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The research experience of postgraduate students: a mixed-methods study

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ABSTRACT

Research experience is widely used in quality assurance exercises to benchmark postgraduate education at the institutional level. However, individual differences in students' research experience have been largely neglected. Furthermore, little is known about how differences in students' research experience are associated with skill development and overall satisfaction. This study addressed these gaps using an explanatory sequential mixed-methods design. Study 1 was a quantitative study that involved surveying 590 research postgraduate students (i.e. 421 PhD and 168 MPhil students). A person-centered approach, specifically latent profile analysis, was used to analyze the data. Our findings revealed that students could be divided into three groups based on their research experience: rewarding, ordinary, and unsatisfactory. Those with a rewarding research experience experienced greater development in their skills and higher levels of satisfaction, while those in the unsatisfactory group demonstrated the worst outcomes. Study 2 was a qualitative study that involved interviews with 10 PhD students. The qualitative findings largely triangulated the quantitative results but also uncovered emerging themes, including the importance of student-supervisor misfit, publication pressure, and the COVID-19 pandemic context. Theoretical and practical implications of these findings are discussed.

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Research postgraduate students; research experience; latent profile analysis; skill development; overall satisfaction

Given the increasing emphasis on accountability in higher education, many countries have focused on measuring and benchmarking the postgraduate research experience for quality assurance and improvement (Australian Council for Educational Research 2000; Canadian Association of Graduate Studies 2019; Cardoso, Rosa, and Miguéis 2020; Pitkin 2021). However, research experience is usually assessed at the institution or the faculty/program level (Sampson et al. 2016). Little work has been done to explore the differences in students' research experience and how the research experience, in turn, shapes students' skill development and overall satisfaction. Furthermore, much of the existing research has adopted an exclusively quantitative approach, and little qualitative work has been done to understand students' perspectives (Ginns et al. 2009). Using a mixed-methods approach that includes qualitative evidence could provide more nuanced insights into how research experience affects students' skill development and overall satisfaction.

Research experience is an umbrella term that includes many dimensions, including supervision, infrastructure, intellectual climate, and peer support (Zeng and Watkins 2010; Zeng, Wang, and

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Shulruf 2016). However, past studies with a quality assurance focus have primarily examined each dimension in isolation (Pitkin 2021). Few studies have explored how students construe their research experiences and how these experiences play a role in skill development and overall satisfaction.

To address the research gaps, we adopted a mixed-methods approach to garner both quantitative and qualitative evidence to understand the research experience of postgraduate students. The quantitative research focused on the individual differences in research experience based on a person-centered approach (i.e. latent profile analysis [LPA]). The qualitative research aimed to achieve a more in-depth understanding by looking into students' explanations of quantitative findings.

Postgraduate research experience

Research experience refers to the quality of research environments provided by universities, which has been extensively used as a performance tool to benchmark postgraduate education quality in many countries, such as Australia and the United Kingdom (Ginns et al. 2009; Marsh, Rowe, and Martin 2002; Pitkin 2021).

The Student Research Experience Questionnaire (SREQ) is one of the most established instruments to capture students' research experience, which divides research experience into environmental and outcome factors (Ginns et al. 2009; Zeng, Webster, and Ginns 2013). Environment factors refer to the research resources that universities offer for students to carry out research activities, including *supervision* (i.e. the quality of supervision), *intellectual climate* (i.e. learning environment provided by the university/faculty), and *infrastructure* (i.e. the accessibility of research infrastructures). Meanwhile, *peer support* (i.e. perceived research support provided by peers) is also recognized as a vital aspect of the research experience, especially in Eastern contexts where social relationships are highly valued (Zeng and Watkins 2010).

Outcome factors pertain to skill development and overall satisfaction, involving *generic skills* (i.e. generic skills such as problem-solving and communication skills) and *overall satisfaction* (i.e. the overall level of satisfaction with the research experience). In this study, *research skills* (i.e. skills needed for accomplishing research work, such as identifying problems in own research field) are also identified as the outcome of research experience due to their importance for postgraduate students (Durette, Fournier, and Lafon 2016). Compared with generic skills, research skills exclusively focus on the skills for engaging in research.

Exploring differences in the postgraduate research experience

Beyond benchmarking exercises, Ginns et al. (2009) found that SREQ is reliable at the individual level. However, few studies have explored the associations among research experience, skill development, and overall satisfaction at the individual level. For example, Zeng, Webster, and Ginns (2013) demonstrated that supervision, infrastructure, and intellectual climate were critical to overall satisfaction, and supervision was beneficial to skill development. However, these studies focused on the effect of each research experience dimension and focused on the average effect across the whole sample, ignoring the individual differences.

