The Research-Teaching Nexus: Not merely an enduring myth

Li-fang Zhang[*], Hugo Horta[**], Jisun Jung[***], and Gerard A. Postiglione[****]

Abstract. For more than a century, whether or not the research-teaching nexus exists has remained an intensely debated issue in the global academy at both the conceptual and empirical levels. Situating teaching styles within the context of teaching, conceptualizing research agendas as a dimension of research, and using academic self-efficacy as a mediator, the present study empirically investigated the research-teaching nexus. Participants were 256 academics in science, technology, engineering, and mathematics (STEM) fields from all of the eight institutions funded by the University Grants Committee in Hong Kong. In the context of participating in the "Academic Profession in the Knowledge-based Society" (APIKS) international survey between late 2017 and early 2018, the participants responded to a short version of the Multi-Dimensional Research Agendas Inventory, a short version of the Research-Teaching Efficacy Inventory, and two scales from the Thinking Styles in Teaching Inventory.

Results showed that academics' research agendas statistically predicted their teaching styles – after age, gender, academic rank, and institutional ranking were considered. Furthermore, academic self-efficacy, especially research efficacy, provided a pathway from research agendas to one of the two teaching styles examined. Limitations and theoretical contributions of the research are discussed; and practical implications of the research findings are proposed for academics in STEM fields and for university senior managers.

Keywords: Teaching styles, research agendas, academic self-efficacy, Hong Kong academics, STEM fields

Introduction

For long, the research-teaching nexus has been a major focal point for debates in the scholarly community. Such debates have been undertaken at both the conceptual level and the empirical level.

[*] Professor, Faculty of Education, The University of Hong Kong, email: lfzhang@hku.hk
[**] Assistant Professor, Faculty of Education, The University of Hong Kong, email: horta@hku.hk
[***] Assistant Professor, Faculty of Education, The University of Hong Kong, email: jisun@hku.hk
[****] Chair Professor, Faculty of Education, The University of Hong Kong, email: gerry@hku.hk

Conceptually, whereas some have long contended that research and teaching should be treated as discrete enterprises (e.g., Newman, 1853; Ortega y Gasset, 1944), others have fervently asserted that the two must be considered a unity (e.g., Griffiths, 2004; Sample, 1972). At the empirical level, the majority of the earlier studies have concluded that there is a near zero relationship between research and teaching (e.g., Coate, Barnett, & Williams, 2001; Hattie & Marsh, 1996). Indeed, facing low correlations between research and teaching variables and their failure in identifying moderators and mediators between those teaching and research variables as a result of their meta-analysis of findings reported in 58 publications, Hattie and Marsh (1996) declared that "We must conclude that the common belief that research and teaching are inextricably entwined is an enduring myth" (p.529).

Nevertheless, several relatively recent studies have shown that the two are intricately related to each other (e.g., Horta, Dautel, & Veloso, 2012; Robertson, 2007; Shin, 2011; Zhang & Shin, 2015). For instance, when examining the relationship between academics' teaching performance (as measured by students' ratings of teaching) and their research productivity in South Korea, Shin (2011) found that the research-teaching nexus varied as a function of academics' career stage, levels of academic qualification, and primary academic disciplines. In studying the association between teaching styles and research productivity among academics in mainland China, Zhang and Shin (2015) concluded that despite the small magnitude of the relationship between the two variables, the research-teaching nexus did exist.

Today, providing a more definitive answer to the question of whether or not there is a significant relationship between research and teaching has become more important than ever before. Such an assertion is based on the fact that virtually few higher educational institutions around the world are exempted from the pressure of competing for global recognition, resulting in exponentially intensified emphasis on academics' job performance, particularly in teaching and research (Land & Gordon, 2015; Rawat & Meena, 2014).

The present study examined the contentious issue over the research-teaching nexus by conceptualizing research agendas as representing a key element of research and teaching styles as one of teaching. Furthermore, this study explored academic self-efficacy as a mediator between teaching and research. Given that existing research has suggested the context-specific nature of the research-teaching nexus (Becher & Trowler, 2001; Kreber & Castleden, 2009), the present research focused on academics in STEM fields in the eight higher educational institutions funded by the University Grants Committee in Hong Kong. The focus of this study on STEM fields was motivated by research evidence demonstrating that these are the fields where knowledge progresses at faster pace and where knowledge quickly becomes obsolete, therefore requiring in principle a much greater – and integrated - nexus between teaching and research to ensure an "in-time" update of content and curriculum in tertiary degree courses (Baukal, 2010). These are also the fields where changing and improving student learning and related outcomes as well as engagement with the social context have been most challenging (e.g., Case, Fraser, Kumar, & Itika, 2016) in globalized and technologically dependent

economies where the build-up of a STEM workforce with quality education is crucial to maintain the competitiveness of cities, nations, and regions (Drew, 2011; Huet, 2018).

Research agendas reflect academics' preferences, strategies, and agency in a combination of broader (e.g., career) and narrower (e.g., research methods) objectives and practices when deciding and pursuing research goals (Ertmer & Glazewski, 2014; Horta & Santos, 2019), while teaching styles concern teachers'/academics' preferred ways of processing information and dealing with tasks in their teaching activities (Zhang & Sternberg, 2005). Academics' research agendas and their teaching styles are believed to be related because the two types of academic activities share at least two crucial commonalities. First, underlying both constructs are people's preferences for how to engage in cognitive activities. Secondly, deeply embedded in both constructs is a third, but highly related construct – that is, learning (alternatively known as knowledge acquisition) (see Brew & Boud, 1995; Horta et al., 2012). As contended by Zhang and Shin (2015), "when what is known as 'a deep approach to learning (Biggs, 1979) is adopted by academics, the link between teaching and research would be more readily established" (p.378).

Results from a thorough search of the literature suggested that the role of academic self-efficacy (i.e., one's belief in one's ability to succeed in academic activities) in the relationship between teaching and research activities had not been explored. Nevertheless, it is reasonable to believe that one's confidence in one's being able to succeed in task performance (i.e., self-efficacy) can buffer the effects of one type of activities (in this case, research agendas) on another (in this case, teaching styles). Moreover, existing studies suggested that academic self-efficacy played a significant role in the association of academics' attributes (e.g., gender identity, emotions) with research and teaching activities, respectively (e.g., Wright & Holttum, 2012; Zhang, Fu, Li, & He, 2019). The present study aimed at identifying if academic self-efficacy would mediate the statistical effects of academics' research agendas on their teaching styles.

Theoretical foundation and relevant research

The present research was guided by Horta and Santos's (2016) classification of academics' research agendas, Sternberg's (1988) theory of mental self-government, and Bandura's (1997) concept self-efficacy.

Research agendas

Research agendas are not a new concept. Indeed, there is an abundant literature on research agenda setting for organizations and communities performed by field experts, governments, and research-funding agencies (Andrews & Johnson, 2016). Research agendas such as these (i.e., research agendas set for organizations and communities) are relatively straightforward and easier to set and pursue

because they have a clear direction, that is, to align research with government priorities for national development (Cantwell, 2011; Horta & Santos, 2016). The factors influencing the way academics decide on their research agendas, however, are less straightforward and has not received much explicit attention in the literature. Although scholars from different domains of scientific inquiry had alluded to the notion of academics' research agenda setting for decades (Bourdieu, 1999; Horlings & Gurney, 2013; Merton, 1957), it was not until 2014 when Ertmer and Glazewski ventured into defining what a research agenda (for individual academics) is, explaining the nature of research agendas, and articulating why it is important for academics, particularly early-career academics, to set research agendas.

According to Ertmer and Glazewski (2014), academics' research agendas represent a combination of researchers' strategic problem-solving frameworks and actions taken to pursue research goals. Ertmer and Glazewski (2014) argued that a research agenda can be understood as both a noun and a verb. As a noun, a research agenda serves as a blueprint for one's academic career – for at least several years. From this perspective, setting a research agenda is important because a research agenda can steer the direction to which an academic would like to go and help to achieve long-term or short-term research goals, or more broadly, academic career goals. As a verb, a research agenda entails the actions an academic takes based on the blueprint. From this perspective, research agenda is important because only when one takes actions, can one's blueprint be transformed into reality.

Horta and Santos (2016) expanded the initial conceptualization proposed by Ertmer and Glazewski (2014), and based on a thorough literature review, concluded that there are at least eight predominant dimensions influencing the research agendas that academics could set and pursue. These include 1) scientific ambition; 2) divergence; 3) convergence; 4) discovery; 5) conservative; 6) tolerance for low funding; 7) mentor influence; and 8) collaboration.

