Educational Psychology Review (2024) 36:87
https://doi.org/10.1007/s10648-024-09924-8

REVIEW ARTICLE

A Systematic Review of Graduate Students' Research Motivation: Themes, Theories, and Methodologies

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Accepted: 19 July 2024

Abstract

This is a systematic review of empirical studies on graduate students' research motivation, a key factor for improving their research performance. A total of 57 articles and conference papers between 1993 and 2023 were identified through the thorough search process and quality assessment, and their research categories and themes, theories, and methodologies were synthesized. Based on this review, a Graduate Students' Research Motivation Model (GSRMM) was constructed, highlighting three main categories: antecedents, consequences, and mediating roles of graduate students' research motivation. The results of the study showed that manipulable antecedents have been extensively explored, but immutable antecedents, consequences, and the mediating roles of research motivation remain underexplored. Self-efficacy theory emerged as the dominant framework in the existing studies. Quantitative research design by means of self-report questionnaires dominated the current studies, which warrants a move towards alternative research measurements. This comprehensive review provides a deeper understanding of graduate students' research motivation and also suggests new avenues for further exploration in this field.

Keywords Motivation · Research motivation · Graduate students · Systematic review

Introduction

Motivation has been extensively studied in the field of education (Dörnyei & Ushioda, 2011). Since the 1970s, researchers have focused on understanding why and how motivation affects students' academic processes and outcomes (e.g., Ryan & Deci, 2020),

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Published online: 13 August 2024

with academic motivation being at the center of this discussion. Decades of studies have revealed that academic motivation is complex and multidimensional in academic settings, and it significantly impacts student performance at different educational levels (Fong, 2022). The goal of graduate students is to develop students who can produce innovative and rigorous scientific work through a system that includes challenging academic tasks and scientific research within an unstructured learning environment (Tiyuri et al., 2018; Westhuizen, 2014). As motivation plays a significant role in becoming an independent researcher (Daumiller & Dresel, 2020), an increasing number of studies have focused on graduate students' academic motivation, particularly through the lens of self-determination theory and social cognitive theory (Litalien et al., 2015; Munoz, 2021).

Graduate students' academic motivation goes beyond a simple focus on academic achievements to include a self-development approach within academic research contexts (Gerasimova, 2010). Research motivation, a type of high-level academic motivation, has drawn the attention of motivational researchers. Given that conducting academic research is challenging and scarcely externally regulated (Daumiller & Dresel, 2020), graduate students' research motivation, an internal psychological factor that drives their research engagement, sustenance, and regulation, significantly influences their behavior, cognition, and psychology (Zhang et al., 2022). However, studies have found that the levels of graduate students' research motivation vary and tend to decrease throughout their research process, resulting in negative and reciprocal interactions between their research attitudes and behaviors. There is much concern about graduate students' negative research attitudes, weak sense of researcher identity, lower research expectations, limited research participation, and ultimately low research productivity (Han & Wang, 2024; Livinţi et al., 2021; Poh & Kanesan Abdullah, 2019). As a result, few graduate students pursue a career in academia beyond graduate study, which undermines the goal of graduate education to equip students with the necessary skills to excel as researchers (Boss & Dunn, 2023).

To date, the importance of research motivation has prompted a systematic review that focuses on the barriers and facilitators of research, informed by expectancy-value theory and self-determination theory (D'Arrietta et al., 2022), as well as a narrative review examining extrinsic motivation and intrinsic motivation among scholars (Tran et al., 2019). However, these reviews have mainly concentrated on the research motivation of university faculties rather than graduate students. Given the increasing number of publications on graduate students' research motivation, there is a clear need for a synthesized review that provides a comprehensive understanding of this topic. Such a systematic review is essential in establishing a solid literature base on the research themes, theories, and methodologies related to graduate students' research motivation. Its findings will enhance accessibility to prior studies for prospective scholars and contribute to a deeper understanding of this important area.

Overview of Academic Motivation

Academic motivation was defined as "the process whereby goal-directed [academic] activity is instigated and sustained" (Schunk, Meece, & Pintrich, 2014, p. 5). Over the past two decades, there has been a growing interest in understanding academic motivation, with studies conducted from various perspectives (Fong, 2022). Decades of studies, guided by several cognitive motivation theories, show that academic motivation is a significant predictor of students' academic outcomes and performance (e.g., Amida et al., 2020; Eccles & Wigfield, 2020).

The significance of academic motivation has garnered considerable attention, leading to several review studies aimed at exploring the concepts and theories of academic motivation (e.g., Fong, 2022), methodology used in motivation studies (e.g., Wigfield & Koenka, 2020), motivation interventions (e.g., Rosenzweig & Wigfield, 2016), and practical educational applications of academic motivation theories (Rowell & Hong, 2013). These reviews contribute to a more nuanced understanding of the significant role that academic motivation plays in students' grit, persistence, engagement, and achievement (Murphy et al., 2019) and the various factors that influence academic motivation, including individual factors such as students' race, ethnicity, culture, social values and academic self-concept (e.g., Litalien et al., 2015), interpersonal factors such as teacher praise, confirmation and social support (e.g., Jia & Cheng, 2022) and contextual antecedents (e.g., Fong, 2022). However, these review studies have primarily focused on samples consisting of kids, primary and secondary school students, and undergraduates, leaving graduate students relatively understudied.

Academic Motivation of Graduate Students

The primary mission of graduate education is to introduce students to the research culture and contribute to the sharing of scientific knowledge (Han & Wang, 2024; Niromand et al., 2022). This is achieved through a combination of academic coursework as well as independent research under the guidance of a supervisor (Han et al., 2024; Tiyuri et al., 2018; Westhuizen, 2014). As students progress, their tasks become less structured and more focused on producing sound, rigorous, creative, and innovative research rather than the consumption of conformity knowledge (Liu et al., 2023). This shift highlights the importance of academic motivation for graduate students, the future independent researchers, to undertake complex academic tasks in a progressively less structured learning environment (Fong, 2022).

Studies of graduate students' academic motivation have been primarily guided by self-determination theory (SDT; Deci & Ryan, 1985) and social cognitive theory (SCT; Bandura, 1994), which were conducted to understand their primary intent to pursue, persist in, and successfully complete graduate education such as motivation to obtain a desirable job and get recognition from others (Amida

et al., 2020). SDT posits that higher levels of internal and autonomous motivation related to academic outcomes like success and graduation are supported (e.g., Lynch et al., 2018) when graduate students' psychological need for autonomy, competence, and related ness are met (Ryan & Deci, 2020). SCT emphasizes the significance of task- and context-specific self-efficacy in understanding the complexity of graduate students' academic motivation in their domain-specific discipline experiences (Munoz, 2021). Self-efficacy plays a crucial role in shaping graduate students' thoughts, emotions, and behaviors that lead to positive outcomes like increased academic engagement, continuation, completion, and overall success (Hardré et al., 2019).

Research Motivation of Graduate Students

The advanced development of graduate students' academic motivation goes beyond mere focus on academic outcomes to include research-related self-development (Gerasimova, 2010). Research motivation, which reflects graduate students' scholarly pursuit and aspiration for scientific contribution, constitutes a type of high-level academic motivation (Litalien, 2015). As academic research endeavors are characterized by minimal external regulation (Daumiller & Dresel, 2020), research motivation, a cognitive process that drives an individual to give rise to, sustain, and regulate research activities (Kuo et al., 2017), is a significant internal factor for graduate students to conduct research.

