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A Project entitled

Compare in-service and pre-service teachers' experience on and the challenges faced by using online teaching during the Covid-19 pandemic

Submitted by

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Declaration

I, Hung Ka Wai, declare that this research is fully conducted by my own under the supervision of Dr Chan Wing Sum, the Senior Lecturer II at The Education University of Hong Kong. The research report has not submitted previously in any one of the tertiary institutions.

Signature

11th April 2023

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1 Abstract

At the onset of the COVID-19 crisis, many countries enforced population lockdowns, which compelled teachers to adapt to remote teaching quickly and without adequate preparation. This article investigates the online teaching experiences and challenges that pre-service and in-service teachers would encounter during the pandemic. The research involved an online survey and a semi-structured interview. The data presented in this article were derived from questionnaire responses by 62 teachers (including 28 in-service and 34 pre-service teachers) and interviews with 6 teachers (including 3 in-service teachers and 3 pre-service teachers). Thematic data analysis focused on tackling the thesis of this article. The survey results indicate that both teachers encountered similar challenges in online teaching, such as difficulties in assessing learning progress and interacting with students during the lesson. However, they have different experiences. For example, pre-service teachers feel stressed under supervision, whereas in-service teachers are busy with extra administrative work in the teaching process.

2 Acknowledgment

I would like to express my sincere gratitude to my supervisor, Dr. Chan Wing Sum, the Senior Lecturer II of the Department of Mathematics and Information Technology at the Education University of Hong Kong. The honors project would not have been accomplished without her guidance and support.

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3 Introduction

This study aims to compare the difficulties faced by in-service and pre-service mathematics teachers conducting online teaching during the Covid-19 pandemic and to identify similarities and differences in the challenges and experiences of the two groups.

Covid-19 has been affecting the world for years, to prevent it from further spreading, different countries have implemented various prevention measures that have altered people's daily lives. As a result, the education sector has also been affected, with schools forced to switch from face-to-face to online teaching. This sudden shift differed from previous epidemics, such as SARS and H1N1. Since the online teaching was first proposed. It presented numerous challenges for in-service and pre-service teachers. They must alter their teaching methods to accommodate the online environment accordingly. As well as to maintain the high quality of teaching and learning processes. Though there are various e-learning tools to aid students' learning process, teachers may be a novice and need assistance to fully apply such new methods in a short period of time. Furthermore, one presumption is that teachers using online teaching may face difficulties.

While there has been some research on the challenges mathematics teachers face during the pandemic, there is a need to pay more attention to the differences

between in-service and pre-service teachers. Hence, this study would like to fill this research gap. As Teachers are the executors of teaching, understanding their teaching experiences would bring a deeper understanding of the practice and changes in online teaching. It also helps us prepare for mathematics teaching in the current and future pandemic era. Therefore, based on the result may provide insights into how best to support mathematics teachers in the transition to online teaching and may have broader implications for the future of mathematics education.

4 Literation Review

The literature review below shows discussions and definitions related to the education curriculum during the pandemic, online teaching on mathematics, teachers' professionalism, and Report on other countries.

4.1 The situation of education curriculum during the Covid-19 pandemic

In Hong Kong, the education sector experienced five waves of epidemic outbreaks (Appendix I). The Education Bureau responded by suspending and gradually resuming classes and bringing forward the summer holidays for students. To continue the education process while maintaining social distancing, schools utilized online teaching using e-learning tools and multiple teaching methods/approaches to respond to the Government's guidance and instruction regarding "Suspending Classes without Suspending Learning" (EDB, 2020). The Government has also provided electronic devices such as laptops or tablets to students in need, particularly those from low-income families (EDB, 2020).

The shift to online teaching can be seen as part of the reform of teaching (Zhang, 2021). Recently, the role of the teacher has been the main focus of this reform, with the teachers' characteristics and executive ability playing an important role (Li, 2005). However, this reform was a rush decision without serious considerations, and it must fully cope with the current/existing situations. There are many points worth discussing regarding this sudden change, such as whether

the current teaching materials are still suitable to former teaching schedules and whether several teaching topics should be deleted. More importantly, current teaching methods and school support raise discussions regarding teachers' future roles. Through historical issues and changes brought about by technologies, some researchers have pointed out that technologies would have a particular impact on the education sector (閻光才, 2021). For instance, If used correctly, technology allows students to acquire knowledge. However, relying solely on online resources to obtain answers does not reflect one's ability. In the past, plagiarizing assignments was common among students. Additionally, some students may lack the ability to determine the accuracy of online information, leading them to believe erroneous information.

4.2 *Online teaching or other related resources*

During the pandemic, many articles and studies have discussed the changes in teaching and learning and ways to improve teaching performance. The increment in online resources has also been a prominent topic..

Online teaching can be divided into two modes (葉建宏, 2020). Synchronous teaching involves real-time interaction between teachers and students, while asynchronous teaching involves pre-recorded videos or online materials that students can access freely.

Research shows that online materials gained massive attention during the pandemic like never before (José, 2021). More and more educators found suitable and proper materials/apps for teaching abstract concepts or interacting during classes. This is beneficial to schools under such circumstances. However, studies (Dhawan, 2020) have pointed out difficulties encountered during online teaching sessions, such as weak or slow internet connections, which can lead to missing or incomplete information and undermine students' learning motivation. It also makes strengthening teacher-student relationships harder and maintains a classroom environment (Siregar & Manurung, 2021; UNESCO, 2020). One noteworthy point to discuss is the noticeably increasing workload of teachers. Studies have suggested improvement tips, such as building communication skills and maintaining an open-minded attitude to better cope with challenges faced during the pandemic. Another point worth discussing is how to handle more complicated mathematics concepts during online teaching. Research (Aldon, 2021) has shown that some mathematics activities in traditional classrooms cannot be manifested online, highlighting the challenges that online teaching has brought to teachers.

