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SPECIAL ISSUE ARTICLE

THE CANADIAN JOURNAL OF CHEMICAL ENGINEERING

Publication tips: How to write scientific articles that master the publication process and communicate your ideas efficiently

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Abstract

This article gives insights on how to write, submit, revise, and publish articles in scientific peer-reviewed journals. I will focus on chemical engineering, but my suggestions apply to other natural sciences and engineering journals as well. I will start by discussing how to write the cover letter and the text of your article, emphasizing the importance of using clear language and highlighting the novelty of your results. I will then suggest how to prepare eye-catching figures and tables that communicate your ideas effectively. Next, I will discuss the peer-review process, explaining the roles of editors and reviewers, as well as how to revise your article and craft a rebuttal letter. I will also explain ethical misconduct in scientific publications.

KEYWORDS

engineering articles, English usage, scientific articles, scientific publications, writing techniques

1 | INTRODUCTION

This article grew from a series of presentations I have been giving since 2012 to departments of chemical engineering in Canada to help graduate students and early-career faculty members write scientific articles that explain their ideas effectively, emphasize their novel contributions, and navigate the peer-review process smoothly. An extended version of these presentations has led to the *Early Career Publishing Workshop*, featured annually in the *Canadian Chemical Engineering Conference* series.

When authors submit their articles for publication in a scientific journal, they are only exposed to a small fraction of the complex operations involved in the publishing process. Authors are asked to submit a cover letter, the article itself, and a few additional documents. Later, they are asked to revise their article to address the reviewers' comments and check the proofs before publication. Most authors are not aware of the sequence of steps that unravel from submission to publication of their final article. I will briefly walk you through the main steps adopted by *The Canadian Journal of Chemical Engineering* (*CJCE*) in this article.

If you are new to scientific publishing, three main questions may come to your mind: *Why* to publish? *Where* to publish? *What* to publish?

Answering the first question is easy. Publishing your findings in a peer-reviewed journal is required for a successful graduate studies program. A healthy publication record is a requisite for a recently graduated MSc or PhD student to get a position in most research-intensive companies. Moreover, academics are mostly judged based on the quantity and quality of their scientific publications. Academic careers are determined—for better or for worse—by the 'publish or perish' paradigm.

Most authors want to publish their results for four main reasons:

1. *Registration*: Once your article is accepted for publication in a peer-reviewed journal, your priority in your field of research is established.
2. *Certification*: A rigorous peer-review process, conducted by experts in your area, will acknowledge the quality of your work and—ideally—improve it.
3. *Dissemination*: Bringing your findings to the knowledge of your peers and society at large by publishing them in widely circulated journals is an obligation of most researchers who rely on public funds to support their work.
4. *Archiving*: Publishing your results in a scientific journal is the best way to save them for posterity. The current open data initiatives, in which experimental data and computer codes are also archived as supplementary information, are making this feature even more salient.

Selecting where to publish your article may be baffling if you are an early-career researcher because options abound. Should you publish in a journal with a wider—such as the *CJCE*—or narrower scope? Should you choose a subscription or an open-access journal? Among the many journals in your area of research, which one should you pick?

I recommend submitting your articles to journals that publish high-quality articles in your area of research. Articles published in journals with extensive circulation and a high reputation tend to be read and cited more often, but keep in mind that most researchers find articles via internet searches and will read those that catch their attention regardless of where they were published. Most leading journals have short review and publication times, but you should also keep publication time in mind when selecting a journal to ensure that your results are promptly available to the readers, *provided* that the fast publication time does not come at the price of low reviewing, editing, and proofreading standards.

The question about publishing in wider scope versus specialized journals is a matter of personal preference. I prefer to publish articles that address many chemical engineering topics in wider scope journals and those that focus on narrower fields in specialized journals, but I follow this guideline very loosely. The beauty of more general journals, such as the *CJCE*, is that they can emphasize the *breadth* and *depth* of their disciplines.

Most traditional journals adopt a subscription model, but they allow the authors to make their articles accessible to non-subscribers by charging an open-access fee. Open access may also be a requirement from funding agencies. Many publishers are establishing *transformational agreements* with different funding agencies and institutions to facilitate open access—free of cost or at discounted fees—for articles published by authors they sponsor. Several transformational agreements have already been, and continue to be, signed by Wiley.[1] All articles published in open-access journals, on the other hand, must pay publication fees. Even though some respectable open-access journals have emerged in the last few years, they have not yet reached the status of their older counterparts. Subscribers of most Wiley journals may also use Wiley's Content Sharing feature, which allows them to share free-to-read full-text online access to articles—regardless of whether the article is open access or not—with those who do not subscribe to the journal. This permits content to be shared among researchers regardless of their subscription status.[2]

Finally, deciding what to publish also requires some consideration. You should publish results that are original and advance the knowledge in your field. Reports of little scientific interest, out-of-date work, and duplications of previously published results must be avoided. My guidelines here are simple: If you cannot come up with two or three bullet points summarizing the new knowledge reported in your article and the impact (even if minor) it may have on the state of the art, you should not submit it for publication. The only exceptions to this rule are critical literature reviews. They are valuable and highly sought after by readers and editors, but the qualification *critical* is essential. The tedious recitation of the main findings in hundreds of previous articles adds no new insight to the technical literature. Even in review articles, the readers still expect to hear the authors' voices, as they condense the previous publications into a coherent body of knowledge, explain contradictory results and concepts held in consensus, and outline the challenges posed by new developments in their subject area.

After deciding what and where to publish, you must start the hard—but pleasant if you do it well—work of writing your article. In the next sections, I will highlight a few important tips to keep in mind as you write your article. As you read the remaining of this article, remember that these are suggestions, not commandments. If you feel they will dampen your voice or impede you from communicating your results as you intend to do, please ignore them. I have done so myself when I felt they did not apply. Every scientific article should be a well-crafted story in which the authors tell a discovery story to their readers. Scientific writing is storytelling, although of a special kind.