Different motivation theories have been applied to address research motivation, with the primary focus on university faculty members (Daumiller & Dresel, 2020). Existing studies of graduate students' research motivation have been informed by achievement goal theory (e.g., Deemer et al., 2007), self-determination theory (e.g., Sawant et al., 2017), self-efficacy (e.g., Kahn & Scott, 1997) and achievement motivation theory (e.g., Liu et al., 2023). Under those different theoretical underpinnings, graduate students' research motivation was found to be influenced by a number of personal and contextual factors such as research interest (e.g., Kerrigan & Hayes, 2016), academic atmosphere (e.g., Han et al., 2023), and supervisor support (e.g., Lynch et al., 2018). Meanwhile, it was also related to a number of cognitive consequences such as research outcome expectations (Bishop & Bieschke, 1998), behavioral consequences such as research productivity (e.g., Adekunle & Madukoma, 2022), and psychological consequences such as subjective well-being (Haider & Dasti, 2022). Therefore, a conceptual framework of graduate students' research motivation could be constructed (see Fig. 1), preliminarily demonstrating the relationship of research motivation with its antecedents or consequences. It provides the overview complexity of academic motivation theories within the research context and serves as a conceptual model to map out the descriptive analyses to be undertaken in this systematic review. In terms of methodological characteristics, those studies have predominately utilized a quantitative design, specifically relying on self-report questionnaires. It should be noted that self-report methodology to some extent yields biased results (Fulmer & Frijters, 2009), and its common use inherently limits the extent to which knowledge in the field of motivation could advance

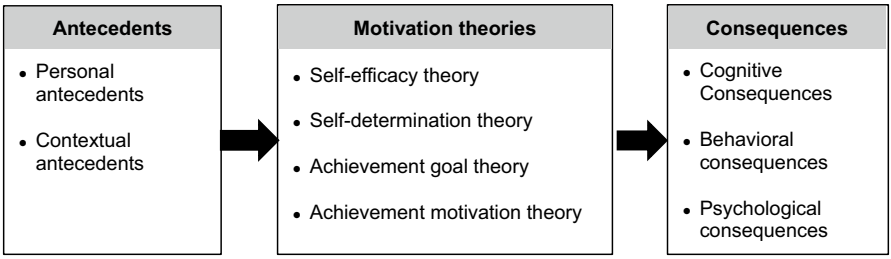

Fig.1 A conceptual framework of graduate students' research motivation

(Wigfield & Koenka, 2020). These limitations could be addressed by incorporating multi-method and multi-trait measurements (Rezaei & Zamani-Miandashti, 2013) to expand the scope of studies of graduate students' research motivation.

To date, the significance of research motivation has prompted a narrative review (Tran et al., 2019) and a systematic review (D'Arrietta et al., 2022), focusing primarily on faculty members. There is a lack of comprehensive knowledge regarding graduate students' research motivation. Given the significance of research motivation in graduate education and scientific progress, in this systematic review, we aim to (a) synthesize categories and themes from empirical studies on graduate students' research motivation, (b) examine how motivation theories are utilized in the studies of graduate students' research motivation, and (c) evaluate the soundness of methodologies adopted in the studies of graduate students' research motivation. The overarching objective is to develop a Graduate Students' Research Motivation Model, which could be an important asset to provide validation of research motivation theories and relations against empirical studies reviewed and holds considerable promise in advancing knowledge and directing future research endeavors in this field.

Methods

This study followed the guidelines outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement (Page et al., 2021), and five phases were involved in this section, namely, establishing eligibility criteria, conducting a thorough search and identification process, selecting relevant studies, extracting and analyzing data, and appraising the methodological quality. A descriptive and quantitative analysis (Gough, 2007) was adopted to identify characteristics and trends related to research themes, theoretical perspectives, and methodologies in the retrieved records. Throughout the entire process, there was a continuous and interactive exchange between the two authors of this study, with ongoing crosschecking of screening, extraction, appraisal, and coding procedures. This iterative process ensured the reliability and accuracy of the research findings.

Eligibility Criteria

Before conducting a systematic search, specific eligibility criteria were established to ensure that the records retrieved align with the research aims. First, ththey must have been published before January 1st, 2024, as there were no studies available to ascertain the starting dissemination year of related studies. Second, peer-reviewed and published empirical studies were included as their quality was guaranteed by rigorous reviews (Han & Gao, 2023). Conference papers were also included as they could provide a preliminary overview of studies (Cela et al., 2015). However, unpublished papers, theses/dissertations, book chapters, books, reports and commentaries, and non-empirical studies such as literature reviews were excluded. Third, the included articles and conference papers were required to be published in English, as it is widely accepted as the language of international journals, with no restrictions on the countries where the studies were conducted. Fourth, the research topics of included studies need to be relevant to graduate students' motivation for academic research. Studies in which research motivation was not directly addressed in research questions and played a minor role were excluded. This exclusion was particularly relevant when research motivation, a type of high-level academic motivation occurred alongside other subtypes of academic motivation. For example, Clercq et al.'s study (2021) was excluded as it primarily focused on degree completion motivation, a subtype of academic motivation, although thesis writing motivation was also involved. Fifth, the target population of the included studies was limited to graduate students, including master's or doctorate students or a mix of both. Studies conducted on academics (e.g., D'Arrietta et al., 2022) and undergraduate students (e.g., Ommering et al., 2021) were excluded from the review.

Search And Identification

The current review commenced with a systematic search in January 2023 and the dataset of included studies was updated in December 2023. To ensure comprehensive searching, five large and multidimensional databases (*Web of Science, ProQuest, EbscoHost, Scopus, and ScienceDirect*) were utilized, along with a specialized educational and psychological database (*PsycINFO*). Additionally, reference checks on the included samples and the use of the most comprehensive academic search engine, Google Scholar, were used as supplements to avoid potential omissions. The keywords that occurred in titles and abstracts were derived from the broad concept and specific types of research motivation as defined by previous studies (D'Arrietta et al., 2022; Deemer, et al., 2010b). Therefore, the substitute terms with correspondent meanings were entered to perform multiple combinations using Boolean operators (AND, OR). The search strings were (*graduate** OR *postgraduate** OR *doctoral** OR *Ph.D.**) AND *research** AND (*motivation** OR *goal** OR *achievement goal** OR

Table 1 Data source and systematic review stages

Data Source	Identification	Screening	Eligibility	Inclusion
Scopus	3681	3640	37	8
Web of Science	2405	1949	21	11
ScienceDirect	711	411	6	1
ProQuest	2358	2136	12	1
EbscoHost	1668	1283	37	13
PsycInfo	464	185	19	3
Googlescholar	927	311	20	6
Reference checks	22	20	14	14
Total	12,236	9935	166	57

*self-determination** OR *intrinsic motivation* OR *extrinsic motivation* OR *self-efficacy*). Initially, a total of 11,287 articles and conference papers were obtained from the search conducted across the databases mentioned and an additional 949 records were retrieved through the two supplementary methods, resulting in a comprehensive dataset for further analysis. Essential search results are presented in Table 1.

