Improving postgraduate students' scientific literacy and self-efficacy using international collaborative research workshops: an exploratory case study in a Chinese university

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Abstract

Postgraduate education in China bears the dual mission of "high-end talent supply" and "scientific and technological innovation" as delegated by the Ministry of Education of China (2017). Improve the quality of postgraduate student training and management is essential for Chinese universities to meet this requirement. This paper investigates the practical effectiveness of using a specially designed, internationally collaborative research training workshop to enhance new Chinese postgraduate students' scientific literacy and self-efficacy.

The research results show that the workshop, which integrates seminar presentations and both individual and group-based student activities, is of practical significance for improving the experiences of first-year postgraduate students. The findings indicate the application of enactive mastery and vicarious learning strategies in research training workshop effectively boost students' motivation, confidence and feeling of accomplishment at their early research career, and can provide ongoing benefits to support Chinese students to further develop research skills and capabilities. The positive findings in this exploratory study can inform future research projects to examine the transferability of this research training workshop model in the broader Chinese higher education context.

Keywords
postgraduate education, scientific literacy, self-efficacy

Cover Page Footnote

Introduction

Postgraduate education, the highest education level in the Chinese national education system, is charged with the responsibility to provide the country's "high-end talent supply" and to drive "scientific and technological innovation" (Communist Party of China Central Committee and the State Council of China, 2016, p.1). These responsibilities have been charged to ensure China meets the OECD's objective for education, as described in the PISA 2006: Science Competencies for Tomorrow's World (OECD, 2007, p.35). This objective is to educate towards 'scientific literacy', that is, educating students to use a scientific, evidence-based approach to decision-making.

To achieve the supply of high-end talent and to drive scientific and technological innovation, Chinese higher education institutions need to provide high-quality postgraduate student education. However, competing demands on universities makes this difficult to achieve. According to the Ministry of Education (MOE) of the People's Republic of China (2019), 2.27 million Chinese students are currently enrolled in postgraduate programs in Chinese universities. Yet, despite these high enrolment numbers, more than 2.9 million Chinese students applied for a postgraduate degree in 2019, an increase of 21.8% from the previous year. This increasing demand for postgraduate studies, driven by social and cultural factors, requires a rapid expansion of Chinese universities' postgraduate degrees in a short time frame, making it difficult to address both growth and quality demands simultaneously. As Song and Liu (2016) argue, enhancing postgraduate student education is now an important and challenging issue for the 1,000 plus Chinese universities that offer postgraduate degrees (Song & Liu, 2016).

The State Council of China has provided guidance for universities to follow as they address the national government's requirements through *The Construction Plan of World-class Universities and First-class disciplines (统筹推进世界一流大学和一流学科建设总体方案*) (2015). Peters and Besley (2018, p.1075) consider China's "double first-class strategy (双一流)" to be a "reform-based performance-related attempt to help universities optimise their disciplinary structures by strengthening the recruitment of talented scholars and scientists both from within China and abroad". The strategy mandates that Chinese universities establish high-quality student teaching systems and strengthen international collaborations and engagements. Internalisation, then becomes an essential component of many Chinese universities' strategies in pursuit of the "double first-class" objective. Many Chinese universities are now broadly engaged with foreign universities, conducting a wide range of activities including twinning programs, student exchange programs, study tours, staff exchanges and visits, transnational teaching, and collaborative research (Huang, 2007; Yang, 2014; Kosmützky & Putty, 2016). Elite Chinese universities (generally the universities under the *985 Project* and the *211 Project*) have a much greater extent of internationalisation compared to provincial or city level universities, meaning these smaller universities will need to optimise their relatively lower level of access to International resources to better manage their programs and students to achieve their mandated goals.

This paper presents an exploratory case study of a Chinese provincial university's implementation of a series of research training workshops for newly enrolled postgraduate students, conducted in collaboration with an Australian university. The objective of the workshops was to improve the participants' scientific literacy by positively influencing their self-efficacy in relation to scientific literacy. The following provides a review of the literature concerning postgraduate student education in China, self-efficacy and the meaning of the term 'scientific literacy'. The research design, findings and a discussion of the findings follows. The potential contribution of this research to extending

understandings of Chinese university management concerning internationalisation, and the practical implications of this exploratory case study, are provided.

Literature Review

The following review discusses current postgraduate education systems and practices in China, the objective of 'scientific literacy' as proposed by the Chinese government, and the potential for developing self-efficacy in Chinese post graduate students as one approach towards improving Chinese post graduate students' outcomes in line with the MOE's expectations.