4.3 *Mathematic teacher's professionalism*

Professionalism has been emphasized in the recent century. According to Boyt, Lusch, and Naylor (2001), it can be defined as a multidimensional structure as the attitudes and behavior one possesses toward one's profession. The teacher will drill deeper into the different aspects. According to Dunne (2011), the metaphor of teaching, cultural influence, and initial hopes for the teaching profession establish a teacher's identity. There is another term, which is teacher resilience. Day and Gu (2014) claim resilience is an unstable state of nature. Also, It can be defined as a different concept with functioning and emotional regulation within a range of personal, relational, and organizational settings. According to the broaden-and-build theory (Day, C. & Gu; Q., 2014), resilience can maintain a positive emotion and augment people's enduring coping resources in the context of past or present adversity. Therefore, building teacher resilience through professional development, self-confidence, and communication was essential.

Research (Zhang, 2014) pointed out that some teachers, especially novice teachers, tried to turn to tool-based teaching when facing difficulties. They explain the complex mathematics concept by using examples. They will only repeat the example and let students loop many exercises while they may not understand the teaching concept fully. In addition, Professor Siu (1993) encourages teachers to think from multiple perspectives when encountering teaching obstacles, such as

asking others for their opinions, reading various books regarding such topics, and even finding peers to discuss related issues. Therefore, it is essential to establish a learning community, help each other widen their horizon, or even give novice teachers a nudge when in the pit.

4.4 *Report from other countries*

Countries have published various research papers on the pandemic's impact on education, including students, in-service and pre-service teachers. The researchers examine teachers' concerns, professional development, and the advantages and disadvantages of online teaching and provide teaching suggestions.

For example, a study in the United States found that the teaching self-efficacy of 361 teachers was lower than in previous studies during the epidemic (Pressley & Ha, 2021). There is also a literature from the South Africa that interviewed 15 primary school teachers, indicating that online teaching presents challenges and limitations for developing countries, such as inadequate educational infrastructure and unequal distribution of educational resources. The study also found that local teachers experienced additional psychological pressure in adapting to online teaching methods (Glietenberg, Petersen & Carolin, 2022). Additionally, there is literature from Malaysia that highlights concerns of local teachers regarding

students' participation in online teaching, and most teachers expressed the desire to improve their own technical skills. (Chin, Jiew & Jupri, 2022).

Besides the above, Researches (Aldon, Cusi, Schacht & Swidan, 2021; Dhawan, 2020; Onyema, Eucheria, Obafemi, Sen, Atonye, Sharma & Alsayed, 2020) indicate that different countries' teachers' teaching and conditions during the pandemic were the mainly negative trend.

5 Research Purpose and Question

Research question is below:

1 What are the experiences and challenges of in-service mathematics teachers using online teaching during the COVID-19 pandemic?

2 What are the experiences and challenges of pre-service mathematics teachers using online teaching during the COVID-19 pandemic?

3 What are the differences and similarities between the experiences and challenges of in-service and pre-service mathematics teachers using online teaching?

As mentioned, Covid-19 affected the traditional way of teaching. It is assumed this would bring particular challenges and difficulties to education. The study aims to find out the experience/difficulties they face regarding teaching mathematics rather than other factors such as family or financial situation, etc.

As the teacher is the executor of teaching, understanding the experience/ difficulties teachers face during this sudden shift can help inform the development of effective precautions such as modifying the teaching materials or teacher training program.

4 Methodology

4.1 Research Design

This study adopted a mixed method using the questionnaire survey and interviews based on the research objectives and literature review. In March 2023, the questionnaire was distributed to the writer's social media and placement school to understand respondents' situations during the pandemic. The research subjects are in-service teachers and pre-service teachers in Hong Kong who need to conduct teaching during the pandemic, such as block practice with about 8 or above weeks. The data provided by the participants were kept strictly confidential, and the questionnaire results were intended solely for academic research purposes. Respondents only needed to spend approximately 10 minutes completing the online questionnaire. Based on their responses to the questionnaire and considering factors such as teaching experience, some would be invited to an interview. If any respondents felt uncomfortable during the research, they could withdraw from the study at any time without any consequences, and all data would be deleted after the completion of the study.

The questionnaire and interview questions for this study were developed based on the questionnaire used in the research conducted by Dr. Zhang (2020). Since both research topic is similar and based on the results of Dr. Zhang's

questionnaire, it shows that the questionnaire is feasible. In addition, Dr. Zhang's questionnaire mainly used open-ended questions to record in detail the teaching situation of in-service teachers during the pandemic. This study selected some of the questions from the questionnaire and added some self-compiled questions that mentioned different teachers' concerns during the pandemic in other literature, trying to summarize the difficulties and experiences encountered by in-service and pre-service teachers in different aspects.

4.2 Research tools

The online questionnaire (Appendix II) is designed with Chinese and English versions to convent the responders' answers in the familiar language. It is divided into three parts.

The first part concerns personal information. Respondents only need to fill in their teaching experience, the grade level they taught during the pandemic, and whether they had online teaching experience before the pandemic. The second part is about self-compiled questions that mentioned some teaching situations during the pandemic in other literature, such as:

"It was difficult to interact with students during online lessons."

"I am satisfied with my performance during teaching."

The respondents only need to select the degree of agreement using a four-point Likert scale from very disagree (0) to very agree (4). This method effectively captures the respondents' attitudes (John, Renata & Adam, 2021).

The third part is an open-ended question, mainly selected from Dr. Zhang's questionnaire, such as :

"During distance teaching, do you think that your way of teaching mathematics somehow changed? Please explain"

"Please list three things that are important for you and you are succeeding in carrying out in distance Mathematics learning. [open]"

Those questions focus on teachers reflecting on their teaching during the pandemic, and there are no right or wrong answers.

Furthermore, interviews were conducted to gain a deeper understanding of the specific situation, such as how they overcame difficulties and their emotional changes during the pandemic. Semi-structured interviews are used. (Appendix III). The interview is audio recorded for repeated viewing and accurate recording purposes.

6.3 *Analytical method*

The collected questionnaires will be compared separately for pre-service teachers and in-service teachers in the following four categories, including:

A. Experience in teaching different mathematics domain

B. Experience in the teaching and learning process

C. Teachers' self-efficacy

D. the considerations of different variables.

In parts A to C, the data obtained in this study is primarily used for comparing and analyzing the proportion of the four-point Likert scale of in-service and pre-service teachers for each question and the content of the interviews. In part D, statistical analysis will be conducted using ANOVA and T-tests with SPSS 29.0.