Study Selection

To ensure that the prospective articles and conference papers met the eligibility criteria, this review was subject to identifying, selecting, and critically appraising the records by following four steps. To begin this process, records were identified through the aforementioned search methods and information sources, and 12,236 records were eventually included (see Fig. 2). Titles and abstracts were further screened to determine their qualification for further consideration. Factors such as duplication, topic appropriateness, language used, article types, and target samples have been at the center of much attention. In the phase of duplicate removal, we manually searched and cross-referenced the authors of conference papers to ensure that the documents were not subsequently published under different titles or by other authors. After the screening, 9769 records were deleted and 166 records were reserved. For records that were deemed desirable or raised questions regarding their eligibility, the ongoing step involved obtaining and independently screening the full-text articles and conference papers by two authors. The variance of opinions was resolved through discussion, ensuring consensus on the inclusion of records. The final step of the process involved determining the inclusion of records. At this stage, 11 records were removed for poor quality, including insufficient information about research objectives, study design, and results. Another 98 records were removed due to the minor role of research motivation in the articles.

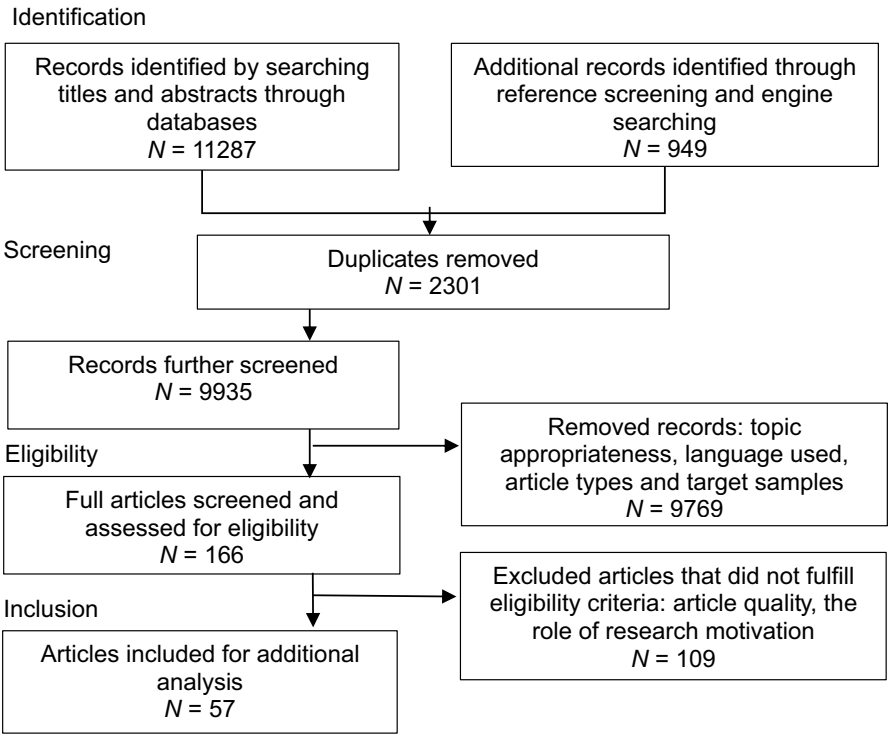

Fig. 2 The PRISMA flow diagram of the selection process

Methodological Quality Appraisal

The methodological quality of both quantitative and qualitative studies was assessed using two assessment tools in this review. The assessment of quantitative studies was based on the 7-item Critical Assessment Tool (CAT) (Roman & Frantz, 2013) with three dimensions: sampling, data quality, and relevance to the research topic. The qualitative study was appraised by the Critical Appraisal Skills Programme (CASP) (Singh, 2013), consisting of a 10-item checklist covering research design, method, findings, and value of results. The mixed-method studies were evaluated using the combination of the quantitative and qualitative assessment tools. Each item in the assessment tools was assigned one point if it met the quality criteria. The final score was calculated as the percentage of points achieved out of all the items, considering the different criteria outlined in the 7-item and 10-item tools (Ekholm et al., 2018). Based on the grading standard (Roman & Frantz, 2013), three levels were defined to represent the methodological quality of studies: good (scoring 67%-100%), satisfactory (scoring 33%-67%), and bad (0–33%), and only articles with satisfactory and good quality were included for further analysis. The quality was evaluated independently by two authors, and any discrepancies were resolved through close inspection and

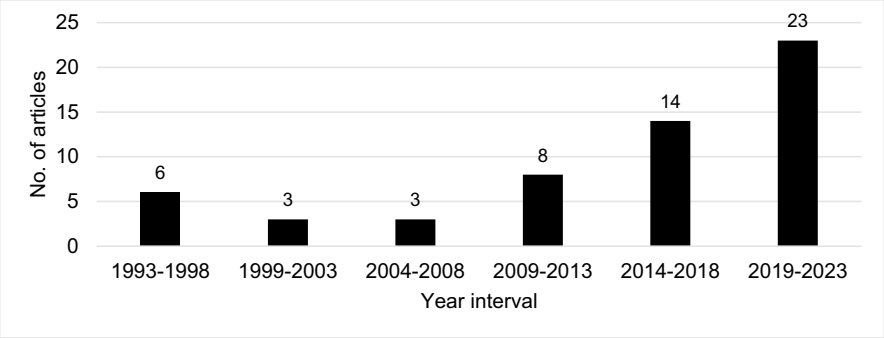

Fig. 3 Trend of article distributions during 1993–2023 ($N = 57$)

adequate discussion to reach a mutual consensus. As a result, 57 articles and conference papers were retained in the systematic review.

Data Extraction and Analysis

A descriptive approach was adopted to report the research patterns identified after conducting data coding of the included articles using Microsoft Excel. An adapted data extraction sheet (Camacho et al., 2021) was developed to facilitate the extraction of relevant information from each article. This sheet consisted of seven categories of data: author(s), publication year, demographic information of participants, motivation theories, research designs, statistical analytics, and research themes. Through a qualitative classification process, the research themes were grouped into three categories that encapsulated the shared features of research findings. For the above indicators, one author extracted the basic descriptive and detailed information and another author cross-checked the extracted data to ensure accuracy and consistency.

Results

57 articles and conference papers were identified on the research motivation of graduate students published before January 1st, 2024. The descriptive characteristics, research categories and themes, motivation theories, and methodologies were synthesized in this section after cross-examinations.

Descriptive characteristics of studies

Generally, a continuous interest in research motivation of graduate students has been witnessed over the past 31 years (Fig. 3) since the first article was published in 1993 (Bishop & Bieschke, 1993). To analyze the temporal distribution of articles, the

31-year duration of the review was divided into 5-year intervals except for the first 6-year interval. In the initial four intervals (1993–2013), there were relatively few articles, with a notable increase in the number of publications observed in the fifth interval (2014–2018), totaling 14 articles. Articles in the last five years (2019–2023) contributed the largest share ($n=23$), particularly reaching a peak in 2022 and 2023 ($n=15$).