Postgraduate Education in China

Postgraduate programs offered by Chinese universities differ in significant ways from post graduate programs offered in most Western countries (e.g. US, UK, Australia, Canada, and New Zealand). First, at the Masters level, Chinese universities' programs are offered over two (professional master degree) to three (academic master degree) years' full-time study, compared to some postgraduate courses in Western universities that can be completed in a single year full time (for example, an MBA). Second, conducting substantial research and successfully completing a thesis examination process is compulsory for students studying a Master degree in China, while in Western universities, students have the choice between completing the Master degree by either research or coursework. Therefore, postgraduate study in this paper refers to higher degrees which contains a substantial amount of research component. Furthermore, enrolment in a postgraduate degree in China is difficult as only approximately 25% applicants are successful, following intensive entry examinations and an interview process (Ministry of Education of China, 2019).

The Chinese higher education systems and practices are largely influenced by social and cultural factors. Li, Morgan and Ding (2008) reveal that the Chinese employment market demands postgraduate qualifications and offers significantly higher salaries for applicants with higher educational level. Most Chinese students seek postgraduate qualification for employment reasons rather than for entry to doctoral degrees. Thus, the students tend to take a pragmatic approach during their postgraduate studies which, it has been argued (Qian, 2011), can lead to low motivation and low levels of innovation. This can affect thesis quality. Wang (2016) has found that new postgraduate students in China lack autonomy and are highly reliant on supervisors to advance their research. Many students expect their supervisors to give them detailed guidance on identifying research questions and selecting research methods (Chen, 2009; Hou, He and Zhu, 2016). This expectation by students for detailed guidance and their pragmatic approach to studies can make it difficult for Chinese universities to respond to the nation's need to be innovative and to reach the objective of developing better 'scientific literacy'.

Scientific Literacy

Prior to 2001, Chinese literature concerning higher education often uses terminology such as "*科研能力 research ability*" and "*科学素质 scientific quality*" as indicators of postgraduate student quality (for example: see). However, more recently, the term "*科学素养* *scientific literacy*" has been used by the State Council of China and the MOE of China in multiple relevant national documents and reports. The Ministry of Education (MOE) of China (2013) issued *Opinions of the Ministry of Education on Deepening the Reform of Science and Technology Evaluation in Colleges and Universities* and urges Chinese higher education institutions to take on responsibilities to improve scientific literacy in China. This term must be distinguished from '*science literacy'*, which

generally refers to an individual's writing, numerical and digital skills and his/her understandings of science (see: Cormally et al., 2009; Roberts, 2007; Majima, 2015).

Scientific literacy, as used by the Chinese government, is an indicator of the quality of students leaving universities. According to Sadler and Zeidler (2009), the phrase has been used ubiquitously in the education sector. It can be understood, in application, as a student outcome on completion of their degree.

The Organisation for Economic Co-operation and Development (OECD)'s understanding of scientific literacy in its *Programme for International Student Assessment (PISA) (2007)* as the extent to which an individual student:

- *Possesses Scientific knowledge and use of that knowledge to identify questions, acquire new knowledge, explain scientific phenomena, and draw evidence-based conclusions about science-related issues.*
- *Understands of the characteristics features of science as a form of human knowledge and enquiry.*
- *Show awareness of how science and technology shape our material, intellectual and cultural environments.*
- *Engage in science-related issues, and with the ideas of science, as a reflective citizen* (OECD, 2007, p.35).

Therefore, individuals who are equipped with scientific literacy are expected to be capable of using a scientific approach to understanding issues and drawing on reliable evidence to solve these issues (Harlan, 2001). Moreover, Robert's (2007) review of scientific literacy suggests the concept extends beyond any particular discipline to include using a scientific approach in personal decision-making. Although PISA's notion of scientific literacy is designed for ordinary citizens, for a postgraduate student, the concept of scientific literacy also applies. Li (2017) specifies the concept of scientific literacy for postgraduate student education, arguing that a successful postgraduate student should possess motivation and persistence (*精神*)[1] in the pursuit of truth, an awareness of research ethics, the skills to process and analyse information, and high level problem-solving skills. Compared to the more general definition of scientific literacy proposed by PISA (OECD, 2007, p.35), Chinese educators emphasise that when applied to post graduate students the term must include a spiritual component, best translated as persistence in the pursuit of truth: a research student must dare to question, always pursue truth, persevere and not give up lightly. Zhang (2008) holds that the concept of scientific literacy should contain three aspects: an intention to conduct research scientifically, an understanding of scientific research theory, and the mastery of scientific research methods.

