

The Design and Implementation of an Undergraduate Health Professional Degree Elective Course on Scientific Writing, Peer Assessment and Critical Appraisal

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Abstract

Background.

Describe the design, delivery and impact of a course delivered in an undergraduate pharmacy program with students whose first language is not English. The aim of this course is to develop pharmacy students' scientific writing, peer assessment and critical appraisal skills.

Methods.

The course is offered in the final year of an undergraduate pharmacy program. In this course, students wrote two structured pharmacy review articles (PRA) based on assigned scientific research articles and peer assessed each others' written PRAs. Students also critically appraised scientific research articles on a weekly basis, completed one pre-journal club written reflective critique based on a assigned scientific research article and moderated one journal club session.

Results.

Course rubrics were developed and validated by the course coordinators. A survey that was administered to students enrolled in the course identified that 85% of the students perceived that they gained adequate writing skills in the course. More than 70% of the students indicated they had the necessary skills to evaluate their peers' written assessments and 93% felt comfortable providing and receiving feedback from peers. More than 90% of the students indicated that their understanding of the primary research articles assigned improved as a result of their contribution to the peer assessment process and writing of PRAs.

Conclusion.

This course improved students scientific writing, peer assessment and critical appraisal skills. Further practice is required to reinforce the skills learned and to strengthen the writing skills of students.

Background

Historically, pharmacy education focused on verbal counseling skills; however, recent developments in pharmacy education have begun to place emphasis on writing skills.^{1,2} With the recent advances in health professions and inter-professional collaboration, the need for strong writing skills has become of great importance.³ Health professionals communicate clinical, technical or scientific research through writing. Professional writing skills and the ability to author scientific documents are recognized by various pharmacy education accreditation entities.⁴⁻⁷ The practice of written communication is a

required element of the Doctor of Pharmacy curriculum by the Accreditation Council for Pharmacy Education (ACPE).⁴⁻⁵ The Association of Faculties of Pharmacy of Canada (AFPC) educational outcomes also emphasize the need for pharmacy graduates to communicate effectively through writing, and to create and disseminate new knowledge in the field of pharmacy.^{6,7}

Despite the importance of having acceptable writing skills in the pharmacy profession, a previous study has indicated that both pharmacy students and preceptors of pharmacy students lacked essential and acceptable writing skills.³ Pharmacy students have recognized the need to improve their writing and other writing-related skills, such as reading, summarizing and paraphrasing.⁸ The recognition of the lack of professional writing skills has also been recognized in other health professions.⁹ The need for developing students' writing skills is greater with students whose first language is not English.¹⁰ It was observed that the writing skills of advanced pharmacy practice experience (APPE) students who are non-native English speakers ranged from 'weak', 'needs improvement', to 'dangerous'.⁸ Moreover, in a study conducted in a health professional school, where students first mother tongue was Arabic, the authors identified that the students had a limited understanding of scientific writing.¹¹ To address students writing abilities, a range of proactive efforts, from institutional initiatives stressing writing throughout the curriculum¹²⁻¹⁷ to course-based and skill-specific programs have been implemented.^{10,18,19} A previous report by Ranelli and Nelson has suggested that the implementation of a writing-intensive course will positively affect students writing skills.³ Clearly, the need to identify approaches to enhance the writing skills of students has been recognized by various health professional schools.¹²

Peer assessment involves judging or evaluating a peers' work and providing constructive feedback. Peer assessment was recognized as a successful means of providing feedback to students in higher education.²⁰ A previous study suggested that students observe different skills when evaluating their peers.²¹ In addition, students self reflect on their own performance, which enables them to improve, provides them an idea about the proper assessment process, and is an effective way to engage students in the learning process.^{22,23} More importantly, peer assessment is important for pharmacists as they are required to provide feedback to peers under their supervision. Wu, et al assessed second-year pharmacy students perceptions and attitudes towards peer assessment and found that 91.9% of the students agreed that this skill will be used in their future career.⁷ The use of peer assessment is not new in the pharmacy or health professional educations. An earlier study demonstrated that students from different health specialities also positively perceived the effects of peer assessment on learning.²⁴⁻²⁶ However, the whether undergraduate pharmacy students positively perceived the use peer assessments to improve their writing skills remains unclear.

