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# The student research experience questionnaire in Japan: validation and structural relations among experience dimensions, skill development and satisfaction

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## Abstract

**Purpose** – Measuring postgraduate students' research experiences is crucial for incorporating student perspectives and ensuring quality assurance and improvement in higher education. However, limited research has been conducted on the relationship between research experiences and student outcomes in non-Western contexts. This study aims to validate the Student Research Experience Questionnaire (SREQ), originally developed in Australia, within the context of Japan and to explore the relationships between different domains of students' research experiences, their perceived skills development and overall satisfaction with their research degree experience.

**Design/methodology/approach** – A total of 126 postgraduate students from a leading national university in Japan participated in the study by completing a questionnaire. The results supported the construct validity of six scales: supervision, infrastructure, intellectual climate, peer support, program design and skill development.

**Findings** – Results of structural equation modeling revealed that supervision, infrastructure, peer support and program design were significantly associated with students' perceived skills development, while supervision and peer support were significantly associated with overall satisfaction.

**Originality/value** – Implications for enhancing the research experiences of postgraduate students in Japan are discussed.

**Keywords** Research experience, Higher education, Measurement tool, Japan

**Paper type** Research article

In recent decades, the mission of quality assurance in higher education has expanded from monitoring the quality of teaching and learning to also strengthening the academic environments in which students learn (Zeng, 2021). This shift has encouraged the adoption of student-centered learning perspectives in quality assurance and enhancement (Beausaert *et al.*, 2013; Prosser, 2004), which emphasize that educational outcomes are not determined by instruction alone but by how students engage with the learning context. Within this context, surveys have proven instrumental in assessing the quality of education from the perspective of undergraduate students' experiences (Ahmad and Al-Thani, 2022; Linn *et al.*, 2015). However, comparatively little attention has been given to understanding and evaluating the



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research experiences of postgraduate students. While some efforts have been made to validate measurement tools and examine research experiences in non-Western contexts, such as Hong Kong (Zeng, 2021; Zeng *et al.*, 2013), no comparable evaluations have been conducted in Japan.

To address this research gap, the present study aims to validate a measurement tool for assessing the research experiences of postgraduate students in Japan and to explore the research experiences of postgraduate students at a national university in the country. A validated measurement tool would enable researchers and institutions to collect valuable data on student experiences across various academic fields, informing decisions on curriculum design, teaching practices, and resource allocation. Furthermore, fostering a culture of continuous improvement through regular assessment and feedback mechanisms can help institutions respond effectively to the evolving needs of students and society. This proactive approach to quality assurance would not only enhance the educational experiences of postgraduate students in Japan but also provide insights into Japan's standing within the global higher education landscape.

## The measurement of postgraduate students' research experience

To date, most measurement tools have primarily focused on assessing the educational experiences of undergraduate students. For instance, the Course Experience Questionnaire (CEQ) (Griffin *et al.*, 2003; Wilson *et al.*, 1997) is one of the most frequently used tools to measure undergraduate students' perceptions of their learning experiences. The application of this questionnaire provides a comprehensive understanding of university students' experiences, contributing to improvements in teaching and learning at the undergraduate level. In contrast, fewer measurement tools have addressed the research experiences of postgraduate students, particularly the factors that influence research skill development and degree completion. Previous studies have identified demographic factors such as age, country of origin, mode of study, and academic discipline as important predictors of whether students complete their research degrees on time (Spronken-Smith *et al.*, 2018; Wollast *et al.*, 2018). Moreover, supervision has increasingly been highlighted as a key factor contributing to degree completion (Mbogo *et al.*, 2020). However, few studies have proposed a comprehensive measurement tool that incorporates both student-related and supervisor-related factors and systematically examines the relationships between these factors and research students' learning outcomes (e.g. generic skill development and satisfaction with the research experience).

The Postgraduate Research Experience Questionnaire (PREQ) was one of the first evaluation tools developed for research students (Marsh *et al.*, 2002). The PREQ is a multidimensional measure of student research experiences, encompassing aspects such as Supervision, Intellectual Climate, Infrastructure, Thesis Examination, and Goal Clarity, as well as outcomes including Generic Skill Development and Overall Satisfaction. Supervision focuses on how satisfied research students are with the support provided by their supervisors. Intellectual climate concerns whether research students perceive a supportive research environment fostered by university faculties. Infrastructure reflects the accessibility of university resources and technology. Thesis Examination addresses the fairness of arrangements for thesis evaluation. Goal Clarity concerns the establishment of clear aims and objectives for research development. Overall Satisfaction focuses on how satisfied students are with the overall quality of their learning experience, particularly the degree curriculum. Skill Development concerns the growth of research skills among students.