Somewhat similarly, Chai (2008, p.47) proposes that "scientific literacy mainly refers to scientific research knowledge, scientific research skills and scientific research spirit." Zhan (2008) divided scientific literacy into four interrelated components - intention, knowledge, ability and spirit (or motivation and persistence). Li (2009) adds that the element of research ethics should also be included when measuring scientific literacy. However, despite the attention paid by the Chinese government and by these and other researchers, there is little discussion in either the English language or Chinese language literature on how to improve postgraduate research students' scientific

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[1] 精神 translates literally as 'spirit' but the intention is to describe a strong desire or high level of motivation.

literacy. This study proposes the development of self –efficacy as one way towards developing scientific literacy for postgraduate students in Chinese universities.

Self-efficacy

Self-efficacy can be defined as a person's beliefs and confidence in their ability to accomplish a task or achieve a desired goal (Bandura, 1994; 1997; Overall, Deane and Peterson, 2011; Beatson, Berg and Smith, 2018; 2019). It is an important factor in future success, more so than actual abilities or skills (Bandura, 1997; Beatson, Berg and Smith, 2019). It is generally accepted that students with higher levels of self-efficacy are more engaged, achieve better academically, and are less likely to burnout or become demotivated during their studies (Multon et al., 1991; Bandura, 1997; Chemers, Hu and Garcia, 2001; Kahu, 2013). More importantly, students' self-efficacy is believed to be malleable and can be enhanced through enactive mastery, vicarious learning, verbal persuasion, and physiological and affective states (Bandura, 1994; 1997; Beatson, Berg and Smith, 2019). Among these four sources, enactive mastery experience is considered as the most salient source of self-efficacy. When individuals take on challenges and successfully accomplish the goals, they gain an experience and develop specific self-belief about success and performance (Bautista, 2011). To help building students' self-efficacy, educators should use positive feedback to communicate performance improvement, so they further develop generalisable skills to better cope with challenges (Panadero et al., 2017).

Self-efficacy has attracted research attention in the literature on doctoral students' teaching and supervision (Overall, Deane and Peterson, 2011; Lambie and Vaccaro, 2011; Lambie et al., 2013; Baltes et al., 2010; Kelley and Salisbury-Glennon, 2016). Forester, Khan and Hesson-McInnis (2004) state that research self-efficacy is an important factor in students' successful research completion, and their pursuit of scholarly contributions beyond graduation. Furthermore, Deane and Peterson (2011) suggest research self-efficacy can enable research students to better accomplish key research activities such as data collection, data analysis, effective writing, and research integration. They also emphasise that students' research self-efficacy can be enhanced when supervisors provide students with both direct help and support for autonomy and argue that "encouraging the student to be open with their ideas and providing opportunities for students to make their own decisions" leads to higher student research self-efficacy (p.791). Lambie et al. (2014) show higher research self-efficacy positively influences student research interests and research knowledge, and students engaged in manuscript writing and publication processes generally show improved research self-efficacy. Baltes et al. (2010) present an interesting finding that indicates research student found that training in basic research design and being provided with information about qualitative research contributed to the development of research self-efficacy.

Although the literature on research self-efficacy generally focuses on doctoral students, the implications are relevant for Masters level postgraduate students in China, due to the requirement to complete substantial research and the writing of a thesis. This study, then, investigates the outcomes of a series of research training workshops on students' self-efficacy and their scientific literacy. The workshop program was designed and delivered collaboratively, involving internationalisation.

Research Training Workshops

Workshops are frequently used in Western universities as an important component of research training programs and Liu, Sheu and Williams (2004) found that research training is a predictor of research students' self-efficacy. Common topics in a research training workshop include research methodology and methods, research software training, literature searches and referencing, career

development, and academic writing (Rempel, 2010; Wisker, Robinson and Shacham, 2007; Lydon and King, 2009; Timmerman et al., 2013; Jepsen, Varhegyi and Edwards, 2012). Wisker, Robinson and Shacham (2007) state that research workshop participants gain not only short-term enhancement of various research skills, but also achieve long-term benefits, including the establishment of collaborative research networks. Lydon and King (2009) point out that workshops that provide enduring benefits need to meet certain criteria, including: concise and clear content, well-planned structure, and high levels of student interactivity. Moreover, they state that workshop facilitators must be highly-experienced and well-prepared; the workshop delivery should be student-oriented, pragmatic, interesting and engaging. Specifically, Timmerman et al. (2013) point out that literature review workshops are very effective in improving students' ability to identify key literature, and can also lead to improvement in other key research skills.