The sample sizes, data collection format, data location, and participants' disciplines are summarized as follows. The sample sizes varied greatly, with the smallest being 13 participants in a semi-structured interview (Gong et al., 2022), and the largest being 1265 questionnaire respondents (Amador-Campos et al., 2023). Studies with over 200 samples[1] accounted for the largest portion (50.88%). In terms of data collection format, most of the studies ($n=29$) collected data via Internet-based surveys, such as electronic mails and online questionnaires, while others ($n=19$) relied on paper-based surveys or face-to-face interviews. It is worth noting that three studies collected data using both paper and online formats to facilitate participation, while six studies did not explicitly report their data sources. A majority of studies drew their samples from a single country ($n=54$), with only three studies conducting cross-country research. The United States ($n=22$) had the highest number of studies, followed by China ($n=13$), Iran ($n=7$), and Turkey ($n=3$). However, many other countries, including Malaysia, South Africa, and Japan made substantial contributions to the studies. Of the three cross-country studies, one included samples from New Zealand, Australia, the UK, and Canada (Overall et al., 2011), while the other two focused on samples from America and Canada (Deemer et al., 2007, 2010a). In terms of participants' disciplines, some studies included participants from multiple areas ($n=16$), while others specifically assessed participants from one discipline, including psychology ($n=10$), natural science ($n=10$), medical science ($n=8$), education ($n=7$). However, six studies did not provide specific information regarding participants' disciplines.

Research Categories and Themes

Upon initial coding of the dataset, it was discovered that the majority of studies ($n=54$) were conducted to determine the relationship between motivation constructs and other relevant constructs. Only three studies surveyed the development and validation of research motivation measures (Deemer et al., 2010a, 2010b; Rivera et al., 2023). The available and original research findings were obtained and classified into three categories, resulting from the identified multiple themes. The first category, antecedents of research motivation, consisted of two themes: personal factors and contextual factors. The second category, consequences of research motivation, was outlined in three themes: cognitive consequences, behavioral consequences, and

[1] When the sample size (N) exceeded 200, the Root Mean Square Error of Approximation (RMSEA) in SEM yielded accurate estimations for models with moderate misspecifications (Curran et al., 2002).

psychological motivation consequences. The third category included the mediating role of research motivation.

Personal Antecedents

The dataset identified immutable and manipulable personal antecedents and how they were related to research motivation, indicating that research motivation can vary depending on its antecedents. Demographic variables, factors that may be inherent and immutable through interventions, include gender ($n=11$), students' years in program ($n=8$), levels of education ($n=6$), discipline ($n=5$), age ($n=4$), race ($n=1$), first-generation college student status ($n=1$), and personality traits ($n=13$) like research interest ($n=5$), autonomy ($n=2$), personality types ($n=2$), research anxiety ($n=2$), learning styles ($n=1$), and subjective well-being ($n=1$). Meanwhile, research experience ($n=12$), knowledge and competence ($n=4$), and attitude ($n=3$) were manipulable factors that may fluctuate over time. These variables provide insights into the individual characteristics and circumstances that may affect research motivation among graduate students.

Studies examining the relationship between gender or discipline and research motivation have yielded inconsistent findings. While one study reported the advantage of female doctoral students in Turkey over males in research self-efficacy (Odaci, 2013), another study with Spain doctoral students reported a reverse pattern when concerning the interaction between gender and year in doctoral programs (Amador-Campos et al., 2023). As nine studies did not report significant gender-based differences (e.g., Tiyuri et al., 2018), a tentative relation cannot be established on gender-based differences in graduate students' research self-efficacy. Similarly, the relationship between discipline and research motivation may not be consistent across all studies or contexts. Some studies found that science students (Odaci, 2013), non-clinical students (Sawant et al., 2017), and paramedical students (Naser et al., 2021) exhibited higher levels of research self-efficacy and extrinsic motivation than those in social science and health science (Odaci, 2013), clinical medicine (Pasupathy, 2018; Sawant et al., 2017) and nursing and midwifery (Naser et al., 2021). However, one study revealed no disciplinary difference in research self-efficacy (Faghihi et al., 1999).

Conversely, age (e.g., Naser et al., 2021), educational levels (e.g., Nazari Bishop & Bieschke, 1998; Naser et al., 2021), years in programs (e.g., Bieschke et al., 1996) and some personality traits (e.g., West et al., 2007) were found to have a unanimous impact on graduate students' inner drives and perceived belief in their abilities to conduct research. Of the identified personality traits, research interest (e.g., Love et al., 2007; Poh & Kanesan Abdullah, 2019), active (vs. sensing) and intuitive (vs. reflective) learning styles (West et al., 2007), and proactive personalities (Zhang et al., 2023) were stimulating to research self-efficacy among American, Malaysian and Chinese doctoral students across various disciplines. Similarly, dispositional autonomy facilitated internal motivation among natural science doctoral students (Lynch et al., 2018). Increased subjective well-being (Odaci, 2013) and decreased research anxiety (e.g., Razavi et al., 2017)

promoted research self-efficacy among graduate students. Manipulable personal antecedents such as research experience, knowledge and competence, and attitude were also significantly related to graduate students' research motivation. Specifically, graduate students' rich research experience ($n = 12$), including performative experiences such as successful publication (e.g., Lambie et al., 2014) and vicarious experiences such as observational learning in personal or team-based research task involvement (e.g., Bishop & Bieschke, 1993; Chesnut et al., 2015; Love et al., 2007) and assistantships (Faghihi et al., 1999), were found to promote their research self-efficacy. However, a longitudinal study revealed that EdD students' research self-efficacy remained consistent throughout the research process regardless of their prior research experience (Kerrigan & Hayes, 2016). Knowledge and competence ($n = 4$) were also significant antecedents of graduate students' research motivation. Doctoral students' abilities to reflect on the completed study (Gong et al., 2022) and the development of critical thinking skills (Odaci & Erzen, 2021) enhanced their beliefs of competence in conducting quality research. Similarly, technology-related skills such as awareness of technology application (Kanama, 2016) and competence in statistical analysis (Niromand et al., 2022) were significantly related to graduate students' highly motivated conditions such as commitment to research and proactive activity. Graduate students' positive attitudes toward research (Rezaei & Zamani-Miandashti, 2013; Salehi et al., 2013) and computers (Odaci & Erzen, 2021) were also significantly antecedents of research motivation.

Contextual Antecedents

The manipulable contextual antecedents were classified into two subthemes: instructional context ($n = 33$) and social-culture influences ($n = 3$). An instructional environment that was supportive and challenging helped to enhance graduate students' research self-efficacy (e.g., Gelso et al., 1996; Lachance et al., 2020; Westhuizen, 2014), achievement motivation (e.g., Liu et al., 2023) and mastery approach goals (Deemer et al., 2009). For example, challenge research stressors such as heavy-loaded research work, tight deadlines, and demanding assessment requirements acted as catalysts for their achievement motivation and increased their research creativity (Liu et al., 2023). Additionally, supervisor-related factors such as autonomy and academic support (e.g., Overall et al., 2011), supportive and directive supervisory style (Love et al., 2007), adequate mentoring relationships (Kahn, 2000), and graduate students' satisfaction with the mentoring process (e.g., Amador-Campos et al., 2023) also stimulated their research motivation. In sum, supervisors play a crucial role in encouraging graduate students to take initiative in their academic research and providing scaffolds to overcome any undesirable motivation factors. Social-culture influences such as peer support, which involves developing academic and emotional connections with peers, and family support, which includes financial and emotional support, were also essential factors in bolstering graduate students' research self-efficacy (Gong et al., 2022).