7 Results

Background

Their background information is as follows:

Table 1: Background information of the respondents and interviewees

Types	Teaching experience	Questionnaire	Interviewee
Pre-service teacher	About 8-10 weeks	34	3
In-service teacher	less than 5 years	17	1
	5-10 years	7	1
	11-15 years	2	0
	more than 15 years	2	1
Total		62	6

According to the collected questionnaires, 62 pre-service or in-service teachers filled out the questionnaire. Based on their teaching age or the content of questionnaire responses, three pre-service and in-service teachers were invited for an interview separately.

7.1 Experience on teaching different mathematic domain

Table 2: Respond on experience in teaching different mathematic domains (part 1)

		Very disagree	Disagree	Agree	Very agree
Teaching "Shape and Space" related topics make me feel difficult.	Pre	2(5.9%)	5(14.7%)	22 (64.7%)	5(14.7%)
	In	2(7.1%)	5(17.9%)	16 (57.1%)	5(17.9%)
Teaching "Measures"	Pre	0(0%)	7(20.6%)	18 (52.9%)	9(6.5%)

related topics make me feel difficult.	In	1(3.6 %)	3(10.7%)	12 (42.9%)	12 (42.9%)

First, it is worth noting that according to the research findings, both in-service and pre-service teachers encounter difficulties in some topics. Specifically, over 80% of the respondents agreed that teaching "shape and space" and "measurement" were difficult.

Table 3: Respond on experience on teaching different mathematic domains (part 2)

		Very disagree	Disagree	Agree	Very agree
Teaching “number” related topics make me feel difficult.	Pre	2(5.9%)	1(47%)	14(41 %)	2(5.9%)
	In	0(0%)	20 (71.4%)	7(25%)	1(3.6%)
Teaching “Data Handling” related topics make me feel difficult.	Pre	4(11.8%)	16 (47.1%)	12 (35.3%)	0(0%)
	In	4(14.3%)	17 (60.7%)	6(21.4%)	1(3.6 %)
Teaching “Algebra” related topics make me feel difficult.	Pre	2(6.6%)	15(50%)	12(40%)	1(3.3%)
	In	5(20%)	14(56%)	5(20%)	1(4 %)

On the other hand, over 50% of the respondents, including in-service and pre-service teachers, agreed did not feel difficult in teaching the topic of "data handling". Similarly, categories such as numbers and algebra also had similar percentages. Thus, the experiences and difficulties encountered by both groups of teachers in teaching different mathematical categories are similar.

7.2 *Experience on teaching process*

To further explore the experiences of in-service and pre-service teachers in teaching and learning, two key aspects will be discussed: classroom instruction and beyond.

Table 4: Respond on experience on experience on teaching process (part 1)

		Very disagree	Disagree	Agree	Very agree
It was difficult to enhance students' learning motivation.	Pre	0 (0%)	1 (2.9%)	15 (44.1%)	18 (52.9%)
	In	0 (0%)	5(17.9%)	20 (71.4%)	3 (10.7%)
It was difficult to assess students' learning progress.	Pre	1 (2.9%)	1 (2.9%)	22 (64.7%)	10 (29.4%)
	In	0 (0%)	6 (21.4%)	16 (57.2%)	6 (21.4%)
It was difficult to interact with students during online lessons.	Pre	0 (0%)	1 (2.9%)	19 (55.9%)	14 (41.2)
	In	1(3.6%)	8 (28.6%)	17 (60.7%)	2 (7.1%)
It was difficult to use different resources for teaching.	Pre	0 (0%)	10(29.4%)	15 (44.1%)	5 (14.7%)
	In	1(3.6%)	6 (21.4%)	18 (64.3%)	3 (10.7%)
It was difficult to handle classroom management.	Pre	0(0%)	10 (29.4%)	13 (38.2%)	11 (32.4%)
	In	4 (14.2%)	13 (46.4%)	9(32.1%)	2 (7.1%)
It was difficult to build a proper teacher-student relationship.	Pre	0 (0%)	4 (11.7%)	17 (50%)	13 (38.2%)
	In	1 (3.6%)	18 (64.3%)	9 (32.1%)	0 (0%)

Over 80% of In-service and pre-service teachers have expressed challenges in the classroom regarding interacting with students, motivating them, and assessing their learning. However, in-service teachers have reported fewer challenges in establishing teacher-student relationships (39.4%) and managing classroom discipline (32.1%), while pre-service teachers have experienced more difficulties in these areas (70.6%, 88.2%). Overall, it can be concluded that both

pre-service and in-service teachers have faced similar challenges and experiences in the classroom during the pandemic.

Table 5: Respond on experience on experience on teaching process (part 2)

		Very disagree	Disagree	Agree	Very agree
Increased workload due to online mode learning.	Pre	2 (5.8%)	9 (26.5%)	13 (38.2%)	10 (29.4%)
	In	0 (0%)	4 (14.2%)	23 (82.1%)	1 (3.6%)
Online learning leads to a decline in students' performance in learning mathematics.	Pre	0 (0%)	8 (23.5%)	24 (70.6%)	2 (5.8%)
	In	0 (0%)	10 (35.7%)	18 (64.3%)	0 (0%)
It was difficult to have proper parental communication	Pre	1 (2.9%)	8 (23.5%)	19 (55.9%)	6 (17.6%)
	In	4 (14.2%)	18(64.3%)	6 (21.4%)	0(0%)
It was difficult to follow the instruction from the school or the education bureau.	Pre	1 (2.9%)	12 (35.3%)	15 (44.1%)	3 (8.8%)
	In	10 (35.7%)	15 (53.6%)	2 (7.1%)	1 (3.6%)

Regarding non-teaching work outside of the classroom, both groups of teachers have indicated that online teaching has resulted in an increased workload and may adversely affect students' math performance. However, in-service teachers have reported less difficulty communicating with parents (21.4%) and following education bureau guidelines (10.7%), while pre-service teachers have faced more challenges in these areas (73.5%, 52.9%). Consequently, both groups of teachers have encountered distinct difficulties in non-teaching work outside the classroom during this period.

Furthermore, examples were collected from survey responses to gain insights into teachers' perceptions of changes and no changes in online teaching.