2 | SUBMISSION DOCUMENTS

When you submit an article to most scientific journals, you will be asked to upload the following information:

UNIVERSITY OF ALBERTA

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Dr. Kirsten Severing
Editor-in-Chief
Macromolecular Materials Engineering

August 27, 2018

Dear Dr Severing:

We are pleased to submit our manuscript entitled "Water-soluble Polymer Flocculants: Synthesis, Characterization and Performance Assessment" for publication in the *special issue of the 20th anniversary of the Macromolecular Materials and Engineering.*

In our manuscript, we review recent advances (in the last 5-10 years) on a broad class of water-soluble polymer flocculants that include synthetic polymers, bio/natural polymers, and stimuli-responsive polymers. We took a unique approach, communicating the *bigger picture* on these topics and identifying research gaps that have been ignored in the past, but need urgent attention to allow further developments in this research area. We also reviewed recent state-of-the-art performance assessment of polymer flocculants, including polymer-particle force measurements and direct dewatering assessment techniques. In addition, we provided the readers with basic polymer reaction engineering tools and polymer characterization techniques required to make water-soluble flocculants with precise microstructures needed to derive structure-property relationships for flocculation processes. This last topic, in particular, is sorely missing from the current research done in this area and, in our opinion, in preventing the development of new flocculants with optimized properties.

Best regards,

J. Soares

João B. P. Soares
Professor, FCIC
Editor-in-Chief, *The Canadian Journal of Chemical Engineering*
Canada Research Chair in Advanced Polymer Reaction Engineering
CAIP Chair in Interfacial Polymer Reaction Engineering for Oil Sands Processing

FIGURE 1 A cover letter example

1. The cover letter
2. The article text, figures, and tables
3. Supplementary material
4. Preferred and non-preferred reviewers.

I will discuss these requirements below. Keep in mind that form and content go hand-in-hand in these documents. Most authors focus on the content but pay less attention to the form of their articles. This is a bad habit. Doing so may

lengthen the review process and, worse, turn off many readers. Readers often stop reading poorly written articles—how many times have you done so yourself?—even if they contain information that is relevant to their work.

2.1 | The cover letter

Many authors are unconcerned about the cover letter they submit with their articles. This is a mistake. The cover letter is the first document that the editor will read before deciding whether the article is worth being considered for publication. High-ranking journals receive many more articles than they can publish; thus, bringing the relevance of your results to the editor's attention in the cover letter is a sensible idea. Make the cover letter count by emphasizing why the topic of your article is important, how your key results advance the previous knowledge on that topic, and why the readers of the journal need to find out about them. Keep the cover letter relevant and short—no longer than a page. Figure 1 is an example of one of my cover letters that implements some of these recommendations.

2.2 | The text

We have been conditioned by decades of poor writing to believe that scientific writing must be impersonal, obscure, and often pompous, with abundant use of jargon and acronyms. This writing style makes it harder for the readers to fully understand many articles—let alone derive any satisfaction from reading them—except if they are highly specialized (and extremely tolerant). Why these poor writing conventions have become established in the scientific literature still baffles me after more than 30 years of writing, reviewing, and editing. I have often come across articles in my own areas of expertise that required immense effort to fully grasp because they were written so clumsily. I am sure you have felt the same way more often than you should. This tradition of murky writing is unfortunate since the main objective of any article is to transmit new findings in a way that should be accessible to a wide audience, not to hide them under a dark cloak of impenetrable language. Reporters say that one should never 'bury one's lede' (the main plot in the story). The average writer of scientific articles takes the opposite approach and often seems to strive to entomb their leads.

The main parts of the text of an article are:

1. Title
2. Authors list
3. Abstract
4. Main text
5. References
6. Supplementary material.

I will discuss each of these main components below.

Craft the title of your article with care. Do not fall for the common mistake of writing convoluted or ambiguous titles. This is your first opportunity to convince the readers that your article is worth their attention. Make it short: up to 15 words is a good guideline. Avoid filler phrases such as 'Studies on ...', 'Characterization of ...', 'Optimization of ...', 'Investigation of ...'; they do not provide any insight on the topic of your article and lengthen the title that you must keep concise. Make the title explicit by stating a key finding or by framing a question. It is a good idea to add keywords you would typically use when looking for articles in your area: this will help interested readers find your article.

For instance, consider the first version of the title of one of my articles:

> Synthesis of nanodiamond-decorated thin-film composite membranes with enhanced antifouling and antibacterial properties.

This is a short title—only 13 words—and identifies the subject and objective of the article. However, it can still be refined a little more. 'Synthesis of' does not need to be included in the title since the Abstract explains that the authors synthesized the membranes, and it is doubtful that potential readers will use 'synthesis of' as keywords in their bibliographical searches. Moreover, the article covers much more than the synthesis of the novel membrane. The word 'enhanced' is also superfluous: Enhanced with respect to what? And why would the authors submit an article about a new membrane that did not include some sort of enhancement? Therefore, a slightly shorter—10 words—and more effective title works better:

> Nanodiamond-decorated thin-film composite membranes with antifouling and antibacterial properties.

Right after the title comes the list of authors. It is considered unethical to add authors without their permission, to include authors who have not contributed substantially to the work reported in the article or, conversely, to exclude authors who participated in the investigation and are rightfully expected to be included. Most journals, including the *CJCE*, ask the corresponding author to specify the roles of each co-author during the submission stage. The list of authors is an important component of a scientific article; you can avoid future headaches by making it accurate. Do

not add authors who have no reason to be included, and do not omit those who should be listed. Minor contributions—complementary analyses, experiments, simulations, technical discussions, etc.—should be recognized in the Acknowledgements, but ensure that these collaborators did not expect to be included as co-authors.

The abstract is a critical component of your article. Spend enough time to write an outstanding one. Most journals make abstracts available to non-subscribers, exposing them to the widest possible audience. (Non-subscribers can download the full article for a fee if the abstract captures their interest.) The editor will also use your abstract to decide whether your article is worth being considered for publication. A good abstract should be short and highlight your main findings. Most journals have size limits for abstracts—typically 200–300 words—but even if the journal you chose does not, you still should keep it short. What you are trying to accomplish in the abstract is to emphasize the most significant results, conclusions, implications, and applications of your work. You may also describe new methodologies you have developed, but do not waste space by writing about standard techniques. Avoid using abbreviations, acronyms (never use non-standard ones), and literature citations. The abstract should captivate the readers' curiosity and convince them to read your article. If you score this goal, you succeeded in writing a good abstract. Make it clear, make it concise, and make it appealing.