Cognitive Consequences

Regarding the cognitive consequences of research motivation, five areas were identified, including research interest ($n=9$), general research ability ($n=1$), research outcome expectations ($n=2$), and academic adaptability ($n=1$).

Research interest was the most widely investigated cognitive consequence and was significantly associated with motivational constructs such as research self-efficacy, mastery-approach goals, and performance-avoidance goals. However, it had no significant relationship with performance-approach goals (e.g., Chumwichan & Siriparp, 2016). Two studies found that counseling psychology students focusing on research task mastery showed higher research interest than those who avoided showcasing any perceived research incompetence relative to others (Deemer et al., 2007, 2009). While five studies revealed that research self-efficacy enhanced research interest (e.g., Lambie & Vaccaro, 2011), there are conflicting results as well. For instance, Kahn and Scott (1997) reported a non-significant relationship between the two variables and Kahn (2001) later reported an indirect effect of research self-efficacy on research interest through research outcome expectations.

Five studies have provided evidence supporting the positive relationship between research motivation and general research ability, as well as specific research skills such as creativity. Intrinsic motivation, extrinsic motivation and failure avoidance motivation influenced by work experience and cultural background stimulated the development of the research ability of Chinese doctoral nursing students (Zhang et al., 2022). Two studies revealed mastery-approach goals and research self-efficacy as precursors of research outcome expectations (Bishop & Bieschke, 1998; Deemer et al., 2009) though the reciprocal relations of the two variables needed to be further investigated. Furthermore, Chinese graduate students' research self-efficacy was found to enhance their learning adaptability, which in turn decreased their academic procrastination (Zhang et al., 2023).

Behavioral Consequences

Numerous studies have examined the positive impact of research motivation on research behaviors in various settings. These studies have consistently found that research motivation enhances graduate students' research behaviors, including research productivity ($n=4$), creativity ($n=4$), innovative and creative behavior ($n=3$), and research engagement ($n=4$). For instance, one study found that rehabilitation science doctoral students in the research track who reported higher levels of research self-efficacy had greater research productivity than their counterparts in the clinical track (Pasupathy, 2018). Furthermore, research advisory relationships have been found to moderate failure avoidance motivation, intrinsic motivation and research productivity among graduate students (Kuo et al., 2017). Meanwhile, intrinsic motivation (Xia et al., 2019), achievement motivation (Liu et al., 2023), creative self-efficacy (Gu et al., 2015), and research self-efficacy (Komşu, 2021) facilitated graduate students' academic creativity. For example, intrinsic motivation

and creative self-efficacy collectively predicted 46% of the variance of creativity among Chinese graduate students, and intrinsic motivation partially mediated the relationship between creative self-efficacy and creativity (Gu et al., 2015). Meanwhile, creative self-efficacy, research self-efficacy, and intrinsic and extrinsic motivation have been shown to promote innovative and creative behaviors and scholarly activity engagement (e.g., Doulani & Hossaini, 2023; Ma et al., 2023).

Psychological Consequences

Four studies revealed the influence of research motivation on the mental health of graduate students. Research self-efficacy and autonomous motivation undermined graduate students' depression, burnout, and anxiety (Chen et al., 2023; Liu et al., 2019) and facilitated their subjective well-being (Chen et al., 2023; Haider & Dasti, 2022). In sum, the research environment in which graduate students operate affects their research motivation types, thereby influencing their mental health.

Mediating Roles

Of the relatively less extensively explored mediation analyses, the unidimensional motivation constructs such as research self-efficacy ($n=7$), creative self-efficacy ($n=4$), and achievement motivation ($n=1$) were mostly examined as mediators, followed by the constructs of multidimensional motivation theories such as intrinsic motivation ($n=4$), and mastery approach goals ($n=1$). Seven studies involved mixed motivation and motivation-related variables as sequential or parallel mediators (e.g., Kahn, 2001) and nine studies examined the mediated effect using a single motivation variable (Han et al., 2022; Meng et al., 2017). Research motivation as a mediator has been tested on three types of consequences, including cognitive consequences such as research interest (e.g., Bishop & Bieschke, 1998) and creativity (e.g., Yao & Yu, 2023), behavioral consequences such as innovative behavior (e.g., Han et al., 2022) and psychological consequences such as psychological well-being (e.g., Haider & Dasti, 2022). In terms of the effect sizes of mediation analysis, most studies ($n=15$) yielded strong support for the mediation effect of research motivation, whereas one study revealed that creative self-efficacy played a minor role in mediating the relationship between supervisor support and innovative behavior, highlighting the significance of the direct influence of supervisor support (Han et al., 2022).

Drawing on the conceptual model (see Fig. 1), the Graduate Students' Research Motivation Model (GSRMM) (Fig. 4) was developed, in which major relationships between research motivation and relevant processes were abstracted as a form of empirical summary. Specifically, this model encompasses three categories resulting from multiple identified themes: antecedents, mediating roles, and consequences of graduate students' research motivation. The first category of the GSRMM focuses on the antecedents of graduate students' research motivation, in which the personal and contextual antecedents proposed in Fig. 1 are reclassified into immutable and manipulable antecedents based on empirical evidence. The core of the

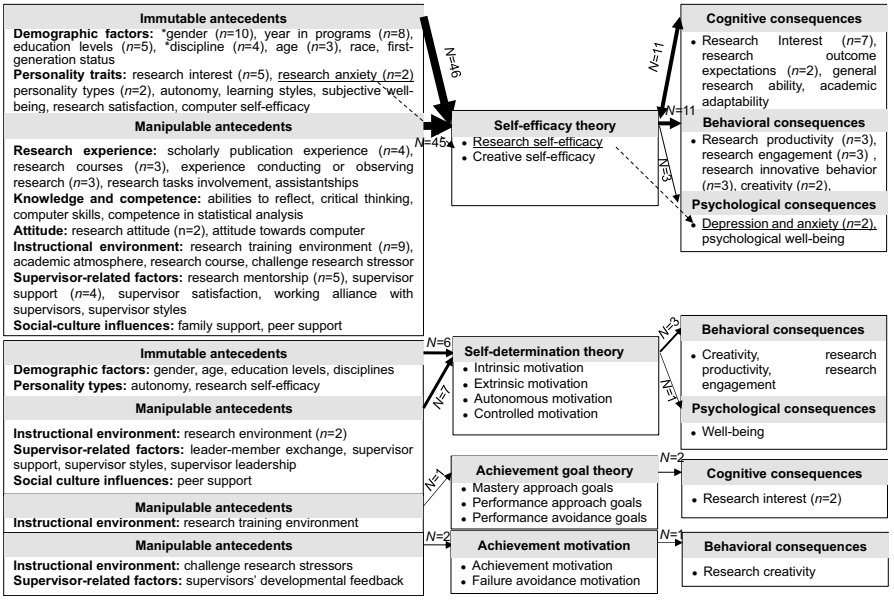

Fig. 4 The Graduate Students' Research Motivation Model (GSRMM). *Note*: Counts of studies were included in parentheses, excluding those that occurred only once; arrow thickness was based on total counts of instances supporting each specific relationship; positive and negative relations were represented in solid and broken lines respectively, and a reciprocal relationship was represented by a double arrow; inconsistent results were marked with asterisks

model consists of four motivation theories that serve as mediators. The third category includes cognitive, behavioral, and psychological consequences of graduate students' research motivation. The counts of these presences and the magnitude of relations in the examined studies were also documented in correspondence to the motivation theory that guided the research inquiry. This model implies that researchers have predominantly directed attention to the antecedents of graduate students' research motivation, especially the manipulable ones, and there is a need for further investigation into immutable antecedents, consequences, and mediating roles of graduate students' research motivation.