Scientific ambition refers to an academic's preference for pursuing a line of research that could lead to one's being recognized as an authority figure in one's field. Divergence refers to one's preference for taking a multidisciplinary approach to research; while convergence denotes a preference for focusing on a single discipline. Discovery suggests academics' preference for cutting-edge research, whereas conservative reflects academics' preference for engaging in research in a well-established field. Tolerance for low funding refers to the degree of tolerance an academic has for engaging in research projects with little to no research funds. Mentor influence concerns the extent to which an academic's research agenda is under the influence of his/her mentor, particularly one's doctoral supervisor. Finally, collaboration refers to one's preference for engaging in collaborative research agendas, by inviting others or by being invited into others' research agendas.

The eight dimensions are not mutually exclusive. Each academic has a research agenda profile based on these eight dimensions, and as such some dimensions have greater weight for some academics than for others, but the research agenda characterization of academics rests in two main typologies: trailblazing versus cohesive research agendas (see below).

To empirically verify their conceptualization of the research agendas, Horta and Santos (2016) designed a self-report inventory known as Multi-Dimensional Research Agendas Inventory (MDRAI; see "Method" for details) and established its reliability and validity through a series of testing among academics worldwide. Further empirical evidence showed that the eight dimensions of research agendas can be classified into two types: trailblazing and cohesive (Santos & Horta, 2018). Trailblazing research agendas are characterized by being more multidisciplinary, collaborative, and with greater scientific ambition and risk-taking research projects, while cohesive research agendas are characterized by a focus on specialization, mastery, stability and low risk taking.

The two types of research agenda orientations identified by Santos and Horta (2018) are particularly enlightening to the present study because they (especially six of the eight dimensions of the research agendas – the exceptions being tolerance for low funding and mentor influence) are highly reminiscent of two of the three types of intellectual styles (i.e., Type I and Type II styles) proposed by Zhang and Sternberg (2005) in psychology. Intellectual styles, an umbrella term for such style constructs as cognitive styles, learning styles, thinking styles, and teaching styles, refer to people's preferred ways of processing information and dealing with tasks. According to Zhang and Sternberg (2005), Type I styles are creativity-generating and they require higher levels of cognitive complexity, while Type II styles suggest conformity and they require lower levels of cognitive complexity. Noticeably, the characteristics manifested in Type I intellectual styles closely resemble the ones associated with trailblazing research agendas, while the features entailed by Type II intellectual styles are highly similar with the characteristics associated with cohesive research agendas. However, would these conceptual links be supported by empirical data? The core mission of this study was to answer this question.

Teaching styles

For decades, scholars in educational psychology have been engaged in investigating the concept of teaching styles. There are different ways to define teaching styles. For example, teaching styles have been defined as "a teacher's personal behaviors and media used to transmit data or receive it from the learner" (Kaplan & Kies, 1995, p.29). In the present research, as a specific style construct under the umbrella term of "intellectual styles", teaching styles refer to teachers' preferred way of processing information and dealing with tasks within the context of teaching (Sternberg, 1997).

Sternberg (1997) contended that like a government that may govern its society in many different ways, teachers may use their abilities in different ways. Teachers' preferred ways of using their abilities in the teaching context can be construed as teaching styles. Sternberg (1997) specified 13 teaching styles. In the present research, only two styles were adopted due to limited space in an international survey questionnaire (see "Research Sample and Procedure" under "Method" for details). The first is the legislative style, a Type I style (Zhang & Sternberg, 2005). Teachers who have a

propensity for using the legislative teaching style enjoy being engaged in tasks that require creative thinking and behaviors not only from themselves but also from their students. The second is the executive style, a Type II style (Zhang & Sternberg, 2005). Teachers scoring high on the executive style are more concerned with implementation of tasks with set guidelines in teaching; they also prefer to give students more specific instructions when assigning students assessment tasks.

To measure teaching styles, Grigorenko and Sternberg (1993) constructed the Thinking Styles in Teaching Inventory (TSTI) and tested among schoolteachers in the United States. Subsequently, the TSTI was tested among teachers and academics in different parts of the world (e.g., Chen, 2007; Clarke, Lesh, Trocchio, & Wolman, 2010; Palut, 2008; Zhang, Fu, Li, & He, 2019).

The existing findings have shown satisfactory psychometric properties of the TSTI and demonstrated the superiority of Type I teaching styles over Type II teaching styles in terms of the ways in which the two types of styles were related to other attributes and outcomes. For example, Palut (2008) concluded that Turkish preschool student teachers scoring higher on Type I teaching styles tended to exhibit higher levels of internal locus of control than those scoring higher on Type II styles. In higher education context, Chen (2007) identified that Type I teaching styles were significantly related to beneficial humour styles (e.g., affiliative style and self-enhancing style) and that Type II teaching styles were highly correlated with detrimental humour styles (e.g., aggressive style and self-defeating style). Within the context of examining the notion of the research-teaching nexus among Chinese academics, Zhang and Shin (2015) concluded that there was a statistically significant, albeit moderate, relationship between the use of Type I teaching styles and research productivity. More recently, Zhang and her colleagues (2019) found that academics who expressed more positive emotions in teaching tended to adopt Type I teaching styles and that those who expressed more negative emotions in teaching tended to report the use of Type II styles. Furthermore, Zhang et al.'s (2019) study concluded that academic self-efficacy mediated the relationship between teaching styles and emotions in teaching.

Academic self-efficacy

Self-efficacy refers to individuals' belief in their ability to succeed in task performance (Bandura, 1997). In investigating academics' self-efficacy, scholars examined academics' belief in their capability of succeeding in teaching, research, and service – academic activities conventionally known as the three pillars of higher educational institutions. In the scanty existing literature, academic self-efficacy has been investigated primarily as an outcome of academics' profile, including academic qualifications (Bailey, 1999), academic rank (e.g., Bailey, 1999; Schoen & Winocur, 1988), gender and gender identity (Schoen & Winocur, 1988; Wright & Holttum, 2012), and research productivity (Hemmings & Kay, 2010; Vasil, 1992). In the past several years, scholars have also tested academic self-efficacy as an antecedent to, for instance, research productivity and curricular construction (e.g.,

Marzuki, Subramaniam, Cooper, Cooper, & Dellaportas, 2017; Pasupathy & Siwatu, 2014). Finally, academic self-efficacy has also been found to mediate the relationship between academics' attributes and academic activities. In this regard, Wright and Holttum (2012) concluded that research efficacy mediated the association between gender identity and research productivity among academics in the United Kingdom. As noted earlier, Zhang et al. (2019) identified that academic self-efficacy mediated the statistically predictive power of Chinese academics' emotions in teaching for their teaching styles. These findings motivated the present researchers to look into the possible mediating effects of academic self-efficacy in the statistically predictive relationship of academics' research agendas to their teaching styles.

Several academic self-efficacy measures have been documented in the literature (e.g., Bailey, 1999; Hemmings & Kay, 2010; Pasupathy & Siwatu, 2011; Schoen & Winocur, 1988; Zhang & Li, 2016). For two reasons, the present study adopted six items from Zhang and Li's (2016) 12-item *Research-Teaching Efficacy Inventory* (RTEI). First, except Zhang and Li's (2016) inventory, the existing inventories were all too long (varying from 30 to 78 items) particularly considering that the present data were collected within the context of a large-scale international survey that covered much other information (again, see under "Method" section). Secondly, Zhang and Li's (2016) inventory is, to date, the only one that involved the assessment of academics' efficacy in winning competitive research grants – a primary academic activity in the present global higher educational context.

Academic work in Hong Kong universities

Academic work in Hong Kong universities has been strongly influenced by government-led policy changes. In terms of research, the Hong Kong Research Assessment Exercise (RAE), which is a combination of the UK Research Assessment Exercise and the Research Excellent Framework (REF), is a major evaluative instrument linked to university funding (Lo & Ng, 2015). In addition, competitive project funding, mainly through the General Research Fund (GRF) grants, the central funding source for research projects in Hong Kong, plays a critical role in individual performance evaluation; constant application to GRF grants is strongly encouraged by the universities in the territory for purposes of performativity (Macfarlane, 2017). This research and research impact evaluation funding schemes place Hong Kong academics under pressure to publish in the most reputable international peer-reviewed journals; they underline the criticality of being research engaged and well networked internationally. This emphasis on research activities is further stressed by the critical importance that research outputs have for tenure and promotion (Horta et al., 2019). At the same time, there are arguments that the Hong Kong research system is currently underfunded when compared with similar systems worldwide (Horta, 2018).

The teaching dimension at Hong Kong universities is also stressed by universities and the government policies (Jung & Chan, 2017). The Teaching and Learning Quality Process Reviews

(TLQPR), a quality assurance scheme adopted to ensure teaching quality, along with Quality Assurance Audits, have been playing a key role in influencing teaching practices and pedagogy at Hong Kong universities (Mok, 2000; UGC, 2010). The University Grants Committee further highlights the relevance of teaching though financing teaching development grants (TDGs) and teaching awards that aim at fostering innovative pedagogies, assessment and learning outcomes, and ultimately disseminating good teaching practices (Mok, 2014). Although teaching in Hong Kong has a long tradition of being teacher-centered, the aforementioned schemes had an impact in promoting a more student-centered teaching (Jin & Cortazzi, 2006; Donoghue, 2006).