The main text of a typical article is subdivided into four main sections: (1) Introduction, (2) Experimental and/or Model Development, (3) Results and Discussion, and (4) Conclusion. The Introduction situates the research described in the article with respect to previous publications and describes the knowledge gap it attempts to fill. The Experimental section—for articles with experimental components—describes the experimental methods and provides all the information needed for their replication. This is a requirement that cannot be overlooked: If your article does not convey all the information needed for the replication of your experiments, it will not be considered a valid scientific contribution. The Model Development section—for articles that propose new mathematical models—explains the modelling procedure and solution methods you used to arrive at your results. The Results and Discussion is the most important section since it details the novelty and significance of your experimental/theoretical findings. Finally, the Conclusion highlights your most impactful results and often suggests future studies to extend the knowledge in your research area.

The conventional division of scientific articles into sections is designed to help the authors tell the story of their research: the Introduction explains what is already known and what the authors tried to clarify in their article, the Experimental/Model Development sections describe the methods the authors used to reach their goals, the Results and Discussion elaborate on what they have found, and the Conclusion summarizes the authors' most relevant findings and what still needs to be done. It is a guide to scientific storytelling. You will benefit if you write these sections well so that most readers understand and appreciate the relevance of your findings. And, believe me, this is hard to do.

How can one become a better writer? I have no simple answer to this question. Writing is both an art and a craft. The art component depends on innate talent—to the chagrin of many, some people are born better writers than others—but the craft dimension can be honed by practice, determination, and often frustrating trial and error. Good writers are typically prolific readers. Read often and read widely: The more you read, the better writer you will become. Start by imitating the style of authors who wrote articles and books that you enjoyed reading and learned from without having to spend superhuman effort in the process. With time, you will develop your own voice and writing style. Good writing is also *rewriting*. It will take several rounds of revisions to arrive at a high-quality article that is ready for submission; allow yourself enough time to write a good article that will be enjoyed by many readers. Tell a good story and do not bury your lead under a sea of irrelevant details and digressions.

Many books explain writing techniques in depth, covering everything from English grammar, to sentence style, to composition techniques.[3–9] Most writers of scientific articles do not try to become better writers. Not surprisingly, they spawn insufferable articles that are hard to understand and impossible to enjoy. Try not to make the same mistake. Spend some time learning from these excellent references on how to become a more proficient writer.

It is not possible to do justice to such an extensive subject herein, but I would like to highlight a few common mistakes that are easy to avoid if you keep your eyes open for them:

1. Try to write most sentences following the simplest possible structure in English: Subject–Verb–Object (S–V–O). The subject names who/what does the action, the verb describes the action, and the object defines who/what is the object of the action.
   Consider the poorly worded sentence formed by two convoluted clauses: *A lack of knowledge about the local catalyst temperature precluded the measurement of the hot spot*. This sentence is confusing and pretentious. Let us rephrase it so it follows the S–V–O style: *Because* $we_{(S)}$ *did not know*$_{(V)}$ *the local catalyst temperature*$_{(O)}$, $we_{(S)}$ *could not measure*$_{(V)}$ *the hot spot*$_{(O)}$. Is not it easier to understand the meaning of the sentence now?

2. Some authors have been conditioned to think that scientific articles must be always written in the passive voice. *The temperature was measured periodically* is in the passive voice because the person, or instrument, that measured the pressure is not named. *We measured the temperature periodically* is in the active voice (*we* measured). I think the reason for the resistance to the active voice arises from the perception that the scientific method is impersonal and should not be affected by who made the measurements, did the calculations, and arrived at the conclusions. Aside from the dubious philosophical implications of this assumption, you should always avoid the passive voice if it restricts you from communicating your ideas more clearly. You can also look for a compromise by choosing an impersonal subject: *The temperature varied periodically*.
   I rewrote the example in (1) above in the active voice to show that it is not an offensive way to describe your experiment, but maybe you got offended anyway. If you do not like it, do not use it. The previous sentence can be rewritten in the passive voice and remain pleasant to the readers' ears: *Because the local catalyst temperature*$_{(O)}$ *was not known*$_{(V)}$, *the hot spot*$_{(O)}$ *could not be measured*$_{(V)}$. There. The subject is gone now. Do you like this version better? Is this version more likable?
3. I find *nominalizations* to be the most aggrieving bad habit in scientific writing (it is almost an addiction for some authors). Nominalization is the use of a verb to describe that an action exists. This awkward way of writing is too prevalent in scientific articles, even though it is so easy to fix: verbs should describe actions, not be transmogrified into nouns. The frequent use of nominalizations often makes me abandon reading an article in despair.
   Let me illustrate the Emperor of Bad Writing with an example:

> The need exists for a more efficient measurement of the catalyst hot spot temperature.

Here, the author used the verb 'to exist' to describe the act of measuring. This sentence can be rephrased in the active voice,

> We need to measure the catalyst hot spot temperature more efficiently.

in the passive voice,

> The catalyst hot spot temperature needs to be measured more efficiently.

or in a combination of both,

> A more efficient method to measure the catalyst hot spot temperature is needed.

Any of these alternative sentences (I prefer the active voice version) is far superior to the tongue-tied first version that used a nominalization.

4. Concision is a virtue that every writer should strive to acquire. George Orwell said it best when he stated that

> A scrupulous writer, in every sentence that he writes, will ask himself at least four questions, thus: What am I trying to say? What words will express it? What image or idiom will make it clearer? Is this image fresh enough to have an effect? And he will probably ask himself two more: Could I put it more shortly? Have I said anything that is avoidably ugly?[10]

These are principles to live by when you work towards becoming a better writer.
When reviewing your article, look out for and eliminate redundancies that make your writing verbose:

- Redundant pairs such as *true and accurate*: accuracy implies truth.
- Redundant modifiers such as *completely finish*: it is not possible to partially finish anything.
- Redundant categories such as *large in size*: large is generally enough to describe your object.
- Meaningless modifiers such as: *For all intents and purposes*, catalyst hot spot temperatures *generally* depend on *certain* intraparticle phenomena that are *really* more fundamental *in kind* than on *any given* chemical reactor technological aspects. We can delete all meaningless modifiers—in italics—without affecting the meaning of the sentence: Catalyst hot spot temperatures depend on fundamental intraparticle phenomena than on chemical reactor technological aspects.
- Look also for phrases that can be replaced by single words. For instance: *due to the fact that* can become *because*, *despite the fact that* is the same as *although*, *it is crucial that* can be expressed as *must* or *should*, *is able to* may be replaced with a simple *can*, etc.

