Pharmacy Education (2022) 22(1) 458 - 465
https://doi.org/10.46542/pe.2022.221.458465

RESEARCH ARTICLE

Impact of a 'Research in pharmacy' course on students' self-reported competence and confidence to conduct research: Findings from a Malaysian university

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Keywords
Competence
Confidence
Malaysia
Pharmacy practice research
Pharmacy student

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Abstract

Objective: To evaluate the impact of a 'Research in Pharmacy' course on students' self-reported competence and confidence to plan and conduct pharmacy practice research. **Method:** This is a pre- and post-intervention study conducted among third year pharmacy undergraduate students in a public university in Malaysia using an online questionnaire. A 'Research in pharmacy' course which encompassed lectures, tutorials, and practical sessions was delivered over a 14-week period. The students were divided into groups and assigned a project supervisor to guide them in planning and conducting a research project that was completed in one term. **Result:** Of the 109 students, 69 and 62 completed the questionnaire in the pre- and post-intervention periods, respectively. Students' interest in conducting research and their interest in learning about research was similar in both periods. However, self-reported ability to conduct research increased significantly. Self-reported competence and confidence to conduct most components of research improved significantly ($p < 0.05$), although, extreme/very competent or confidence level was lower than 50% for most items. Overall, median total competence score (66.0 versus 74.0, $p < 0.001$) and median total confidence score (66.0 versus 71.5, $p < 0.001$) increased significantly after the course. Most students were very satisfied/satisfied with the online lectures (54.8%) and online project supervision (64.6%). Lack of time (61.3%) was the major challenge students encountered during the course. **Conclusion:** A 'Research in pharmacy' course with both didactic and experiential components improved self-reported competence and confidence to plan and conduct research among pharmacy undergraduate students. Future studies should investigate the facilitators and barriers to students' interest in pharmacy practice research.

Introduction

Pharmacy practice research is crucial to the advancement of the pharmacy profession; It is critical to developing and implementing innovative ideas that will improve the quality of pharmaceutical services and to assess the impact of new and existing services on patient care in both hospital and community settings. In addition, practicing pharmacists need knowledge of research practices to review and appraise existing literature to make clinical decisions (Deal *et al*., 2016). Previous studies have shown that practicing pharmacists understand the importance of

pharmacy practice research, and they have interest to participate in pharmacy practice research (Abubakar *et al*., 2018; Alhomoud, 2020; Awaisu & Alsalimy, 2015; Awaisu *et al*., 2015a; Sarwar *et al.*, 2018; Sultana *et al*., 2016; Zeidan *et al.*, 2019). However, lack of knowledge and training regarding research is one of the barriers mitigating against pharmacists' involvement in research and scholarly activities (Abubakar *et al*., 2018; Alhomoud, 2020; Awaisu & Alsalimy, 2015; Awaisu *et al*., 2015a; Sarwar *et al*., 2018; Sultana *et al.*, 2016; Zeidan *et al*., 2019). In addition, pharmacists with previous research training and experience have better skills, and more interest in learning about research and conducting research (Alhomoud, 2020; Yeo, Tan, & Wan, 2020). There is limited emphasis on research and scholarly training in undergraduate and postgraduate pharmacy training programmes (Deal *et al*., 2016), although there has been an increase in research skills training among pharmacy institutions (Fuji & Galt, 2009). Building pharmacy students' interest and attitude towards research through undergraduate research training has been proposed (Awaisu *et al.*, 2015a). The most effective method to train pharmacy undergraduate students in research, however, is unknown. Some pharmacy schools provide research training through didactic, experiential or a combination of both methods (Fuji & Galt, 2009).

Few studies have investigated the perception and attitude of pharmacy undergraduate students towards pharmacy practice research. A previous study revealed that pharmacy students acknowledged the importance of research in pharmacy profession and demonstrated a positive attitude towards research, although most of the students indicated a lack of confidence in designing and conducting research (Kritikos *et al.*, 2013). In another study, students' involvement in research had an influence on their attitude and perception towards research and the authors posited that attitude and perceptions towards research could be nurtured among future pharmacists through formal training (Kritikos *et al*., 2013). In Malaysia, the lack of competence and confidence to plan and conduct research has been reported among practicing pharmacists (Yeo, Tan, & Wan, 2020). In addition, a previous study revealed that pharmacy undergraduate students have positive attitude and good perception towards a research-project-based learning module (Elkalmi *et al.*, 2020). Most pharmacy students, however, lack research experience as the completion of a research project is not a graduation requirement in most pharmacy schools (Fuji & Galt, 2009). There is paucity of data describing the impact of research training on pharmacy students' ability to conduct research. This study, therefore, evaluated the impact of a 'Research in pharmacy' course on the self-reported competence and confidence to plan and conduct pharmacy practice research among pharmacy students.