Although these policies were aimed at promoting a balance between research and teaching and mitigating the concern that the evaluation system was overemphasizing research to the detriment of teaching, the reality is that Hong Kong academics continue to prefer to be engaged mainly in research. Furthermore, this engagement in research vis-à-vis teaching has been rising. According to the Changing Academic Profession (CAP) survey in 1993 and 2007, and the Academic Profession in Knowledge Society (APIKS) in 2018, the percentage of Hong Kong academics who prefer research increased from 54% in 1993, to 63% in 2007, and 82% in 2018.

The present study and its hypotheses

The principal objective of this research was to examine the mediating role of academics' research and teaching efficacy in the statistically predictive relationship of research agendas to teaching styles – when key demographic variables (i.e., gender, academic rank, age, and institutional type) were taken into account. Founded on the nature of each of the three key research variables, relevant literature as reviewed, and on the conditions for mediation articulated by Baron and Kenny (1986), it was predicted that overall, research agendas would statistically significantly affect teaching styles directly – and indirectly, via academic self-efficacy (see the "Conceptual Diagram" for the relationships specified among the three key research variables). Furthermore, these relationships should remain after the demographic variables are controlled for.

Specifically, the following research hypotheses were made:

Hypothesis 1: Trailblazing research agendas would positively predict academic self-efficacy, whereas cohesive research agendas would negatively predict academic self-efficacy;

Hypothesis 2: Academic self-efficacy would positively predict the Type I legislative teaching style, but negatively predict the Type II executive style;

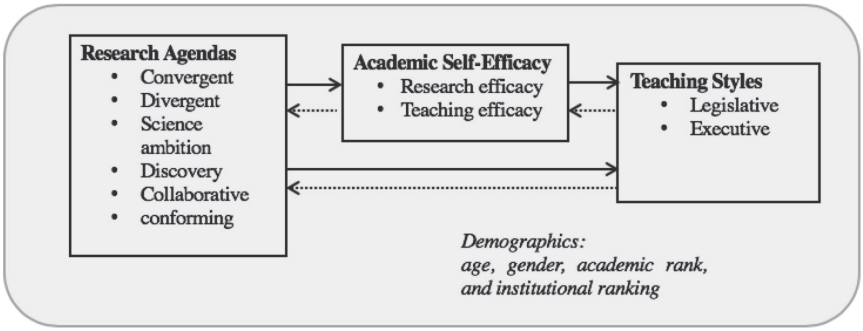
Hypothesis 3: The trailblazing research agendas would positively predict the legislative teaching style, but negatively predict the executive style; Meanwhile, cohesive research agendas would negatively predict the legislative style, but positively predict the executive style;

Hypothesis 4: Research agendas would statistically predict teaching styles indirectly – through

academic self-efficacy.

It should be noted that the relationships specified here are not causal. The relationships indicated by the broken arrows in the conceptual diagram are equally possible.

Prior to testing these hypotheses, the psychometric properties of three parsimonious inventories, each assessing one of the three constructs, were explored. Such an exploration was effectively the preliminary objective of this research.



Note: The present study tested the relationships indicated by the solid arrows.

Figure 1. Conceptual diagram: Relationships among research agendas, teaching styles, and academic self-efficacy

Method

Research sample and procedure

This study was part of a larger research project – the third international investigation into the academic profession (known as the "Academic Profession in the Knowledge-based Society" – APIKS survey study) – a collaborative project among academics from 30 jurisdictions, including Hong Kong. Data collection was conducted between late 2017 and early 2018. This article presents findings derived from data collected from academics in STEM fields in Hong Kong and based on the three aforementioned key research variables, controlling for key demographics.

Ethics approval was granted by the Human Research Ethics Committee of the University of Hong Kong before data collection. Both online and printed versions of the questionnaire were sent to academics (n=5,892) who were involved in both research and teaching in all eight of the University Grants Committee-funded institutions in Hong Kong. Contact information of the academics was obtained from the eight institutions' websites.

In all, 552 completed questionnaires were returned, constituting a 9.3% return rate, but five were disqualified due to their systematic missing responses to different sections in the questionnaire.

Therefore, a total of 547 questionnaires were usable, of which, 256 were completed by academics in STEM (science, technology, engineering, mathematics) fields.

Among the 256 STEM academics (193 males and 63 females), 177 were from universities that have been consistently ranked by global university ranking systems (e.g., Times Higher Education, Quacquarelli Symonds, and Webometrics) as the top three in Hong Kong and 79 were from the remaining five universities. The participants' ages varied from 28 to 76 years, with the median age being 44. In terms of academic rank, there were 74 full professors or readers, 53 associate professors, principal lecturers, senior lecturers, or equivalent, 86 assistant professors, research assistant professors, or lecturers, and 43 post-doctoral fellows or equivalent (who had both teaching and research responsibilities).

Instruments

In response to the APIKS international survey, the research participants provided basic demographic information (e.g., age, gender, academic rank, institutional affiliation, and primary academic discipline) and answered a wide range of questions regarding career and general work situation and activities, professional situations, research, teaching, knowledge exchange, and university governance and management. In addition, the participants responded to 24 items selected from three self-report inventories – items added by the Hong Kong team members (i.e., authors of this article) in line with the agreement reached among the 30 international research teams – that each of the 30 participating teams may add a small number of questions of their own research interest. The 24 items included: 1) 12 items from the Multi-Dimensional Research Agendas Inventory (MDRAI; Horta & Santos, 2016); 2) six items from the Thinking Styles in Teaching Inventory (TSTI; Grigorenko & Sternberg, 1993); and 3) six items from the Research-Teaching Efficacy Inventory (RTEI; Zhang & Li, 2016). For items in all three inventories, the participants were instructed to indicate, on a 7-point Likert scale, how well each of the 24 statements described themselves, with "1" suggesting "not at all well" and "7" denoting "extremely well."

Multi-dimensional research agendas inventory

The MDRAI (Horta & Santos, 2016) contains 35 items assessing the aforementioned eight dimensions of the research agendas. As previously introduced, the MDRAI has thus far been tested in three studies with academics from different parts of the world. Findings of these studies were documented in three publications (Horta & Santos, 2016, 2019; Santos & Horta, 2018). All three studies resulted in satisfactory psychometric properties for the MDRAI, with the initial model (Horta & Santos, 2016) showing good fit indicators: ($X2/df = 1.987$; $CFI = 0.965$; $PCFI = 0.795$; $RMSEA = 0.033$; $P[RMSEA \leq 0.05] < 0.001$). The validity of the inventory has also been demonstrated by results from cluster

analysis (Santos & Horta, 2018), and all the eight scales were demonstrated to have factorial validity with items having standardized loadings above 0.50 (from 0.517 to 0.921), convergent validity, with an average variance extracted also above the 0.50 mark for all items (from 0.529 to 0.855), and discriminant validity (see Horta & Santos, 2016). The composite reliability indicator showed items ranging from 0.765 to 0.922, and above the 0.7 threshold indicating that the items are reliable (see Hair et al., 2010).

In the present study, 12 items (see the Appendix), each two items assessing one of the six dimensions of the MDRAI. As noted in the previous section, these six dimensions were adopted because of their conceptual link with the two types of teaching styles. These dimensions are scientific ambition, divergence, discovery, collaboration, convergence, and conservative, with the first four being the dimensions characterizing trailblazing research agendas and the last two featuring cohesive research agendas.

Thinking styles in teaching inventory

The TSTI (Grigorenko & Sternberg, 1993) is a self-report test containing 49 statements evaluating seven of the 13 teaching styles proposed by Sternberg (1997). The inventory has been validated in various studies in different cultural contexts (Chen, 2007; Clarke, Lesh, Trocchio, & Wolman, 2010). As noted earlier, the present study adopted six items evaluating two teaching styles: the legislative style (a Type I style) and the executive style (a Type II style) (see Appendix for the six items).

Research-teaching efficacy inventory

The RTEI (Zhang & Li, 2016) consists of 12 items, with six measuring research efficacy and six testing teaching efficacy. Due to the limited space in the international survey questionnaire and with the aim of establishing a shorter version of the RTEI, the Hong Kong team adopted three items to evaluate research efficacy and another three to assess teaching efficacy (also see the Appendix).