Building on the PREQ, the Student Research Experience Questionnaire (SREQ) was developed (Ginns *et al.*, 2009). The SREQ modified the original PREQ by excluding the Thesis Examination and Goal Clarity dimensions, while expanding the dimensions of Intellectual Climate and Generic Skill Development. Overall, the SREQ includes four dimensions: Supervision, Infrastructure, Intellectual and Social Climate (renamed from

Climate), and Skill Development (renamed from Generic Skill Development). The SREQ assumes that research experience should be associated with students' skill development and overall satisfaction. The SREQ has been validated among research students in Hong Kong (Zeng, 2021; Zeng *et al.*, 2013). These studies further support the construct validity of the four SREQ scales and suggest the potential for applying the SREQ in different countries, especially within Asian universities. Therefore, this study aims to modify and validate the SREQ within the context of Japanese higher education, and explore the research experiences of postgraduate students in Japan.

**Japan's context of higher education**

Since the late 1950s, Japan has developed a modern higher education system influenced by both the German research university tradition and the U.S. doctoral model to meet growing national needs for research and development (Arimoto *et al.*, 2019). Within this system, universities are commonly grouped into three administrative sectors, national, local public, and private, but their institutional missions and research intensity are not uniform within each sector. While national universities have historically included many research-intensive institutions, some national universities place greater emphasis on undergraduate teaching and professional preparation than on postgraduate research. Conversely, a number of local public and private universities are also highly research active. Accordingly, rather than treating sector type as a proxy for research intensity, the present study focuses on a research-intensive national university context in which postgraduate students are substantially engaged in research training. This sampling choice allows us to examine the applicability of the SREQ in a setting where research supervision and day-to-day research practices are salient features of student experience. At the same time, we recognize that postgraduate research experiences may differ in teaching-oriented institutions or in research-intensive private/local public universities, and we therefore interpret the findings as most directly generalizable to similar research-intensive settings.

In postgraduate programs in Japan, the standard duration for a research master's degree is typically two years, while a doctoral degree generally requires three years of study. However, individual graduate schools have the authority to extend these periods based on specific circumstances, allowing students to complete their studies over a prolonged period of up to eight years (Ikkatai *et al.*, 2020). The design of postgraduate programs in Japan reflects the influence of foreign educational models, resulting in varied approaches to research training across disciplines. For example, Japanese universities adopt an individualized mentorship style, emphasizing focused research under the guidance of a single advisor, which reflects the German model's tradition (Zhang *et al.*, 2024). Team-based supervision, drawing inspiration from the model of the United States, may also be applicable (Ali *et al.*, 2016). This dual approach enables Japan's higher education system to effectively cater to the specific needs of different academic fields while aligning with global standards.

Research on postgraduate education and research training in Japan has grown in recent years. Survey-based studies indicate that features of doctoral training and supervision are associated with graduates' career decisions and satisfaction with their programs (Shibayama and Kobayashi, 2017). Related work also suggests that students' attributes and the local laboratory environment are linked to doctoral progression and subsequent career pathways (Kobayashi and Shibayama, 2023). On the other hand, some scholars explicitly studied postgraduate students' educational outcomes. For example, Muroya *et al.* (2021) compared postgraduate training curricula using an objective knowledge test, which assesses educational outcomes but does not directly evaluate the research learning process. Qualitative studies using semi-structured interviews have also explored aspects of Japanese postgraduate students' learning experiences (e.g. Nagano *et al.*, 2019), but interview-based approaches are not easily scalable for routine monitoring or cross-cohort comparison. Taken together, prior work has not yet provided a validated instrument for systematically assessing postgraduate

students' research experiences across programs. Accordingly, the present study examines the reliability and validity of the Student Research Experience Questionnaire (SREQ) for use in the Japanese context.

This study will also utilize the validated measurement tool to examine the research experiences of postgraduate students in Japan. Assessing research experiences throughout students' academic journeys is crucial, as research on stress among Japanese doctoral students highlights various challenges, contributing to the growing body of literature on doctoral education and student well-being. Huang's (2021) study on the stress experienced by doctoral students in Japan, based on a national survey, sheds light on critical challenges in their research journey. The findings underscore that academic issues such as publication pressures, graduation requirements, and funding are significant stressors, reflecting the high expectations and competitive environment of doctoral programs. Furthermore, the study reveals disciplinary differences in concerns, with humanities and social sciences students particularly anxious about timely graduation, while applied sciences students express heightened concerns about career prospects, reflecting uncertainties about securing stable and relevant employment. These factors collectively contribute to elevated stress levels among doctoral students, highlighting the importance of support systems, including mentoring, mental health resources, and career guidance. Exploring postgraduate research experiences is essential not only to identify challenges but also to implement preventive measures that can reduce stress and improve overall student well-being. By gaining deeper insights into these experiences, institutions can create more supportive environments that address potential issues before they escalate.