Critical appraisal skills are also important for all health professionals. Critical appraisal skills are important for implementing evidence-based medicine (EBM) and sound policies in clinical settings. Critical appraisal training has been demonstrated to significantly increase the confidence and understanding of both evidence and the critical appraisal concepts.²⁷ The application of critical appraisal

skills through journal clubs has been suggested in an earlier study to further enhance critical appraisal skills.²⁸

To further address the scientific writing, peer assessment and critical appraisal skills in an undergraduate pharmacy program with students whose first language is not English, we designed a course with specific assessments to assess and reinforce these skills.

Methods

All pharmacy students enrolled in the final professional year of the program were registered in the course. Students involved in this study have completed a series of pre-requisite courses, which addressed elements of a scientific research article, different study designs, methods to appraise scientific literature and the basics of statistics. In addition, students completed two research courses that involved conducting research, in clinical or basic science, and writing scientific research articles based on their research findings prior to enrolling in this course. Therefore, students had sufficient skills to appraise the scientific literature assigned in this course. The grading rubric domains and descriptions were created by the course coordinators. Students were introduced to the course content and grading rubrics at the course orientation. Surveys were administered to capture students' perceptions about the skills gained in the course and to capture the students' perceptions on the use of peer assessment. Written informed consent was obtained from students who participated in the course surveys. This study was reviewed and approved by the Qatar University - Institutional Review Board (QU-IRB 225-E/13).

The course was created with the purpose of developing and enhancing scientific writing skills in both pharmaceutical and clinical sciences, peer assessment and critical appraisal of scientific literature skills (Table 1). The first component of the course focused on enhancing students' writing skills. Students were required to write two PRAs based on two scientific research articles (one clinical pharmacy and one pharmaceutical sciences), summarize them, and evaluate their content within the overall context of the research topic. Successful completion of the PRA requires extensive reading and research of the relevant topic by the student. The PRA consists of two sections; in the first section, the student writes a brief background and describes the purpose of the study, researchers' methods, study findings, and conclusions. The second section is a commentary on the research where the student discusses the importance of the information provided by the scientific research article, identifies strengths and weaknesses, provides suggestions for improvements and recommends future research studies to fill any remaining gaps in the area of interest. At the start of the course, faculty from the Foundation program at Qatar University were invited to provide one English writing workshop aimed at addressing pertinent topics such as how to avoid translating from Arabic to English; Arabic was the mother tongue for the majority of students enrolled in the course. Instructors used an evaluation rubric to assess the PRA content, completeness, coherence and cohesion, vocabulary and sentence structure (Appendix 1). The PRAs were submitted through the Turnitin® program, which checks for the originality of the written assignment. The course instructors used the same program to grade the assignments and to provide

constructive written feedback. The PRA was marked by two individuals; one evaluator who assessed the English aspect and the second evaluator who assessed the scientific content of the PRA.

The second component of the course was directed towards developing students' peer assessment skills (Table 1). Each PRA was followed by a peer assessment review session where each student reviewed an assigned PRA and addressed strengths and weaknesses. Students met and discussed the strengths and limitations of the written PRA and provided suggestions for improvement. This was followed by a focus group discussion and provision of general feedback by the instructors involved in grading the PRA assignment.

The third component of the course was designed to develop and enhance critical appraisal of scientific literature skills (Table 1). Three assessments were utilized to achieve this goal. The first assessment was the moderation of a journal club. Instructors from both clinical pharmacy and practice and pharmaceutical sciences background moderated the scientific research article sessions. Each instructor chose two scientific research articles from their field; the first was moderated by the instructor and the second was moderated by a group of students. The students were evaluated for participation by the same instructor. On completion of the course, students were exposed to scientific literature from both disciplines. Students were randomly assigned into a group five or six students and were required to moderate a journal club session based on a pre-selected scientific article. Students were given one week to prepare their moderation session. The instructor evaluated each student within the group individually using an evaluation rubric (Appendix 2). The evaluation criteria of the rubric included leadership skills, preparation and pre-reading, and listening skills. Following the moderation, questions were directed to each member of the moderation group to assess the students ability to critical appraisal the literature.