Similar findings are reported in the Chinese literature. Tian (2008) suggests successful workshop programs can improve overall student quality and enhance the research culture on campus. Dong et al. (2012) emphasise the importance of workshop quality control and also support Tian's (2008) findings by indicating that a strong on-campus academic culture can greatly enhance student performance and academic quality. Huang (2014) outlines that in addition to gaining insights into research frontiers and enhancing knowledge accumulation, workshops also enhance research students' general skills, including independence, critical thinking, and social interaction. It is generally accepted that effective use of workshops can reduce supervision pressure, enhance students' necessary research skills, and lead to successful research completion.

Workshops are also a fundamental component of Chinese postgraduate students learning. However, the purpose of the workshops is not always to respond in a timely manner to the learning needs of participating students. Tian (2008) clearly outlines that most of the workshops are randomly scheduled based on the availability of visiting scholars and provide a forum for the presentation of these scholars' current research projects, rather than considering whether the topics are suitable for the participating students. Workshop topics in Chinese universities are less diversified than those typically offered in Western universities and are mostly in the format of research seminar presentations that are didactic rather than participative. Gong (2006) states that due to poor planning and management, workshops in Chinese universities are often found to be disordered and organized in an instrumental manner. Despite these limitations, workshops are an accepted component of research training for post graduate students in China and therefore provide a forum familiar to both western and Chinese academics that can be harnessed through international collaborations. Research on co-operative teaching in China shows positive influences on Chinese student development of skills, such as English language competency, critical thinking skills, and communication (He, Craig and Wen, 2013; Dempsey and Tao, 2017).

Previous studies suggest the growing number of international students undertaking postgraduate research degrees in Anglophone universities provide opportunities for intercultural exchange of knowledge and academic values (Ryan, 2012; Bastalich, 2017). However, discussion of co-operative postgraduate students training in China is rare. Hence, this research contributes to the literature by exploring the practical efficacy of designing and implementing a series of workshops facilitated by a foreign academic for postgraduate research students attending a provincial Chinese university.

Research Questions

As the existence of international collaborative postgraduate training program in Chinese universities is rare, research workshop's effectiveness has not been studied or thoroughly investigated in the past. The design of the pilot workshop program, and the investigations conducted in this research, is exploratory in nature. Within this pilot exploratory study, the following research questions are investigated:

> **RQ1**. Does the research training workshop series enhance post graduate students' scientific literacy and self-efficacy?

> **RQ2**. If so, what aspects of the workshop series contributed to the development of students' scientific literacy and self-efficacy?

Research Design

This study was conducted as a case study in the School of Business Administration, Shandong University of Finance and Economics (SDUFE), in 2017 and 2018 to explore the effectiveness of a series of planned workshops for newly enrolling post graduate students' self-efficacy and the development of their scientific literacy. A pilot workshop program was designed collaboratively between an Australian visiting academic and the academic staff of SDUFE. It was coordinated and delivered by the Australian lecturer. The workshops were made mandatory (but not as a credit-bearing subject) for newly enrolled SDUFE postgraduate students for both years of the study.

Structuring the Workshop Program

When designing the workshop program, the facilitators endeavored to include content that could be helpful to newly enrolling research students and aimed to ensure the delivery was interactive and engaged the students. After discussions with SDUFE faculty executives and academic, it was decided the workshop would be offered in two parts on one day per week: a morning and an afternoon session. The table below summarises the content and features of the six-week workshop series.

Table 1

The content and features of the six-week workshop

Program	Morning Session	Afternoon Session
	Seminar- presented by the foreign lecturer	Student interactive exercises
Week 1	Introduction of postgraduate research student training in Australia, and showcase an example of first-year research proposal	Student self-introduction and discussion of research purposes and prospects.
Week 2	Literature review - purpose and techniques	Key literature search and selection.
Week 3	Research methodology and philosophical foundations	Individual presentation - critical review of a piece of key literature.
Week 4	Overview of quantitative and qualitative research methods	Forming research groups (4-5 students) and select a research project.
Week 5	Communicating research contribution	Groups draft a research proposal and exchange proposals with other groups.
Week 6	Conference simulation: students present their group research projects and provide discussant comments for other groups. Faculty academics are also invited to act as panel discussants and provide comments.	