Methods

Study design, setting and population

This study is a descriptive, cross sectional study conducted among third year bachelor of pharmacy students using a self-administered, validated and pretested online questionnaire. The study was conducted in a public university located in the Eastern coast of Malaysia. The study population included all third year undergraduate students who had registered for the 'Research in pharmacy' course. All students in this population were invited to participate in the study. Participation was voluntary and no incentive(s) was given to the students to participate in the study. Students who did not provide consent and those who did not complete the questionnaire were excluded from the study. A convenient sampling technique was used to recruit the respondents and the responses were anonymous.

Description of the course

The 'Research in pharmacy' course is a three credit unit subject offered to third year pharmacy undergraduate students at the School of Pharmacy, International Islamic University of Malaysia, Malaysia. The course learning outcomes include: (a) to describe the principles of research design; (b) to explain the theories, methodology and practical skills required to conduct research; (c) to apply the knowledge and skills of research in writing research proposal, report and articles. The course content included 28 topics, including: introduction to research, research ethics regulation, literature search and appraisal, research objective/questions, research methods, research designs, sampling techniques, data collection and biostatistics. Four tutorials and nine practical sessions as well as lectures formed the course. The course content was delivered over a 14-week period during the first term of the 2020/2021 academic year. The topics were delivered through online lectures due to the COVID19 pandemic while the practical sessions involved hands-on training on critical appraisal, assessment of bias, data collection methods, biostatistics including descriptive and inferential analyses and analysis using the statistical package for the social sciences (SPSS), and scientific report and scientific paper writing.

The course outcomes included undertaking a group research project and producing a project report at the end of the term. In view of this, the students were divided into 14 groups and a project supervisor was assigned for each group. The project supervisor was a lecturer with previous research experience. The project supervisors provided guidance for the group of students assigned to them. Each group submitted a research proposal and presented their proposal to two other lecturers (not their supervisors). The proposals were sent to the research ethics committee at the School of Pharmacy for approval before data collection. Each group collected data for their respective projects, analysed and interpreted their findings. Of the 14 groups, 12 groups conducted surveys while two groups conducted systematic reviews. At the end of the term, each group submitted their research project report and presented their findings to two lecturers other than their supervisors.

Study instrument

The questionnaire used for this study was adopted from a previous study conducted among practicing pharmacists (Awaisu *et al*., 2015a). The questionnaire was available in the English language, which is the language of instruction at the school. The questionnaire consisted of 58 items that are divided into five main sections. The first section had four items that collected demographic information. The second section consists of five items regarding previous research experience and interests. The third and fourth sections consisted of 22 items, each assessed students' self-reported competence and confidence to plan and conduct pharmacy practice research using a 5-point Likert scale. The fifth section covered information on students' satisfaction with online lectures, tutorials and practical, and difficulties experienced by the students during the term (for post-intervention survey only). The questionnaire was prepared using Google Forms and the hyperlink was then shared with the students in the first week of the term. The responses received in the pre-intervention period were analysed and the Cronbach's alpha coefficient was 0.96 and 0.97 for the competence and confidence domains, respectively. The overall Cronbach's alpha value for the questionnaire was 0.98.

Data collection

Data was collected using an online self-administered questionnaire. The pre-intervention data was collected in the first week of the term while the post-intervention data was collected at the end of the term. The hyperlink for the online questionnaire was shared with all the students through the WhatsApp group created for the course. Participation in the study was voluntary. The students were required to tick a consent button before filling the questionnaire. A reminder was sent to the students every two days.