## Theoretical framework

The Presage-Process-Product (3P) model conceptualizes educational outcomes as emerging from presage conditions (learner- and context-related inputs) that shape the process of learning and engagement, thereby producing products (learning and evaluative outcomes) (Biggs, 1993). Subsequent scholarship has further elaborated this model by foregrounding the interdependence between teaching-learning contexts, participants' experiences, and learning processes, and it continues to inform contemporary higher-education research (Trigwell and Prosser, 2020). Recent empirical work still draws on the 3P logic to formulate and test theoretically guided relations among contextual factors, learning processes, and outcomes across a range of learning settings, underscoring its ongoing relevance in contemporary contexts (e.g. Long *et al.*, 2025). Building on this logic, Trigwell and Dunbar-Goddet (2005) applied a 3P-informed perspective to postgraduate student research experience, arguing that dimensions of research experience can be treated as antecedent conditions that structure students' engagement in research and their subsequent outcomes. Importantly, this adaptation is best understood as a conceptual ordering for specifying and testing theoretically guided relations, rather than as a causal mechanism that can be assumed in the absence of direct evidence on intervening processes.

Within postgraduate research training, the research environment constitutes a salient set of presage conditions because it shapes students' opportunities to participate in research practices, access material and informational resources, and obtain guidance and feedback (Biggs *et al.*, 2001). In particular, the quality of supervision, the adequacy of infrastructure and resources, the intellectual and social climate within laboratories and departments, the availability of peer support, and the quality of program design are widely recognized as central features of the research learning context that plausibly precede, and sometimes condition, students' day-to-day research activity and professional development (Zeng, 2021; Zeng *et al.*, 2013). As evidence on postgraduate research experience in Japan remains limited, a framework is needed that can organize diverse features of the research learning context into analytically tractable inputs and relate them to meaningful outcomes. The Presage-Process-Product (3P) model is well-suited to this purpose because it provides a theory-driven structure

for examining how contextual and learner-related conditions in a given system are associated with students' developmental and evaluative outcomes (Biggs, 1993; Trigwell and Dunbar-Goddet, 2005). In the Japanese context, where institutional practices and expectations around supervision, laboratory membership, peer relations, and program organization may take distinctive forms, a 3P-informed lens can help reveal which aspects of the research environment are most strongly linked to students' perceived skill development and satisfaction, thereby generating evidence that is both comparable to international work and sensitive to local conditions (Zeng, 2021; Zeng *et al.*, 2013).

In this study, presage conditions are operationalized using five research experience dimensions in the instrument: supervision, infrastructure, intellectual climate, peer support, and program design. We examine their associations with two consequential outcomes, skill development and overall satisfaction, to evaluate whether the measurement functions coherently and whether the expected nomological pattern holds in the Japanese context. This approach is consistent with prior work on the SREQ, which treats core aspects of the research environment as experience dimensions and positions skill development and satisfaction as consequential outcomes (Ginns *et al.*, 2009; Zeng, 2021; Zeng *et al.*, 2013). At the same time, we remain cautious in interpretation as the hypothesized model represents a theory-driven ordering rather than evidence of causality, and alternative explanations including reciprocal relations remain possible with observational survey data. Nevertheless, this model provides a rigorous framework for evaluating whether the observed covariance structure is consistent with the 3P-informed specification and the conceptual assumptions embedded in the instrument.

Based on this model, we propose the following research questions:

*RQ1*. (Measurement model): Does the Japanese-adapted Student Research Experience Questionnaire demonstrate adequate psychometric functioning in a research-intensive national university context in Japan?

*RQ2*. (Structural relations): How are the five research experience dimensions (Supervision, Infrastructure, Intellectual Climate, Peer Support, and Program Design) related to (a) Skill Development and (b) Overall Satisfaction, when examined within a structural equation modeling framework?

## The present study

Building on the adapted 3P-informed perspective and prior work on the measurement of postgraduate research experience, the present study has two objectives aligned with the research questions above. To address RQ1, we evaluate the psychometric adequacy of the Japanese-adapted instrument by examining internal consistency and testing the hypothesized measurement structure. To address RQ2, we use structural equation modeling to estimate the relations between the five research experience dimensions (i.e. supervision, infrastructure, intellectual climate, peer support, and program design) and two outcomes (i.e. skill development and overall satisfaction) within a single model.