As shown in Table 1, the workshop integrated both seminar presentation and student interactive research activities. The seminar content presented by the Australian lecturer is core knowledge and skills often taught in Australian universities. The lecturer's personal experiences gained during his doctoral studies were also shared with the students. The last week of the program involved a student conference model to provide practice opportunities for participation in a formal academic experience involving presenting, discussing and publication. Students were asked to conduct individual and group presentations and gained experience as a discussant as well as a presenter. Research project reports were selectively published in SDUFE's research journal. The workshop recorded near-perfect attendance by all the newly enrolling post graduate students in the School of Business Administration, SDUFE. A total of 29 students in 2017 and 31 students in 2018 participated in the workshops.

Data Sources

Multiple data sources were collected to gain an in depth understanding of the students' experiences and perceptions of the value of participating in the program. This research then uses triangulation for validation purposes, employing different research approaches and making observations from multiple positions (Creswell, 2013). These data sources include:

1. Pre-workshop Self-evaluation Questionnaire. This questionnaire contains questions asking students to self-evaluate their current scientific literacy on a five-point Likert scale. Eight questions cover the three dimensions of scientific literacy (Chai, 2008): motivation and persistence, theoretical knowledge, and scientific research skills. The questionnaire also contains several open-ended questions asking students to discuss their reason for undertaking postgraduate study and the type of research contribution they believe they can make. The purpose of these questions is to understand each student's motivations and beliefs before conducting the research in order to capture their self-efficacy. The instrument was administered electronically at the beginning of the week one workshop using Qualtrics.

2. Workshop Experience Questionnaire. This questionnaire comprises questions about the students' self-perceived improvement in scientific literacy and self-efficacy, scored on five-point Likert scales. It also asks students to rank the workshop activities in order of perceived helpfulness. These questions ask students to identify what aspects of the workshop they found helpful to their research. This questionnaire was administered at the end of the student conference in week 6 using Qualtrics.

3. Workshop Facilitator's Reflective Notes. During and after every workshop, the facilitator wrote reflective notes recording his observations of the level of student engagement with various workshop content and activities, and student feedback in the form of asynchronous discussions with students. These notes were discussed with SDUFE academics and administrative personnel regularly and adjustments were made to the program content during the workshop series on the basis of these discussions.

4. Student Performance Evaluation and Feedback. Although the workshop was not a credit-bearing subject, student assessment data were collected, and formal feedback on tasks was provided. Two tasks were evaluated – the individual oral presentation of a critical literature review, and a group presentation of a research project. Formal feedback was provided on the content and presentation of the content for both tasks using marking rubrics forms.

5. Follow-up Communication. The facilitator met some of the 2017 workshop participants in an informal group meeting in July 2018. The meeting was not pre-planned, the facilitator visited SDUFE during a trip to China and contacted the students. Nine participants were on campus. They attended and shared their experiences, including achievements and setbacks and whether they believed the workshop helped them to advance their research.

The adoption of a mixed-method approach allows the researchers to collect, analyse and integrate both quantitative and qualitative data to address the research questions (Dingwall et al., 2017). By integrating the various data sources, the researchers were able to evaluate the workshop program from both the insider and outsider perspectives.

Results and Discussions

Students' Scientific Literacy and Self Efficacy Before the Workshop

The results of newly enrolled post graduate students' self-evaluation of their scientific literacy are shown in Table 2. The results show that although the students generally believe that they are motivated to conduct scientific research, they lacked confidence in their theoretical knowledge and research skills. This is very common for new Chinese postgraduate students because undergraduate degrees in China are very exam-orientated and so provide very little preparation for research. Students are expected to develop research knowledge and skills progressively throughout their postgraduate study.