After you create the habit of concision, detecting and eliminating these redundancies from your prose will become your second nature. Consequently, the readers will enjoy reading your articles and understand your ideas more easily. The ideas in a scientific article may be unavoidably complex; to compensate for that, its writing should never be. Keep in mind Alexander Pope's warning: 'And ten low words oft creep in one dull line'.[11]

5. Hedges are common—sometimes inescapable or even recommended—in scientific articles, but you should use them with moderation. Hedges are expressions such as *sometimes, possibly, likely, perhaps, to a certain extent, in some respects*, etc. They indicate that the authors are uncertain about the implications of their results or conclusions. Since scientific knowledge is always evolving, it is not surprising that hedges abound in articles, but when used in excess, they can become irritating. If the authors are so unsure about their findings, then why are they reporting them? Besides, the readers are aware that scientific knowledge is always in flux and that the authors' position should be understood under this transitory context.
6. Emphatics are the opposite of hedges. Terms such *as everyone knows, it is generally agreed that, as it can be plainly seen, obviously*, etc. If used in excess, the author may seem arrogant. Moreover, if *obviously everyone knows it*, then why is the author talking about it? Use emphatics (and hedges) with moderation.

When you are writing your article, you should also avoid falling into the trap of the *Curse of Knowledge*. This is a cognitive bias that afflicts practically everyone. It occurs when a person tries to communicate ideas to others, assuming that they have a background knowledge that they actually lack. There is no easy fix for the Curse of Knowledge. It depends on your target audience and on your own sensitivity to this tricky bias. The best way to minimize it is to put yourself in your reader's shoes. Imagine that you only have the knowledge of the average reader you are trying to reach and ask the question: Would I be able to understand my article if I had their background knowledge—instead of knowing this subject in depth after having dedicated X years of my life to it—based on the information I am providing them? Albert Einstein can come to our rescue here: 'If you can't explain it simply, you don't understand it enough.' Keep this in mind when writing your article.

Authors usually loathe writing the References section of their articles. So do I, but it is important that all references follow the format required by the journal you selected—which regrettably varies widely from journal to journal—and that the information is complete. Failure to do so will award you with multiple queries during the review or proofing stage of your article. It is more convenient to get the references right when you first submit your article. More importantly, make sure that your references are up-to-date and that you do not fail to mention any relevant previous publication. You must acknowledge the contributions of other authors who have contributed to your area of research. (It is a good idea to read the papers you have cited too: do not cite papers that you have not read just because they are cited by other authors.)

Finally, experimental data and simulations that are important for the in-depth understanding of your work, but that may be too extensive and/or distracting to be included in the main body of your article, should be submitted as Supplementary Material. Typical contents are complementary analytical data, extensive statistical analyses, tables and plots of additional experimental results, lengthy computer simulations, etc. The current Open Data initiatives also let you share all your experimental results and/or computer codes with the scientific community (if you agree to do so).

2.3 | Figures and tables

The common saying that 'a figure is worth a thousand words' applies to figures in scientific articles. Figures condense your results into aesthetically pleasing images that capture the attention of the readers and motivate them to read your article. Most journals also ask authors to prepare graphical abstracts. When properly designed, they catch the readers' attentions as they browse the journal's table of contents.

Design your figures for clarity, simplicity, and impact. Use colours—judiciously—in your figures. Even if the figures in the print version of your article may appear in grayscale, their online version (where most readers will see them) will be in colours. Journals have minimum resolution requirements for figures: Ensure that your figures adhere to these requirements. The publication of articles submitted with low-resolution figures may be delayed—and in extreme cases, even denied—until the authors provide figures with adequate resolution. Figure captions are also important. They should provide enough information for the reader to understand the figure without referring to its discussion in the text.

Figure 2 is an example of a well-designed figure previously published in the *CJCE*. It is an elegant representation of velocity and pressure fields—as concisely explained in the caption—in porous media. The image is impactful and self-explanatory when combined with the figure caption.

Tables are the second-best method to summarize information in your article. Many of the comments I made above for figures also apply to tables: Design them for clarity, simplicity, and impact, and use captions to make the reader understand their contents without having to read the main text. Figure 3 is an example of a properly designed table previously published in the *CJCE*.

2.4 | Preferred and opposed reviewers

You will be asked to list the names of preferred reviewers when you submit your article. Preferred reviewers should

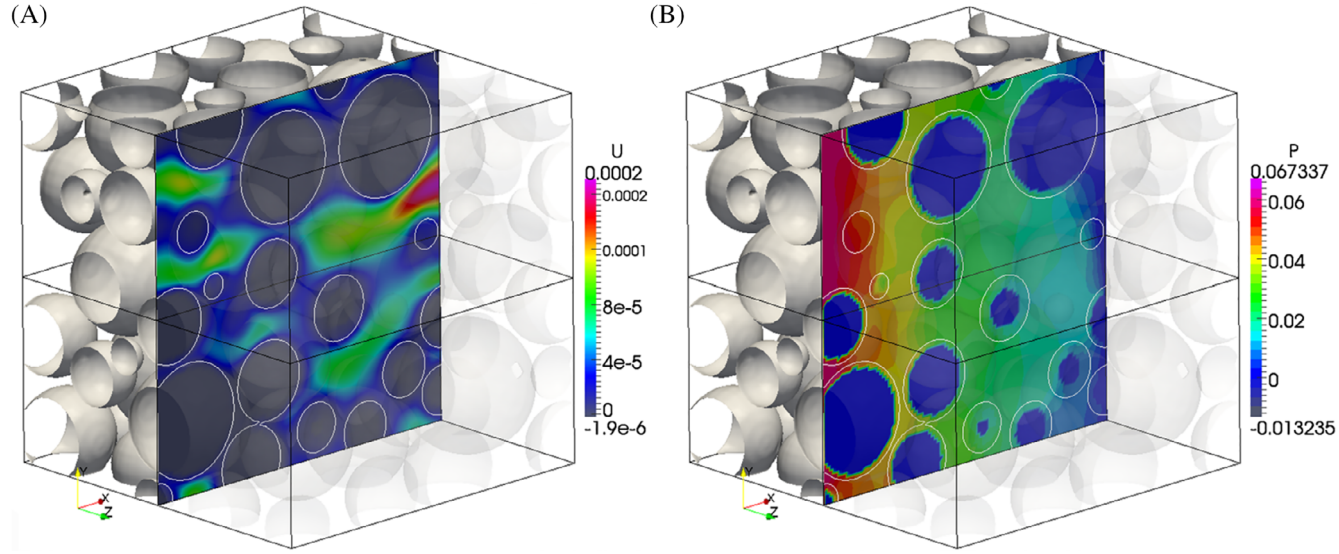

FIGURE 2 An example of a well-designed figure published in *The Canadian Journal of Chemical Engineering* (*CJCE*).[12] Original caption: Water flow through a granular porous media (velocity [m/s] and pressure [Pa] contours).