Data analysis

The data was analysed using the Statistical Package for Social Sciences (SPSS) version 23. Both descriptive and inferential analyses were conducted. Categorical variables were presented as frequencies and percentages while continuous variables were presented as means and standard deviations. The responses were transformed into scores using the following rule: 1 for not competent/confident at all, and 5 for extremely competent/confident. The total competence/confidence score was calculated as a sum of the competence/confidence score for all the items. Chi square test, Fisher exact test (where applicable), paired sample T-test and Wilcoxon Signed Ranks Test were used to evaluate the differences between the pre-intervention and post-intervention responses. *P* values of less than 0.05 were considered as statistically significant.

Results

Demographic characteristics

A total of 69 and 62 students completed the questionnaire in the pre- and post-intervention periods, respectively. Similarly, the students overall ability to conduct research increased significantly after the intervention. Interest in conducting research and interest in learning about research, however, were not improved among the students after the course. Table I describes the characteristics of the students who participated in the study.

Students' self-reported competence to plan and conduct research in the pre- and post-intervention periods

There was a significant increase in self-reported competence to conduct several components of research pharmacy practice research after the course ($p < 0.05$). The percentage of students who indicated extremely/very competent increased significantly after the course in the following components: conception of research idea (11.6% versus 35.5%), searching the literature efficiently (29.0% versus 54.8%), formulating research hypotheses/questions (13.0% versus 45.2%), and proposing appropriate study designs/methods (10.1% versus 41.9%). All of the components of pharmacy practice research skills

Table I: Characteristics of the students who participated in the study

Variable	Pre-intervention (n = 69)	Post-intervention (n = 62)	*P* value
Mean age	21.3 ± 0.7	21.9 ± 0.8	< 0.001*
Gender			0.839#
Male	16 (23.2)	16 (25.8)	
Female	53 (76.8)	46 (74.2)	
Area of pharmacy interest after graduation			0.386#
Hospital	33 (47.8)	33 (53.2)	
Community	8 (11.6)	4 (6.5)	
Industrial	4 (5.8)	8 (12.9)	
Academia	8 (11.6)	4 (6.5)	
Undecided	16 (23.2)	12 (19.4)	
Others	-	1 (1.6)	
Previous research experience	15 (21.7)	41 (66.1)	<0.001#
Previous research related training	10 (14.5)	19 (30.6)	0.017#
Interested in conducting research			0.312#
Not interested/not very interested at all	8 (11.6)	8 (12.9)	
Somewhat/very/extremely interested	61 (88.4)	55 (87.1)	
Interest in learning about research			0.145#
Not very interested/not interested at all	7 (10.1)	6 (9.7)	
Somewhat/very/extremely interested	62 (89.9)	56 (90.3)	
Overall ability to conduct research			0.009#
Poor	11 (15.9)	5 (8.1)	
Fair	32 (46.4)	16 (25.8)	
Good/very good/excellent	26 (37.7)	41 (66.1)	

*Paired sample T-test
#Chi square test

improved after the course, except: ethical consideration, outlining detailed statistical plan to be used in data analyses and managing and storing data including data entry into a database. Although, the course improved self-reported competence among the students, the percentage of students who indicated extremely/very competent after the course was less than 50% for most of the items except searching the literature efficiently (54.8%), defining target population, sample and eligibility criteria (51.6%), designing a data collection form (53.2%), summarising data in tables or charts (61.3%), and preparing a presentation (oral or poster) (62.9%). Overall, the median total competence scores increased from 66.0 before the course to 74.0 after the course (p < 0.001). Table II summarises the self-reported competence to plan and conduct pharmacy practice research among the students in the pre- and post-intervention periods.

Students' self-reported confidence to plan and conduct research in the pre- and post-intervention periods

Overall, students' median total confidence scores to plan and conduct pharmacy practice research increased after the course from 66.0 in the pre-intervention period to 71.5 in the post-intervention period (p < 0.001). The self-reported confidence to plan and conduct research improved significantly in all components except for: critically reviewing research literature, ethical considerations, outlining detailed statistical plans to be used in data analyses, designing a data collection form, managing and storing data including data entry into a database, and choosing and applying appropriate inferential statistical tests and methods. Despite an increase in self-reported confidence, less than 50% of the students indicated extremely/very confident for most of the items. The components with ≥ 50% of respondents answering extremely/very confident for include: defining a target population, sample and eligibility criteria (50.0%), ethical considerations (51.6%), summarising data in tables or charts (59.7%), interpretation of the findings and determining the significance of obtained results (50.0%), and preparing a presentation (oral or poster) (53.2%). Table III describes the students' self-reported confidence to plan and conduct research in the pre- and post-intervention periods.