## Methods

### *Participants and procedures*

Current research postgraduate students were recruited from a flagship national university in Japan via university email and promotional posters. A total of 126 postgraduate students participated in the online survey, comprising 49 females and 77 males ($M_{age}$: 28.5 years, $SD = 4.24$). Among them, 44 were pursuing research master's degrees, while 82 were enrolled in doctoral programs. These students represented a broad range of academic disciplines, with 25 students from humanities-related fields and 101 from science-related fields. The majority of participants were full-time students, with only 19 enrolled on a part-time basis. The sample included 69 Japanese students and 57 international students. Nearly one-third of the

respondents (30.95%, $N = 39$) were in their first year, while more than one-third (41.27%, $N = 52$) were in their second year. Fewer than one-third (27.78%, $N = 35$) were in their third year. Ethical approval for the study was obtained from the Human Research Ethics Committee of the first author's university prior to data collection.

*Sample size considerations*

As recruitment was conducted within a single institution and participation was voluntary, the final sample size ($N = 126$) reflects the size of the accessible postgraduate research cohort and the response obtained during the data-collection period (e.g. within the scheduled recruitment window and without incentives). As a result, the present study should be interpreted as an initial, context-specific validation rather than a definitive test of a fully item-level SEM in a large population. We therefore interpret model fit indices and structural estimates cautiously as small samples can reduce precision (i.e. larger standard errors and wider confidence intervals), lower power to detect small associations, and increase sensitivity to sampling variability (Wolf *et al.*, 2013). Accordingly, conclusions are based on the overall pattern of estimates and their uncertainty rather than on dichotomous interpretations, and replication with larger, multi-institution samples is needed to evaluate the stability and generalizability of the measurement structure and structural relations.

*Instrument*

In the present study, we adapted the Student Research Experience Questionnaire (SREQ), which was initially developed in the Australian context and later adapted for research students in the East Asian context (e.g. Hong Kong) (Zeng, 2021; Zeng *et al.*, 2013). The original measurement includes 5 domains: supervision (7 items), infrastructure (7 items), intellectual climate (7 items), generic skill development (7 items), and overall satisfaction (1 item). In a related study (Zeng *et al.*, 2013), a sub-scale, "peer support" (7 items), was added to capture Hong Kong students' research experiences. All the items from these subscales were reviewed by experts in psychometric measurement, education, and research, as well as by research students and staff members who work with research students at the flagship national university. This review aimed to gather critical feedback and assess the content validity of the questionnaire to ensure its relevance to the Japanese context. Based on the feedback, a new domain, "program design" (7 items), was added to capture the comprehensive structure, organization, and effectiveness of the research programs, including aspects such as course content and alignment with students' academic and professional goals (see Appendix 1 for the whole questionnaire). The questionnaire was translated from English to Japanese for students. A back translation (Ozolins *et al.*, 2020) from Japanese to English was also adopted to ensure the accuracy of the Japanese translations. Students were asked to respond to each item of the translated questionnaire based on the extent to which they agreed with a statement, using a 5-point Likert scale (from 1 = strongly disagree to 5 = strongly agree), consistent with the original SREQ questionnaire. Additionally, students provided demographic information, including gender, age, academic discipline, mode and year of study.

*Data analysis*

This study aimed to examine the psychometric properties of the SREQ based on responses from individual students in Japan. Initially, all the participants were included. However, prior to data analysis, two cases were excluded: one due to missing background information and another due to the complete absence of responses on the skill development scale. For the remaining dataset, missing values accounted for less than 5% of the total. Full Information Maximum Likelihood (FIML) was applied to address the missing values.

Following best practices for robust psychometric testing and model validation, the sample was randomly divided into two subgroups ($N_1 = 62$, $N_2 = 62$) for analysis. Exploratory Factor

Analysis (EFA) was performed on the first subgroup using Mplus 8.11 to examine the factorial structure of the 43 SREQ items. Additionally, the internal consistency of the identified scales was assessed using Cronbach's alpha.

Subsequently, Confirmatory Factor Analysis (CFA) was conducted on the second subgroup, also with Mplus 8.11, to evaluate the scale validity and confirm the factorial structure. Since chi-square is sensitive to sample size (Schumacker and Lomax, 2016), we relied on model fit indices, including the Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR), to assess the model's goodness of fit. According to Hu and Bentler (1999), a good fit is indicated by CFI and TLI values of 0.95 or above, an RMSEA of 0.06 or below, and an SRMR of 0.08 or below.

Furthermore, correlational analyses were conducted to explore the relations between the domains of research experience (i.e. supervision, infrastructure, intellectual climate, peer support, and program design) and students' perceived skill development and overall satisfaction. Structural Equation Modeling (SEM) was further employed to examine the relations between domains of students' research experiences and their perceived skill development and overall satisfaction.