Table 2

Newly enrolled postgraduate students' self-evaluation of scientific literacy

Scientific Literacy	Specific Performance	Likert Scale *					Mean
		1	2	3	4	5	
Motivation & Persistence	Whether the student dares to question and pursues truth	0	2	29	23	6	3.55
	Whether the student has perseverance, and does not giving up lightly	2	2	12	32	12	3.83
Theoretical Knowledge	Whether the student can search and identify key literature	6	27	17	10	0	2.52
	Whether the student has good understanding of the important theories/frameworks relevant to his/her research	6	31	13	10	0	2.45
	Whether the student can identify a scientifically investigable question	2	31	21	4	2	2.55
Research Skills	Whether the student has a good understanding of relevant research methodology and methods	15	31	8	6	0	2.08
	Whether the student has good communication skills	4	39	13	4	0	2.28
	Whether the students can learn independently	4	16	21	19	0	2.92
* 5 as the highest (very satisfied/strongly agree) and 1 as the lowest (very dissatisfied/strongly disagree)							

Data collected via students' in-class discussions and the facilitator's notes also show most students chose to undertake a postgraduate program in order to find (better) jobs. For example, a student indicates in week one interactive sessions:

> *"It was very difficult for me to find jobs as a bachelor graduate. Most of the jobs demand master qualification. My bachelor degree does not satisfy the requirement of my desired jobs"* – Workshop Notes, Nov 2018

Similarly, several students indicated that the main reason that they chose to pursue a postgraduate degree is to earn higher salaries. Many of them explicitly indicated that they have no passion to advance to a doctorate degree and pursue an academic career.

Additionally, students showed a generally very low-level of research self-efficacy, as very few students believed they could accomplish research goals independently. Many stated they just simply follow their supervisors' directives. For instance, a student indicated she relies on the supervisors a lot:

> *"I don't have a clear research direction at the moment. I think it will be related to real estate management. I am in a state of confusion now, and I don't know what I want to research. After speaking with my supervisor, the instruction given is reading more literature"* – Workshop Notes, Nov 2017

These observations are consistent with the literature on the influence of the employment market on students' reasons for enrolling in postgraduate studies in China. A postgraduate qualification is regarded as a job-seeking necessity and a means for improved compensation (Li, Morgan and Ding, 2008; Wu, 2014). It also supports the concerns raised by Qian (2011) that Chinese postgraduate students lack genuine interest in research and are likely to be pragmatic about accomplishing research tasks. This situation is deleterious for Chinese universities because it makes it difficult for them to meet the MOE of China's expectation that postgraduate education should provide high-end talent to advance innovations.

Improvement in Scientific Literacy and Self Efficacy after completing the Workshop

The workshop experience questionnaire, distributed at the end of the workshop program, collected students' perceptions of the extent of their improvements in scientific literacy and self-efficacy on a five-point Likert scale. Results are shown in the Tables 3 and 4.

Table 3

Improvement in Scientific Literacy

Improvement in Scientific Literacy	2017		2018		Total	
	Frequency	%	Frequency	%	Frequency	%
Four or more areas were improved	17	58.62%	7	22.58%	24	40.00%
One to three areas were improved	10	34.48%	18	58.06%	28	46.67%
No improvement in any area	0	-	0	-	0	-
Unsure	2	6.90%	6	19.35%	8	13.33%
Total	29	100%	31	100%	60	100%

Table 4

Improvement in Self-efficacy

	Students' response on self-efficacy questions	% of positive response	
		2017	**2018**
1	Now I can confidently search and review a literature	47.62%	55.18%
2	Now I have a good understanding of research methodologies	19.04%	13.80%
3	Now I have a good understanding of different research methods	47.62%	20.68%
4	Now I can confidently conduct research activities independently	19.04%	27.58%
5	Now I can confidently communicate my research contributions	9.52%	-
6	Now I can confidently develop my own necessary research skills	28.58%	34.48%
7	Now I can confidently work collaboratively in a research group	28.58%	48.28%

The results indicate that participating students were very positive about the workshop program and considered that both their scientific literacy and self-efficacy had improved after completing the program. More specifically, students reported they believed their research skills and theoretical knowledge had both improved, with the greatest improvement reported for research skills. Student responses also indicate they have gained in their self-efficacy in relation to literature review skills and research methods. In comparison, self-efficacy gains were less in relation to communicating about a research methodology and a research contribution. One possible cause for these results is the structure of a common postgraduate program in Chinese universities. Unlike the Master by Research degree in Western universities, postgraduate students in Chinese universities will need to complete many coursework modules and so spend less time on research activities. These coursework modules include discipline-relevant theory subjects, econometrics, statistical methods, and academic English. Philosophy and methodology subjects are rarely included. Hence, Chinese postgraduate students have less exposure to methodological issues but will receive more quantitative training in their post graduate degree than is typically the case in Western universities.

To identify causes of increased self-efficacy, students were asked to rank the workshop content and activities in order of perceived helpfulness and their enjoyment of the workshops. The results are presented in Table 5.

