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Experiences in Teaching and Learning

### 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 and purpose:** Strong writing skills are critical to the pharmacy profession. This paper describes the design, delivery, and impact of a course intended to develop pharmacy students' scientific writing, peer assessment, and critical appraisal skills.

**Educational activity and setting:** The course was offered in the final year of an undergraduate pharmacy program with students whose first language is not English. In this course, students write two structured pharmacy review articles (PRA) based on assigned scientific research articles and peer assess each others' written PRAs. Students also critically appraise scientific research articles on a weekly basis, complete one pre-journal club written reflective critique based on a assigned scientific research article, and moderate one journal club session.

**Findings:** Course rubrics were developed and validated by the course coordinators. A survey 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 writing PRAs and the peer assessment improved their critical and analytical skills.

**Summary:** 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 and purpose

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

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(PharmD) curriculum by the Accreditation Council for Pharmacy Education.<sup>4,5</sup> 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 as well as disseminate new knowledge in the field of pharmacy.<sup>6,7</sup>

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

Peer assessment involves judging or evaluating a peers' work and providing constructive feedback. Peer assessment is recognized as a successful means of providing feedback to students in higher education.<sup>20</sup> A previous study suggested that students observe different skills, including knowledge and awareness of one's own learning process, when evaluating their peers.<sup>21</sup> In addition, students self reflect on their own performance, which enables them to improve, provides them with an idea about the proper assessment process, and is an effective way to engage students in the learning process.<sup>22,23</sup> More importantly, peer assessment is important for pharmacists as they are required to provide feedback to peers under their supervision. Wu et al<sup>7</sup> 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. The use of peer assessment is not new in pharmacy or health professional education. An earlier study demonstrated that students from different health specialties also positively perceived the effects of peer assessment on learning.<sup>24–26</sup> However, whether undergraduate pharmacy students positively perceive the use of 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 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.<sup>27</sup> The application of critical appraisal skills through journal clubs has been suggested in an earlier study to further enhance critical appraisal skills.<sup>28</sup>

To further address 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 evaluate and reinforce these skills. The purpose of this paper is to highlight the course and explore student perceptions on the skills gained in the course and on the use of peer assessment tools.

## Methods

The objectives of this study were addressed by building components of the new Research Evaluation Presentation Skills VI (PHAR 506) course and distributing a survey to all undergraduate pharmacy students completing PHAR 506 within the College of Pharmacy at Qatar University. Students enrolled in the final professional year of the program were registered in the course. Students involved in this study had 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 at least one research course 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. Qatar University Institutional Review reviewed the study proposal and issued exemption from a full ethics review (QU-IRB 225-E/13). All participants provided written informed consent.

### *Curriculum information*

At the College of Pharmacy at Qatar University, a bachelor's of science in pharmacy degree (entry-to practice) is offered over four professional years. This degree program has obtained international accreditation from the Canadian Council for Accreditation of Pharmacy Programs. The PHAR 506 course is the sixth and final installment of a series of pre-requisite courses that address elements of a scientific research article, different study designs, methods to appraise scientific literature, and the basics of statistics. This is a mandatory one-credit hour (15 direct contact hours) course in the fourth professional year of the pharmacy degree program. The aim of this course is to enhance scientific writing skills, and student learning outcomes include: the ability to perform quality scientific and health research writing, perform verbal communication skills through peer mentoring, effectively communicate research findings, and critically appraise published literature.

### *Course orientation*

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 effectively paraphrase and how to avoid translating from Arabic to

English; Arabic was the mother tongue for the majority of students enrolled in the course. Students were introduced to the course content and grading rubrics at the course orientation. The grading rubric domains and descriptions were created by the course coordinators.

### Components of PHAR 506

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 pharmacy review articles (PRAs) based on two scientific research articles (one clinical pharmacy and one pharmaceutical sciences) assigned by the course instructor. Each PRA required students to summarize the articles 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, 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. 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 (Turnitin LLC) program, which checks for the originality of the written assignment. Similarity reports for student submissions were generated immediately and students had the ability to re-write their report until the due date. Bibliographic material, quoted material, and small sources were excluded from the similarity report. The course instructors used the GradeMark feature on Turnitin to grade the assignments and provide constructive written feedback. The PRA was marked by two independent instructors, one evaluator who assessed grammar 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.

### Assessments in PHAR 506

The first assessment was the moderation of a journal club. Instructors from both clinical pharmacy practice and pharmaceutical sciences backgrounds 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. Each article was released one week prior to the session to allow students time for pre-reading and critically assessing the article before attending the journal club. For student moderation, students were randomly assigned into a group of five or six students and evaluated for participation by the same instructor. The instructor evaluated each student within the group individually using an evaluation rubric (Appendix 2). Following the moderation, questions were directed to each member of the moderation group to assess the student's ability to critically appraise the literature. On completion of the course, students were exposed to scientific literature from both disciplines.