The second assessment was the pre-journal club reflective critique. Each student was required to complete one reflective critique for one scientific research article. The student read the assigned research article and critically appraised it by answering assigned questions (Appendix 3). The reflective critique assignment addressed questions such as the study rationale, study objectives, major strengths and limitations of the study, and overall conclusions of the study. Students were also expected to identify future studies and potential applications of the respective study. The reflective critique was then submitted to the instructor, who selected the scientific research article, to assess and grade its content.

The third assessment was participation in the moderation sessions' discussions. The scientific research article was released to all students one week prior to the session. Students were expected to participate and be actively involved in the discussion in all the journal club sessions. The instructor leading the given session evaluated the students' participation and engagement in the discussion throughout the session. A rubric was used to assess students on their listening skills, level of engagement and promptness. (Appendix 4).

The three different components of the course; the PRA assignments, peer assessment review sessions and journal clubs were intertwined throughout the semester. The course started with a journal club

session, with the remaining course sections and their assessments interlinking throughout the semester, ending with a peer assessment review session of the last submitted PRA in the course.

Results

At the end of the course, students were asked to complete a survey that consists of eight questions about the writing process and skills gained in the course, problems encountered, and areas of improvement (Table 2). Approximately, half of the students (48%) identified searching the literature, 20% identified reading/highlighting the article, and 16% identified listing ideas and summarizing them, as methods used to develop ideas to aid them in the writing process. Moreover, students indicated that the most interesting aspect about this course was developing new writing-related skills and comparing different fields and literature, 24% and 28%, respectively. Students also indicated that English writing workshops (16%) and the experience of writing PRAs (16%) were interesting. Challenges identified by the students in the course included the ability to paraphrase (40%), use of grammar and punctuation (20%), assignment length (20%) and summarizing ideas (12%). Students gained skills that allowed them to present information clearly and concisely (20%), appraise the literature critically (16%), write a commentary on the research and support the commentary (16%), paraphrase (16%) and correct grammar and punctuation errors (16%). After completion of the course, a third (32%) of the students believed that they could organize their ideas well. Students also indicated that they could comfortably perform a literature review (24%) and provide concise background information (24%). Students showed improvements in writing information pertaining to the background of the study, using vocabulary and transition words and paraphrasing. When students were asked about the areas that need improvement, many students identified issues pertaining to punctuation and grammar (36%), linking paragraphs (16%), identifying the study thesis statement (16%) and being able to provide evidence to support their identified strengths and limitations in the commentary part of the PRAs (16%). Only one student (4%) identified the critical appraisal skills as an area of improvement. Students were also asked about their plans to improve their weaknesses; 24% of the students suggested that they will go back to refresh their memory about the basics of the English language grammar, and 44% will read more resources to reinforce the skills learned.

Another questionnaire was administered to students to explore their perceptions of the peer assessment and their confidence in evaluating each others' work (Table 3). Approximately 70% of the students believe they have the necessary skills to assess each others' work accurately. Students were comfortable and open to feedback from their colleagues as indicated by 94% of the respondents. They also perceived that their partners will be honest in their assessments (81.8%). However, 21% do not agree to include the peer assessment in the total assignment grade. Peer assessment was perceived by approximately 70% of students as a necessary skill that is needed in the pharmacy career. Finally, a high percentage of students (85%) perceived that they enhanced their writing skills after completing two PRAs. Moreover, 91% of students perceived that the course improved their understanding of the primary literature.