Data analysis

Given that the items included in each of the scales tested are substantially fewer (at least by half) than those contained in each of the scales in the original inventories, the internal structure of each of the short inventories was examined using exploratory factor analysis with the maximum likelihood method and an oblique rotation. Factor extraction was conducted based on Kaiser's (1974) criterion (Eigenvalues > 1.0) and the Scree plot (Bryant & Yarnold, 1995). Factor analysis was conducted at the item level. Furthermore, before exploratory factor analysis was conducted, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and the Bartlett Test of Sphericity were performed to ensure the fit of the data. The internal consistency of the scales in the three aforementioned inventories was estimated with Cronbach's (1951) alpha.

To preliminarily examine the data, descriptive statistics and correlation analyses concerning each main research variable (i.e., research agenda, teaching style, academic self-efficacy) were conducted. Moreover, correlational analyses and ANOVA were carried out to identify the relationship between demographic factors (i.e., gender, age, academic rank, institutional ranking) and the key variables. Because three of the demographic factors (age, gender, and academic rank) were significantly related to the key variables, they were put under control in the remaining analyses for testing the research hypotheses.

The research hypotheses were tested with two types of statistical analyses. First, hierarchical multiple regressions with stepwise method were used to analyze the predictive effects of research agendas with respect to teaching styles. Second, simple mediation models using PROCESS macro (Hayes, 2013) were performed to test the statistical relationships among research agendas, academic self-efficacy, and teaching styles. Given that results showed that the partial correlations between academic self-efficacy and the executive teaching style were not significant (see Table 2), no possible causal association was expected, in a statistical sense, between academic self-efficacy and the executive style (Preacher & Hayes, 2008). Therefore, the mediating effect of academic self-efficacy in the relationship between research agendas and the executive style was not tested. The mediating effect of academic self-efficacy was only examined concerning the relationship between research agendas and the legislative teaching style (Baron & Kenny, 1986). The bootstrapping approach was adopted to determine this effect (Preacher & Hayes, 2008). The amount of variance explained by the indirect effect of academic self-efficacy in each mediation model was calculated as the ratio of indirect effect to total effect (Brown, 1997).

Results

Validity and reliability: The MDRAI, TSTI, and RTEI

Statistics concerning the KMO measure of sampling adequacy and the Bartlett Test of Sphericity (BTS) indicated that items in all three inventories were fit for exploratory factor analysis. For research agendas, KMO = .66, and the BTS indices were p = .000, approximate Chi^2 = 1349.74, and df = 66. For academic self-efficacy, KMO = .69, and the BTS indices were p = .000, approximate Chi^2 = 392.24, and df = 15. For teaching styles, KMO = .60., and the BTS indices were p = .000, approximate Chi^2 = 273.76, and df = 15. Because all of the KMOs reached 0.60 and all p values for BTSs were smaller than .05, it was appropriate to test the items in each of the three inventories with factor analysis, respectively (Cerny & Kaiser, 1977; Hair, Babin, Black, & Anderson, 2010).

Based on the criterion set for eigenvalues, four factors for the 12 items in the MDRAI were extracted. However, the Scree plot showed an obvious break on the third data point, suggesting that a two-factor solution would be more appropriate. Costello and Osborne (2005) argued that eigenvalues

could overestimate the actual number of factors and that the best way to determine the number of factors is to consider what's revealed by the Scree plot in conjunction with the number of hypothesized number of factors. As illustrated earlier, the present study anticipated a two-factor solution from a theoretical standpoint. Therefore, further exploratory factor analysis was conducted, with the 12 items being forced into two factors. Results supported the ways in which the items were expected to cluster (see Table 1 for detailed statistics).

Table 1. Oblimin-rotated two-factor model for multi-dimensional research agendas inventory (N = 256)

Item	Factor 1	Factor 2
1		.63
2		.73
3	.50	
4	.47	
5	.72	
6	.76	
7	.71	
8	.65	
9	.59	
10		.81
11	.61	
12		.77
% variance	27.46	20.78
Cumulative Variance	27.46	48.24
Eigenvalue	3.30	2.49

Note: Variables with factor loadings of less than |.30| are omitted; #see the Appendix for corresponding items.

Inspection of the Scree plot and eigenvalues suggested the six items assessing the two teaching styles fell into two factors, as expected. The three items assessing the legislative style loaded on the first factor, with eigenvalue being 1.96 and factor loadings being .82, .84, and .72 for items 13, 14, and 15 in the Appendix, respectively. The three items evaluating the executive style loaded on the second factor, with eigenvalue being 1.69 and factor loadings being .66, .77, and .81, for items 16, 17, and 18 in the Appendix, respectively. The two factors accounted for 60.87% of the variance in the data.

Inspection of the eigenvalues and Scree plot indicated the six items assessing the two aspects academic self-efficacy also yielded two factors, as anticipated. The three items assessing teaching efficacy loaded on the first factor, with eigenvalue being 2.45 and factor loadings being .88, .84, and .77 for items 19, 20, and 21 in the Appendix, respectively. The three items testing research efficacy loaded on the second factor, with eigenvalue being 1.54 and factor loadings being .68, .80, and .88, for items 22, 23, and 24, respectively. The two factors accounted for 66.46% of the variance in the data.

As regards the internal reliability of the inventories, all scales in the three inventories possessed satisfactory internal reliability – based on the cut-off score .60 proposed by Hair, Black, Babin, Anderson, and Tatham (2006). Specifically, Cronbach's alphas for the research agenda scales were .91 (scientific ambition), .84 (divergence), .62 (convergence), .83 (discovery), .87 (conservative), and .73

(collaboration). Cronbach's alphas were .71 and .61 for the legislative teaching style and the executive teaching style, respectively. Cronbach's alphas were .78 and .70 for teaching efficacy and research efficacy, respectively.

Descriptive statistics and partial correlations among main research variables

Table 2 shows the descriptive statistics and partial correlation coefficients among research agendas, teaching styles, and academic self-efficacy, with academic rank, gender, and age being controlled. Normality of data distribution was secured, with the scales' skewness values varying from -.91 to .31 and kurtosis values varying from -.68 to 1.33.

As indicated in Table 2, statistically significant partial correlation coefficients were found among all of the three key variables in different combinations, except between academic self-efficacy and the executive style. Cohen, Cohen, West, and Aiken (2013) noted that correlation coefficients from 0.1 to 0.3, from 0.3 to 0.5, and greater than 0.5 indicate small, medium, and large magnitudes, respectively. According to these criteria, the partial correlation coefficients between research agendas and the legislative style and those between academic self-efficacy and the legislative style were small. The partial correlations between research agendas and academic self-efficacy were small-to-moderate. Regarding the partial correlations between research agendas and the executive style, only the correlation between the convergence dimension of the MDRAI and the executive style and that between the conservative dimension of the MDRAI and the executive style were significant, with the magnitudes of these correlation coefficients being small and moderate, respectively.

Multiple regressions: Research agendas predicting teaching styles

Table 3 presents the results of stepwise regression analyses concerning the relationship of research agendas to teaching styles. With demographic factors being controlled, research agendas uniquely accounted for 7.6% of the variance in the legislative style. Specifically, scientific ambition (β = .20, p = .005), convergence (β = -.16, p =.011), and collaboration (β = .13, p = .047) respectively predicted the legislative teaching style.

With demographic factors being controlled, only the conservative dimension of the MDRAI showed a statistically significant predicting effect on the executive style (β = .34, p = .000). The conservative dimension of the research agenda uniquely explained 10.7% of the variance in the executive teaching style.

Table 2. Descriptive statistics and partial correlations among research agendas, teaching styles, and academic self-efficacy

	Mean	SD	Skewness	Kurtosis	1	2	3	4	5	6	7	8	9
1 Research Efficacy	4.823	1.205	-.454	.067									
2 Teaching Efficacy	5.144	.864	-.547	1.327	.230***								
3 Convergent	3.329	1.471	.310	-.665	.047	-.122							
4 Divergent	4.748	1.352	-.480	-.139	.171**	-.017	-.175**						
5 Science ambition	5.363	1.472	-.905	.270	.417***	.148*	.188**	.192**					
6 Discover	5.025	1.375	-.508	-.224	.362***	.112	-.141*	.277***	.356***				
7 Collaborative	5.420	1.170	-.828	.701	.295***	.232***	-.060	.189**	.334***	.360***			
8 Conservative	3.329	1.425	.257	-.682	.067	-.040	.447***	.005	.033	-0.259***	-.025		
9 Legislative	5.128	.938	-.426	.102	.139*	.185**	-.098	.167**	.152*	.104	.158*	.007	
10 Executive	3.717	1.084	.120	-.124	.070	.072	.238***	.122	.082	-.033	.104	.345***	-.007

Notes: *p<.05; **p<.01; ***p<.001. Academic rank, gender, and age were partialled out.