Table 4. Comparison of different technologies at time = 408 days

Parameter/Technology	P-CRIP	L-CRIP	LVW
Coal Seam	Ardley	Ardley	Ardley
Module in-seam Length (m)	32	51	51
Avg. Syngas Flow Rate at Wellhead per Module (Nm^3/day)	2675	2903	4343
Dry Syngas Composition (dry gas basis)			
CH_4	45.42	39.06	50.00
CO	0.03	0.05	0.02
CO_2	42.60	40.91	40.06
H_2	0.19	0.55	0.06
N_2	11.45	14.06	9.86
O_2	0.32	5.38	0.00
Total Carbon Initially in Place (kg)	55 406 000	55 406 000	55 406 000
Avg. Coal Conversion Efficiency (%)[a]	0.851	0.840	1.414
Avg. HHV of Syngas (MJ/Nm^3)	17.12	14.77	18.83

[a]Defined as (kg of Carbon in produced syngas)/(kg of Total Carbon Initially in Place) * 100

FIGURE 3 Example of a well-designed table published in *The Canadian Journal of Chemical Engineering* (*CJCE*)[13]

be experts in the areas covered in your article who are at arm's length from all the authors listed in the article. Former or current collaborators and colleagues from your and your co-authors' institutions should not be selected as preferred reviewers, although some exceptions may apply when few experts are available in certain research areas. Editors will generally select one or two reviewers from the list of preferred reviewers—if they are at arm's length—and others from their own reviewer databases.

You will also be asked to list opposed reviewers. These are people whom the authors may suspect would not write an unbiased review, either because they have competing research interests or for personal reasons. Editors will honour your request and exclude opposed reviewers from assessing your article.

3 | THE PEER-REVIEW PROCESS

The peer-review process starts immediately after you finish submitting your article. Figure 4 describes the editorial workflow followed by the *CJCE*, which is like that of most other scientific journals.

When you submit an article to the *CJCE*, a member of the editorial team first checks it for English usage, format requirements, and figure quality. The editorial team also uses iThenticate to check for plagiarism and self-plagiarism (see Section 4 below for more details). If the editorial office is unsatisfied with the quality of your article, it will be returned for corrections and resubmission.

If the editorial team approves your article, they send it to the Editor-in-Chief (EIC). The EIC takes a first look

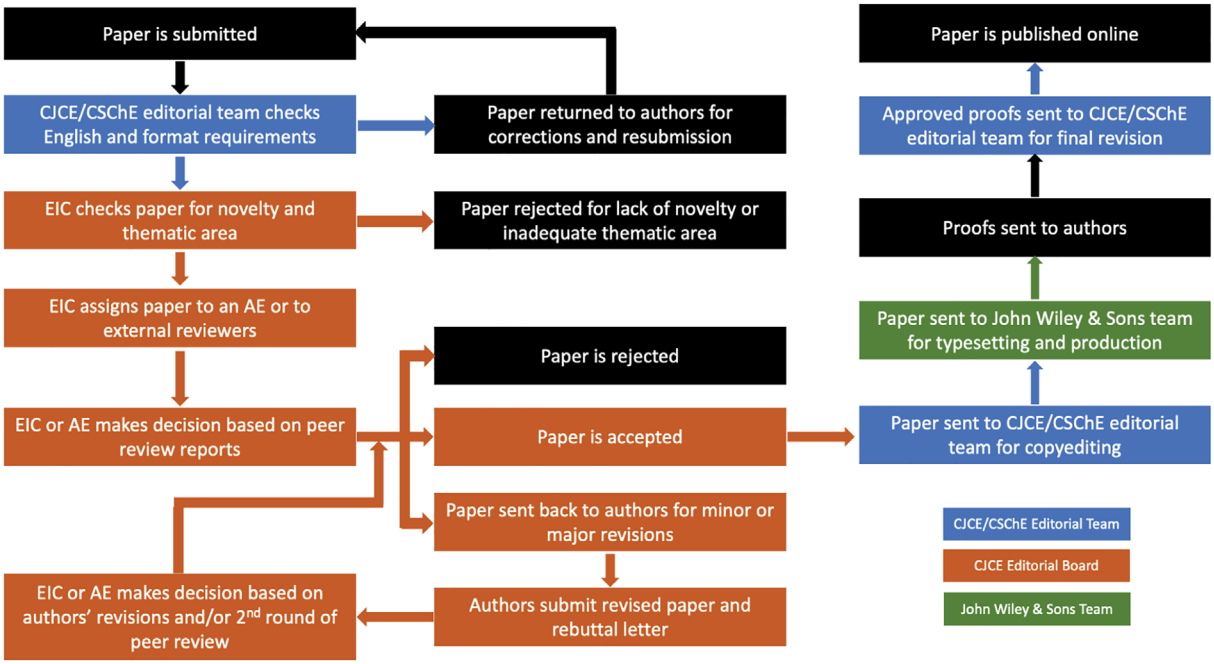

FIGURE 4 Flowchart describing the publication process in *The Canadian Journal of Chemical Engineering* (*CJCE*) and other scientific journals (EIC: Editor-in-Chief, AE: Associate Editor, CSChE: Canadian Society for Chemical Engineering)

at it, focusing on its novelty and thematic suitability for publication in the *CJCE* using the information provided in the cover letter, Abstract, Introduction, and Conclusion. The EIC may reject the article if it does not fit the journal's scope or if the results are not novel or relevant. The authors are responsible for providing enough information to convince the EIC that their article is worth being considered for publication.