Discussion

Pharmacists in their practice add knowledge to the scientific literature by conducting clinical and practice research and critically evaluating others' research work. Moreover, pharmacists communicate with all health care members verbally and non-verbally to achieve the shared goal of providing the best care for their patients. This necessitates that students acquire strong writing skills, whether basic academic writing skills or scientific writing skills. This concept is reinforced by the AFPC accreditation body. The AFPC Educational Outcomes (EO) focus on what graduates are able to do at the end of a first professional degree in pharmacy; with the scholar outcome addressing the ability of pharmacy graduates to apply the core knowledge and skills required to be a medication therapy expert, and are able to master, generate, interpret and disseminate pharmaceutical and pharmacy practice knowledge.⁶ The communicator outcome addresses the ability of pharmacy graduates to communicate effectively with target audiences using different strategies including writing.⁶ Pharmacy graduates should be able to communicate in writing and participate in practice-based research where they can apply the principles of scientific inquiry and critical thinking to achieve the aforementioned outcomes.⁶ Therefore, our course was designed to enhance the writing skills and supportive skills such as peer assessment and critical appraisal of pharmacy students.

Pharmacy students surveyed about the course indicated that their writing skills were enhanced and that they developed new writing-related skills after completion of this course. This is supported by what was suggested by Ranelli and Nelson, who indicated that a course focused on writing and related skills can result in positive outcomes in students' writing skills.³ The self-assessment survey indicated that more than 80% of students feel that they enabled the necessary writing skills that will enable them write and communicate science. Most of the students indicated that they have the necessary skills to accurately assess their peers (72.7%) and comfortably receive feedback from them (94%). In addition, a very low percentage of students (4%) feel that they need to improve their critical appraisal skills.

Despite the improvements seen in the writing skills of the students, a weakness in students writing mechanics (grammar, vocabulary and punctuation) was identified. This is in alignment with the perceptions of APPE students whose first or best language is not English. The preceptors' assessment of writing-related skills (grammar and vocabulary) of non-native English students ranged from weak to need improvement.¹³ Therefore, students should build on the skills gained in this course and practice writing to further improve their skills. Incorporation of more workshops in the course may also be of benefit to the students. These workshops are a means of incorporating curricular instructions on writing skills. Furthermore, providing students with constructive feedback regarding the submitted PRAs is essential. To further ensure that the student enhances their writing skills, feedback from the first assignment before submitting the second are needed to aid with the writing context and clarity.

Developing students writing abilities in pharmacy education by incorporating writing activities into the curriculum faces real challenges. Instructors usually resist incorporating writing activities because they do not have sufficient time to read and grade a large number of written assignments.²⁹ To overcome this challenge, the PRAs were graded by two instructors. The English aspect of the PRAs was graded by a

teaching assistant; only the scientific content was graded by the instructor who assigned the scientific research article. This also helped in accounting for any inconsistencies in the grades and interpretation of the rubrics amongst the respective instructors. The success of implementing a course which emphasizes on scientific writing skills into the curriculum requires that students are exposed to previous writing exercises, the necessary skills to critically appraise the literature and the basic components of a scientific research article.

Students responses to the peer assessment questionnaire (Table 3) are in alignment with other pharmacy students. Kritikos *et al.* assessed students perceptions and attitudes towards the peer assessment activity. Students agreed that they understand the peer assessment process (95%) and that they should assess peers (75%). However, 43% of students felt that peers can provide a fair assessment compared to 81% in our study.²⁵ Moreover, Kimberly *et al* found that 95% of students perceived they have the necessary skills to assess their peers, similar to our results.²⁶

Critical appraisal skills were also improved after the end of the journal club sessions and assessments as indicated by 90% of students. This result agrees with Odierna *et al.* where they identified significant improvements in the knowledge of health evidence and confidence of learners following journal club sessions.²⁷

Conclusion

The course was designed and implemented for fourth-year pharmacy students. The course, a pharmacy research, evaluation and presentation course, achieved its goal to train students how to critically read and discuss scientific literature, with writing employed in service to this overall goal. Continuous practice is needed to reinforce and strengthen the skills learned in the course.