This study aimed to uncover individual differences in research experience using a person-centered approach, which has been increasingly employed in higher education and could enrich the existing research in two aspects (Denson and Ing 2014). First, person-centered approaches enable researchers to identify subgroups of students with similar or different types of research experience. Second, person-centered approaches provide avenues to explore how multiple research experience dimensions are synergistically associated with skill development and overall satisfaction. Different dimensions of research experience complement each other in fostering students' research development, and exploring them in a synergistic fashion might be more theoretically fruitful. For example, supervision focuses on support and mentoring so students can navigate their research journeys (Lee

2008), whereas peer support concentrates on mutual interactions and collaborative learning (Meschitti 2019). However, few studies have explored how multiple research experience dimensions simultaneously facilitate or inhibit skill development and overall satisfaction.

Postgraduate education in Hong Kong

To enhance its international competitiveness, the Government of the Hong Kong special administrative region (HKSAR) endeavored to develop Hong Kong as a higher education hub (Mok and Cheung 2011). One measure HKSAR took was to expand the scale of postgraduate education to attract more research funding and talents, accounting for the dramatic growth of postgraduate education. The number of postgraduate research students in Hong Kong's eight publicly-funded universities has increased 155% over the past two decades, reaching 8,514 in 2022 (University Grants Committee 2022).

The expansion of postgraduate education has led to great concerns about quality assurance, such as a lack of high-quality supervision and inadequate opportunities to access research infrastructures (Shin, Postiglione, and Ho 2018). Although there were sustained calls for assessing student experience for accountability (University Grants Committee 2019), many of the existing studies on the research experience have been conducted in Western contexts. Considering the differences in quality assurance systems (Marginson 2011) and students' learning (King 2022; King and McInerney 2014; King, McInerney, and Pitliya 2018), it is debatable whether the importance of research experience demonstrated in Western countries can be generalized to Eastern cultures. Hence, this study focused on research experience in the Hong Kong context.

The present study

The current study aimed to explore postgraduate students' research experience using an exploratory sequential mixed-method design. In the quantitative stage (Study 1), a person-centered approach was utilized to explore whether students varied in their research experiences and how the research experience profiles were associated with students' skill development and overall satisfaction. Two research questions were explored:

RQ1. What are the different research experience profiles of postgraduate students?

RQ2. To what extent do skill development and overall satisfaction differ as a function of research experience profile membership?

In the qualitative stage (Study 2), we triangulated the quantitative findings via individual interviews. Two research questions were proposed:

RQ3. What are students' perceptions of their research experience?

RQ4. Which aspects of students' research experience are important to their skill development and overall satisfaction?

Study 1: the quantitative study

Methods

Participants and procedures

The sample included 590 postgraduate research students at a university in Hong Kong[1]. Among the participants, 421 (71.4%) were from the PhD program, 168 (28.5%) were from the Mphil program, and one (0.1%) student did not report the program. Of these, 293 (49.7%) students majored in STEM fields (e.g. engineering and science), and 297 (50.3%) majored in non-STEM fields (e.g. education and law). There were 307 (52%) females and 283 (48%) males. The number of year one,

year two, year three, and year four students were 206 (35%), 166 (28%), 85 (14%), and 77 (13%), respectively. Fifty-six (10%) students did not report their year level.

Several measures were taken to reduce the potential social desirability bias. First, all participants were recruited on a voluntary basis via the university email lists. The online survey avoids in-person contact and reduces social desirability bias. Second, we anonymized the survey without collecting any identifying information. Third, we emphasized that the survey data will only be used for research purposes. We also highlighted the importance of giving authentic responses.

Instruments

Research experience. We used an adapted version of SREQ (Ginns et al. 2009; Zeng 2006; Zeng, Webster, and Ginns 2013) to measure students' research experience, including supervision, infrastructure, intellectual climate, and peer support. Cronbach's alpha coefficients for the four variables were 0.95, 0.90, 0.93, and 0.94, respectively.

Skill development and overall satisfaction. Outcome variables were measured by generic skills (i.e. problem-solving, developing ideas and presentation, analytical skills, ability to plan the work, tackling unfamiliar problems, communication skills, and the ability to learn independently), research skills (i.e. systematic understanding of the knowledge in one's field, identifying problems, research methodologies, and overall research skills), and overall satisfaction. The Cronbach's alpha coefficients for generic and research skills were 0.89 and 0.81, respectively.

