology & Evolution*, *4*, 999. <https://doi.org/10.1038/s41559-020-1231-5>
- Pinho-Gomes, A. C., Petersen, I., Johnson, A. M., & Phillips, A. N. (2020). Unintended Consequences of Social Distancing Policies on Young Adults’ Mental Health. *The Lancet Psychiatry*, *7*, 731-732
- Pyhältö, K., Tikkanen, L., & Anttila, H. (2022). The Influence of the COVID-19 Pandemic on PhD Candidates’ Study Progress and Study Wellbeing. *Higher Education Research & Development*, *42*, 413-426. <https://doi.org/10.1080/07294360.2022.2063816>
- Riccaboni, M., & Verginer, L. (2022). The Impact of the COVID-19 Pandemic on Scien-

- tific Research in the Life Sciences. *PLOS ONE*, 17, e0263001. <https://doi.org/10.1371/journal.pone.0263001>
- Smith, J., & Johnson, L. (2019). Discipline-Specific Impacts of the COVID-19 Pandemic on Research and Academic Activities. *Higher Education Research and Development*, 38, 949-961.
- Su, B., Zhang, T., Yan, L., Huang, C., Cheng, X., Cai, C., & Cui, D. (2021). Online Medical Teaching in China during the COVID-19 Pandemic: Tools, Modalities, and Challenges. *Frontiers in Public Health*, 9, Article ID: 797694. <https://doi.org/10.3389/fpubh.2021.797694>
- Tang, Y. M., Chen, P. C., Law, K. M. Y., Wu, C. H., Lau, Y.-Y., Guan, J., & Ho, G. T. S. (2021). Comparative Analysis of Student's Live Online Learning Readiness during the Coronavirus (COVID-19) Pandemic in the Higher Education Sector. *Computers & Education*, 168, Article ID: 104211. <https://doi.org/10.1016/j.compedu.2021.104211>
- Tunzelmann, N. V., Ranga, M., Martin, B. R., & Geuna, A. (2003). *The Effects of Size on Research Performance: A SPRU Review*.
- UNESCO (2021). *School Closures and Regional Policies to Mitigate Learning Loss Due to COVID-19: A Focus on the Asia-Pacific*. http://uis.unesco.org/sites/default/files/documents/school_closures_and_regional_policies_to_mitigate_learning_losses_in_asia_pacific.pdf
- UNESCO (2022). *UNESCO Responds to the Global Crisis in Education Due to COVID-19*. <https://www.unesco.org/en/articles/unesco-responds-global-crisis-education-due-covid-19>
- Viglione, G. (2020). Are Women Publishing Less during the Pandemic? Here's What the Data Say. *Nature*, 581, 365-366. <https://doi.org/10.1038/d41586-020-01294-9>
- Vincent-Lamarre, P., Sugimoto, C. R., & Larivière, V. (2020). *The Decline of Women's Research Production during the Coronavirus Pandemic*. Nature Index. <https://www.natureindex.com/news-blog/decline-women-scientist-research-publishing-production-coronavirus-pandemic>
- Wang, J., Liang, Z., Zhang, M., Kang, D., & Zeng, Q. (2022). Effects of the COVID-19 Pandemic on Chinese Graduate Students' Learning Activities: A Latent Class Analysis. *Frontiers in Psychology*, 13, Article ID: 877106. <https://doi.org/10.3389/fpsyg.2022.877106>
- Zeng, Q., Liang, Z., Zhang, M., Xia, Y., Li, J., Kang, D., Yi, D., & Wang, J. (2021). Impact of Academic Support on Anxiety and Depression of Chinese Graduate Students during the COVID-19 Pandemic: Mediating Role of Academic Performance. *Psychology Research and Behavior Management*, 14, 2209-2219. <https://doi.org/10.2147/PRBM.S345021>
- Zhou, M., & Mou, H. (2022). Tracking Public Opinion about Online Education over COVID-19 in China. *Educational Technology Research and Development: ETR & D*, 70, 1083-1104. <https://doi.org/10.1007/s11423-022-10080-5>