Abbreviations

PRA: pharmacy review article; ACPE: Accreditation Council for Pharmacy Education; AFPC: Association of Faculties of Pharmacy of Canada; APPE: advanced pharmacy practice experience; EBM: evidence based medicine

Declarations

Ethics approval and consent to participate:

Written informed consent was obtained from students who participated in the course surveys. This study was reviewed and approved by the Qatar University- Institutional Review Board (QU-IRB 225-E/13).

Consent for publication:

Not applicable

Availability of data and materials:

All data generated or analysed during this study are included in this published article [and its supplementary information files].

Competing interests:

FM and DAB are the coordinators of the course evaluated in the current research.

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Authors' contributions:

AO and FM wrote the manuscript; AO, FH, SR, HE, DAB and FM were involved in preparing figures and analysis of the data; AO, FH, SR, HE, DAB and FM revised the manuscript. AO, SR and FM collected the data. All authors read and approved the final manuscript.

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Authors' information:

The corresponding author's academic career started in 2011 as an Assistant Professor of Pharmaceutical Sciences at the College of Pharmacy (CPH), Qatar University, one of the few Pharmacy programs outside of Canada that has full international accreditation by the Canadian Council for Accreditation of Pharmacy Programs. In 2014, she was appointed as the Head of the Pharmaceutical Sciences Department and held this position until September 2018. Currently, she is an Associate Professor of Pharmaceutical Sciences and the Chair of the Strategic Planning Committee at the College of Pharmacy (CPH), Qatar University. She has been involved in the design and delivery of many pharmaceutical sciences courses/modules at both the undergraduate and graduate level; with a focus on pathophysiology, pharmacology, molecular biotechnology and research skills and methodology. She have mentored a number of undergraduate and graduate students. In addition, she have a strong passion for identifying novel teaching tools that could be used to further enhance the delivery of her lectures, developing effective assessment tools to enhance scientific writing skills and identifying means of further developing leadership skills in health professionals.

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Tables

Table 1. Overview of the Research Elective Course Content

Section	Objective	Content	Learning Assessments
Scientific Writing	Develop/ enhance scientific writing skills	Classroom feedback sessions Writing workshops	Writing two “pharmacy review articles”
Peer Review Sessions	Develop peer assessment skills	Two peer review sessions: Focus group discussion General feedback by instructors	Completing two peer review forms
Journal Club Sessions	Strengthen scientific literature appraisal skills	Moderated sessions by instructors Moderated sessions by students	Moderating journal club sessions Completing pre-session reflective critiques Participation

Table 2. Self- Assessment Survey	
Question	Responses N (%)
1. What methods did you use to explore and develop your idea during the writing process?	
Listed ideas and summarized	4 (16)
Prioritized ideas	3 (12)
Searched the literature	12 (48)
Compared different studies	1 (4)
Read around the subject	3 (12)
Brainstorming	3 (12)
Reading/highlighting the article	5 (20)
Rephrasing ideas from article	1 (4)
Discussion with colleagues and professors	1 (4)
2. What were some unexpected problems you encountered with writing?	
Finding weaknesses and strengths	2 (8)
Summarizing	3 (12)
Mental block	2 (8)
Paraphrasing	10 (40)
Limited space	5 (20)
Grammar/Punctuation	5 (20)
Prioritizing ideas	1 (4)
Appraising papers	1 (4)
Supporting ideas with evidence based practice	1 (4)
Legitimacy of a website	1 (4)
Linking ideas together	1 (4)
Full text availability	2 (8)
Number of references allowed – too limited	1 (4)
Commentary section	1 (4)
3. What was the most interesting thing you did in this writing project?	