Motivation Theories and Constructs

The results indicated that four cognitive motivation theories have been utilized in studies of graduate students' research motivation: self-efficacy theory, self-determination theory, achievement goal theory, and achievement motivation theory.

Among these theories, self-efficacy theory emerged as the most prominent framework in the reviewed articles ($n=46$) (See Fig. 4), with two generally identified constructs: research self-efficacy (RSE, $n=42$) and creative self-efficacy (CSE, $n=4$). Research self-efficacy refers to one's belief in their competence in successfully fulfilling various tasks in the research process (Kahn & Scott, 1997). Various

instruments have been developed to measure RSE, of which some aimed to capture different aspects of students' perceived capabilities in performing research tasks related to research completion, such as the capabilities of preparation, conceptualization, application, and presentation (e.g., Bieschke et al., 1996), and some focused on skills required for performing research, such as design, practical and quantitative research skills (e.g., Phillips & Russell, 1994). CSE was assessed by two uni-dimensional scales: the 8-item Creative Self-Efficacy Scale (Carmeli & Schaubroeck, 2007) and the 3-item Creative Self-Efficacy Scale (Tierney & Farmer, 2002).

Self-determination theory (SDT) characterizes research motivation as a psychological process through which research behaviors are supported and research competence is developed for intrinsic needs such as deriving enjoyment or extrinsic rewards such as obtaining approval (Deemer et al., 2010b). SDT was also applied in the articles of the dataset ($n=12$) with four constructs: intrinsic motivation (IM, $n=11$) and extrinsic motivation (EM, $n=7$), autonomous motivation (AM, $n=1$) and controlled motivation (CM, $n=1$), all of which were measured as a global construct or mostly as specific motives. Specifically, in the mostly adopted Research Motivation Scale (Deemer et al., 2010b), IM was measured as an intrinsic reward and EM was measured as an extrinsic reward.

Achievement goal theory and achievement motivation theory were also applied in this corpus. Based on achievement goal theory, research motivation refers to the goals that serve to direct an individual's behaviors in research-related achievement situations (Deemer et al., 2010a). Two studies focused on mastery-approach goals, performance-approach goals, and performance-avoidance goals, and these three constructs were measured using the Achievement Goal Questionnaire (Elliot & McGregor, 2001) to explore one's reasons for achievement activity involvement. Additionally, one study developed a scientific achievement goal scale (Deemer et al., 2010a) to measure graduate students' specific goals related to scientific achievement. Achievement motivation as a global construct was measured by the Achievement Motivation Scale (Man et al., 1994) in two studies while failure avoidance motivation as a specific construct was examined using the Achievement Motives Scale-Revised (Lang & Fries, 2006) and Research Motivation Scale (Deemer et al., 2010b) in three studies.

Methodological Characteristics of Studies

This section tracks and analyzes the research designs, data sources, statistical analytics, and methodological quality of the 57 empirical studies. The findings revealed that scholars prefer quantitative research designs ($n=53$) over qualitative ($n=1$) and mixed-method ones ($n=3$). Self-report questionnaires ($n=53$) were the most commonly used data collection method in the included quantitative studies. However, the credibility and rigor of this method were reported as a limitation in some studies (e.g., Liu et al., 2023). The only qualitative study (Gong et al., 2022) presented a comprehensive view of the sources of graduate students' research self-efficacy through interviews. The mixed-method studies (Kanama, 2016; Love et al., 2007; Meng et al., 2017) collected

data through focus groups, semi-structured interviews, and questionnaire surveys, which provided a better understanding of graduate students' research motivation.

Two kinds of statistical analytics were applied across studies: quantitative ($n=52$) and qualitative analysis ($n=3$). For quantitative data analysis, the direct verbiage in the samples was reported here using the following three categories suggested by Gall et al. (2007). Specifically, descriptive statistics ($n=52$) employed mean and standard variation. Correlational statistics ($n=46$) used structural equation modeling (SEM), bivariate and multivariate correlation analyses, multiple linear regression, and hierarchical regression. Statistical significance tests ($n=39$) included t-test, ANOVA, ANCOVA, MANOVA, chi-square, tests of independence and association. For the qualitative analysis, coding schemes were applied to analyze themes and subthemes irrespective of their function as a pilot survey or a clarification of quantitative results.

The methodological quality of all studies was rated by the predetermined criteria mentioned in the method section, and the analysis of the reports indicated that the included studies were generally of high quality. Ratings indicated that 68.4% of studies ($n=39$) were of good rating, 31.6% of studies ($n=18$) received satisfactory ratings and no studies scored less than 33%. Of the 56 quantitative and mixed-method studies, 92.9% of studies ($n=52$) provided evidence of reliability for motivation measures using internal consistency coefficients. However, evidence on the validity of research motivation scales received the lowest scoring since only 28 studies reported the validity of scales. Future studies warrant a report of validity coefficients, including construct validity as well as discriminant and convergent validity when relevant.

Discussion

This systematic review examined 57 empirical studies spanning over 31 years from 1993 to 2023 to investigate what motivates graduate students to conduct research. The analysis of multiple themes revealed three distinct research categories pertaining to graduate students' research motivation: antecedents, consequences, and the mediating roles. Among these, manipulable antecedents, including some of personal and contextual antecedents, were found to be the most predominant factors. Three dominant theories were commonly adopted in studies of graduate students' research motivation, namely, self-efficacy theory, self-determination theory, and achievement goal theory. Quantitative research design using self-report questionnaires was the most prevalent method employed in these studies. These findings provide a better understanding of academic motivation of graduate students in a research context and have significant implications for stimulating graduate students' enthusiasm and commitment to research.

Descriptive Characteristics of Studies

An investigation of the 57 studies showed a continuous increase in studies on graduate students' research motivation. Notably, the last five years accounted for the largest proportion of the knowledge base, with 42.11% ($n=24$) of studies published

between 2019 to 2023. This surge in research output signifies scholars' heightened recognition of the significance of graduate students' research motivation. During the past 31 years, numerous scholars have dedicated their efforts to discerning the theoretical impact of research motivation on graduate students' pursuit of research and practical benefits for advancement in research programming and training (e.g., Deemer et al., 2007), leading to the growth of empirical studies. The increased attention to motivational variables in graduate students' research activities also implied the continued priority placed on motivation within the field of educational psychology (Dörnyei & Ushioda, 2011).

Although the studies of graduate students' research motivation have been conducted across varied countries, a sustained number of studies have been conducted in the Unites States and the result may be plausibly explained by two facts. The first fact is that American scholars have continuously ranked as the largest producers of scholarly articles across various research fields, establishing themselves as global leaders in psychological research (Camacho et al., 2021). In addition, defining the criteria for including publications in the English language may lead to language bias (Ekholm et al., 2018). However, given that motivation studies conducted in a homogeneous context may not identify human universals, future researchers may expand samples beyond the USA or even WEIRD (Western, educated, industrialized, rich, democratic) cultural context (Ekholm et al., 2018) to mirror the diversity of research motivation and to enable the provision of more precise recommendations for motivation researchers worldwide.