All items used in this study were rated on a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). The details of these variables and items can be found in the Appendix.

Data analysis

LPA was used to answer the first research question with Mplus 8.0 (Muthén and Muthén 1998-2017). LPA is a person-centered approach that focuses on identifying subgroups of individuals within a population who share similar response patterns on variables (Lubke and Muthén 2005). It is similar to other clustering methods that cluster individuals who are similar to each other. However, compared to more traditional clustering methods, such as K-means clustering, LPA is more accurate because it considers measurement errors and provides several goodness-of-fit indices that help researchers compare models and select the best one (Bray and Dziak 2018).

LPA can be contrasted with variable-centered methods, such as linear regression and structural equation modeling. In variable-centered approaches, the associations between variables are assumed to be consistent across the population. Hence, variable-centered approaches are more suitable for exploring the relationship between independent variables (e.g. supervision) and dependent variables (e.g. skill development) in a population without considering individual differences. In contrast, LPA assumes that the relationships between variables are different across subgroups, and that a population can be divided into different subgroups. Hence, it could identify subgroups of individuals with similar response patterns and help researchers better understand subgroups within a population and the relationship between variables across different subgroups.

A combination of fit indices was used to determine the optimal number of profiles. Lower values of the Akaike Information Criteria (AIC), Bayesian Information Criteria (BIC), and sample size adjusted BIC (aBIC) indicated a better fit (Nylund, Asparouhov, and Muthén 2007). A significant *p*-value of Lo-Mendel-Rubin's Likelihood ratio test (LMR) and *p*-value of Bootstrap Likelihood ratio test (BLRT) suggested that the *K* class model fits better than the *K-1* class model. Entropy values higher than 0.70 indicated an accurate classification. Meanwhile, the theoretical interpretation and representativeness of each profile (>5% of the sample) were also considered (Lubke and Muthén 2005).

To answer the second research question, a series of analysis of variance (ANOVA) tests were conducted to examine the differences in skill development and overall satisfaction across latent profiles.

Results

Preliminary results

Table 1 shows the descriptive statistics and correlations among variables. The correlations among research experience, skill development, and overall satisfaction were significant, ranging from 0.20–0.65.

Rq1: Research experience profiles

To determine the optimal number of research experience profiles, a series of profiles were fitted and compared. The model fit indices are reported in Table 2. Our results indicated that a five-profile solution led to convergence issues due to the large number of parameters being extracted, leading to unreliable findings. Hence, we compared the model fit indices from one- to four-profile solutions. The values of AIC, BIC, and aBIC decreased with the increase in profile numbers, and the *p*-value of L-M-R LRT and Bootstrap LRT was still significant with the increase in profile numbers. Although these indices indicated that the four-profile was superior to the three-profile solution, the proportion of the smallest profile in the four-profile solution was 3%, less than the minimum criteria of 5%. Two profiles in the four-profile solution (3% and 13% of the participants, respectively) displayed notably similar configurations (i.e. rewarding research experience) that were not substantively distinct from each other. Hence, the three-profile solution was considered optimal, which showed satisfactory classification accuracy, with entropy being 0.79.

The three research experience profiles are displayed in Figure 1, including *unsatisfactory research experience* (15.69% of participants, $N = 91$), *ordinary research experience* (68.97% of participants, $N = 400$), and *rewarding research experience* (15.34% of participants, $N = 89$).

Profile means and standard errors are provided in Table 3. There were significant differences in supervision, infrastructure, intellectual climate, and peer support across three groups, with the highest for the rewarding research experience profile and the lowest for the unsatisfactory profile.

We explored the relationship between students' field of study and the likelihood of being in a particular profile. As shown in Table 4, students' field of study did not impact profile membership.

Rq2: Differences in skill development and overall satisfaction across research experience profiles

As shown in Table 5, students in the rewarding research experience profile reported the highest level of generic skills ($M = 4.32$, $SE = 0.05$), research skills ($M = 4.35$, $SE = 0.04$), and overall satisfaction ($M = 4.56$, $SE = 0.06$), followed by those in ordinary and unsatisfactory research experience profile. Chi-square statistics were significant for each outcome across three profiles. We also analyzed each of the specific generic and research skills, which followed the same pattern as those with the rewarding experience having the highest level of generic and research skills.

Table 1. Descriptive statistics and correlations among variables.