Enhancing writing skills/Develop new skills	6 (24)
Experience writing a Pharmacy Review Articles	4 (16)
Enhancing own knowledge	1 (4)
Studying/comparing different fields and literature	7 (28)
Exposed to a variety of methods	2 (8)
Workshops to enhance English and Writing	4 (16)
Apply critical appraisal skills	2 (8)
Critical thinking	1 (4)
Comparing own thoughts with literature	1 (4)
Exchanging ideas with colleagues	1 (4)
Opportunity to express own views	2 (8)
4. What have you learned from these writing projects?	
How to write research article	3 (12)
Exposure to different types of research article	1 (4)
Confidence in finding strengths and limitations	3 (12)
Everything is possible	1 (4)
Present information clearly and concisely	5 (20)
Commentary on research and support the commentary	4 (16)
Paraphrasing skills	4 (16)
Active reading	1 (4)
Correcting grammar/punctuation	4 (16)
Using external references	1 (4)
Learning about different topics	2 (8)
How to critically appraise a paper	4 (16)
Understanding papers	1 (4)
Summarizing key points	3 (12)
Scientific writing	2 (8)
Prioritizing/organizing ideas	2 (8)
5. Things you do well	

Provide concise background information	6 (24)
Appropriate organization of ideas	8 (32)
Evidence to support argument	2 (8)
Paraphrasing	3 (12)
Summarizing	4 (16)
Critical appraisal of article	3 (12)
Providing sufficient references for support	1 (4)
Grammar/spelling	3 (12)
Literature review	6 (24)
Scientific writing	1 (4)
Commentary on the paper	1 (4)
Expressing own views in a written form	1 (4)
Finding strengths and limitations	2 (8)
Good understanding of subject before starting	1 (4)
6. Areas where you have shown recent improvement	
Commentary of research	2 (8)
Summarizing information	3 (12)
Writing background information	4 (16)
Looking deeper into the article	1 (4)
Grammar/punctuation/paragraph style	4 (16)
Vocabulary/transition words	4 (16)
Referencing	1 (4)
Paraphrasing	5 (20)
Flow of ideas	1 (4)
Critical appraisal skills	4 (16)
Supporting/refuting ideas using evidence	1 (4)
Literature search	2 (8)
Prioritizing ideas	1 (4)
Improving own views on topics	1 (4)

Comparing ideas	2 (8)
7. Areas needing further work	
Punctuation/grammar	9 (36)
Supporting strengths and limitations with explanations	4 (16)
Commentary on research	2 (8)
Identifying most important issues	4 (16)
Varying vocabulary	3 (12)
Opening and Concluding sentences	3 (12)
Importance of each paper in practice	1 (4)
Assembling thoughts and ideas	2 (8)
Interpreting results	1 (4)
Referencing	2 (8)
Paraphrasing	1 (4)
Providing robust background	1 (4)
Linking paragraphs and paragraph structure	4 (16)
More knowledge on topic	1 (4)
Critical appraisal skills	1 (4)
Summarizing ideas	1 (4)
Subscribing to educational writing material	1 (4)
8. Steps you will take to attain your goal	
Practice punctuation, read rules on punctuation and paragraphs	6 (24)
Visit writing lab	2 (8)
Use online resources	3 (12)
Give more supporting evidence on ideas	1 (4)
Read more resources	11 (44)
Keep updated with topics	1 (4)
Peer review	1 (4)
Proofread	2 (8)
Spend time writing other topics	2 (8)

	Statement	Agree (%)	Disagree (%)
1	I believe I have the necessary skills to accurately assess my partner's work.	72.7	0
2	I believe my partner has the necessary skills to accurately assess my work.	69.7	6
3	I am comfortable receiving an assessment from my partner.	93.9	3
4	I am comfortable providing an honest assessment to my partner.	93.9	0
5	I will provide an honest assessment to my partner.	97.0	0
6	I believe my partner will provide an honest assessment to me.	81.8	0
7	I believe the assessment of students is the responsibility of faculty and not of other students.	42.4	36
8	I believe peer assessment is a skill I will use in my pharmacy career.	72.7	6
9	I believe peer assessment should be a factor of the total assignment grade.	21.2	64
10	Do you think your ability to understand primary scientific papers has improved as a result of this course?	90.9	3
11	Do you think your ability to communicate science to other scientists through writing has improved as a result of the Pharmacy Review Article assignments?	84.8	3

Supplementary Files

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