Types of projects and students' satisfaction with online lectures and virtual project supervision

Most of the students conducted cross-sectional surveys (87.1%). The students experienced some difficulties in conducting their research projects, including: lack of time (61.3%), delays during data collection (16.1%) and lack of face-to-face supervision (14.5%). Overall, most of the students were very satisfied/satisfied with the online lectures (54.8%) and online supervision (64.6%). Table IV shows the difficulties and the level of satisfaction with the lectures and supervision among the students.

Discussion

The current study revealed that most undergraduate pharmacy students have an interest in conducting research and in learning about research. These observations are consistent with the results of previous studies conducted among practicing pharmacists (Abu-bakar et al., 2018; Awaisu & Alsalimy, 2015; Awaisu et al., 2015a). Interest levels, however, were higher among the students compared to practicing pharmacists in Malaysia (Yeo, Tan,

Table II: Students' self-reported competence to plan and conduct research in the pre- and post-intervention periods

Variable	Pre-intervention n (%)		Post-intervention n (%)		*P* value
	Extremely/ very competent	Moderately – not competent at all	Extremely/ very competent	Moderately – not competent at all	
Conception of research idea	8 (11.6)	61 (88.4)	22 (35.5)	40 (64.5)	0.002
Searching the literature efficiently	20 (29.0)	49 (71.0)	34 (54.8)	28 (45.2)	0.004
Critically reviewing research literature	11 (15.9)	58 (84.1)	22 (35.5)	40 (64.5)	0.015
Formulating research hypotheses and research questions	9 (13.0)	60 (87.0)	28 (45.2)	34 (54.8)	<0.001
Proposing appropriate study designs/methods	7 (10.1)	62 (89.9)	26 (41.9)	36 (58.1)	<0.001
Writing research proposals or developing a protocol	5 (7.2)	64 (92.8)	24 (38.7)	38 (61.3)	<0.001
Defining a target population, sample and eligibility criteria	13 (18.8)	56 (81.2)	32 (51.6)	30 (48.4)	<0.001
Determine appropriate sample sizes	14 (20.3)	55 (79.7)	27 (43.5)	35 (56.5)	0.005
Choosing an appropriate sampling technique (e.g. random sampling)	12 (17.4)	57 (82.6)	30 (48.4)	32 (51.6)	<0.001
Determining outcome measures (variables to measure)	13 (18.8)	56 (81.2)	29 (46.8)	33 (53.2)	0.001
Ethical considerations	31 (44.9)	38 (55.1)	37 (59.7)	25 (40.3)	0.115
Outlining detailed statistical plans to be used in data analyses	12 (17.4)	57 (82.6)	20 (32.3)	42 (67.7)	0.066
Designing a data collection form	24 (34.8)	45 (65.2)	33 (53.2)	29 (46.8)	0.036
Developing and validating a study instrument (e.g. questionnaire)	18 (26.1)	51 (73.9)	30 (48.4)	32 (51.6)	0.011
Collecting relevant data using pre-planned data collection forms	15 (21.7)	54 (78.3)	27 (43.5)	35 (56.5)	0.009
Managing and storing data including data entry into a database	20 (29.0)	49 (71.0)	26 (41.9)	36 (58.1)	0.144
Statistical analyses using software (e.g. STATA, SPSS, Epi Info)	2 (2.9)	67 (97.1)	15 (24.2)	47 (75.8)	<0.001
Choosing and applying appropriate inferential statistical tests and methods	6 (8.7)	63 (91.3)	15 (24.2)	47 (75.8)	0.018
Summarising data in tables or charts	28 (40.6)	41 (59.4)	38 (61.3)	24 (38.7)	0.023
Interpretation of the findings and determining the significance of obtained results	16 (23.2)	53 (76.8)	26 (41.9)	36 (58.1)	0.025
Preparing a presentation (oral or poster)	26 (37.7)	43 (62.3)	39 (62.9)	23 (37.1)	0.005
Writing a manuscript for publication in a scientific journal	9 (13.0)	60 (87.0)	19 (30.6)	43 (69.4)	0.019
Total competence score (Range)	66 (36 – 109)		74 (42 – 94)		<0.001#