	1	2	3	4	5	6	7
1. Supervision	-	0.44**	0.52**	0.31**	0.41**	0.65**	0.60**
2. Infrastructure		-	0.68**	0.45**	0.33**	0.49**	0.34**
3. Intellectual climate			-	0.54**	0.35**	0.57**	0.39**
4. Peer Support				-	0.29**	0.38**	0.20**
5. Generic skills					-	0.41**	0.42**
6. Research skills						-	0.45**
7. Overall satisfaction							-
M	4.06	3.68	3.54	3.75	3.92	4.00	3.83
SD	0.80	0.76	0.75	0.84	0.55	0.60	0.79

Note. *$p < 0.05$, **$p < 0.01$

Table 2. Model fit indices for the models with varying numbers of latent profiles.

$N_{profile}$	AIC	BIC	aBIC	Entropy	L-M-R LRT (*p*)	Bootstrap LRT (*p*)	Class Size Per Profile
1	5473.26	5508.16	5482.76	n/a	n/a	n/a	580
2	4928.35	4985.07	4943.80	0.87	<.001	<.001	113, 467
3	**4801.53**	**4880.06**	**4822.92**	**0.79**	**<.05**	**<.001**	**91, 400, 89**
4	4698.85	4799.20	4726.18	0.84	<.05	<.001	17, 371, 117, 75
5[a]	4645.42	4767.59	4678.70	0.86	0.08	<.001	14, 68, 383, 36, 79

Note. AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion; aBIC = sample-size adjusted BIC; L-M-R LRT = Lo-Mendell-Rubin Likelihood Ratio Test; LRT = likelihood ratio test; n/a = not applicable; [a] The five-class solution leads to the convergence issues due to the large number of parameters being estimated, and the result was not trustworthy; Bolded numbers indicated selected model.

Study 2: the qualitative study

Methods

Participants and procedures

Individual interviews were completed with 10 PhD students. All of them were recruited separately from the same university where the quantitative study was conducted. Purposive sampling was used to achieve a diverse mix according to gender, year of program and field of study, maximizing the variation of the sample. The qualitative study participants were different from the quantitative study participants as our survey was anonymous. Hence, we were not able to track the survey participants. As shown in Table 6, There were five males (50%) and five females (50%). Half of the participants were in the STEM fields (50%).

Data collection and analysis

Interview questions were developed following the same theoretical framework used in Study 1. While the interviews were semi-structured, they provided flexibility for themes to emerge. The interviews aimed to (1) explore students' perceptions of research experience (e.g. '*How would you describe your research experience in terms of supervision/infrastructure/intellectual climate/peer support?' and 'what factors are important to your research experience?*') and (2) examine the role of research experience in facilitating skill development and overall satisfaction (e.g. '*How important is the supervision/infrastructure/intellectual climate/peer support* to *your overall satisfaction?*').

The interview recordings were transcribed verbatim for analysis. Thematic analysis was adopted to derive themes. Following the six phases suggested by Braun and Clarke (2006), we first read the interview transcripts and then created initial codes. The codes were refined and grouped to form themes, which were later reviewed, named, and defined. Finally, representative quotes were listed for each identified theme.

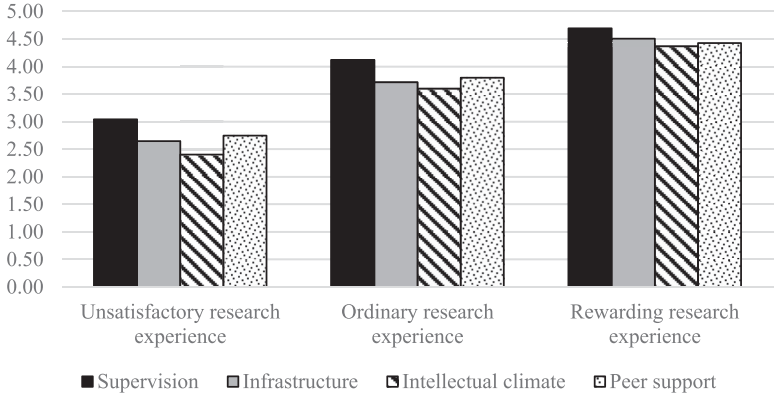

Figure 1. Final model with the three-profile solution.

Table 3. Mean differences in research experiences profiles.

	Unsatisfactory ($N = 91$) M (SE)	Ordinary ($N = 400$) M (SE)	Rewarding ($N = 89$) M (SE)	ANOVA	
				$F(2,577)$	η^2
Supervision	3.04 (0.10)	4.12 (0.03)	4.78 (0.03)	171.42***	0.37
Infrastructure	2.63 (0.07)	3.72 (0.02)	4.61 (0.04)	336.21***	0.54
Intellectual climate	2.39 (0.06)	3.61 (0.02)	4.47 (0.04)	493.32***	0.63
Peer support	2.73 (0.10)	3.81 (0.03)	4.49 (0.06)	161.24***	0.36

Note. ***$p < .001$.