Table 6: Respond on “change” and “no changes” in online teaching

Aspects	Examples of change	Frequency		Examples of invariance	Frequency	
		pre	in-		pre-	in
Teaching content	Changing the teaching order of different topics	0	2	Teaching flow	3	6
	Changing the teaching material	2	4	Teaching with Mathematic language	9	5
Teaching activities	The teaching approach has become one-sided	2	2	Reward system	2	2
	Different to carry out a practical exercise	5	8			
Teaching interaction	Decrease in classroom interaction between teachers and students	4	12	Asking a question and inviting students answer r	9	5
Teaching tool	More use of online recourses	7	12	Use PPT/e-book	4	1
Assessment	Difficult to assess student learning progress	3	4	Give homework	2	3
	Using Kahoot!/Nearpod, assess the learning objective.	1	1			
Preparation of teaching	Spend more time on preparing to teach, i.e., search more online recourses	1	2	Kept teaching attuite	1	0

Analysis of the survey responses and interviews revealed that many teachers had experienced a reduction in classroom interaction and a lack of opportunities for hands-on activities, particularly in the measurement domain. Furthermore, the increased use of online resources was seen as a challenge for monitoring student progress. However, both in-service and pre-service teachers acknowledged that

traditional classroom elements, such as teaching language and questioning, have remained unchanged.

In addition, some teachers mention some experiences and difficulties with online teaching during the pandemic. The dialogue is recorded following:

Table 7: Interviewee's dialogue

"The students have undergone three years of online learning, which has resulted in a lack of visual experience and difficulty in imagining three-dimensional shapes."
"Compared to traditional teaching, utilizing online tools to teach students numerical grids is particularly challenging."
"The time required for grading assignments has doubled."
"I feel pressure when parents are present next to their children during my teaching. "

The above dialogue details the content of Table 6. In-service and pre-service teachers revealed their interview that grading homework has become more time-consuming, and some teachers have reported experiencing pressure from parents. Additionally, adapting traditional teaching methods to the online environment has been a challenge for both groups of teachers.

7.3 *Teacher's self-efficacy*

Table 8: Respond to teacher's self-efficacy (part 1)

		Very disagree	Disagree	Agree	Very agree
I am able to tackle technical problems during teaching.	Pre	0 (0%)	0 (0%)	29 (85.3%)	5 (14.7%)
	In	2 (7.1%)	4 (14.2%)	16 (57.1%)	6 (21.4%)

Regarding teacher self-efficacy, the study investigated teachers' confidence in their ability to handle technical issues in online teaching. Notably, all pre-service teachers agreed or strongly agreed that they possessed the necessary skills, while 20% of in-service teachers expressed some uncertainty. However, both groups reported feeling capable of handling technical issues in online teaching.

Table 9: Respond to teacher's self-efficacy (part 2)

		Very disagree	Disagree	Agree	Very agree
I am satisfied with my preparation before teaching.	Pre	0 (0%)	18 (52.9%)	16 (47.1%)	0 (0%)
	In	0 (0%)	7 (25%)	17 (60.7%)	4 (14.3%)
I am satisfied with my performance during teaching.	Pre	7 (20.1%)	24 (70.6%)	3 (8.8%)	0 (0%)
	In	0 (0%)	10 (35.7%)	14 (50%)	4 (14.3%)
Overall, I can effectively maintain the learning and teaching process under online mode learning.	Pre	1 (2.9%)	18 (52.9%)	15 (44.1%)	0 (0%)
	In	0 (0%)	10 (35.7%)	17 (60.7%)	1 (3.6%)

In terms of preparedness and teaching performance, in-service teachers were found to be more satisfied than pre-service teachers, with nearly 90% of pre-service teachers reporting dissatisfaction with their teaching performance, compared to 35% of in-service teachers. These findings suggest that pre-service and in-service teachers may have differing perceptions of their teaching abilities and preparedness.

In addition, the study also aimed to capture teachers' emotional changes from the COVID-19 outbreak to the present, as reported in interviews.

Table 10: Interviewees share their emotional changes during the pandemic

	Beginning of pandemics		End of pandemics
Pre-service	Unfit → uneasy →	frustrated → reflective → tense →	confident reluctance
In-service	doubt → Helpless →	worry → worried → busy →	cherish happy

Results indicated that pre-service and in-service teachers experienced different emotional changes during this period. Pre-service teachers expressed worry about their observation performance during the outbreak and required time to adapt to teaching. In contrast, in-service teachers expressed regret and concern about their students' declining abilities compared to their previous knowledge. Their moods ranged from negative to positive, with some initially feeling anxious but later becoming more confident or happy. Some teachers also reported cherishing opportunities to interact with students more.

Furthermore, the survey also asked teachers to identify three things they believed were important and achievable and three things they could not implement. These items were classified into six aspects, and the frequency with which they

were mentioned was analyzed.

Table 11: Respond on success/failure to carry out distance Mathematics learning

Aspect	Freq	Succeed in carrying out			Failure to carrying out		
		Freq	Pre-	In-	Freq	Pre-	In-
Assess student's learning progress	42	14	6(8.7%)	8(14.5%)	28	15(23.4%)	13(25%)
Teacher-student interaction	38	16	11(15.9%)	5(9.1%)	22	14(21.8%)	8(15.3%)
Enhance student's learning motivation	37	11	4(5.8%)	7(12.7%)	26	16 (25%)	10(19.2%)
Using teaching tools	31	24	16 (23.1%)	8(14.5%)	7	4(6.3%)	3(5.8%)
Classroom management	25	17	11(15.9%)	6(10.9%)	8	6(9.4%)	2(3.5%)
Teaching content	19	11	10(14.5%)	1(1.8%)	8	4(6.3%)	4(7%)
IT ability	19	9	2(2.9%)	7(12.7%)	2	1(1.6%)	1(1.8%)
Internet equipment	10	6	4(5.8%)	2(3.6%)	4	2(3.1%)	3(5.8%)
Perpetration work	8	8	3(4.3%)	5(9%)	0	0(0%)	0(0%)
Care learning difference	7	0	0(0%)	0(0%)	7	1(1.6%)	6(10.5%)
Teacher's professional	7	6	2(2.9%)	4(7.3%)	1	1(1.6%)	0(0%)
Parent support	4	2	0(0%)	2(3.6%)	2	0(0%)	2(3.5%)

Results showed that evaluating student learning progress was identified as necessary by 42 teachers, but 65% (28 teachers) reported being unable to implement it successfully. Conversely, using teaching tools and different teaching resources was mentioned most frequently as achievable by 24 teachers.