The second assessment was a 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 student participation in the two moderation sessions (one by the instructor and the second by a group of pre-assigned students). The students who were not moderating 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

**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	Completing two peer review forms
Journal club sessions	Strengthen scientific literature appraisal skills	General feedback by instructors Moderated sessions by instructors Moderated sessions by students	Moderating journal club sessions Completing pre-session reflective critiques Participation

**Table 2**  
Self-assessment survey.

Question	Response n (%)
<b>1. What methods did you use to explore and develop your idea during the writing process?</b>	
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)
<b>2. What were some unexpected problems you encountered with writing?</b>	
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)
<b>3. What was the most interesting thing you did in this writing project?</b>	
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)
<b>4. What have you learned from these writing projects?</b>	
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)
<b>5. Things you do well</b>	
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)

(continued on next page)

**Table 2** (continued)

Question	Response n (%)
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)
Support ideas with literature	1 (4)

(Appendix 4).

The three different components of the course (PRA assignments, peer assessment review sessions, 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.

### Survey

At the end of the course, students were asked to complete a survey that was mostly adapted from previously published work in the field. The final version of the survey consisted of eight key themes (Table 2). The survey was developed using Google Forms (Alphabet Inc.), and the link to the survey was shared with students. Participation in this survey was completely voluntary and no incentives were provided to complete the survey. Google Forms was also used to analyze the survey responses. Responses to the survey remained confidential and no identifiers were captured to reduce the risk of bias and maintain student confidentiality.

### Results

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 (Table 2). Moreover, students indicated that the most interesting aspect about this course was developing new writing-related skills (24%) and

comparing different fields and literature (28%). 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, 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 (16%). Only one student 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 reinforce learned skills (Table 3). The perception of students to the statements reflected in Table 3 were based on three categories: agree, neutral, or disagree. Approximately 70% of the students agreed that they have the necessary skills to assess each others' work accurately. Students agreed that they were comfortable and open to feedback from their colleagues as indicated by 94% of the respondents. They also perceived that their partner will be honest in their assessments (81.8%). However, 21% did not agree to include the peer assessment in the total assignment grade. Peer assessment was perceived by approximately 70% (33) of students as a necessary skill that is needed in the pharmacy career. Finally, a high percentage of students (85%, 33) perceived that they enhanced their writing skills after completing two PRAs. Moreover, 91% (33) of students perceived that the course improved their understanding of the primary literature.

## Discussion

Pharmacists add knowledge to the scientific literature by conducting clinical and practice research and critically evaluating others' research works. Moreover, pharmacists communicate with a multitude of healthcare professionals verbally and non-verbally to achieve the shared goal of providing the best patient care. This necessitates that students must acquire strong writing skills, whether basic academic writing skills or scientific writing skills, prior to graduation. This concept is reinforced by the AFPC Educational Outcomes (EO) that focus on outcomes prior to graduation in pharmacy. There are seven EOs and within each, key competencies outline what a pharmacy student must achieve prior to graduation. One of those EOs is "scholar," which addresses 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.<sup>6</sup> The communicator outcome addresses the ability of pharmacy graduates to communicate effectively with target audiences using different strategies including writing.<sup>6</sup> 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.<sup>6</sup>

Pharmacy students surveyed indicated that their writing skills were enhanced and that they developed new writing skills after completion of this course. This is supported by Ranelli and Nelson,<sup>3</sup> who indicated that a course focused on writing and related skills can result in positive outcomes in students' writing skills. The self-assessment survey indicated that more than 80% of students feel that they grasped the necessary writing skills that will enable them to 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%) felt that they need to improve their critical appraisal skills.

Despite the improvements seen in the writing skills, 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 where the preceptors' assessments of writing- skills (grammar and vocabulary) of non-native English students ranged from "weak" to

**Table 3**  
Peer-peer assessment questionnaire.

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
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

“needs” improvement.<sup>13</sup> 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 the student enhances their writing skills, feedback from the first assignment before submitting the subsequent 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.<sup>29</sup> To overcome this challenge, the PRAs were graded by two instructors. The English aspect of the PRAs was graded by a teaching assistant while the scientific content was graded by the instructor who assigned the 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 that emphasizes 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) were in alignment with other pharmacy students. Kritikos et al<sup>25</sup> assessed students perceptions and attitudes towards the peer assessment activity. Students agreed that they understand the peer assessment process (95%) and they should assess peers (75%).<sup>25</sup> However, only 43% of students felt that peers could provide a fair assessment<sup>25</sup> compared to 81% in our study. Moreover, Kimberly et al<sup>26</sup> found that 95% of students perceived they have the necessary skills to assess their peers, similar to our results.

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

One of the limitations of our study is that Arabic was the mother tongue for the majority of students enrolled in the course. Further studies are needed to assess the impact of such assessments and the course in a more diverse cohort of students. Another limitation of our study is the low sample size.

## Conclusions

The PHAR 506 course was designed for fourth-year pharmacy students. The learning outcomes of the course including advancing scientific writing skills were achieved. Continuous practice is needed to reinforce and strengthen the skills learned in the course.

## Author statement

AO and FM data curation and writing - original draft; AO, FH, SR, HE, DAB and FM methodology, formal analysis, visualization and validation; AO, FH, SR, HE, DAB and FM writing - reviewing & editing; AO, SR and FM investigation; FM project administration, supervision, conceptualization. All authors read and approved the final manuscript.

## Disclosure(s)

None.

## Declaration of Competing Interest

None.

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## Appendix A

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