Table 4. The Relationship between field of study and research experience profiles.

Predictor	Ordinary VS. Dissatisfying		Rewarding VS. Dissatisfying		Rewarding VS. Ordinary	
	Odds ratio (SE)	*p*-value	Odds ratio (SE)	*p*-value	Odds ratio (SE)	*p*-value
Field of study (1 = STEM 0 = non-STEM)	1.10 (0.25)	0.682	0.95 (0.27)	0.859	0.86 (0.22)	0.531

Table 5. Mean differences in skill development and overall satisfaction.

	Unsatisfactory ($N = 91$) M (SE)	Ordinary ($N = 400$) M (SE)	Rewarding ($N = 89$) M (SE)	ANOVA	
				$F(2,577)$	η^2
1. Overall generic skills	3.60 (0.08)	3.90 (0.02)	4.33 (0.05)	47.13***	0.14
2. Generic skills – problem-solving	3.55 (0.09)	3.92 (0.03)	4.33 (0.06)	34.30***	0.11
3. Generic skills – developing ideas and presentation	3.68 (0.09)	3.94 (0.03)	4.28 (0.07)	19.40***	0.06
4. Generic skills – analytical skills	3.59 (0.10)	3.89 (0.03)	4.31 (0.08)	25.01***	0.08
5. Generic skills – ability to plan the work	3.62 (0.09)	3.96 (0.03)	4.40 (0.07)	31.77***	0.10
6. Generic skills – tackling unfamiliar problems	3.41 (0.10)	3.71 (0.03)	4.21 (0.07)	27.86***	0.09
7. Generic skills – communication skills	3.34 (0.10)	3.78 (0.03)	4.20 (0.07)	32.12***	0.10
8. Generic skills – the ability to learn independently	3.94 (0.11)	4.09 (0.03)	4.58 (0.05)	22.98***	0.07
9. Research skills	3.71 (0.09)	3.99 (0.02)	4.40 (0.05)	38.65***	0.12
10. Research skills – systematic understanding of knowledge in my field	3.67 (0.10)	4.06 (0.03)	4.45 (0.06)	33.20***	0.10
11. Research skills – identifying problems	3.68 (0.09)	3.86 (0.03)	4.21 (0.08)	14.08***	0.05
12. Research skills – research methodologies	3.69 (0.09)	3.98 (0.03)	4.36 (0.06)	22.02***	0.07
13. Research skills – overall research skills	3.80 (0.10)	4.07 (0.03)	4.57 (0.06)	31.16***	0.10
14. Overall satisfaction	2.93 (0.10)	3.88 (0.03)	4.56 (0.06)	144.11***	0.33

Note. ***$p < .001$.

Results

As shown in Table 7, themes that emerged from the qualitative interviews were categorized based on our research questions 3 and 4: students' perceptions of their research experience and the aspects of research experience that were important to students' skill development and overall satisfaction.

Table 6. Demographic information of interview participants.

Participant No.	Gender	Year of study	Field of study
1	Male	1	STEM (Pharmacy)
2	Male	3	Non-STEM (Education)
3	Male	4	STEM (Civil Engineering)
4	Female	3	Non-STEM (Education)
5	Female	4	STEM (Chemistry)
6	Male	5	Non-STEM (Sociology)
7	Female	3	Non-STEM (Chinese)
8	Male	2	STEM (Statistics and Actuarial Science)
9	Female	2	Non-STEM (Arts)
10	Female	2	STEM (Civil Engineering)

Table 7. Themes from the qualitative data.

Categories	Themes	Descriptions of themes
RQ3: Students' perceptions of their research experience	Rewarding experience	● Helpful and thorough feedback received from supervisor ● Being respected and cared for by supervisor ● Supportive relationship with peers ● No complaint about intellectual climate ● Infrastructure meets research needs
	Ordinary experience	● Being supervised with a laissez-faire approach ● Supervision is available but slow and general ● Little complaint about peer support ● Intellectual climate can be improved ● Infrastructure meets research needs
	Unsatisfactory experience	● Ineffective and unhelpful supervision ● Product- or result-oriented supervision ● Low support from peers or faculty ● Low perceived benefits of intellectual climate on research outcomes ● Insufficient lab resources to ensure research efficiency ▲Student-supervisor misfit in research topic and supervision style ▲ Publication pressure of supervisors ▲ COVID-19 pandemic
RQ4: Aspects of research experience that were important to students' skill development and overall satisfaction	Supervision that focuses on the bigger picture	● Guidance on topic selection and research design ● Answering students' questions during the research process ● Reviewing students' papers
	Specific advice and social support offered by the peers	● Specific guidance ▲ Social support
	Intellectual climate that broadened students' horizons	● Knowledge exchange with other researchers ● Being aware of the current research in the field
	Infrastructure as a basic requirement	● Basic requirements for research

Note. ● = themes explaining quantitative results, ▲= emerging themes.