If the EIC approves the paper, it will either be assigned to an Associate Editor (AE) with expertise in the article's research areas or the EIC will oversee the review process. The EIC or AE will then ask at least two or three experts to review the article. The reviewers must evaluate the paper according to the following criteria:

- Are the results novel and relevant?
- Have the authors made mistakes in the methodology or interpretation of results?
- Are the discussions and conclusions supported by the experiments and/or simulations?
- Are the experiments/simulations described in sufficient detail to be replicated by other researchers?

After reading the paper, the reviewers decide if the article should be accepted in its original form—a very rare outcome—should be resubmitted with minor/major revisions or should be rejected.

A rejection decision is always unpleasant. Most reviewers avoid making it, but a reviewer will rightly reject articles that:

- Do not contain novel or relevant findings.
- Contain mistakes in methodology and result interpretation.
- Only repeat the results of previous articles.
- Are hard to understand because of unclear sentences, poor grammar, confusing explanations, missing data, incomplete method descriptions, etc.
- Contain text, figures, and/or tables prepared without proper attention to details.

The reviewer's main attribution is to assess the significance and novelty of the results and conclusions in the article, to determine if there are conceptual mistakes in the methodology and result interpretation, and to ask for additional clarifications that make the paper clearer and useful for a wide audience. The reviewer *should not* act as a research director, rejecting or criticizing an article because they would rather follow a different approach. This recommendation is summarized by A. R. Timming:

> This simple dichotomy (*what's wrong with this paper?* vs *how would I have done this study differently?*) is at the very heart of the poverty of peer review. If reviewers confined

> themselves to the first question only, then peer review would be fair and constructive. But reviewers do not confine themselves to the first question. Instead, they venture into the second. A study can be methodologically and theoretically sound, but still rejected by the reviewer simply because, in spite of its soundness, it could have been done differently. As we all know, there is any number of solutions to a single problem. Reviewers tend to prefer their own solution to that of the authors.[14]

Considerate reviewers should also follow the Rapoport Rules when writing their reviews.[15] A version of these rules appears below:

1. You should attempt to re-express the authors' position so clearly, vividly, and fairly that they say, 'Thanks, I wish we would have thought of putting it that way'.
2. You should list any points of agreement, especially if they are not matters of general or widespread agreement.
3. You should mention anything you have learned from the authors.
4. Only then are you permitted to critique the work you were asked to review.

Becoming a good reviewer takes time and dedication. When you are asked to review a paper, take this assignment seriously, as much as you take your role as an author. Above all, abide by the Golden Rule: Review the articles of other authors as you would like your articles to be reviewed.

If you do not get the disappointing rejection decision or the surprising acceptance-without-changes good news, you should revise your article, considering the reviewers' comments, and write a rebuttal letter explaining the changes you made in your article. Answer *all* questions from the reviewers in the rebuttal letter and explain which changes you made to account for them. Do not ignore any comment made by the reviewers. Ignoring them is inconsiderate, will lengthen the review process, and may lead to the rejection of your article.

Some authors like to highlight the changes they made in their article with a different font colour. I recommend this practice because it helps the editor and reviewers—if the editor sends your article for a second round of reviews—locate your changes in the text. Inexperienced authors may answer some of the reviewers' questions in their rebuttal letters without making the corresponding changes in the article. Unless the question is trivial and does not require further elaboration, the author must revise the article to clarify all questions the reviewers asked. If the reviewer could not follow the rationale in the original version of the article, it is likely that other readers may also face the same hurdle. One of the objectives of the peer-review process is to make your article accessible to a wider audience by eliminating some of the doubts they may have when they read it after publication.

Figure 5 shows excerpts of one of my rebuttal letters. In one example, I agreed with the suggestion made by the reviewer and indicated how I revised the manuscript to account for it. In the other example, I disagreed with the reviewer. You do not have to agree with all the suggestions made by the reviewer, but you must explain why you do not.

If your answers to the reviewers' comments and the changes made in the revised article are satisfactory, you will receive an acceptance letter from the editorial office. In a few weeks after acceptance, you will receive proofs of your article. Review the proofs, looking for mistakes possibly made during the production stage. Pay special attention to equations, tables, and figures. The copy editor may review and edit your article to improve English grammar and sentence structure. In some rare cases, the meaning of a sentence may be altered by mistake during this stage. Read the proofs carefully to avoid this happening. Moreover, answer all queries that may come with your proofs and provide any missing information and/or format changes requested by the copy editor.

In the unfortunate case of a rejection, do not despair. It may happen to anyone. Use the *relevant* comments made by the reviewers to write a better article and improve the quality of your research. If you are a graduate student, think of it as an opportunity to write a better thesis and have a smoother thesis defence later. Albert Einstein's saying is helpful at these times: 'A scientist is a mimosa when he himself made a mistake, and a roaring lion when he discovers a mistake of others'. Finding and criticizing the mistakes of others is easy; generating relevant new results and advancing the knowledge of your subject area is hard. You will not get it right every time.

Should you appeal a rejection decision? 'Generally, not' is my recommendation. It takes effort to convince the editor that your article should be reconsidered for publication after it has been rejected, especially if the decision was based on solid grounds. It is more productive to revise the article, taking into consideration the reviewers' comments, and submit it to another similar journal. However, if you think that your article received unfair and/or incorrect reviews, you may have a good chance of changing the editor's mind. Such cases happen when the reviewers missed the importance, impact, or novelty of results you had clearly shown in your paper,

Agreeing with the reviewer

Why would H_2 affect the activation and propagation steps after a certain threshold concentration? Can the authors offer possible mechanistic explanations?

Reply: We also find this observation puzzling, but it is a reproducible phenomeno. We are sure it is real. Since we do not understand the mechanism that may regulate this behaviour, we decided not to speculate on its possible causes in the original version of our manuscript.

We made this point more clear in the revised version of the paper with the statement:

This behavior is unexpected, but reproducible and easy to model empirically. Since we do not understand why the catalyst behaves in this way, we prefer not to speculate about what may be causing this effect.

Disgreeing with the reviewer

The paper deals with a well known matter which was the subject of a huge number of investigation in the last few decades. However it has some merit which may deserve publication after a substantial revision. Indeed it contains a very large number of experimental data which are certainly useful for people active in polyolefin field and the prediction of MW and its distribution can have a practical importance.