## Results

Overall, respondents reported medium-to-high scores across all research experience variables measured. On a 5-point scale, the highest mean score was observed for supervision ($M = 4.06$, $SD = 1.03$), followed by peer support ($M = 3.99$, $SD = 0.94$). Scores for intellectual climate ($M = 3.57$, $SD = 0.79$), infrastructure ($M = 3.39$, $SD = 0.63$), and program design ($M = 3.31$, $SD = 0.59$) were comparatively lower. The self-perceived level of skill development was high ($M = 4.06$, $SD = 0.97$), as was the overall satisfaction ($M = 4.04$, SD = 0.99).

### *Exploratory factor analysis*

Exploratory factor analysis (EFA) was conducted to examine the underlying structure of the 43-item instrument using principal axis factoring with Promax rotation. Results are presented in Table 1. Sampling adequacy and factorability were satisfactory. A six-factor solution was retained and accounted for 65.7% of the total variance. All items met the retention criteria (primary loadings ≥0.50; cross-loadings ≤0.30), and no items were removed. Internal consistency estimates for the resulting scales were high, ranging from 0.849 to 0.970. Full item loadings are reported in Table 2.

### *Confirmatory Factor Analysis*

Confirmatory factor analysis (CFA) evaluated six congeneric measurement models and the overall measurement model. Following Hu and Bentler's (1999) criteria, the fit indices

**Table 1.** Exploratory factor analysis diagnostics and summary

| Component | Result |
|---|---|
| Extraction method | Principal axis factoring |
| Rotation | Promax (oblique) |
| Kaiser-Meyer-Olkin (KMO) | 0.866 |
| Bartlett's test of sphericity | $\chi^2(861) = 2042.423$, $p < 0.001$ |
| Retention criterion | Eigenvalue >1 |
| Number of factors retained | 6 |
| Total variance explained | 65.7% |
| Item retention rule | Loading ≥0.50; cross-loading ≤0.30 |
| Items retained/excluded | 43 retained; 0 excluded |
| Internal consistency (α range) | 0.849–0.970 |

**Table 2.** Exploratory factor analysis and reliability

| Scales | Items | Factor 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| | | Factor loading | | | | | |
| 1. Supervision | s1 | 0.926 | 0.02 | 0.04 | 0.02 | 0.05 | 0.07 |
| | s2 | 0.966 | 0.02 | 0.11 | 0.06 | 0.08 | 0.05 |
| | s3 | 0.923 | 0.02 | 0.03 | 0.08 | 0.05 | 0.06 |
| | s4 | 0.918 | 0.02 | 0.02 | 0.05 | 0.02 | 0.04 |
| | s5 | 0.885 | 0.03 | 0.04 | 0.11 | 0.02 | 0.02 |
| | s6 | 0.938 | 0.02 | 0.02 | 0.06 | 0.03 | 0.04 |
| | s7 | 0.961 | 0.03 | 0.04 | 0.07 | 0.03 | 0.05 |
| 2. Infrastructure | i1 | 0.10 | 0.904 | 0.02 | 0.03 | 0.03 | 0.01 |
| | i2 | 0.06 | 0.704 | 0.01 | 0.04 | 0.02 | 0.01 |
| | i3 | 0.07 | 0.739 | 0.03 | 0.04 | 0.03 | 0.02 |
| | i4 | 0.08 | 0.878 | 0.01 | 0.05 | 0.04 | 0.05 |
| | i5 | 0.09 | 0.769 | 0.04 | 0.02 | 0.03 | 0.04 |
| | i6 | 0.05 | 0.834 | 0.02 | 0.05 | 0.06 | 0.02 |
| | i7 | 0.05 | 0.905 | 0.01 | 0.06 | 0.03 | 0.02 |
| 3. Intellectual climate | ic1 | 0.02 | 0.04 | 0.798 | 0.10 | 0.05 | 0.10 |
| | ic2 | 0.02 | 0.04 | 0.797 | 0.03 | 0.06 | 0.03 |
| | ic3 | 0.11 | 0.07 | 0.610 | 0.02 | 0.05 | 0.02 |
| | ic4 | 0.04 | 0.02 | 0.782 | 0.04 | 0.11 | 0.03 |
| | ic5 | 0.02 | 0.05 | 0.897 | 0.02 | 0.06 | 0.02 |
| | ic6 | 0.01 | 0.03 | 0.940 | 0.04 | 0.05 | 0.04 |
| | ic7 | 0.01 | 0.04 | 0.844 | 0.02 | 0.03 | 0.02 |
| 4. Peer support | p1 | 0.02 | 0.05 | 0.03 | 0.715 | 0.02 | 0.03 |
| | p2 | 0.03 | 0.03 | 0.02 | 0.882 | 0.03 | 0.03 |
| | p3 | 0.03 | 0.04 | 0.03 | 0.877 | 0.03 | 0.04 |
| | p4 | 0.04 | 0.04 | 0.03 | 0.902 | 0.04 | 0.03 |
| | p5 | 0.02 | 0.05 | 0.05 | 0.902 | 0.02 | 0.01 |
| | p6 | 0.03 | 0.03 | 0.02 | 0.829 | 0.03 | 0.01 |
| | p7 | 0.03 | 0.04 | 0.03 | 0.940 | 0.04 | 0.02 |
| 5. Program design | pd1 | 0.04 | 0.03 | 0.03 | 0.02 | 0.890 | 0.05 |
| | pd2 | 0.02 | 0.01 | 0.01 | 0.03 | 0.847 | 0.05 |
| | pd3 | 0.03 | 0.03 | 0.02 | 0.04 | 0.868 | 0.04 |
| | pd4 | 0.11 | 0.08 | 0.03 | 0.02 | 0.677 | 0.03 |
| | pd5 | 0.10 | 0.05 | 0.02 | 0.01 | 0.654 | 0.02 |
| | pd6 | 0.03 | 0.04 | 0.03 | 0.02 | 0.902 | 0.01 |
| | pd7 | 0.01 | 0.02 | 0.02 | 0.01 | 0.825 | 0.05 |
| 6. Skill development | sd1 | 0.02 | 0.05 | 0.06 | 0.02 | 0.03 | 0.905 |
| | sd2 | 0.03 | 0.03 | 0.05 | 0.04 | 0.07 | 0.963 |
| | sd3 | 0.03 | 0.04 | 0.05 | 0.05 | 0.02 | 0.942 |
| | sd4 | 0.04 | 0.04 | 0.03 | 0.02 | 0.04 | 0.964 |
| | sd5 | 0.03 | 0.05 | 0.02 | 0.01 | 0.06 | 0.919 |
| | sd6 | 0.02 | 0.03 | 0.01 | 0.05 | 0.04 | 0.883 |
| | sd7 | 0.03 | 0.02 | 0.04 | 0.02 | 0.02 | 0.952 |
| Cronbach's alpha | | 0.937 | 0.896 | 0.849 | 0.970 | 0.858 | 0.965 |