Rq3: Students' perceptions of their research experience

The results were consistent with the quantitative study (Study 1) that students' research experience could be categorized into three groups based on their interviews: rewarding, ordinary, and unsatisfactory.

Rewarding research experience group. Students classified into the rewarding research experience group spoke optimistically about almost all areas of their research experience. They were pleased with the supervision received. Participant #4, for example, mentioned that 'I can feel that [my supervisor] really cares about me. She often asks me how I am doing. When she assigns me a task, she does not push me but gives me sufficient time to do it.' Meanwhile, they tended to 'have harmonious relationships with

peers' (Participant #7) and lend academic support to each other. Students in this group did not have any complaints about the perceived intellectual climate and research infrastructure.

Ordinary research experience group. Students categorized in the ordinary research experience group had mixed comments about their overall research experience. Most students were moderately satisfied with their supervision and expected more effective guidance. For example, Participant #3 stated, 'Although the supervision is different from what I expected, my supervisor does provide support to me. The negative aspect is that he is unfamiliar with my research area.' Students also perceived a moderate level of peer support and intellectual climate. As shared by Participant #2, 'The research conference organized by the faculty is a platform for communication, but the quality is not high. Some students' sharing is inspiring, while others are underprepared.' Meanwhile, students were generally satisfied with the research infrastructure.

Unsatisfactory research experience group. Students were classified as unsatisfactory when they reported negative feelings in multiple areas of their research experience. They conveyed that they did not obtain effective support from their supervisors and peers. As complained by Participant #8, 'The guidance from my supervisor is very general … feedback does not make sense. Meanwhile, no support from peers. Team meetings are also not helpful. Everyone would just ask some questions and talk about their research, but they do not help each other.'

One participant reported that the lack of infrastructure support notably impacted her research experience:

> The lab is most needed for us who study organic chemistry. However, the fume hood at our school is of low quality, which impacts not only the quality of experiments but also students' health. Sometimes the machine breaks down, and it usually takes a long time to repair. (Participant #5)

Emerging themes. Three emerging themes deepened our understanding of the postgraduate research experience. The first was the student-supervisor misfit regarding the research topic and supervision style. For example, Participant #6 stated, 'My research topic is different from my supervisor's. If there is a better match, it will save much time.' Some participants also reported that they would gain better research experience if their 'supervisor's supervision style matched their research needs' (Participant #2).

The second emergent theme was the publication pressure experienced by the supervisors. Compared with the professors who were more established in their fields, early-career faculty members were more stressed with heavy research workload and had less time to supervise students. For instance, Participant #6 stated, 'My supervisor has not passed the tenure review yet. He has a lot of work and pressure, so it is impossible for him to spend much time [providing guidance].' In contrast, Participant #10 reported that her supervisor was about to retire and thus had less pressure at work. 'I think my supervisor is now more focused on developing students. He hopes I can graduate with some achievements, like publishing some good papers.'

The third emergent theme was remote learning during the period of COVID-19. Participant #9 shared, 'Online communication and face-to-face are quite different, including your understanding of the person. [Online communication] makes you feel you do not know the person well.' COVID-19 has further exacerbated students' dissatisfaction with research infrastructure because students 'cannot go to the university, office, or the library' (Participant #7).

Rq4: Aspects of research experience that had been important to students' skill development and overall satisfaction

Supervision that focuses on the bigger picture. Supervision was regarded as the paramount facet of students' research experience and supervisors were expected to help their students navigate through their research. As illustrated by Participant #10, 'Many of my research ideas came from my supervisor. I did not come up with the overall research roadmap, so my supervisor gave me a general goal, and I needed to complete the small details.' The main functions of supervision mentioned included guiding topic selection and research design, answering students' questions

during the research process, and recommending resources related to students' research. For example, Participant #7 shared that

> The way he [supervisor] guides me is that after I send him something I wrote, he would provide me with suggestions for revision and sometimes reference books to read. He would revise very carefully and offer guidance on my ideas and writing styles. I think it is very helpful.