Table 5

Most helpful and least helpful workshop content or activities

The most helpful content or activities						
Workshop content/activity	1st Rank %		2nd Rank %		3rd Rank %	
	2017	2018	2017	2018	2017	2018
Literature review techniques	23.81%	25.81%	33.33%	9.68%	19.05%	9.68%
Conference simulation	19.05%	29.03%	-	16.13%	9.52%	16.13%
Personal Stories*	23.81%	9.68%	19.05%	-	4.76%	9.68%
The least helpful content or activities						
Communicating contribution	4.76%	-	4.76%	12.90%	4.76%	9.68%
Methodology and philosophy	9.52%	6.45%	9.52%	12.90%	14.29%	19.35%
Research methods	-	3.23%	9.52%	16.13%	9.52%	16.13%

The results shown in Table 5 indicate that students found the seminar on literature searches and literature reviews, the conference simulation, and the personal stories shared by the Australian lecturer very helpful. In contrast, they considered the seminars on communicating the research contribution; research methodologies and philosophies; and research methods less helpful and less enjoyable. After cross-referencing with other evidence collected using the facilitator's reflection notes, dialogue with SDUFE staff members, and students' informal feedback in the follow-up meetings, explanations for these findings and the contribution of the program to the students' development of student scientific literacy and self-efficacy are proposed.

First, the most important research task for a newly enrolled Chinese postgraduate student is literature collection and review. As revealed in the pre-workshop questionnaire, many new Chinese postgraduate students do not initially have a clear research direction. This is because the application process for a postgraduate degree in China involves examinations, unlike in Western universities where applicants need to submit research proposal drafts. And as indicated by the students (Workshop Notes, Nov 2017), it is common for supervisors to instruct them how to search, organise and review literature at the early stage to formulate a research question. However, many new students have little experience to draw on to conduct a literature review. Hence, the seminar introducing literature review techniques, in combination with the literature review presentation activities, equipped the new postgraduate students with some necessary skills to initiate their research. As Timmerman et al. (2013) suggest, literature review training is essential for research students, and students' mastery of literature review skills can positively develop other research skills. The study reported here found literature review training was important for improving postgraduate students' scientific literacy and self-efficacy. Literature review workshops should be given priority when planning postgraduate students' training. A student reflected in the second questionnaire explaining why she found the literature review seminar very effective, indicating "now I know the difference between an annotated bibliography and a literature review". This was common

feedback given by students on the literature review component of the workshop program. It was observed during the student conference activity that students had learned from the workshop program. They presented more systematic and critical literature reviews in their group research projects than their individual literature view presentations in week three.

Second, the conference simulation was well-received by the students. A lot of effort by the facilitator and SDUFE staff member created a genuine academic environment for the new postgraduate students. The faculty dean was invited to give an opening talk; several academics voluntarily participated and acted as a review panel and provided comments. A 'best paper' award was also announced and given to the winning group as voted by the academic panel members. Although some students indicated they felt pressured knowing they must present in front of the faculty dean and academics, they also reported finding the experience rewarding and feeling a sense of accomplishment. A student reported in the second questionnaire explaining why he enjoyed the conference simulation:

> *"I feel like I attended a real-conference. I know as a postgraduate student, I need to attend conferences and present papers, I always wondered how it feels. Now I think I really liked the feeling. I feel very proud for my group, we completed a research report in a very short time and received many positive comments"* – Workshop Notes, Dec 2018

This finding largely supports Tian (2008) and Dong et al. (2012)'s conclusion that effective use of workshops enhances on-campus academic culture, which can lead to better research outcomes. Moreover, the inclusion of a conference simulation was effective, giving students a sense of pride and accomplishment. In addition to the symbolic value, students also gained some first-hand experience of future academic life, such as attending a conference, providing discussant comments, and conducting collaborative research with colleagues. Because Chinese universities need to train many postgraduate students each year, students may not gain much real conference experience due to resource restrictions. Conference simulation workshops such as that reported here can be used as a cost-efficient alternative to give students some necessary academic experience and to facilitate better research skills development. Also, as Larkin (2004, p.36) indicates, conference simulation "can provide an enhanced and more authentic way to capture what students are actually learning while the learning is taking place". In the study reported here, it was also a win-win situation for both the workshop facilitator and the students. The facilitator was able to include an assessment component to better evaluate the effectiveness of the workshop program in preparing new postgraduate students for their future research; and, the students had a chance to produce and present a research paper in an academic environment and gain valuable experience in the process.