The studies included in this review were conducted with varying sample sizes and data collection forms. Qualitative research involved a handful of face-to-face interview participants, while quantitative research included a considerable number of online questionnaire respondents. More than half of the studies had sample sizes of over 200 participants, and there has been a noticeable increase in large-sample studies in the past five years. This is probably because more diverse statistical methods, such as regression modeling and SEM, and more advanced statistical software applications, such as AMOS, were employed across large samples to improve the precision and stability of the results (Kyriazos, 2018).

Research Categories and Themes

As the GSRMM indicates, of the three identified categories, the antecedents of graduate students' research motivation, particularly manipulable ones, have been explored extensively. However, certain aspects require careful consideration. First, while immutable personal antecedents such as gender have received much attention, a tentative relation cannot be established on the gender-based differences in graduate students' research self-efficacy. This is because rather contradictory findings were reported. A meta-analysis reported a small correlation but an overall non-significant relationship between gender and research self-efficacy among researchers (Livinţi et al., 2021). This may be attributed to the use of different self-efficacy scales (Munoz, 2021) with some studies employing scales designed to measure graduate students' skill-specific research self-efficacy or research self-efficacy at

various research stages. Second, of the manipulable personal antecedents, graduate students' research experience was found to be the most influential. However, two studies reported that research self-efficacy of doctoral students in education did not differ in research experience (Kerrigan & Hayes, 2016; Lambie & Vaccaro, 2011). The disciplinary difference may be a moderator in the examined relationship considering the domain-specific nature of research self-efficacy (Livinţi et al., 2021). This is a topic that warrants future investigations. Additionally, a shortcoming of this line of research is the challenge of capturing the temporal dynamics of research self-efficacy during the graduate study, particularly in relation to specific types (i.e., personal or team-based) and the quality (i.e., positive or negative) of graduate students' research experience. The predominance of cross-sectional studies makes it difficult to capture the malleability of graduate students' research self-efficacy.

The review also examined the manipulable contextual antecedents that impact graduate students' research motivation. The influence of supervisor-related factors on specific motivational constructs such as research self-efficacy is well established. A meta-analysis reported that research mentoring experience is significantly related to research self-efficacy among researchers, including doctoral students, faculty members and academics (Livinţi et al., 2021). However, the extant studies mainly focused on interpersonal relationship between supervisors and graduate students, such as authoritarian-benevolent leadership (e.g., Xia et al., 2019). More investigations covering the instrumental function in the practical supervisor-student relationship, such as working alliance with supervisors and supervisor support, are needed in the future research. In summary, the manipulable variables, including some of the personal antecedents and contextual antecedents, suggest the potential for stimulating and enhancing graduate students' research motivation through intentional interventions (Odaci & Erzen, 2021). Although those interventions could potentially modify the quantity and quality of graduate students' research motivation, the mechanisms underlying these changes remain underexplored; therefore, future research is expected to unravel how contextual factors influence motivational dynamics.

Results showed that cognitive consequences were more attractive themes than behavioral and psychological consequences. Graduate students' research interest, the most widely investigated cognitive consequence, was found significantly related to specific motivational constructs such as research self-efficacy, mastery-approach goals, and performance-avoidance goals while showing no significant relationship with performance-approach goals (e.g., Chumwichan & Siriparp, 2016). It is worth highlighting that although research interest was examined as a consequence of research motivation in nine studies, it was also investigated as an antecedent in three studies, suggesting a reciprocal relationship between research motivation and research interest. As to behavioral consequences, results revealed a positive association between research self-efficacy and research productivity, echoing a systematic review (Uwizeye et al., 2022) which revealed a significant role of research self-efficacy in researchers' productivity. Comparatively, psychological consequences of research motivation have been less studied, and this is plausibly related to the fact that motivational theories were primarily adopted to elucidate the intricate mechanisms underlying human cognitive processes and behavioral patterns (Wigfield & Koenka, 2020).

The majority of studies have investigated the direct relations between research motivation and relevant variables, neglecting the exploration of mediating models. In addition, the unidimensional motivation constructs were employed by most researchers as mediating variables. These findings showed the oversimplification of this complex and multidimensional psychological concept, which posed a challenge in fully conceptualizing the dynamic interactions among the distinguishable but relevant motivation variables in the field of academic research (Daumiller & Dresel, 2020). Therefore, more comprehensive and multidimensional research motivation models need to be developed and utilized to allow for a deeper exploration of the complexity underlying research motivation and to direct graduate students towards adaptive motivation paths through which beneficial research effects can be enhanced (Han et al., 2022).

Motivation Theories and Constructs

Self-efficacy theory, "people's beliefs about their capabilities to produce designated levels of performance" (Bandura, 1994, p. 71), was mostly adopted in the database, implying scholars' preference for this theory to understand graduate students' readiness and perceived strengths and weaknesses in specific research tasks (Bishop & Bieschke, 1998; Naser et al., 2021). This finding aligns with previous evidence that validated self-efficacy as the most useful and adequate motivational framework for studying research motivation (Daumiller & Dresel, 2020). However, as research self-efficacy has mostly focused on the intensity of individuals' motivation in existing literature (Munoz, 2021), there is a need to further explore the multidimensional nature of motivation and its impact on various aspects of research outcomes. Recent studies have started to incorporate multidimensional motivation theories, such as self-determination theory and achievement goal theories, aligning with the underlying belief that both quantitative and qualitative distinct forms of motivation should be considered to explain graduate students' cognitive, behavioral, and affective differences (Deemer et al., 2010a). Specifically, favorable motivation forms such as intrinsic reasons and mastery goals have been found to be related to positive research performance such as research interest (e.g., Deemer et al., 2009), research ability (e.g., Zhang et al., 2022) and creativity (e.g., Xia et al., 2019), whereas the unfavorable forms such as extrinsic reasons and performance-avoidance goals were related with negative research outcomes (Deemer et al., 2007).

In sum, the GSRMM productively branches academic motivation into a research context with graduate students, an area that has been insufficiently investigated within academic motivation. The identified antecedents shed light on how graduate students' research motivation is informed by their personal experience and learning environment, indicating the need for individual and organizational interventions to stimulate and sustain graduate students to research by igniting their passion and creating a research-supportive environment. The multiple motivation theories and constructs are conducitve to unpack the nature and complexity of graduate students' research motivation, benefiting multiple stakeholders in graduate education by providing a comprehensive understanding of graduate students' research tasks. Moreover, the various consequences of research motivation informed by this model

highlight the importance of enhancing graduate students' inner drives to research to promote their favorable research performance and well-being. It is expected that a proliferation of scholarly inquiry will be conducted on the antecedents, mediators, and consequences of graduate students' research motivation to improve the comprehensiveness of the GSRMM.