Specific advice and social support offered by the peers. Compared with the general and directional guidance received from the supervisor, peers could provide specific advice, such as how to use experimental apparatus. For example, Participant #5 mentioned that

> When I first entered the program, I did not know how to do many experiments or use the instruments. When I had problems that the senior students had also encountered before, they helped me and provided opportunities for me to learn faster. Skill development and peer support are highly relevant.

Intellectual climate that broadens students' horizons. Regarding intellectual climate, several participants indicated that the opportunities to listen to other researchers' sharing helped them broaden their horizons and get new insights, such as 'learning new methodologies and making one aware of the current research in the field' (Participant #9).

Infrastructure as a basic requirement. Infrastructure is viewed as a 'basic requirement for research' (Participant #3). Most participants were satisfied with the research infrastructure, and hence, mentioned it as having a relatively small impact, especially for social sciences students who can 'easily conduct their research with a personal laptop' (Participant #6).

Overall, no differences by field of study were identified in terms of students' research experience, skill development and research satisfaction. Although research practices did vary between fields of study, they did not necessarily translate into different outcomes. For example, compared with non-STEM students, those in the STEM fields were more likely to have regular team meetings where supervisors gathered their students to share research progress. However, this did not necessarily mean that students who did not participate in such meetings perceived less support. One-on-one meetings with the supervisor, email communications, and reading groups were other ways for the students to obtain supervision and peer support. For example, Participant #4, categorized in the rewarding research experience group, had no team meetings but frequently communicated with her supervisor regularly. She was satisfied with the supervision and stated, 'The communication with my supervisor is more frequent [during busy times]. When it's not that busy, we may communicate once every couple of days.'

Discussion

This study aimed to explore the variations in postgraduate students' research experience with a mixed-methods approach. The quantitative study found that students' research experience could be grouped into unsatisfactory, ordinary, and rewarding profiles. Students with varying research experience profiles differed in their skill development and overall satisfaction. The qualitative results showed how students perceived their research experience and illustrated how different aspects of the research experience facilitated skill development and overall satisfaction. These findings demonstrated the necessity of going beyond institutional level studies and focusing on individual differences in research experience (Sampson et al. 2016).

The variations in the postgraduate research experience

Compared with previous benchmarking exercises that paid attention to the average research experience at the institutional level (e.g. Australian Council for Educational Research 2000; Pitkin 2021), the identification of rewarding, ordinary, and unsatisfactory research experience at the individual level unpacked the role of research experience in individual development. It should be noted that only

a small percentage of students (15.34%) were in the rewarding group. This finding suggests that there is a large room for universities to optimize students' research experience. As the expansion of postgraduate education has raised increased concerns about the quality of talent development in Hong Kong (Shin, Postiglione, and Ho 2018), this finding provides valuable information for stakeholders to optimize individual research experience.

Several factors that influenced students' research experience were found in the qualitative interviews. First, the importance of the fit between supervision styles and student needs is consistent with previous research (Gurr 2001). The student-supervisor misfit regarding the research topic and supervision style would decrease the effectiveness of supervision (Cardilini, Risely, and Richardson 2022). Second, the negative influence of COVID-19 corroborates previous research, which indicated that the lockdown of universities would lead to limited access to institutional resources, libraries, and laboratories. Meanwhile, remote learning during the COVID-19 pandemic hindered students' communication with their supervisors. These barriers decreased academic opportunities and the quality of research experience (Jung, Horta, and Postiglione 2021). Third, supervisors' publication pressure was negatively associated with students' research experience. To benchmark with the top universities worldwide, Hong Kong universities prioritized faculty publications to improve their rankings in the global university league tables, linking research output with promotion and tenure (Mok 2005). Under the tremendous pressure of tenure, early career supervisors were more likely to devote much more time to their own research, lowering the quality of supervision. In contrast, supervisors who had tenure might have less pressure to produce research outputs and could allocate much more time to their students.

We found that students' satisfaction with their research experience was not influenced by their field of study, which is inconsistent with some studies conducted in Western countries. For example, Johnston et al. (2016) demonstrated that postgraduate students in STEM-related majors interacted more with their supervisors and peers through the laboratory/research group meetings, while non-STEM students were more isolated, and students had less chance to discuss their research with their peers. Our study showed that various communication formats could complement each other. Non-STEM students could receive effective support from their supervisors and peers through one-on-one meetings, email communication, and reading groups.