Table 3. Regression models for predicting teaching styles by research agenda

	Model	Predictors included	Beta	*p*	R^2	R^2 Change	*df*	F
Legislative Style as DV	**Model 1 *(demographic)***				.013		3, 252	1.136
		academic rank	.164	.084				
		gender	-.047	.459				
		age	.094	.316				
	Model 2				.089	.076	5, 249	4.058***
		academic rank	.306	.002				
		gender	-.007	.915				
		age	.158	.086				
		science ambition	.195	.005				
		convergence	-.163	.011				
		collaboration	.131	.047				
Executive Style as DV	**Model 3 (demographic)**				.033		3, 252	2.837*
		academic rank	.002	.986				
		gender	-.071	.262				
		age	-.174	.063				
	Model 4				.140	.107	4, 251	10.178***
		academic rank	-.061	.497				
		gender	-.084	.161				
		age	-.162	.066				
		conform	.335	.000				

Notes: *p<.05; **p<.01; ***p<.001. DV = dependent variable.

Contributions of research agendas to the legislative style: Mediating effects of academic self-efficacy

Table 4 presents statistics resulted from tests of mediation models concerning the mediating effects of academic self-efficacy in the relationship between research agendas and the legislative style. Results concerning the total effects of the dimensions of the research agenda on the legislative style suggested that divergence (β = .13), scientific ambition (β = .12), and collaboration (β = .15) had statistically significant positive impact on the legislative style, uniquely accounting for 3%, 4%, and 3% variance in the legislative style, respectively.

Furthermore, data suggested that five out of the 12 mediation models satisfied the conditions for simple mediation (Baron & Kenny, 1986), with four involving research efficacy and one involving teaching efficacy. First, research efficacy significantly strengthened the positive effect of the divergence dimension of the research agendas to the legislative style [indirect effect = .017, 95%CI = (.002, .047)], with the indirect effect of research efficacy accounting for 14% of the variance in the relationship. Second, research efficacy significantly strengthened the positive effect of the discovery dimension of the research agendas on the legislative style [indirect effect = .033, 95%CI = (.004, .072)], with the indirect effect of research efficacy accounting for 37% of the variance in the relationship. Third, research efficacy significantly strengthened the positive effect of collaboration dimension of the research agendas on the legislative style [indirect effect = .027, 95%CI = (.001, .075)], with the indirect effect of research efficacy accounting for 18% of the variance in the relationship. Fourth, research efficacy also showed significant mediating effect in the relationship of the conservative dimension of the MDRAI to the legislative style. Even though the total effect of the conservative dimension of the research agenda on the legislative style was not significant (β = -.006, p >.893), its indirect effect on the legislative style through research efficacy was marginally significant [indirect effect = .014, 95%CI = (.001, .039)], thus indicating a mediating effect (Hayes, 2009; Shrout & Bolger, 2002).

Finally, teaching efficacy significantly strengthened the positive effect of the collaboration dimension of the research agendas on the legislative style [indirect effect = .025, 95%CI = (.004, .063)]. The indirect effect of teaching efficacy accounted for 16% of the variance in the said relationship.

Discussion

Summary of key findings

This research examined the long-debated issue over the research-teaching nexus by investigating the relationship between two important intellectual processes (i.e., research agendas and teaching styles)

Table 4. Mediation models regarding the roles of academic self-efficacy in the relationship of research agendas to the legislative style

IV	M	DV	a	b	c'	c	ab	95% CI of ab	mediation model			total effect model			R^2_{demo}
									$R^2_{Mediation}$	F	df	R^2_{Total}	F	df	
Convergent	RE	Legislative	.074	.144*	-.087	-.076	.011	-.002, .037	.059	3.138*	5,250	.027	1.749*	4, 251	.01
Divergence	**RE**	**Legislative**	**.147****	**.114***	**.109***	**.125****	**.017**	**.002, .047**	**.064**	**3.342****	5,250	**.044**	**2.908***	4, 251	**.01**
Science Ambition	RE	Legislative	.314***	.092	.093*	.122**	.029	-.004, .072	.058	2.069*	5,250	.047	3.065*	4, 251	.01
Discovery	**RE**	**Legislative**	**.292*****	**.114***	**.057**	**.090***	**.033**	**.004, .072**	**.047**	**2.456***	5,250	**.029**	**1.869**	4, 251	**.01**
Collaboration	**RE**	**Legislative**	**.262*****	**.104***	**.125***	**.152****	**.027**	**.001, .075**	**.062**	**3.315****	**5,250**	**.042**	**3.056***	**4, 251**	**.01**
Conservative	**RE**	**Legislative**	**.101***	**.136****	**-.020**	**-.006**	**.014**	**.001, .039**	**.042**	**2.199**	**5,250**	**.013**	**.853**	**4, 251**	**.01**
Convergence	TE	Legislative	-.051	.228**	-.064	-.076	-.012	-.035, .002	.066	3.513**	5,250	.027	1.749*	4, 251	.01
Divergence	TE	Legislative	-.005	.240**	.126**	.125**	-.001	-.024, .022	.087	4.790***	5,250	.044	2.908*	4, 251	.01
Science Ambition	TE	Legislative	.052	.221**	.110**	.122**	.011	-.005, .040	.083	4.521***	5,250	.047	3.065*	4, 251	.01
Discovery	TE	Legislative	.022	.234***	.085	.090*	.005	-.013, .030	.070	3.746**	5,250	.029	1.869	4, 251	.01
Collaboration	**TE**	**Legislative**	**.120****	**.209****	**.127***	**.152****	**.025**	**.004, .063**	**.078**	**4.246*****	5,250	**.047**	**3.056***	4, 251	**.01**
Conservative	TE	Legislative	.019	.239***	-.010	-.006	.005	-.013, .026	.056	2.970*	5,250	.013	.853	4, 251	.01

Notes: *p<.05; **p<.01; ***p<.001. IV = Independent Variable, M = Mediator, DV = Dependent Variable, RE = research self-efficacy, TE = teaching self-efficacy; a = the direct effect of research agenda on academic self-efficacy; b = the direct effect of academic self-efficacy on teaching style with research agenda being controlled; c' = the direct effect of research agenda on teaching style with academic self-efficacy being controlled; c = the total effect of research agenda on teaching style; ab = the indirect effect of research agenda on teaching style through academic self-efficacy; R^2_{Total} concern variation resulted from models using research agenda and demographics (i.e., age, academic rank, gender) as predictors; R^2_{demo} refers to the variation in teaching style accounted for by demographics; $R^2_{Mediation}$ concern the variation yielded from mediation models using research agenda, academic self-efficacy, and demographics as predictors; Statistically significant results are in bold type.

as well as the possible buffering effect of academic self-efficacy in this relationship. Results of the present study supported previous findings in favor of the argument for the existence of the research-teaching nexus (Horta et al., 2012; Robertson, 2007; Shin, 2011; Zhang & Shin, 2015).

Indeed, the statistically significant relationships identified in the present research were consistent with what had been anticipated on the basis of nature of each of the three key variables examined and on relevant literature. Specifically, it was found that, in general, academics who reportedly set and pursued two of the three dimensions that characterize trailblazing research agendas (i.e., scientific ambition and collaboration) and those who indicated that they did not set and pursue a cohesive research agenda (i.e., convergence) reported that they tended to use the creativity-generating legislative teaching style. At the same time, academics who reportedly set and pursued cohesive research agendas (e.g., having higher scores on the conservative dimension) exhibited a propensity for using the norm-favoring executive style.

Moreover, the findings indicated that the statistical contributions of academics' research agendas to their teaching styles were not always straightforward. When the bootstrapping test was used, the association between research agendas and teaching styles was shown to be buffered by academic self-efficacy in five of the 12 models tested.

Why the present findings are credible

The question is: How could one be assured that the present findings represent true relationships among the three research variables rather than having been obtained by statistical chances? This question must be answered particularly given that some of the partial correlation coefficients among the three main research variables have reached the moderate level (Cohen et al., 2013), thus threatening a potential problem of multi-collinearity. Furthermore, the need for ensuring the authenticity of the association also arises from the fact that only four of the six dimensions of the research agendas examined had direct effects on teaching styles. One could argue that four types of facts should buttress the credibility of the present findings.

Conceptual and methodological considerations

To begin with, one of the primary motivators for conducting this study was, as illustrated in the literature review, that the three key constructs are conceptually linked. Second, the statistically significant relationships were the results of stringent data analyses – with possible confounding effects of key demographics removed. Third, the contents of the items in each of the inventories are unique, focusing on research agendas, teaching styles, and academic self-efficacy, respectively, thus leaving little room for semantic resemblance across the items in the inventories.