indicated good model fit for all congeneric models and the overall measurement model (Table 3), providing support for the proposed measurement structure in this sample.

*Correlations*

Table 4 shows the correlations among variables. All variables significantly correlated with each other ($p < 0.01$), with correlations ranging from 0.324 to 0.740, indicating a range of moderate to strong positive relationships between the variables.

**Table 3.** CFA fit indices for congeneric models and the overall measurement model

| Model | $\chi^2$ | df | CFI | TLI | RMSEA | SRMR |
|---|---|---|---|---|---|---|
| Supervision | 18.43 | 14 | 0.978 | 0.956 | 0.038 | 0.024 |
| Infrastructure | 26.32 | 14 | 0.958 | 0.953 | 0.049 | 0.041 |
| Intellectual climate | 30.59 | 14 | 0.960 | 0.956 | 0.050 | 0.044 |
| Peer support | 20.02 | 14 | 0.963 | 0.967 | 0.036 | 0.023 |
| Program design | 28.95 | 14 | 0.956 | 0.954 | 0.050 | 0.038 |
| Skill development | 21.05 | 14 | 0.971 | 0.962 | 0.041 | 0.023 |
| Overall measurement model (including the overall satisfaction item) | 1638.42 | 819 | 0.950 | 0.953 | 0.042 | 0.039 |

*Structural model: predictors of skill development and overall satisfaction*

Structural equation modeling was conducted with the five research experience dimensions specified as predictors of two outcomes. The overall model demonstrated robust fit, with excellent fit indices ($\chi^2 = 1875.21$, df = 820, CFI = 0.951, TLI = 0.950, RMSEA = 0.045, SRMR = 0.041), confirming the validity of the hypothesized relationships. The standardized path estimates are reported in Table 5. Because the five predictors were significantly intercorrelated, their covariances were freely estimated in the SEM and are reported in Table 6. For skill development, supervision ($\beta = 0.42$, $p < 0.001$) and peer support ($\beta = 0.39$, $p < 0.001$) showed the strongest associations. Infrastructure ($\beta = 0.11$, $p < 0.05$) and program design ($\beta = 0.20$, $p < 0.05$) were also significantly associated with skill development. For overall satisfaction, supervision ($\beta = 0.53$, $p < 0.001$) and peer support ($\beta = 0.48$, $p < 0.001$) were significantly associated with satisfaction. Figure 1 presents a better visualization of the results. Overall, the findings suggest that relational dimensions of postgraduate research experience, particularly supervision and peer support, are most consistently linked to both perceived skill development and overall satisfaction in this sample.