Reply: We disagree with Reviewer 3. There are no "huge number of investigations" on this area in the last decade. In fact, Reviewer 3 did not provide a single example to substantiate his/her assertion. This statement also contradicts the opinion of Reviewer 1: "This remains an important and unresolved industrial issue. There have been a few prior efforts using two site models to model supported metallocene polymerizations. This manuscript is the first report of using a three site model capable of predicting the entire molecular weight distribution. The results are striking, and provide convincing evidence that a three site model is accurate over a wide range of process conditions, and far superior to two site models."

FIGURE 5 Excerpts of a rebuttal letter

or when the reviews contain factual errors that led to the rejection decision. Reviewers are as fallible as authors; if you detect a mistake in the reviewer's report, you should indicate it to the editor and ask for the paper to be reconsidered for publication.

4 | ETHICAL MISCONDUCT

The following examples of ethical misconduct are not tolerated in any reputed scientific journal:

1. Falsifying data, fabricating data, or manipulating images
2. Duplicate or multiple concurrent submissions
3. Authorship misrepresentation
4. Plagiarism
5. Self-plagiarism.

Most of these actions need little explanation. The first is related to reporting false scientific data/images to increase the relevance or to expedite the publication of the article—I do not need to explain why this is a bad idea. The second is concerned with publishing the same article twice or simultaneously submitting the same article to more than one journal—this is poor judgement. Author misrepresentation involves excluding authors who contributed significantly to the work reported in the article or including authors who have not agreed to be listed as co-authors—never do that: Excluded authors will likely complain; unconsented authors may be displeased, even if your intention was to honour them. The second to last entry in the list, plagiarism, is taking someone else's work or ideas and passing them off as your own—this will eventually backfire with enormous negative consequences for the authors. All of these ethical misconduct actions may have devastating consequences for your career, ranging from a letter of reprimand sent to you and/or your supervisor to suspension from publication in a journal or from all journals from a publisher to suspension from publication in journals from multiple publishers. They may even lead to criminal proceedings. In summary: do not do it.

I left self-plagiarism as the last item because several authors find this concept confusing. Here are some examples of self-plagiarism:

- Copying entire sentences/paragraphs from your previous publications (journal papers, conference proceedings, book chapters, any material for which you do not hold the copyright). This applies even to text in the Introduction sections of previous papers.
- Copying figures and tables from your previous publications without proper acknowledgement.

- Rewriting a paper by adding just a few new experimental or theoretical results.
- Making a new paper by assembling parts of your previous papers.

Self-plagiarism is a form of 'double dipping', taking credit again for a work that you have already published. Even though self-plagiarism is not treated as harshly as the other instances of ethical misconduct, it will still be detected—software such as iThenticate makes it a trivial task—and the editorial office will return the article to you, either as a full rejection or asking for substantial changes before resubmission. To save time and aggravation, avoid repeating whole sentences and paragraphs from your previous articles. The only exception to this rule is when you need to describe previously published experimental methodologies since there are only a few different ways that they can be explained succinctly in an article. In these cases, editors generally tolerate more repetition than they would in the Introduction, Results and Discussions, and Conclusion; these must always be original.

How can you substantially reduce self-plagiarism if your article continues the work you have published before? Resist the temptation to copy-and-paste information from your previous publications (I know, it is hard to do, but you must). Here are a few suggestions on how to achieve this:

- If you need to repeat some information from the Introduction of a previous article to make your new paper easier to understand, do not copy-and-paste it, but rewrite it. You can probably do a better job the second time around and even include some new references that may have been published during the time elapsed between your previous and current publications.
- If you really must copy-and-paste text from previous articles—it may be unavoidable on some rare occasions—enclose the text between quotation marks and refer to where it first appeared.
- If you need to use (a few) figures and tables from previous articles, cross-reference them to the original publication. You may need to get copyright release permission from the publisher of the original material.
- If you find a few interesting new results that are not extensive enough to write a full article, submit a *short communication*, referring to the article where the initial and more detailed study was first reported.
- If you want to summarize the work of several of your previous articles in a single, ampler-scope publication, write a *feature article*, which is similar to a literature review, but narrower in scope and usually focused on the work of a single research group.

When in doubt, ask others. More experienced colleagues and editors will gladly help you avoid ethical