Substantive sense arising from direct effects

Finally (and indeed, most importantly), the present results should reflect real association among the three research variables owing to the substantive sense that they make. Consider two examples of the direct statistical effects of the research agendas on the two teaching styles:

Academics who expressed significantly stronger scientific ambition were more likely to use the creativity-generating legislative teaching style. In the present research, scientific ambition was indicated by one's explicit expression of the desire to be one of the most respected experts in one's field. It is highly likely that when an academic is aspired to become one of the most respected experts in his/her field, he/she would be engaged in truly pioneering research – research that calls for high level of creativity. To be creative in research, one has to possess a wide range of attributes – such as flexible and complex thinking, perseverance, knowledge, and intrinsic motivation (Sternberg & Lubart, 1995). These attributes are precisely those needed in creative teaching (i.e., the use of the legislative teaching style). That is to say, academics' scientific ambition in terms of their research agenda might have transcended contexts – the attitudes and attributes associated with scientific ambition in research might have also been applied to academics' teaching activities. Alternatively, it is possible that academics' deep engagement in knowledge acquisition permeated their pioneering research and creative teaching simultaneously (Brew & Boud, 1995; Zhang & Shin, 2015).

As another example, the data showed that when academics adopted a cohesive research agenda (i.e., convergence in this context), their creativity-generating legislative teaching style tended to be negatively affected. This finding can be easily explained. It is highly possible that pursuing research in a single area of scientific inquiry (i.e., convergence) as opposed to diversifying into other research fields (i.e., divergence) may (ultimately) lead to outstanding research products due to one's superior mastery of the research area. However, a strongly oriented convergent research agenda may also be conducive to academics' entrenchment into one particular domain of knowledge. Such entrenchment may hurt one's creative thinking and behaviors not only in one's research but also in one's academic activities in other domains, including teaching. Alternatively, given that the design of this research is correlational, it is equally possible that creative teaching (i.e., using the legislative teaching style) has worked against the convergent research agenda. This is possible for the following line of reasoning: Creative teaching is characterized by divergent thinking and behaviors. Teaching creatively might have necessarily exposed academics to different domains of knowledge and diverse ways of problem solving, which, in turn, might have broadened their horizon for research, potentially contributing to a more divergent research agenda, but defying a convergent research agenda.

Substantive sense arising from indirect effects

In addition to having identified direct statistically significant effects of research agendas on teaching styles, the present study found that academic self-efficacy, particularly research efficacy, has provided a pathway for the significant contributions of research agendas to the legislative teaching style.

Collectively, the results suggested that when academics were more confident in their ability to successfully carry out academic activities, especially research activities (recall that four of the five mediating results involved research efficacy), the statistically positive effects of trailblazing research agendas (i.e., divergence, discovery, and collaboration) on the legislative teaching style tended to be strengthened. Moreover, although there was no direct association between the cohesive research agenda (the conservative dimension) and the legislative style, when research efficacy was considered, a negative relationship was shown between the two.

Individually, each of the five significant mediating effects makes substantive sense. For instance, when research efficacy was treated as a mediator, the statistically positive relationship between the discovery dimension of the research agenda and the legislative style became stronger. One possible explanation is that pursuing scholarship in cutting-edge scientific fields (i.e., focusing on discovery) may have fostered academics' efficacy in research; such efficacy/confidence might have, in turn, promoted their tendency to use their creativity in teaching (i.e., teaching in the legislative style). Alternatively, teaching creatively (i.e., using the legislative teaching style) may have boosted academics' creative self-efficacy, that is, people's belief in their ability to produce creative outcomes (Karwowski & Kaufman, 2017; Mathisen & Bronnick, 2009). It is conceivable that academics' creative self-efficacy could transcend, potentially leading to higher levels of research efficacy, which in turn, might have encouraged academics to undertake cutting-edge research (i.e., pursuing a discovery research agenda).

As another example, although pursuing scholarship in safe and stable scientific fields may not directly hurt creative teaching, it might have negatively affected academics' efficacy in research; The reduced research efficacy, in turn, might have negatively influenced creative teaching – at least in a statistical sense.

Indubitably, there could be alternative buffers (e.g., personality traits, emotions, occupational stress, departmental/institutional support and expectations) between academics' research agendas and their teaching styles. Based on the present findings, however, one likely buffer is academic self-efficacy, particularly research efficacy.

Linking the present findings to the existing literature

One could argue that with a correlational research design as the current one, all of the explanations given are merely post-hoc speculations. Nevertheless, taken together, the present findings resonate with the existing scholarship on the research-teaching nexus. The results supported Brew and Boud's (1995) conjecture that underlying both research and teaching is knowledge acquisition. As has been previously explained, research agendas and teaching styles are principally linked by the specific attributes (e.g., thinking, attitudes, and behaviors) involved in the two intellectual processes (i.e., research agendas and teaching styles). Moreover, successfully identifying a mediator between the two

intellectual processes can also be considered as lending support to Brew and Boud's (1995) conjecture because it is when the relationship between two intellectual processes was investigated that a mediator was identified. More than two decades ago, Hattie and Marsh (1996) searched for moderators and mediators in 498 correlations (with overall correlation coefficient being 0.06; between various teaching variables and research variables) from 58 articles, but without success.

It is possible that previous failures in identifying mediators between teaching and research had to do with the fact that the specific teaching and research variables examined were not intellectual processes per se, but rather more overt teaching and research outcomes as indicated by different measures of teaching performance and of research productivity. From this perspective, the present findings have offered a possible key to the riddle concerning the intricate relationships between research and teaching.

Limitations and future research directions

The present research has at least six major limitations that require close attention in future investigations. First, although the present research findings were consistent with the conceptually- and empirically-based research hypotheses, dovetailed the existing literature, and were readily interpretable, the relationships revealed should not be considered to be causal. For example, the present research suggested that academics' trailblazing research agendas contributed to a tendency for them to conduct creative teaching. However, it is probable that it is academics' creative teaching that has contributed to their engagement in trailblazing research. Whether or not a causal relationship exists awaits a much better designed study – such as a longitudinal study that investigates a possible cross-lagged association between research agendas and teaching styles.

Second, despite the fact that the present study has identified meaningful relationships among the three key research variables, the results should not be overly generalized. This caution is warranted by the facts that 1) only four of the six dimensions of the research agendas directly contributed to the two teaching styles investigated; and 2) the mediating effects of academic self-efficacy were only identified in the case of one of the two teaching styles tested. In addition, other personal attributes (e.g., personality traits, emotions, and occupational stress) as well as environmental factors (e.g., departmental/institutional support and expectations) may also play critical roles in the relationship between teaching and research. As such, further investigation must be conducted to ascertain if the present findings would be replicated. Moreover, findings obtained from a qualitative approach (such as interviews) would facilitate a better understanding of how the three key variables interact.

Third, the present study shares with other survey studies a repeatedly noted limitation – the reliance on self-report data. With all data having been obtained from academics' self report, there is no way of knowing if, for example, an academic who reported a high level of scientific ambition actually possessed that high level of scientific ambition – and more importantly, was pursuing a

scientifically ambitious research agenda. Future researchers can take one of the following (or both) strategies to overcome such a limitation. One strategy is to reduce the possibility of eliciting socially desirable responses by employing a brief measure of social desirability. The other strategy is to supplement self-report measures with a more objective measure. For instance, researchers could examine academics' actual research agendas through, among other ways, studying academics' writing about their research agendas, interviewing academics about their research agendas, and having experts evaluate academics' teaching performance as well as research products. Results based on such objective measures would enhance the credibility of the present findings.

Fourth, it should be cautioned that although the 12-item MDRAI has resulted in good reliability and validity data in the present research, each dimension of research agenda was only assessed by two items. Thus, there was only a limited amount of data for analyses. Would the 12-item inventory work for other research samples? This question must be answered by results from further empirical investigation.

Fifth, as Shin (2011) pointed out, the research-teaching nexus could vary as a function of academic discipline and context (Becher & Trowler, 2001; Kreber & Castleden, 2009). The present findings were merely based on data collected from academics in STEM fields in Hong Kong. Therefore, the present findings should not be generalized to academics in STEM fields elsewhere in the world, nor should they be generalized to academics in non-STEM fields.

Finally, the present research sample has certainly far exceeded the 5:1 ratio of participants-to-items requirement (Gorsuch, 1983). Nevertheless, the data were merely from 9.3% of the academics surveyed. One cannot pinpoint a definite reason for why the response rate was so low, especially considering that three email reminders about completing and returning the questionnaire were sent to the targeted participants. The low response rate, however, might have been due to the heavy workload that academics are constantly faced with. Heavy workloads might have made it impossible for the majority of the surveyed academics to find time to respond to surveys, including the present one. As such, the responses provided by the present participants may deviate from those of the total targeted research population. Therefore, the present findings await replications by future studies that either take improved strategies for promoting survey response rates or adopt a more purposeful sampling procedure.