Methodological Characteristics of Studies

The current studies on graduate students' research motivation revealed a predominance of quantitative research designs, followed by mixed-method and qualitative ones. This is because reliable and replicable results in motivation research could be generated by quantitative methods with scaling properties that permit refined and standardized statistical analyses (Elliott, 2004). However, there are some limitations of quantitative methods when used in studies of graduate students' research motivation. For instance, averaging out responses to motivation questionnaires across graduate students may hinder the comprehensive representation of subjective nuances inherent to their individualized experiences (Love, 2007). Additionally, quantitative methods are insufficient in offering explanations about how graduate students' motivational processes operate in the research context (Kanama, 2016). To address these limitations, motivation theorists encouraged the use of qualitative and mixed-method studies to strengthen the generalizability and validity of research findings and advance knowledge development in this field (Eccles & Wigfield, 2020).

Regarding data collection methods, questionnaires predominated the quantitative research on graduate students' research motivation. Although the analytical practices associated with self-report data have made substantial contributions to advance the pursuit of methodological precision and the theoretical exploration and validation of research motivation constructs (Fulmer & Frijters, 2009), self-report questionnaires are susceptible to response bias such as misinterpretation, and under- or overrepresentation of items, which could potentially lower the data's credibility (Adekunle & Madukoma, 2022). Meanwhile, an additional concern pertains to the lack of rigor in the conceptualization and operationalization of self-report questionnaires, which could engender conflicting outcomes when different scales are employed to measure the same motivation construct (Fulmer & Frijters, 2009). For example, the previously mentioned incongruous results regarding the effects of gender-based differences on graduate students' research self-efficacy could be attributed to the choice of measurement scales. Most importantly, the common use of that methodology may result in monomethod bias and consequent overestimation of correlations (Furr, 2018). To address these issues, the following suggestions may be considered in future studies. First, researchers may consider incorporating additional data sources such as reports from supervisors to cross-validate the self-report data provided by graduate students and conduct dyadic paired research (Kuo et al., 2017; Zhang et al., 2023). Second, the anchoring vignette method could be used to correct heterogeneity in self-report data and improve interpersonal comparability (Voňková & Hullegie, 2011). Third, refining and utilizing highly reliable questionnaires is warranted in future studies. Researchers should address considerations such as the factor

structure of multidimensional scales, internal consistency, test–retest reliability, and multi-group measurement invariance, which could enhance the quality and comparability of measurement instruments, ultimately leading to more robust and reliable research outcomes (Camacho et al., 2021).

Limitations

Despite the valuable insights provided by the preliminary summary of the extant studies of graduate students' research motivation, two main limitations warrant attention. First, though systematic procedures were followed in the development of the search strategy, not all available studies were included in the database due to the stringent eligibility criteria. For instance, as the inquiry was confined to peer-reviewed empirical journal articles and conference papers, the exclusion of grey literature, theses/dissertations, book chapters, books, and reports, etc. may potentially increase publication bias and narrow the scope of research findings. Additionally, the sole inclusion of publications in the English language may overlook pertinent "native literature" in native languages, thereby impeding a comprehensive understanding of graduate students' research motivation. Second, we decided against a meta-analysis and instead opted for a systematic review to integrate qualitative, quantitative, and mixed methods studies, thus foregoing the calculation of effect sizes for the investigated relationships between variables.

Directions for Future Research

The major findings of research categories and themes, motivation theories and constructs, and research methodologies have been outlined. Consequently, broad directions are provided to propel future studies.

First, insights derived from prior experiences advocate further exploration of the under-investigated research themes, including immutable antecedents, behavioral and psychological consequences, and mediating roles of graduate students' research motivation to balance the intellectual structure of graduate students' research motivation. At the same time, understanding the nature of manipulable contextual antecedents and the underlying mechanisms through which they influence motivational dynamics could offer evidence-based implications for educators to implement intentional interventions and effective research programming, ultimately benefitting graduate students' research motivation (Odaci & Erzen, 2021).

Second, sustained attention to self-efficacy theory appears to be appropriate as it represents a robust motivational framework for understanding research motivation. One endeavor would be to understand the contextual and domain-specific nature of research self-efficacy, including potential differences among graduate students from various disciplines. Additionally, future studies need to advocate the underrepresented multidimensional motivation theories such as self-determination theory and

achievement goal theory, to elucidate the complexity and multiplicity of graduate students' research motivation.

Third, given the predominance of quantitative research design by means of self-report questionnaires, it is imperative to adopt integrative methodological approaches that retain the strengths of self-report methods while supplementing and validating self-report data by incorporating alternative measurement techniques (Fulmer & Frijters, 2009). For example, researchers could consider adopting "in-the-moment" reporting methods such as experience sampling, daily dairy methods, and think-aloud protocols that allow for a deeper understanding of the dynamic patterns of research motivation in a natural context in real time (Wigfield & Koenka, 2020). Researchers could also integrate self-report data with behavioral methods like observations and overt behavioral indexes such as research performance and task completion rates to comprehensively measure the behavioral consequences of research motivation (Kuo et al., 2017). In addition, longitudinal designs such as cross-lagged panel analysis need to be encompassed to learn how research motivation unfolds over time, enabling long-term trends to be monitored (Litson et al., 2021; Meng et al., 2017). Despite the demanding and time-consuming nature of longitudinal designs, they offer valuable insights into attenuating potential biases, such as method effects and affective effects. Qualitative and mixed-method study designs on graduate students' research motivation also need to be incorporated into future studies to enhance the generalizability and validity of research findings (Eccles & Wigfield, 2020).

Educational Implications

Based on current findings, there are several implications for enhancing graduate students' research motivation. First, immutable personal antecedents remind us that personality traits could be actively leveraged as a selection base to identify and foster highly motivated graduate students. Graduate students could be inspired to pursue research interests by observing their supervisors' passionate and respectful attitudes toward scientific inquiry considering the modeling effect of the research attitudes and behaviors of faculty members. It is also important to prioritize the personal growth and well-being of graduate students by promoting process-oriented values and developing scholarly abilities, and by increasing positive social connections and collaborative discussions with supervisors and peers.

Second, the support and feedback of supervisors are crucial in navigating the power differentials in the supervisor-student relationship. Supervisors should provide guidance and feedback to graduate students through regular meetings and empower them to take the initiative in conducting their research. They should also encourage students to identify and select research topics, reduce constraints on the implementation of creative and innovative ideas, and provide necessary feedback to address research challenges, so as to facilitate the transition of graduate students from periphery participation in research to becoming independent researchers.

Last but not least, a supportive research training environment is essential for creating a collaborative academic atmosphere. Academic institutions should provide supervisors

with a leadership training program to guide graduate students collaboratively and foster team-based cooperative dynamics. This will allow graduate students to overcome research difficulties and challenges through collaboration, knowledge sharing, and mutual support. Additionally, academic institutions should establish incentive structures to match graduate students' aspirations and provide ample opportunities for them to develop research skills and partake in research ventures such as rich interactive seminars, academic lectures, and international academic exchange activities.

Author Contributions Jiying Han contributed to the conception and design of the review article. Yahui Wang performed the literature search, screening work, coding work. Both authors analyzed data and wrote the draft, critically revised the work, and approved the final manuscript.

Funding This study is funded by Humanity and Social Science Foundation of China's Ministry of Education 2024, the Project of Outstanding Young and Middle-aged Scholars of Shandong University, and Shandong University Program of Graduate Education and Reform under grant number XYJG2023037.

Declarations

Ethical Approval This review article encompasses no studies involving human participants or animals undertaken by any of the authors.

Conflict of Interest The authors declare no competing interests.

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