## Discussion

The aspects of research experiences covered by the SREQ scales have been validated for use in the Japanese context, demonstrating consistency with findings from prior studies conducted in other East Asian settings, such as Hong Kong (Zeng, 2021; Zeng *et al.*, 2013). In the Japanese context, psychometric assessment of the SREQ using exploratory factor analysis revealed a clear multi-factor structure, with no cross-loadings exceeding 0.30 among the items, supporting the discriminant validity of the factors. Confirmatory factor analysis further demonstrated that the model fit the Japanese data well, aligning with the factorial structure initially identified by Ginns *et al*. (2009). Internal consistency of the SREQ scales was high, with Cronbach's alpha coefficients indicating reliable measurement across all domains. These findings confirm that the SREQ is a valid and reliable tool for analyzing the research experiences of postgraduate students in Japan.

In the theoretical framework of the SREQ, it is proposed that aspects of research experiences predict student skill development and overall satisfaction (Ginns *et al.*, 2009; Zeng *et al.*, 2013). The findings of this study generally supported this framework. We found that supervision and peer support directly predicted skill development and overall satisfaction. These findings align with work emphasizing that supervisory and peer relationships are central to students' academic progress and emotional wellbeing (Bruce and Stoodley, 2013). However, in contrast to their impact on both skill development and overall satisfaction, infrastructure and program design had a positive effect only on skill development. Positive infrastructure and program design theoretically predict skill development as they provide necessary tools, resources, and structured learning opportunities. Satisfaction with infrastructure and program design did not predict overall satisfaction. Given the modest

**Table 4.** Correlations among variables

| Scales | Supervision | Infrastructure | Intellectual climate | Peer support | Program design | Skills development | Overall satisfaction |
|---|---|---|---|---|---|---|---|
| Supervision | – | 0.538 | 0.585 | 0.640 | 0.372 | 0.622 | 0.737 |
| Infrastructure | – | – | 0.699 | 0.504 | 0.639 | 0.526 | 0.605 |
| Intellectual climate | – | – | – | 0.699 | 0.549 | 0.610 | 0.610 |
| Peer support | – | – | – | – | 0.324 | 0.640 | 0.728 |
| Program design | – | – | – | – | – | 0.464 | 0.407 |
| Skill development | – | – | – | – | – | – | 0.740 |

**Note(s):** The correlational analysis was conducted with the whole sample. All correlations are significant at the 0.01 level

**Table 5.** Structural equation model fit indices

| Predictor → outcome | $\beta$ | SE | $p$ |
|---|---|---|---|
| Supervision → Skill Development | 0.42 | 0.11 | <0.001 |
| Infrastructure → Skill Development | 0.11 | 0.05 | 0.028 |
| Intellectual Climate → Skill Development | 0.14 | 0.12 | 0.243 |
| Peer Support → Skill Development | 0.39 | 0.08 | <0.001 |
| Program Design → Skill Development | 0.20 | 0.09 | 0.026 |
| Supervision → Overall Satisfaction | 0.53 | 0.12 | <0.001 |
| Infrastructure → Overall Satisfaction | 0.17 | 0.14 | 0.225 |
| Intellectual Climate → Overall Satisfaction | 0.21 | 0.16 | 0.189 |
| Peer Support → Overall Satisfaction | 0.48 | 0.07 | <0.001 |
| Program Design → Overall Satisfaction | 0.26 | 0.18 | 0.149 |

**Table 6.** Estimated covariances among exogenous predictors

| Covariance (exogenous variables) | Standardized covariance | $p$ |
|---|---|---|
| Supervision ↔ Infrastructure | 0.538 | <0.01 |
| Supervision ↔ Intellectual climate | 0.585 | <0.01 |
| Supervision ↔ Peer support | 0.640 | <0.01 |
| Supervision ↔ Program design | 0.372 | <0.01 |
| Infrastructure ↔ Intellectual climate | 0.699 | <0.01 |
| Infrastructure ↔ Peer support | 0.504 | <0.01 |
| Infrastructure ↔ Program design | 0.639 | <0.01 |
| Intellectual climate ↔ Peer support | 0.699 | <0.01 |
| Intellectual climate ↔ Program design | 0.549 | <0.01 |
| Peer support ↔ Program design | 0.324 | <0.01 |