In terms of successful implementation, pre-service teachers emphasized teaching performance during the school term, including teacher-student interaction and classroom management. In contrast, in-service teachers mentioned using information technology, improving student learning motivation, etc. However, regarding unsuccessful implementation, both groups of teachers expressed similar concerns, focusing on evaluating students, teacher-student interaction, and improving student learning motivation.

Moreover, the study examined whether teachers had acquired any new knowledge or skills during the outbreak.

Table 12: Respond responds have learned something during the pandemic

"learning" something concerning mathematics teaching during the epidemic	Responds		
	Freq	Pre-	In-
Online resources on mathematical teaching	22	12	10
Enhance IT ability	13	4	9
Online Teaching strategy	2	2	0

Results indicated that 37 teachers reported learning from various aspects, including mathematics teaching resources such as Number Pieces: Math Centre and technology use skills like video production and classroom operation software.

7.4 *Consideration of different variables*

The study considered several variables, including teaching experience and online teaching experience. To investigate the impact of teaching experience on teachers' views, the participants were divided into two groups based on their teaching experience (less than five years and more than five years), and normality tests were conducted on each group.

Table 13: Different variables: Teaching age (part 1)

Descriptive statistical analysis				
	Teaching age	Number	Average	Standard deviation
Experience in teaching different mathematic topics	Pre-service	29	13.21	1.56
	Less than 5 year	16	12.19	2.21
	5 year or above	12	12.75	1.42
Experience in the teaching and learning process	Pre-service	34	30.21	3.62
	Less than 5 year	16	26	2.35
	5 year or above	12	24.75	2.62
Teacher's self-efficacy	Pre-service	34	9.91	1.50
	Less than 5 year	16	10.63	1.58
	5 year or above	12	12	1.28

Analysis of variance (ANOVA) was then used to determine whether there were significant differences in teachers' self-efficacy in the learning and teaching process.

Table 14: Different variables: Teaching age (part 2)

One-way ANOVA						
		SS	DF	MS	F value	Sig.
Experience in teaching different mathematic topics	SSB	10.80	2	5.40	1.68	0.196
	SSW	173.45	54	3.21		
	SST	184.25	56			
Experience in the teaching and learning process	SSB	355.93	2	177.96	17.05	<0.001
	SSW	615.81	59	10.44		
	SST	971.74	61			
Teacher's self-efficacy	SSB	45.28	2	22.64	9.81	<0.001
	SSW	136.15	59	2.31		
	SST	181.43	61			

Table 15: Post hoc test

Scheffe method					
	Teaching age	Teaching age	Mean difference (i-j)	Std Error	Sig.
Experience in teaching different mathematic topics	Pre-service	Less than 5 year	-5.63	0.68	0.72
		5 year or above	-1.02	0.56	0.20
	Less than 5 year	Pre-service	0.56	0.68	0.72
		5 year or above	-0.46	0.62	0.76
	5 year or above	Pre-service	1.02	0.56	0.20
		Less than 5 year	0.46	0.62	0.76
Experience in the teaching and learning process	Pre-service	Less than 5 year	4.21	0.98	<0.001
		5 year or above	5.46	1.08	<0.001
	Less than 5 year	Pre-service	-4.21	0.98	<0.001
		5 year or above	1.25	1.23	0.60
	5 year or above	Pre-service	-5.46	1.08	<0.001
		Less than 5 year	-1.25	1.23	0.601
Teacher's self	Pre-service	Less than 5 year	-0.71	0.46	0.31
		5 year or above	-2.26	0.51	<0.001

efficacy	Less than 5 year	Pre-service	-1.54	0.58	0.04
		5 year or above	0.71	0.46	0.31
	5 year or above	Pre-service	1.54	0.58	0.04
		Less than 5 year	2.25	0.51	<0.001

Post hoc tests were performed using the Scheffe method and formed the table. According to Table 14, the aspect "Experience in teaching different mathematic topics" ($F=1.68$, $p>0.05$), the F value does not achieve a significant level, which means there is no significant difference between the teaching age.

However, the aspect "the experience in the learning and teaching process" ($F=17.05$,$p<0.05$) and "Teacher's self-efficacy" ($F=9.81$,$p<0.05$), both F values achieve a significant level, which means there is a significant difference between the teaching age.

In Table 15, we find that significantly different experiences in the learning and teaching process come from pre-service and in-service teachers with less than five years or more than five years of experience. In addition, the significant difference in "Teacher's self-efficacy" comes from pre-service and in-service teachers with more than five years of experience.

In addition, the study also examined the impact of online teaching experience on teachers' views. T-tests were conducted to compare the learning and teaching process differences between teachers with and without online teaching experience.

Table 16: Different variables (experience of online teaching before the epidemic)

		Have you ever conducted online teaching before the epidemic?	no.	Average	Sd	t value	Sig.
Experience on teaching different mathematic topic	Pre-	Yes	15	13.47	1.36	0.65	0.29
		No	14	13.07	1.90		
	In-	Yes	13	12.69	2.56	0.65	0.01
		No	15	12.20	1.32		
Experience on teaching process	Pre-	Yes	17	26.76	4.88	-3.02	<0.001
		No	17	30.59	1.87		
	In-	Yes	13	23.79	3.64	-2.28	<0.001
		No	15	26.21	1.63		
Teacher's self efficacy	Pre-	Yes	17	10.18	1.42	1.01	0.29
		No	17	9.65	1.62		
	In-	Yes	13	11.50	1.61	0.67	0.52
		No	*15*	*11.07*	*1.77*		

Results indicated that pre-service and in-service teachers with online teaching experience had different views on the learning and teaching process than those without experience.

8 Discussions

This section is to discuss respondents' results, with the implications of findings and reflected. Including the possible reason for similar and different results between in-service and pre-service teachers and the enlightenment from both parties.