*Chi Square test;
#Wilcoxon Signed Ranks Test

Table III: Students' self-reported confidence to plan and conduct research in the pre- and post-intervention periods

Variable	Pre-intervention		Post-intervention		*P* value
	Extremely/ very confident	Moderately – not confident at all	Extremely/ very confident	Moderately – not confident at all	
Conception of research idea	12 (17.4)	57 (82.6)	25 (40.3)	37 (59.7)	0.006
Searching the literature efficiently	20 (29.0)	49 (71.0)	29 (46.8)	33 (53.2)	0.047
Critically reviewing research literature	13 (18.8)	56 (81.2)	21 (33.9)	41 (66.1)	0.072
Formulating research hypotheses and research questions	8 (11.6)	61 (88.4)	28 (45.2)	34 (54.8)	<0.001
Proposing appropriate study designs/methods	8 (11.6)	61 (88.4)	23 (37.1)	39 (62.9)	0.001
Writing research proposals or developing a protocol	7 (10.1)	62 (89.9)	23 (37.1)	39 (62.9)	<0.001
Defining a target population, sample and eligibility criteria	12 (17.4)	57 (82.6)	31 (50.0)	31 (50.0)	<0.001
Determine appropriate sample sizes	11 (15.9)	58 (84.1)	28 (45.2)	34 (54.8)	<0.001
Choosing an appropriate sampling technique (e.g. random sampling)	11 (15.9)	58 (84.1)	27 (43.5)	35 (56.5)	0.001
Determining outcome measures (variables to measure)	9 (13.0)	60 (87.0)	29 (46.8)	33 (53.2)	<0.001
Ethical considerations	30 (43.5)	39 (56.5)	32 (51.6)	30 (48.4)	0.384
Outlining detailed statistical plans to be used in data analyses	9 (13.0)	60 (87.0)	16 (25.8)	46 (74.2)	0.077
Designing a data collection form	19 (27.5)	50 (72.5)	27 (43.5)	35 (56.5)	0.068
Developing and validating a study instrument (e.g. questionnaire)	19 (27.5)	50 (72.5)	30 (48.4)	32 (51.6)	0.019
Collecting relevant data using pre-planned data collection forms	13 (18.8)	51 (81.2)	25 (40.3)	37 (59.3)	0.008
Managing and storing data including data entry into a database	13 (18.8)	56 (81.2)	21 (33.9)	41 (66.1)	0.072
Statistical analyses using software (e.g. STATA, SPSS, Epi Info)	4 (5.8)	65 (94.2)	12 (19.4)	50 (80.6)	0.030
Choosing and applying appropriate inferential statistical tests and methods	8 (11.6)	61 (88.4)	15 (24.2)	47 (75.8)	0.069
Summarising data in tables or charts	28 (40.6)	41 (59.4)	37 (59.7)	25 (40.3)	0.036
Interpretation of the findings and determining the significance of obtained results	12 (17.4)	57 (82.6)	31 (50.0)	31 (50.0)	<0.001
Preparing a presentation (oral or poster)	20 (29.0)	49 (71.0)	33 (53.2)	29 (46.8)	0.007
Writing a manuscript for publication in a scientific journal	6 (8.7)	63 (91.3)	21 (33.9)	41 (66.1)	<0.001
Median Total confidence score (Range)	66 (36 – 104)		71.5 (43 – 91)		<0.001#

*Chi Square test;
#Wilcoxon Signed Ranks Test

Table IV: Students' satisfaction with online lectures and online project supervision

Variable	Frequency	Percentage (%)
Type of project		
Cross-sectional survey	54	87.1
Review	8	12.9
Experienced difficulties	59 (95.2)	95.2
Type of difficulty experienced		
Lack of time	38	61.3
Lack of face-to-face supervision	9	14.5
Delays during data collection	10	16.1
Others	2	3.2
Satisfaction with online lecture		
Very satisfied	8	12.9
Satisfied	26	41.9
Neutral	22	35.5
Dissatisfied	6	9.7
Satisfaction with online supervision		
Very satisfied	12	19.4
Satisfied	28	45.2
Neutral	19	30.6
Dissatisfied	3	4.8

& Wan, 2020), and could be attributed to the increasing recognition of the importance of research to the advancement of the pharmacy profession. There was no significant increase in students' interest in conducting research or their interest in learning about research after the course. A previous study found that research course training significantly increased research interest among pharmacy students (Overholser *et al.*, 2010). This was inconsistent with the results from the present study, and could be attributed to the high level of interest in research among the students before the intervention. It was found that research training significantly improved students' self-reported overall ability to conduct research and this is in agreement with the result of a previous study which demonstrated that an intensive training increased knowledge of research among practicing pharmacists (Awaisu *et al*., 2015b).