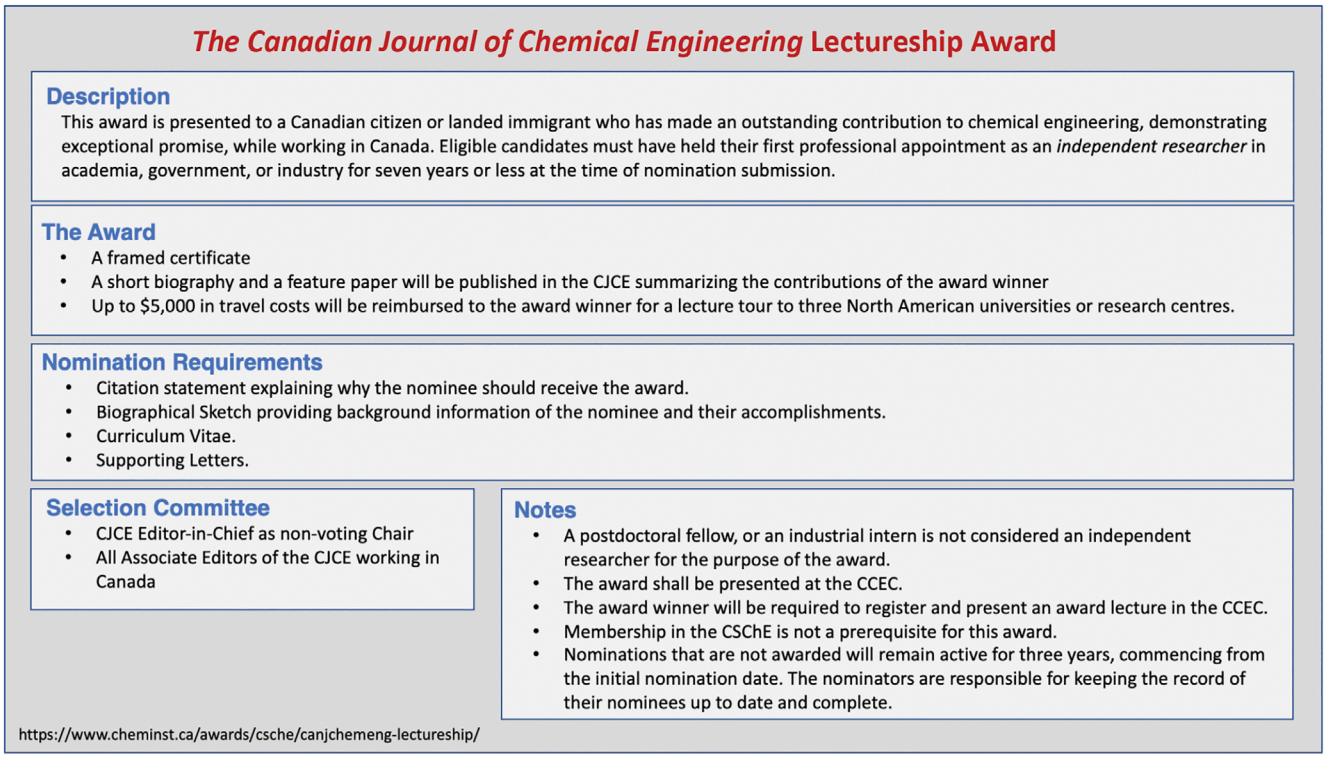

FIGURE 6 *The Canadian Journal of Chemical Engineering* Lectureship Award

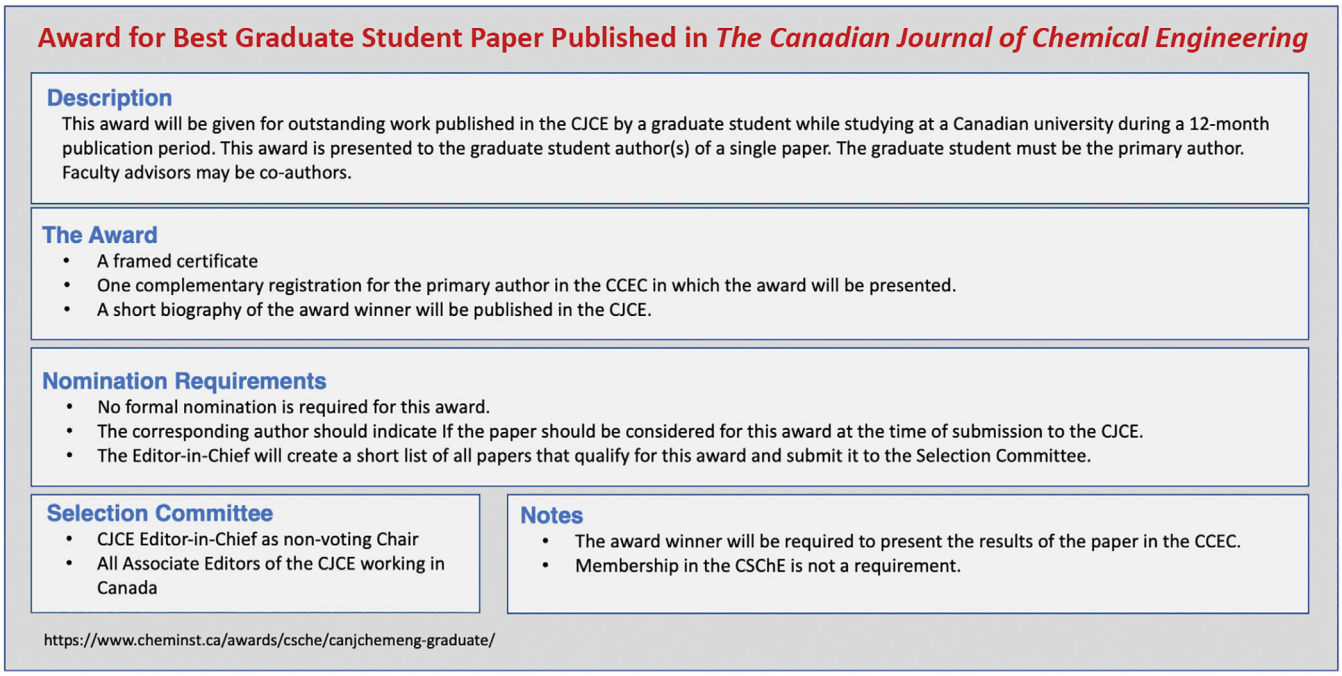

FIGURE 7 Award for Best Graduate Student Paper Published in *The Canadian Journal of Chemical Engineering*

misconduct pitfalls. In the end, everyone benefits from high standards in publication ethics.

5 | *CJCE* AWARDS

The *CJCE* sponsors two CSChE awards: *The Canadian Journal of Chemical Engineering* Lectureship Award (Figure 6) and the Award for Best Graduate Student Paper Published in *The Canadian Journal of Chemical Engineering* (Figure 7). These awards are designed to recognize the contributions of graduate students and early-career researchers in Canadian research institutions. Qualifying authors who submit papers to the *CJCE* are automatically considered for the Award for Best Graduate Student Paper Published in *The Canadian Journal of Chemical Engineering*, but candidates for *The Canadian Journal of Chemical Engineering* Lectureship Award must be nominated by their colleagues or institutions.

6 | CONCLUSIONS

Publishing your results in scientific articles is an obligation you owe to society, a benefit to your career, and sometimes a requirement for graduation. Above all else, writing a scientific article that reports new contributions coming from your research work should be fun.

Unfortunately, many authors find that writing articles is a laborious and thankless task. I suspect that most authors feel like this because they have been conditioned by the large number of ineptly written and often dreary articles they were compelled to read (and mimic in their own writings) during their graduate studies and professional lives.

It does not have to be this way. Writing scientific articles should be rewarding. After all, it is the best opportunity you have to share your discovery story with your colleagues. I hope that the tips I shared in this article will help you enjoy writing your own articles.

I will leave you with a few words of advice from Alexander Pope:

> True easy in writing comes from art, not chance.
> As those move easiest who have learned to dance.
> 'Tis not enough no harshness gives offence
> The sound must seem an echo to the sense.[11]

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