8.1 *The possible reason for similar and different results*

8.1.1 *Teaching Age*

The present study found that the age of teachers affects teaching experience and self-efficacy. As such, age could contribute to the differences in experiences and challenges the two parties faced during the pandemic. Previous research has indicated a close relationship between the age of teachers and their professional development. The research shows that teachers with more experience have a greater level of professional maturity. As a flexible term covered in the literature review, professional teachers are more resilient in responding to resources in adverse situations, either past or present (Day & Gu, 2014). Therefore, pre-service teachers may encounter difficulties during an internship, as they lack professional experience and may not be able to solve some problems, which leads to an increase in psychological pressure. In contrast, in-service teachers have already acquired

a certain level of teaching knowledge and experience, allowing them to handle most of the current teaching work, such as communicating with parents or following school guidelines, and they can quickly adjust their mindset. Therefore, they may have a different experience from pre-service teachers in these areas, as reflected in the results that they face fewer difficulties in administrative work.

However, since online teaching is appearing in the education sector for the first time, both still need to adapt to it and use more digital software. According to the results, most of the difficulties that the interviewees encountered are related to online teaching.

Based on the research results, the emotions and changes experienced by both groups are quite similar. First, as teachers, they feel that they were unable to teach their students effectively during the early stages or the changes brought by the pandemic. One example would be increased workload, which increase their pressure which brings about a more negative emotion. However, these changes no longer bother them after the pandemic, so they have a more positive attitude. Some current teachers overcame their emotions during the pandemic and believed they could teach effectively.

In summary, in-service and pre-service teachers face similar difficulties and challenges during the pandemic, such as difficulty in assessing students' learning progress and interacting with students. However, their reactions to these challenges may differ due to differences in experience and professional knowledge. For example, in interviews, in-service teachers stated that they would try to use online resources such as Nearpod to grasp students' classroom performance. They have different approaches, resulting in different levels of self-efficacy and teaching experience reflected in the research results.

8.1.2 *Teacher training program*

Teachers training is another result reflected in the research, which it is a part of teachers' professional development. According to the result, it is found that teachers who had online teaching experience before the outbreak often had different experiences and difficulties in the teaching process compared to those with no experience. This highlights the importance of teachers training which provides educators with the necessary experience to tackle such challenges effectively. Its primary purpose is to enhance teachers' training in mathematical teaching knowledge, including subject matter knowledge (SMK) and knowledge of content and teaching(KCT) (Ball & Bass, 2002).

In-service or pre-service teachers will learn the mentioned knowledge in their university. However, mathematical concepts usually remain relatively constant in terms of subject matter knowledge. For example, facing specific difficulties or misconceptions students encounter on certain topics or how to construct students' mathematical knowledge will not be affected by the pandemic. Therefore, results shows that both groups feel more challenging especially with the "measurement" and "shape and space" categories. The possible reason is that these two categories involve concrete and physical operations in their mathematical knowledge level (Glietenberg, Petersen & Carolin, 2022), which will provide sensory support in the traditional classroom, such as demonstrating how to use a ruler for measurement or taking out physical objects like some three-dimensional shapes to allow students to touch and do hands-on activities. These topics must be presented concretely to make it easier for students to understand. The difficulty that teachers are facing is transferring these traditional teaching methods to online teaching because classes are conducted via a flat screen, making it challenging to imagine three-dimensional objects. Therefore, they need additional help in teaching these topics.

In addition, teacher training also involves enhancing teachers'

knowledge of content and teaching(KCT), including selecting teaching examples and methods. However, due to the improvement of technology, teaching strategies continue to evolve (Ball, Thames & Phelps, 2008). For example, new teaching tools or methods have been introduced, such as the current promotion of technology to support teaching, which may have yet to be mentioned in the university teacher training of most in-service teachers when the technology was not well developed at that time. However, the opportunity for in-service teachers to receive teacher training is limited. Generally, it is through inviting university lecturers or guest speakers to hold workshops or lectures at schools, with a frequency of at most once or twice a semester . On the other hand, pre-service teachers have just completed or processed their teacher training to obtain more up-to-date information and teaching tools closely related to the current social and technological trends (Lee, 2021). As a result, pre-service teachers' content and pedagogical knowledge may be different. For example, during interviews, pre-service teachers said they would try to practice the knowledge and tools they learned at university in their teaching practicum. While in the research survey, in-service teachers reflected the need to learn the video production technique. For pre-service teachers, some university assignments required them to make

videos for submission. Therefore, the research results show they may have similar experiences when teaching different mathematical fields, but there are differences in the teaching process.

8.2 *Enlightenment for pre-serve and in-service mathematics teachers.*

Now that the pandemic is under control and schools have resumed full-scale classes, it cannot be guaranteed that there will not be another sudden event. Based on the research results and the possible reasons discussed above, we propose three points that current or prospective teachers should pay attention to prevent such events.

Firstly, the research results indicate that during the pandemic, pre-service or in-service teachers faced many challenges, especially in online teaching. Such as interacting with students and evaluating their learning outcomes. This is an opportunity for teachers to recognize their shortcomings. Therefore, even though traditional face-to-face classroom teaching has resumed, teachers also need to practice different teaching methods and tools during face-to-face classroom teaching in order to improve teaching skills and be able to carry out the teaching and learning process effectively in case of emergencies (Fuertes, Dulsat & Álvarez, 2021). For instance, in traditional classrooms, teachers could experiment different method such as flipped classrooms, tablet learning, gamification, or using

multimedia material. It also meant absorbing the experiences of different teaching methods, rather than simply repeating the teaching steps of the past. Secondly, teachers can establish or expand their professional community by conducting online courses or seminars to share experiences and resources with other teachers. This can benefit teachers in 3 ways, which are saving experimental time, better understanding different teaching methods and tools, and learning how to respond to different student needs and challenges (Pourdavood & Song, 2021; Moorhouse, 2021). Therefore, teachers need to learn constantly and to improve and cope with changes in the teaching environment whereas student needs and strive to achieve a variety of teaching methods for each topic. By learning new teaching methods and skills, building a professional teacher community, and innovating teaching methods, these 3 methods allows teachers to enhance their teaching ability and diversity as well as to make teaching more exciting and compelling.