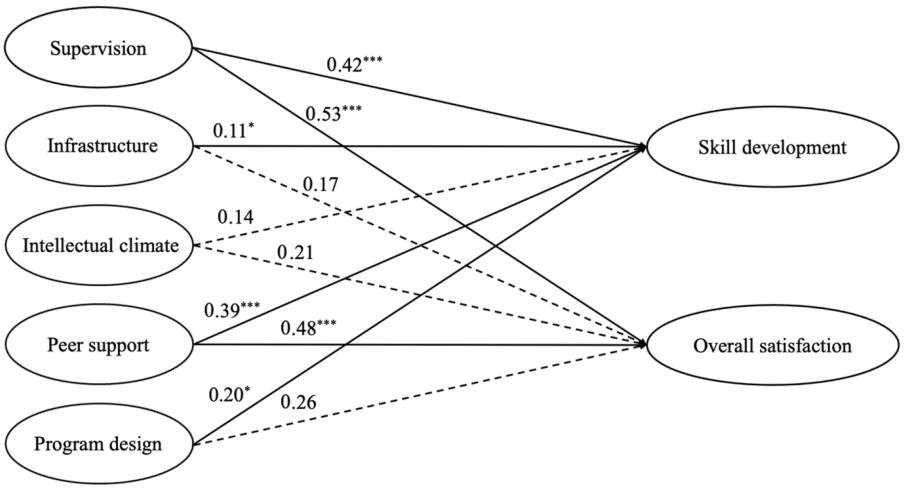


**Figure 1.** Structural equation model of the effects of research experiences on skill development and overall satisfaction. *Notes.* Values shown without brackets and connected by solid arrows represent statistically significant parameter estimates, while values shown in brackets and connected by dashed arrows represent non-significant estimates. $^{***}p < 0.001$, $^{*}p < 0.05$

sample size for SEM ($N = 126$), these null associations should be interpreted cautiously, as smaller samples can reduce statistical power to detect small effects and yield less precise estimates (e.g. larger standard errors and wider confidence intervals) (Wolf *et al.*, 2013).

Although the overall pattern broadly aligns with the SREQ framework, the present findings also diverge from prior Hong Kong validation work in two ways. In Hong Kong samples, intellectual climate has been reported as a positive correlate of overall satisfaction (Zeng *et al.*, 2013; Zeng, 2021), whereas this association was not observed in our Japanese sample. Conversely, peer support showed a clearer link with overall satisfaction in the present study than has been emphasized in the Hong Kong work. One plausible interpretation is that the most salient organizational "unit" of postgraduate research life differs by context. In Japan, postgraduate training is often experienced through laboratory- or group-based structures (e.g. Kenkyushitsu), where day-to-day work, informal learning, and socio-emotional coping can be tightly embedded in peer networks (Adams *et al.*, 2002). Prior research on doctoral educational experiences suggests that such relational ties can be central to students' identity development, well-being, and satisfaction, sometimes more so than broader departmental conditions (Dericks *et al.*, 2019). Under this interpretation, a favorable intellectual climate may matter, but its effects on satisfaction could be indirectly operated through more proximal relationships such as peers and supervisors rather than appearing as a direct predictor in a single-institution model. Future research should replicate these analyses using multi-institution, cross-national samples and formally test measurement and structural invariance, to determine whether the observed differences reflect true contextual variation or measurement artifacts.

Despite the robustness of the measurement tool in measuring the research experiences of Japanese students, there are limitations of the present study that results should be interpreted with caution. The sample size of the current study is relatively small and the scope of participant recruitment is narrow. The sample was drawn exclusively from one national university in Japan, which limits the diversity of the student population represented. This sampling method may not fully capture the variety of postgraduate research experiences across different institutional types, disciplines, and regional contexts within Japan. A modest sample can reduce the precision of parameter estimates (e.g. larger standard errors and wider confidence intervals) and limit the ability to detect small associations (Wolf *et al.*, 2013). Additionally, the reliance on cross-sectional data further limits the generalizability of the findings. To address these limitations, future research can include participants from a broader range of universities and different geographical regions in Japan. Moreover, employing a longitudinal research design would allow for a deeper understanding of how research experiences evolve throughout students' academic journeys. Expanding the participant pool and adopting a longitudinal approach would provide a more comprehensive and nuanced understanding of the postgraduate research experience in Japan, enabling more meaningful comparisons across diverse academic settings. Nevertheless, as the psychometric properties of this measurement tool have been validated in other East Asian context (Zeng *et al.*, 2013), it remains a crucial instrument for exploring the relationships between research experiences and learning outcomes of research students in Japan.

## Conclusion

The current study illustrates that the SREQ is a valid and reliable instrument for assessing postgraduate research experiences within the Japanese context. This validation provides a strong foundation for its application in future research to examine the multifaceted aspects of postgraduate education in Japan. Such investigations could have practical implications for enhancing the overall quality of postgraduate education by identifying strengths and areas for improvement within Japan's research environment. Additionally, the SREQ holds potential for cross-cultural studies to evaluate postgraduate research experiences in other countries. By applying the SREQ in diverse cultural contexts, such studies would contribute to enriching global discussions on postgraduate education and

research training, fostering a deeper understanding of how different systems and environments influence student experiences and outcomes.

**Data availability declaration**
The data that support the findings of this study are not publicly available due to privacy and ethical restrictions.

**Supplementary material**
The supplementary material for this article can be found online.

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