Overall, students' self-reported competence and confidence to plan and conduct several components of research improved significantly after the intervention. These findings are consistent with previous studies which revealed that research training and the application of research knowledge through research projects significantly increased the knowledge and confidence of participants to undertake research (Awaisu *et al*., 2015b; Patel *et al*., 2018; Perez, Rabionet, & Bleidt, 2017). A similar study conducted among pharmacy residents revealed that a multimodal research training that encompasses online lectures, an interactive workshop and longitudinal research experience improved knowledge and confidence to conduct research, and also increased research publication rate (Barreto *et al*., 2020). In another study, a research certificate programme which consisted of seven training sessions developed for pharmacy residents was found to improve confidence and attitude towards research; research knowledge, however, was not improved after the training programme (Weeda & Went, 2021). The type and nature of the research training has an impact on students' research interest and learning outcomes. The delivery of the components of research through lectures, tutorials and practical sessions coupled with the application of the knowledge to plan and conduct research in a group-based project is crucial to improving competence and confidence amongst students. This strategy has been described as an essential approach in a previous study (Perez, Rabionet, & Bleidt, 2017). Research understanding among students will be enhanced if this idea is taught in lectures and tutorials and then followed-up with practical hands-on sessions and real world applications of research knowledge through a project.

Although, the intervention improved competence and confidence in planning and conducting research, the percentage of students with high competence and confidence level was less than 50% for most of the research skills. Generally, students' competence and confidence was lower for: choosing appropriate inferential statistical test, conducting analyses using software and writing a manuscript for publication. This could be due to the group-based nature of the research project executed by the students. The students worked in groups and delegated responsibility to each group member. This could limit their ability to apply the research knowledge acquired from the lectures and tutorials in their research projects, thus, affecting their levels of competence and confidence. In addition, two groups conducted systematic reviews and this could affect their ability to conduct statistical analyses. Also, the online mode of delivering the course content may affect the students' learning experience. Studies have shown that pharmacy students find online teaching and learning less effective compared to face-to-face. The skills with lower self-reported levels of competence and confidence highlight topics that require improvement in subsequent years. Future studies should compare the impact of an individual and group-based research project on students' self-reported competence and confidence to plan and conduct research. The research training provided in this course is aimed at preparing the students for a final year elective research project course when students will plan and conduct a research project independently.

Most of the students were satisfied with the online mode of delivering the course content and the online project supervision deployed due to the COVID19 pandemic. Although, the authors did not ask the students regarding their learning preference, pharmacy students have a negative perception towards online teaching and learning. However, in view of the COVID19 pandemic, teaching and learning activities were forced to move online and pharmacy students needed psychometric traits such as grit and resilience to maintain focus and achieve their goals. A previous study revealed that pharmacy students have moderate levels of grit and academic resilience, and this was significantly associated with academic achievement (Abubakar *et al.*, 2021a; Abubakar *et al.*, 2021b). Grittiness could explain the perseverance demonstrated by the students to achieve the course learning outcomes.

This study has a number of limitations and should be interpreted with caution. Firstly, the competence and confidence domains were assessed subjectively and this could be influenced by the Hawthorn effect, where respondents overestimate their responses. The subjective assessment could be validated using an objective assessment of the students and an evaluation of the perception of the project supervisors. Secondly, the study was conducted in one school and this may limit the external validity of the study. Despite these limitations, the current study revealed that research training including both didactic and experiential components significantly increase pharmacy students' self-reported competence and confidence to plan and conduct research.

Conclusion

A research in pharmacy course with both didactic and experiential components significantly improved self-reported competence and confidence to plan and conduct pharmacy practice research among undergraduate students. Students' overall ability to conduct research increased significantly after the course. However, students showed lower self-reported competence and confidence levels in planning and conducting statistical analyses and writing a manuscripts for publication. The students were satisfied with the research training course.

Acknowledgements

The authors wish to thank all the students who participated in this study.

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