In addition, the research results also indicate that teachers often need to enhance students' learning motivation, reflecting the students' lack of interest in learning and concentration. Therefore, teachers need to cultivate students' learning interests and independent learning in daily teaching. For example, in the interviews, some teachers would use a reward system to improve students' classroom performance. Teachers need to make sure that students understand the

importance of learning, such as the relationship between mathematical knowledge and daily life, or some mathematical history stories, etc. (Tay, Lee & Ramachandran, 2021). Most importantly is to increase their curiosity and guide them to explore on their own, instead of teachers or parents forcing them to learn. It is also necessary to pay attention to their learning attitudes and give positive feedback and support at all times, to enhance students' learning confidence and make them more actively participate in learning. As a result, improving students' learning motivation and interest is important in education work. By encouraging students to learn independently and establishing a good teacher-student relationship, teachers can improve students' learning effectiveness and interest, making them more passionate about learning.

Finally, the research results indicate that teachers often need help to evaluate students' learning outcomes or teach specific topics. Teachers need to start thinking about how to teach unified knowledge in different educational environments, reflecting the importance of adjusting and designing appropriate courses for teachers. (Chia & Zhang, 2022). For example, as mentioned in the article, some topics involve physical objects or hands-on operations. In interviews, some teachers pointed out that they postponed teaching the dimensional measurement to face-to-face classroom teaching. It is easier for teachers to

evaluate how well students grasp certain concepts, which allows teachers to adjust to the teaching environment accordingly. Last but not least, teachers must prepare different assessment methods for different educational environments, understand students' learning outcomes and feedback, and adjust and optimize the course according to feedback (UNESCO, 2020). In summary, adjusting and designing appropriate courses is a problem teachers must pay attention to during the pandemic and in future teaching. By adjusting and redesigning course content, and continuously optimizing course effectiveness through feedback and evaluation, teaching can become more effective and meaningful.

9 Limitations and Suggestion

9.1 *Limitations*

Firstly, the insufficient sample size of the study hindered its accuracy and further investigation. For instance, in the interview aspect, there was a lack of interviewees from different age groups, especially those who have been teaching for over 15 years, thus preventing a comprehensive understanding of teaching experiences across different age groups. Similarly, in the questionnaire aspect, the number of responses from different age groups differed, with fewer responses from those in grades 11 to 15 or those who have been teaching for over 15 years. This limited the ability to conduct ANOVA analysis on different age groups. It may cause the Type II error and could have affected the accuracy of analyzing each teaching age group.

Secondly, the sample population mainly consisted of individuals from my social circle. For example, peers who studied together and teachers from two block practice schools were invited to participate. However, they shared similar academic backgrounds as pre-service or in-service teachers. This lack of representation of pre-service teachers from other institutions or in-service teachers from different school environments may not fully reflect the actual situation of pre-service and in-service teachers in Hong Kong.

Additionally, to make the questionnaire more appealing and convenient for respondents, it was designed to take around 10 minutes. However, this may have limited the level of detail in the questions and section, such as the questionnaire only asking for the participant's level of agreement without asking them to provide any explanation or reasoning.

Furthermore, the lack of skilled questioning techniques in semi-structured interviews left room for improvement. Each interviewee received different questions; some critical questions may have been skipped. The subjective influence may have obstructed the accuracy of the interview results.

In summary, factors such as insufficient sample size and population, questionnaire design, and interview techniques can all impact the results. Therefore, it is necessary to pay attention to and improve these factors during the research process to enhance the accuracy and reliability of the study.

9.2 *Suggestions*

9.2.1 *Based on the research findings*

Firstly, the results indicate that in-service and pre-service teachers face particular challenges. In the last part, I have discussed in detail the enlightenment of the pandemic on in-service and pre-service teachers. I tried to provide recommendations to other stakeholders, including educational

authorities and teacher training schools. Firstly, the education sector may need to promote appropriate online teaching methods/materials or professional development. Although various online teaching resources are available, not all are suitable for teaching and require time for selection or even investment in designing and inventing teaching tools for specific subjects to provide tailored support for each topic (Vale & Graven, 2023). Additionally, it is necessary to enhance the promotion and clarification of different teaching methods in society to prevent social bias. For example, as revealed in the interviews, teachers initially had doubts about the effectiveness of online teaching.

Furthermore, it is necessary to updated precaution to handle unforeseen circumstances, preventing the use of inadequately tested methods.

Moreover, the results indicate that in-service teachers may also face challenges. However, some in-service teachers would be supporting teachers to pre-service teachers. Therefore, there may have room to support that in-service teacher. To ensure the teaching experience for pre-service teachers during.

9.2.2 *Based on the research design*

To enhance the accuracy and reliability of the research, which can be used to inform policy and practice in the education sector., there are several steps

that can be taken.

Firstly, data could be collected from various educational backgrounds, such as different banding schools. This would allow for a more diverse and representative sample and provide a more comprehensive understanding of the challenges faced by teachers in different contexts. Additionally, the sample size could be increased to improve the statistical power of the study and ensure that the findings are more generalizable to the wider population.

Furthermore, pre-testing or better preparation for the questionnaire or interviews could be considered to ensure more detailed and accurate data collection. This could involve piloting the questionnaire or interview questions with a small sample of participants before the main data collection phase to identify any ambiguities or issues with the questions. Moreover, add an item "reason" that requests responders to provide further detailed information. This would help to refine the questionnaire or interview questions and ensure that the data collected is of the highest quality.

10 Conclusion

The research aimed to understand and compare the experiences and difficulties faced by in-service and pre-service teachers during the pandemic. Based on the integrated data, both groups encountered similar difficulties in online teaching. These difficulties mainly arose during teaching, including interacting with students and assessing their learning progress. However, they had different experiences, such as the pressure on pre-service teachers from supervising teachers' observations and completing university requirements. In contrast, in-service teachers were mainly occupied with administrative work during the pandemic, such as notifying parents and assisting with school operations. Despite the research limitations and points out that although the pandemic is gradually receding, different education stakeholders should take this opportunity to reflect on themselves and improve in all aspects to bring higher quality teaching and learning process for students in the future.