Conclusions

Irrespective of its limitations, the present research possesses strong scientific value arising from its three major achievements. First, the study provided preliminary reliability and validity of three parsimonious self-report scales/inventories assessing research agendas, teaching styles, and academic self-efficacy, respectively. Second, the study was the first to examine the teaching-research nexus issue by testing the relationship between two fundamental intellectual processes – research agendas

and teaching styles; additionally, for the first time, a mediator (i.e., academic self-efficacy) between two intellectual processes was considered. These findings have made significant contributions to the scholarship on the research-teaching nexus in that they have presented a challenge to Hattie and Marsh's (1996) conclusion that the research-teaching nexus is a myth. On the contrary, the present findings have lent strong support to the literature in favor of the existence of a research-teaching nexus. Indeed, going beyond the existing findings showing the being of the research-teaching nexus, the present findings revealed that the relationship between research and teaching can be intricately entwined. That is to say, the relationship between teaching and research can not only be moderated by demographic variables (e.g., age, gender, academic rank, and institutional ranking), but also be mediated by other attributes (e.g., academic self-efficacy). Finally, the study is also scientifically valuable because it has built a bridge between psychology and higher education by examining the long-debated issue over the research-teaching nexus in higher education through a psychological lens.

Apart from carrying scientific value, the present research findings have practical implications for academics and university senior managers as well as for researchers in the fields of higher education and psychology. For researchers, the present findings concerning the three inventories suggest that it is viable to simply use the brief versions of the inventories to evaluate the relevant constructs, particularly when a survey contains multiple variables where participants' concentration on the items needs to be held.

The present findings do justify a positive link between research and teaching. Notwithstanding that justification, given the small amount of variations in teaching styles accounted for by research agendas, one should say that the relationship between research and teaching needs to be further strengthened. There could be many ways to do so. The present findings indicated that one way for academics to align their teaching with their research is to stay confident in their ability to successfully carry out their academic activities, especially research activities. The present findings further suggest that one possible way for university senior managers to foster the synergy between research and teaching is to encourage academics to set and pursue trailblazing research agendas and to be engaged in creative teaching. Moreover, university senior managers' creating a work environment that is conducive to the development of academic self-efficacy, particularly research efficacy, could greatly contribute to the integration between research and teaching among academics.

Finally, because this study was conducted among Hong Kong academics, the present findings have special practical implications for Hong Kong higher education. Most obviously, as previously introduced, a strong emphasis is placed on both research and teaching in Hong Kong higher education context. However, the present findings merely revealed a weak, albeit statistically significant, link between teaching and research. This would mean that if Hong Kong academics are aspired to strive for excellence in both teaching and research, they would have to bear tremendous work pressure. To reduce such pressure, measures have to be taken to create a better synergy between research and teaching activities. Certainly, these measures require efforts from individual academics. More

importantly, they call for a viable mechanism to be built by university senior managers because the ways in which academics pursue their work can be heavily influenced by their work environment (Zhang, Fu, & Li, in press). Ultimately, university senior managers play a crucial role in shaping academics' work environment (Basham, 2012).

Acknowledgement: This research was funded by the General Research Fund (Grant number: 17604 015) as administered by the University Grants Council of the Hong Kong Special Administrative Regi on, the People's Republic of China. The authors' sincere thanks go to all of the research participants.

References

Andrews, R.N., & Johnson, E. (2016). Energy use, behavioral change, and business organizations: Reviewing recent findings and proposing a future research agenda. *Energy Research and Social Science*, *11*, 195-208.

Bailey, J.G. (1999). Academics' motivation and self-efficacy for teaching and research. *Higher Education Research & Development*, *1*8(3), 343-359.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: W. H. Freeman.

Baron, R.M., & Kenny, D.A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, *51*(6), 1173-1182.

Basham, L.M. (2012). Leadership in higher education. *Journal of Higher Education Theory and Practice*, *12*(6), 54-58.

Baukal, C.E. (2010). Continuing engineering education through distance learning. *European Journal of Engineering Education, 35*(2), 225-233.

Becher, T., & Trowler, P.R. (2001). *Academic tribes and territories.* Buckingham: Open University Press.

Biggs, J.B. (1979). Individual differences in study processes and the quality of learning outcomes. *Higher Education*, *8*, 381-394.

Bourdieu, P. (1999). The specificity of the scientific field. In M. Biagioli (Ed.), *The science studies reader* (pp. 31–50). New York: Routledge.

Brew, A., & Boud, D. (1995). Teaching and research: Establishing the vital link with learning. *Higher Education*, *29*, 261-273.

Brown, R.L. (1997). Assessing specific mediational effects in complex theoretical models. *Structural Equation Modelling: A Multidisciplinary Journal, 4,* 142–156.

Bryant, F.B., & Yarnold, P.R. (1995). Principal components analysis and exploratory and confirmatory factor analysis. In L.G. Grimm & P.R. Yarnold (Eds.), *Reading and understanding multivariate statistics* (pp. 99–136). Washington, DC: American Psychological Association.

Cantwell, B. (2011). Transnational mobility and international academic employment: Gatekeeping in an academic competition arena. *Minerva*, *49*(4), 425-445.

Case, J., Fraser, D.M., Kumar, A., & Itika, A. (2016). The significance of context for curriculum development in engineering education: a case study across three African countries. *European Journal of Engineering Education, 41*(3), 279-292.

Cerny, C.A., & Kaiser, H.F. (1977). A study of a measure of sampling adequacy for factor-analytic correlation matrices. *Multivariate Behavioral Research*, *12*(1), 43-47.

Chen, G.H. (2007). *University teachers' humor production in the classroom and student ratings of teaching effectiveness*. Unpublished dissertation, The University of Hong Kong.

Clarke, T.A., Lesh, J.J., Trocchio, J.S., & Wolman, C. (2010). Thinking styles: teaching and learning styles in graduate education students. *Educational Psychology*, *30*(7), 837-848.

Coate, K., Barnett, R., & Williams, G. (2001). Relationships between teaching and research in higher education in England. *Higher Education Quarterly, 55*(2), 158-174.

Cohen, J., Cohen, P., West, S.G., & Aiken, L.S. (2013). *Applied multiple regression/ correlation analysis for the behavioral sciences.* Abingdon, UK: Routledge.

Costello, A.B., & Osborne, J.W. (2005). Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis. *Practical Assessment, Research and Evaluation*, *10*(7), 1-9.

Cronbach, L.J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*, *16*, 297-334.

Donoghue, S.L. (2006). Institutional potential for online learning: A Hong Kong case study. *Educational Technology & Society, 9*(4), 78–94.

Drew, D.D. (2011). *STEM the tide: reforming science, technology, engineering and math education in America*. Baltimore: Johns Hopkins University Press.

Ertmer, P.A., & Glazewski, K.D. (2014). Developing a research agenda: contributing new knowledge via intent and focus. *Journal of Computing in Higher Education*, *26*(1), 54-68.

Gorsuch, R.L. (1983). *Factor analysis* (2nd ed.). Hillsdale, NJ: Erlbaum.

Griffiths, R. (2004). Knowledge production and the research-teaching nexus: The case of the built environment disciplines. *Studies in Higher Education, 29*(6), 709-726.

Grigorenko, E.L., & Sternberg, R.J. (1993). *Thinking Styles in Teaching Inventory*. Unpublished test, Yale University.

Hair, J.F., Babin, B.J., Black, W.C., & Anderson, R.E. (2010). *Multivariate data analysis* (7th ed.), Upper Saddle River, NJ: Pearson.

Hair, J., Black, W.C., Babin, B., Anderson, R., & Tatham, R. (2006). *Multivariate data analysis* (6th ed.). Upper Saddle River, NJ: Pearson Educational, Inc

Hattie, J., & Marsh, H.W. (1996). The relationship between research and teaching: a meta-analysis. *Review of Educational Research*, *66*(4), 507-542.

Hayes, A.F. (2009). Beyond Baron and Kenny: Statistical mediation analysis in the new millennium. *Communication Monographs, 76*(4)*,* 408-420.

Hayes, A.F. (2013). *Introduction to mediation, moderation, and conditional process analysis.* New York, NY: The Guilford Press.

Hemmings, B., & Kay, R. (2010). University lecturer publication output: Qualifications, time, and confidence count. *Journal of Higher Education Policy and Management*, *32*(2), 185-197.

Horlings, E., & Gurney, T. (2013). Search strategies along the academic lifecycle. *Scientometrics*, *94*(3), 1137-1160.

Horta, H. (2018). The declining scientific wealth of Hong Kong and Singapore. *Scientometrics, 117*(1), 427-447.

Horta, H., Dautelc, V., & Velosob, F.M. (2012). An output perspective on the teaching-research Nexus: An analysis focusing on the United States higher education system. *Studies in Higher Education*, *37*(2), 171-187.

Horta, H., Jung, J., Zhang, L.F., & Postiglione, G. (2019). Academics' job-related stress and institutional commitment in Hong Kong universities, *Tertiary Education and Management*, Accepted for publication.

Horta, H., & Santos, J.M. (2016). An instrument to measure individuals' research agenda setting: the multidimensional research agendas inventory. *Scientometrics*, *108* (3), 1243-1265.