The finding that students liked the facilitator's personal story was an unexpected finding. Originally, the open-ended question asked the students to rank their favourite workshop content and activities and 'personal story' was not a response option. However, quite a few students mentioned in their responses that they found hearing the story useful to understanding research and life as an academic and gaining some understanding of the differences between postgraduate education in Chinese and Australian universities. In response to an open-ended question seeking students' feedback to improve future workshop programs, a student clearly stated: "I hope you can talk more about how postgraduate students in Australian universities study, research, and live in Australia". Thus, this collaborative research-training workshop program also seems to offer an internationalisation experience for Chinese students.

As Beatson, Berg and Smith (2018) highlight, student self-efficacy can be altered using enactive mastery, vicarious learning, persuasion, and through physiological and affective states. The

workshop model used in this study embedded several of these approaches. The provision of enactive mastery is a very powerful source of self-efficacy beliefs (Bandura, 1997; Beatson, Berg and Smith, 2018) as a student can experience an improvement in their capability. The positive experience students gained in the conference simulation greatly boosted their morale and the belief that they were capable of becoming successful researchers. Vicarious learning can explain why the students liked the personal stories shared by the facilitator. Students seeing a comparable person's success are likely to replicate that person's behavior and believe their striving can result in the desired outcomes. During the workshop series, the facilitator narrated his research journey including his motivation, achievements and setbacks. These real personal experiences can potentially reduce students' stress by demonstrating the positive outcomes for a similarly uncertain and, at times, unclear research journey. This seemed to confirm for the students that it is normal to feel uncertain and to struggle at times. The story, that the facilitator successfully completed a doctoral program in Australia as both a non-native speaker and a mature age student, gave them confidence in their own ability to succeed. Also, as Lydon and King (2009) emphasise, an effective workshop should cater to student needs and the use of personal narrations in the workshops presented in this study was a useful approach to personalizing the material and responding to students' affective states.

The long-term effect

This study also used a follow-up group meeting to identify whether the workshop series could provide enduring benefits for participating students. In the follow-up meeting held in July 2018, nine of the 2017 workshop participants reported on their research progress, highlighted their successes and setbacks and commented on their perceptions of the impact of the workshops on their post-attendance progress. Four students indicated they had successfully published or submitted a draft paper to academic journals, and the other five students reported that they had commenced publication activities. Eight of the nine students indicated they had a much clearer picture of their research as a consequence of the workshops and had successfully accomplished several key activities, including identifying research question(s), completing literature reviews, and selecting relevant research method(s). All students agreed that the workshop experience was positive and helpful and indicated that they found the conference simulation particularly helpful. They were proud that SDUFE had published their workshop research papers in a special edition of the school journal. The fact that students enjoyed publication success and then went on to engage in more publication activities demonstrates the impact of enactive mastery experiences on improving these students' research self-efficacy (Lambie et al., 2014; Beatson, Berg and Smith, 2018).

Conclusions and Research Limitations

The findings of this study demonstrate that a carefully designed, internationally collaborative research-training workshop series can improve new Chinese postgraduate students' scientific literacy and self-efficacy. Using an exploratory case study approach and a combination of quantitative and qualitative data sources, this study contributes to the understanding of postgraduate education in China and provides recommendations to improve the effectiveness of postgraduate student management and education in Chinese universities. In addition, this study demonstrates an innovative way for Chinese universities to engage with foreign universities by collaboratively designing and facilitating research training workshops that also further enhance higher education internationalisation. These positive findings indicate the value of a larger project on extending the workshop model to include more faculties and universities in China.

There are several limitations to this study that should be addressed. First and probably most importantly, this study is exploratory, and the analysis of data sources is non-traditional. The

interpretations are subjective and cautious. Further research projects should include a more robust empirical analysis to measure changes in students' student scientific literacy and self-efficacy using standardised instruments in order to provide more concrete results. Secondly, a total of 60 observations over two years is a relatively low number of observations and this limits the empirical significance of the findings. Thirdly, due to the complicated administrative arrangements, it may not be easy for Chinese universities, especially smaller ones, to conveniently source foreign academics to run similar programs. Hence, this study's findings may lack transferability. Although we have no evidence that similar workshops facilitated by Chinese universities' own staff would not have similar effects, the findings of this study do indicate the students showed interest in the international perspective on postgraduate research training.

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