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12 Appendix

12.1 *Appendix I- Time slot of policy from EDB under five wave pandemics*

2020	
25th January	Extended the New Year holidays
5th May	Gradual resumption of classes would commence
10th July	All primary and secondary schools will start their summer vacation earlier on the 13th, and the gradual resumption of classes will commence on 23rd September 2020.
2nd December	Suspended classes in all primary and secondary schools
2021	
11th January	All grades can be arranged to return to school, but the number of students should still be at most one-sixth of the school, and elementary schools can only go to school in the morning.
3rd February	the number of students should still not exceed one-third of the school
26th march	the number of students should still not exceed the-third of the school
24th May	Half-day face-to-face class resumption.
2022	
14th January	Suspended face-to-face class in primary schools until 6th March
26th April	Classes will resume after the Easter break, and half-day face-to-face classes will resume gradually
1st December	Resume a whole day face-to-face class if the percentage of students who have received two doses of the vaccine and have passed the 14-day interval after vaccination, either at the whole-school or individual-grade level, reaches 70% or more of the total number of students eligible for vaccination at the school.
2023	
15th February	Gradual resumption of face-to-face classes would commence

12.2 *Appendix II - Questionnaires*

Part 1

Interviewee's basic information 受訪者背景

1. How long have you been a mathematics teacher?

   您作為數學教師的教齡

   ( ) pre-service teacher 實習老師 ( ) less than 5 years 少於 5 年

   ( ) 5-10 years 任教 5-10 ( ) 11-15 years 任教 11-15 年

   ( ) more than 15 years 多於 15 年

2. In which grade do you teach at your school?

   您在學校的教授數學課的年級（可選多項）

   ( ) Primary 1 小一 ( ) Primary 2 小二 ( ) Primary 3 小三

   ( ) Primary 4 小四 ( ) Primary 5 小五 ( ) Primary 6 小六

3. Have you ever conducted online teaching **before** the epidemic?

   在這段疫情**之前**，你曾否進行過在線教學？

   ( ) YES 有 ( ) NO 沒有

Part 2

Statement about online mode teaching under Covid-19, chosen put a "tick" in the appropriate box.

以下句子是有關於疫情期間對教學的描述, 請於相應的方格打剔

	During online mode teaching under Covid-19 疫情下的網上教學期間……	1: 非常不同意 4: 非常同意				
		1	2	3	4	不適用
4.	Teaching "number" related topics make me feel difficult. 關於「數」範疇的教學感到困難					

5.	Teaching “Shape and Space” related topics make me feel difficult. 關於「圖形空間」範疇的教學感到困難					
6.	Teaching “Measures” related topics make me feel difficult. 關於「度量」範疇的教學感到困難					
7.	Teaching “Data Handling” related topics make me feel difficult. 關於「數據處理」範疇的教學感到困難					
8.	Teaching “Algebra” related topics make me feel difficult. 關於「代數」範疇的教學感到困難					
9.	It was difficult to enhance students’ learning motivation. 提高學生學習動機感到困難					
10.	It was difficult to build a proper teacher-student relationship. 與學生建立良好關係感到困難					
11.	It was difficult to handle classroom management. 管理課室秩序感到困難					
12.	It was difficult to follow the instruction from the school or the education bureau. 跟從學校/教育局指引感到困難					
13.	It was difficult to have proper parental communication. 與學生家長溝通感到困難					
14	It was difficult to interact with students during online lessons. 在課堂期間與學生互動感到困難					
15	It was difficult to use different resources for teaching. 運用不同資源數學教學感到困難					
16	It was difficult to assess student’s learning progress.					

	評估個別學生數學學習成效感到困難					
17	I am able to tackle technical problems during teaching. 我具備足夠資訊科技能力處理應對網上教學的技術問題					
18	Online mode of learning leads to a decline in students' performance in learning mathematics. 遙距教學導致學生學習數學表現下降					
19	Increased workload due to online mode learning. 遙距教學導致工作量增加					
20	I am satisfied with my preparation before teaching. 我滿意自己在教學前的準備工作					
21	I am satisfied with my performance during teaching. 我滿意自己在教學中的表現					
22	Overall, I can effectively maintain the learning and teaching process under online mode learning. 整體而言，我在遙距教學下能夠高效地維持良好師生的學與教					

Part 3

Open questions about your teaching.

以下關於您教學的開放性問題，答案沒有對錯之分

23. How are you dealing with distance MATHEMATICS teaching during this period? Please describe your work briefly. (online teaching, recording videos, online forums,…)

    在受疫情影響的這段時間，你如何進行遠程數學授課？ 請簡單描述你的工作（如在線實時教學，錄製視頻授課，在線論壇討論答疑等等）。

24. During distance teaching, do you think your way of teaching mathematics somehow changed? Please explain.

在遙距教學期間，你的教學方式與實體教學有什麼變化？（如：教學方式，學生參與，課程構）

25. During distance teaching, do you think your way of teaching mathematics maintained some basic features as before? Please explain.
    遙距教學期間的教學方式有沒有沿用實體教學的一些風格？（如：教學風格，學生參與，課程結構）
26. Please list **three** things that are important for you and that you are succeeding in carrying out in distance Mathematics learning.
    舉出三件你認為對遠程數學授課重要並且成功實施的事
27. Please list **three** things that are important for you and you are not succeeding in carrying out in distance Mathematics learning.
    舉出三件你認為對遠程數學授課重要但是未能成功實施的事
28. Do you think you are “learning” something concerning mathematics teaching during the online teaching experience during the epidemic? Please explain in detail.
    在受疫情影響的這段在線教學期間，你有沒有「學習」到一些關於數學教學的東西？請具體說明 (學習了什麼，從哪裏得悉這些資訊)

12.3 *Appendix II – interview question and record dialogue*

訪談題目 (5-10 mins)

1. Please share your views about what are important things/elements when teaching mathematics.

   請分享，你認在教授數學時為重要的是什麼

2. Please share your views on online mode teaching.

   請分享你對線上遙距教學的看法

3. Please share the most profound things during the epidemic.

   請分享疫情期間較深刻的事情

4. During the epidemic, have you encountered any challenges in teaching mathematics?

   疫情期間，你有沒有在數學教學上遇到挑戰/困難？

5. Please share how/what methods did you use to overcome the above difficulties?

   請分享你如何/運用什麼方法克服上述的困難？

6. Please share your feelings regarding the changes in teaching mood from the beginning of the epidemic to the present (such as from classes suspended to some classes resumed…

   請分享疫情起初至現在教學上的心情轉變 (停課, 部分復課…)