Horta, H. & Santos, J.M. (2019). Organizational factors and academic research agendas: an analysis of academics in the social sciences. *Studies in Higher Education*,
DOI: 10.1080/03075079.2019.1612351

Huet, I. (2018). Research-based education as a model to change the teaching and learning environment in STEM disciplines. *European Journal of Engineering Education, 43*(5), 725-740.

Jin, L., & Cortazzi, M. (2006). Changing practices in Chinese cultures of learning. *Language Culture and Curriculum, 19*(1), 5–20.

Jung, J., & Chan, C.K.Y. (2017). Academics' perception on research versus teaching and their recognition. In Postiglione, G.A. & Jung, J. (Eds.), *The Changing Academic Profession in Hong Kong* (pp. 145-160). Dordrecht: Springer.

Kaiser, H. (1974). An index of factor simplicity. Psychometrika, *39*(1), 31–36.

Kaplan, E.J., & Kies, D.A. (1995). Teaching and learning styles: Which came first? *Journal of Instructional Psychology*, *22*(1), 29-33.

Karwowski, M., & Kaufman, J.C. (Eds.)(2017). *The creative self: Effect of beliefs, self-efficacy, mindset, and identity*. San Diego, CA: Elsevier Academic Press.

Kreber, C., & Castleden, H. (2009). Reflection on teaching and epistemological structure: Reflective and critically reflective processes in 'pure/soft' and 'pure/hard' fields. *Higher Education, 57*, 509-531.

Land, R., & Gordon, G. (2015). *Teaching excellence initiatives: modalities and operational factors*. York, UK: Higher Education Academy.

Lo, W.Y.W., & Ng, F.S.K. (2015). Trends and Developments of Higher education research in Hong Kong: in pursuit of a cosmopolitan vision. *Higher Education Policy,* 28(4), 517-534.

Macfarlane, B. (2017). Publication and Performativity. In Postiglione, G.A., & Jung, J. (Eds.), *The Changing Academic Profession in Hong Kong* (pp. 97-108). Dordrecht: Springer.

Marzuki, M., Subramaniam, N., Cooper, B.J., & Dellaportas, S. (2017). Accounting academics' teaching self-efficacy and ethics integration in accounting courses: A Malaysian study. *Asian Review of Accounting*, *25*(1), 148-170.

Mathisen, G.E., & Bronnick, K.S. (2009). Creative self-efficacy: An intervention study. *International Journal of Educational Research*, *48*(1), 21-29.

Merton, R.K. (1957). Priorities in scientific discovery: a chapter in the sociology of science. *American sociological review, 22*(6), 635-659.

Mok, K.H. (2000). Impact of globalization: A study of quality assurance systems of higher education in Hong Kong and Singapore. *Comparative Education Review, 44*(2), 148–174.

Mok, K.H. (2014). Enhancing quality of higher education for world-class status. *Chinese Education and Society, 47*(1), 44–64.

Newman, J.H. (1853). *The idea of a university*. Garden City, NY: Doubleday.

Ortega y Gasset, J. (1944). *Mission of the university*. Princeton, NJ: Princeton University.

Palut, B. (2008). The relationship between thinking styles and level of externality: A study of Turkish female preschool student teachers. *Social Behavior and Personality: An International Journal*, *36*(4), 519-528.

Pasupathy, R., & Siwatu, K.O. (2011). Fostering confident researchers: Research self-efficacy as a faculty developmental tool. *International Journal of University Teaching and Faculty Development*, *1*(4), 249-261.

Pasupathy, R., & Siwatu, K.O. (2014). An investigation of research self-efficacy beliefs and research productivity among faculty members at an emerging research university in the USA. *Higher Education Research & Development*, *33*(4), 728-741.

Piaget, J. (1952). *The origins of intelligence in children*. New York: International Universities Press.

Preacher, K.J., & Hayes, A.F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods, 40,* 879-891.

Rawat, S., & Meena, S. (2014). Publish or perish: Where are we heading? *Journal of Research in Medical Sciences*, *19*(2), 87-89.

Robertson, J. (2007). Beyond the 'research/teaching nexus': Exploring the complexity of academic

experience. *Studies in Higher Education, 32*(5), 541-556.

Sample, S.B. (1972). Inherent conflict between research and education. *Educational Record*, *53*, 17-22.

Santos, J.M., & Horta, H. (2018). The research agenda setting of higher education researchers. *High Education*, *76*, 649-668.

Schoen, L.G., & Winocur, S. (1988). An investigation of the self-efficacy of male and female academics. *Journal of Vocational Behavior*, *32*, 307-320.

Shin, J.C. (2011). Teaching and research nexuses across faculty career stage, ability and affiliated discipline in a South Korean research university. *Studies in Higher Education*, *36*(4), 485-503.

Shrout, P.E., & Bolger, N. (2002). Mediation in experimental and nonexperimental studies: New procedures and recommendations. *Psychological Methods*, *7*(4), 422-445.

Sternberg, R.J. (1988). Mental self-government: A theory of intellectual styles and their development. *Human Development*, *31*, 197-224.

Sternberg, R.J. (1997). *Thinking styles*. New York: Cambridge University Press.

Sternberg, R.J., & Lubart, T.I. (1995). *Defying the crowd: Cultivating creativity in a culture of conformity*. New York: Free Press.

UGC (University Grants Committee) (2010). *Aspirations for the higher education system in Hong Kong*. Hong Kong: The University Grants Committee. Retrieved from www.ugc.edu.hk/eng/ugc/publication/report/her2010/her2010.htm

Vasil, L. (1992). Self-efficacy expectations and causal attributions for achievement among male and female university faculty. *Journal of Vocational Behavior*, *41*(3), 259-269.

Wright, A.B., & Holttum, S. (2012). Gender identity, research self-efficacy, and research intention in trainee clinical psychologists in the UK. *Clinical Psychology and Psychotherapy*, *19*, 46-56.

Zhang, L.F., Fu, M.C., & Li, D.T. (in press). Hong Kong academics' perceived work environment and job dissatisfaction: The mediating role of academic self-efficacy. *Journal of Educational Psychology.*

Zhang, L.F., Fu, M.C., Li, D.T., & He, Y.F. (2019). Emotions and teaching styles among academics: the mediating role of research and teaching efficacy. *Educational Psychology*, *39*(3), 370-394.

Zhang, L.F., & Li, B. (2016). *Research-Teaching Efficacy Inventory*. Unpublished test, The University of Hong Kong.

Zhang, L.F., & Shin, J.C. (2015). The research-teaching nexus among academics from 15 institutions in Beijing, mainland China. *Higher Education*, *70*(3), 375-394.

Zhang, L.F., & Sternberg, R.J. (2005). A threefold model of intellectual styles. *Educational Psychology Review*, *17* (1), 1-53.

Appendix: Items in the three inventories

Inventories	Scales	Items
Multidimensional Research Agenda Inventory	Convergence	1. My expertise is focused on a single scientific area.
	Convergence	2. I believe that specialization in one area is preferable to diversification.
	Divergence	3. I look forward to diversifying into other areas.
	Divergence	4. I would be interested in pursuing research in other fields.
	Scientific Ambition	5. I aim to be one of the most respected experts in my field.
	Scientific Ambition	6. Being a highly regarded expert is one of my career goals.
	Discovery	7. I find cutting-edge scientific areas more appealing than well-established ones.
	Discovery	8. I prefer cutting-edge research to safe research, even when the odds of success are much lower.
	Collaboration	9. My scientific articles are enhanced by collaboration with coauthors.
	Conservative	10. I prefer fields of study that are considered safe or stable.
	Collaboration	11. I enjoy collaborating with other authors in my scientific articles.
	Conservative	12. I prefer safe or stable fields of study
Thinking Styles in Teaching Inventory	Legislative	13. I prefer to allow students to plan an investigation of a topic that they believe is important.
	Legislative	14. I like to use tasks that allow each student to do things his or her own way.
	Legislative	15. In my classes, I try to motivate students to use their creative abilities.
	Executive	16. I think that guidelines for teaching should contain step-by-step strategies for implementing lessons.
	Executive	17. I prefer to assign paper/project topics to my students rather than having them select their own topics.
	Executive	18. Students should learn to follow their teachers' directions precisely.
Research-Teaching Efficacy Inventory	Teaching efficacy	19. I know how to improvise in response to changing circumstances when I teach.
	Teaching efficacy	20. I know how to adjust the level of difficulty of my teaching to suit the students so that they can understand and learn.
	Teaching efficacy	21. I can be very creative in my work with students.
	Research efficacy	22. If I try hard enough, I am able to design innovative research projects.
	Research efficacy	23. I have no difficulty in carrying out my research plans.
	Research efficacy	24. If I put in enough efforts, I can be very successful in securing competitive research grants.