To reiterate, this study was conducted in the Hong Kong context, where most postgraduate students were from mainland China and largely influenced by Confucian heritage culture. Many students reported that the student-supervisor misfit in supervision style was a major barrier that decreased their satisfaction with their research experience. However, students do not dare to express their concerns to their supervisors as supervisors are respected as knowledgeable authorities, and students seldom question their supervisors due to high power distance (Zeng and Watkins 2010). In contrast, the supervisor-student relationship is less hierarchical in Western countries, and students are more likely to negotiate expectations with their supervisors.

Furthermore, our study showed that peer support was an important dimension of research experience in Hong Kong, which positively contributed to students' overall satisfaction and skill development. However, peer support is rarely considered in the Western literature. The critical role of peer support in students' research experience might be influenced by the collectivist culture, where students are more closely affiliated with their peers and benefit from obtaining both academic and emotional support from their peers (King 2015; Wang et al. 2021). Chinese culture even has specific terms for peers studying under the same supervisor, such as *shixiong* (academic elder brother) and *shijie* (academic elder sister), which emphasizes the family-like bonds that characterize peers in such collectivist contexts.

The role of the research experience in skill development and overall satisfaction

We found that students in the rewarding research experience profile had a higher level of skill development and overall satisfaction than their peers in ordinary and unsatisfactory profiles. This finding

aligns with previous variable-centered research, which reported a positive relationship between research experience and the outcomes (e.g. Zeng and Watkins 2010). However, past studies focused on each dimension of the research experience in isolation. Our study extends them by revealing how multiple dimensions of research experience were synergically associated with skill development and overall satisfaction.

Meanwhile, the qualitative results demonstrated the distinct but complementary roles of different aspects of the research experience. This finding is within expectation. For example, Zeng and Watkins (2010) found that supervision plays a key role in helping students navigate their research journey by setting research goals, refining the research topic, and providing feedback. Brew, Boud, and Malfroy (2017) demonstrated that a vibrant intellectual climate, such as seminars and conferences, functioned as a good way to offer participants a broad outlook by exchanging their research ideas. Unexpectedly, our results indicated that the effect of research infrastructure on skill development and overall satisfaction was smaller relative to other dimensions. We surmised that this is because all participants were from a prestigious university in Hong Kong, where the research infrastructure has already largely satisfied students' needs.

Practical implications, limitations, and future directions

This study has significant practical implications. First, the identification of rewarding, ordinary, and unsatisfactory profiles provides a nuanced understanding of individual differences in research experience, which can inform stakeholders to tailor interventions for the subgroups of students based on their needs. Second, the qualitative research showed why students are satisfied/dissatisfied with their research experience, pointing out potential areas of improvement. Third, the positive linkages among research experience profiles, skill development, and overall satisfaction highlight the necessity of optimizing students' research experience to help them develop generic and research skills (Sampson et al. 2016).

Despite its strengths, two limitations should be addressed. First, although the sample in quantitative and qualitative were purposefully selected to maximize variation to represent the diversity of postgraduate students, the sample did not cover all disciplines. Hence, we encourage future studies to examine the robustness of our research findings with a more diversified sample. Second, since Study 1 was an anonymous survey, we could not track these participants. Hence, participants in Study 2 were recruited separately. We encourage future studies to conduct a more rigorous design and triangulate the findings by recruiting interviewees from the quantitative study.

Conclusions

Research postgraduate students have different research experiences, which have important implications for their skill development and overall satisfaction. The quantitative study identified three major subgroups: rewarding, ordinary, and unsatisfactory. The qualitative findings largely corroborated the quantitative results but also highlighted other key themes such as student-supervisor misfit, the COVID-19 pandemic, and supervisors' publication pressures as potentially important dimensions of students' research experience. Providing an optimal research experience should be a key institutional goal, and the findings of this study might provide useful inputs to higher education institutions.

Note

1. Higher education in Hong Kong is rooted in both the British colonial heritage and traditional Confucian culture (Postiglione and Jung 2017). On the one hand, the academic culture is influenced by the British higher education system, which highlights a more collegial relationship between supervisors and students and the supervisor-student relationship is characterized by mutual respect. On the other hand, the traditional Confucian culture

emphasizes hierarchy and power distance between the supervisor and the student. Although most postgraduate students in this sample university are from the Chinese context and influenced by traditional Confucian culture, the university has very strong British roots. At an institutional level, the university encourages free interaction and exchange between supervisors and students with no duress, harassment and conflict of interest. Meanwhile, most academic staff in this university were from or educated in Western countries (e.g. the UK, Canada, Australia, and the US).

Disclosure statement

No potential conflict of interest was reported by the author(s).

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