

Journals with open discussion forums are excellent educational resources for peer review training exercises

Nadine Borduas-Dedekind¹, Karen C. Short², Samuel P. Carlson³

¹Department of Chemistry, University of British-Columbia, Vancouver, V6T 1Z1, Canada

²USDA Forest Service, Missoula Fire Sciences Laboratory, Missoula, Montana 59808, USA

³Department of Land Resources and Environmental Science, Montana State University, Bozeman 59717 USA

Correspondence to: Nadine Borduas-Dedekind (borduas@chem.ubc.ca)

Abstract. Journals with open discussion forums lend themselves well for peer review exercises to train early career scientists. Earth System Science Data (ESSD) is an open-access journal for the publication of interdisciplinary datasets and articles, and is thus an example of an educational resource in the peer review process. We offer our experiences in peer review training with manuscripts submitted to ESSD, and we do so from the disparate perspectives of workshop instructor, student, and author. We then provide recommendations for the structure of a peer review workshop. We seek to promote the use of open discussion forums, including ESSD, for educational purposes, as they can provide mutual benefits to trainees, authors, reviewers, and editors.

Short summary. This article describes the use of the open discussion manuscript review process as an educational exercise for early career scientists.

Main text.

1. Introduction

The peer review process is an integral part of the scientific endeavour, yet most reviewers have no formal training. The learning process may have occurred by observing what reviewers write from experiences as authors or by advice from an advisor. There are resources available from publishers and scientific associations, such as Nature's Focus on Peer Review Masterclass,¹ American Chemical Society's Reviewer Lab,² and Wiley's Peer Review Training.³ There are also published articles by researchers describing strategies and tips, like "Learning the Rope of Peer Reviewing",⁴ "How to Write a Thorough Review",⁵ "Refereeing Template: A Guide to Writing an Effective Peer Review",⁶ and "The Golden Rule of Reviewing".⁷ Gratifyingly, there is a growing number of outlets to help recognize the reviewers' behind-the-scenes contributions to the peer review process, such as Publons (now Web of Science), and reviewer awards by journals. These resources are great, but structured implementation of these tips and templates are required to train early career scientists.

Here, we describe a framework to apply this peer reviewing advice into a workshop for trainees. For instance, instructors can run peer reviewer training workshops within their groups or classroom to provide formal schooling in this important process. Research outlets like Earth System Science Data (ESSD), which is an open access, interactive peer reviewed journal for the publication of interdisciplinary data in the advancement of earth science, lend themselves particularly well to teaching the peer review process. Manuscripts are often extensive, and therefore different sections and dataset components can be delegated to different trainees to review. This exercise can lead to a thorough review mutually beneficial to trainees, reviewers, editors, and authors.

Authors of data publications benefit from rigorous peer review, especially in an open access, interactive forum like that of ESSD. Published datasets are intended to be used widely, and interactions with potential users help ensure the products are research- and application-ready. The interactive public discussion style of peer review can provide valuable end-user documentation beyond what is included in the final data paper or product metadata. However, a large earth science dataset may be challenging to review adequately within the typical time constraints of a publication outlet.

Since ESSD datasets and articles can be extensive, the reviewer benefits from having a team of trainees evaluate the data and the manuscript. This process ensures a high quality and thorough review, beyond what one senior reviewer

50 could produce. Editors can help facilitate the communication between the authors and the review team of trainees. If
51 this peer review training practice becomes more common, editors can start relying on these group exercises as
52 regular reviewers.

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54 We, the authors of this paper, have collective experience with manuscripts published as preprints in ESSD that have
55 been used in peer review training exercises, and we share here our experiences. In the following sections we –
56 Nadine Borduas-Dedekind (NBD), Samuel Carlson (SC), and Karen Short (KS) – describe these experiences from
57 the perspective of instructor, student trainee, and author, respectively. We then offer recommendations for others
58 interested in using open discussion publishing forums for peer review training exercises.

59 60 2. Personal perspectives

61 **Perspective from a workshop instructor (NBD)**

62 I am an assistant professor and my research group is composed of young researchers new to the peer review process.
63 To help provide transparency to the process of publishing research, I ran a workshop within my research group (2
64 PhD, 3 MSc and 2 BSc students) using an ESSD manuscript with a large suite of instrument data⁸. The students
65 were enthusiastic about participating, and I was particularly impressed with the quality of the review we wrote as a
66 group. During the review, the students took leadership in evaluating the data, checking databases and code, and
67 asking questions about the operation of different instruments. At the end of the process, our group review was
68 substantially more thorough than a review I could have written on my own. In addition, we included all our names
69 on the review to ensure the students also received credit. The authors' and the editor's feedback was excellent.
70 Following our posted reviewer comment, we communicated with the authors and shared the presentation of the
71 overview of the sections of the manuscript. As importantly, the students appreciated the behind-the-scenes look at
72 how a peer review was conducted. I plan to run this exercise again, either using manuscripts I receive for review, or
73 articles posted in open discussion forums. I recommend that authors, reviewers, editors, and readers consider this
74 peer reviewing practice to help train the next generation of reviewers.

75 76 **Perspective from a student (SC)**

77 I gained my first review experience as a participant in a collaborative student review of an ESSD manuscript. There
78 were approximately 10 students who participated in a one-credit special-topics class convened for this purpose. It
79 was instructive to learn to develop constructive criticism of a dataset and of the methods under review. For me, this
80 review process was the first time I had formed my own perspective on the quality and validity of data, methods, or
81 findings, rather than treating all scientific products as beyond reproach. This experience was a key learning
82 milestone in growing into an independent scientist. Contributing to the review thus pushed me to consider
83 assumptions incorporated in the dataset and methods. At the end of the course, the students selected a leader who
84 posted the reviewer comment on the open discussion forum in their name. Overall, I benefited from the opportunity
85 to participate in the process of science, to test my knowledge of earth science and statistical tools, and to practice
86 creative thinking and technical problem solving.

87 88 **Perspective from an author (KS)**

89 As an author of several large geospatial data publications, I have found the group-review assignment capable of
90 providing considerably more discussion than a single-party review within the allotted time. My initial ESSD
91 submission⁹ was reviewed by a class of graduate students over a six week period. As a class assignment, the time
92 was clearly spent putting the dataset of over 1.6 million records through its paces. Feedback included thoughtful
93 comments on topics like data format, accessibility, quality control, and utility that I was able to respond to at length
94 in the interactive comment process. In contrast to typical peer reviewers, who tend to be selected because they are
95 inordinately familiar with the subject matter and data under consideration and therefore tend to keep their reviews
96 relatively "high level," the early career scientist training exercise prompted me to respond in detail to specific
97 questions concerning data quality and to provide usage notes that would benefit the broader user community. From
98 an author's perspective, I recommend having a look at published discussions^{8,9} from these peer-review trainee
99 exercises and how they led to a high quality review of a data paper.

100 101 3. Peer-reviewing training workshop

102 **Recommendations for training in peer reviewing**

103 We reflect on our respective experience as an instructor, trainee, and author to offer recommendations for a
104 workshop using open discussion forums to provide peer-review guidance for early career scientists. The workshop

105 could be embedded into a senior undergraduate or graduate course and count towards credit, or conducted within a
106 research group. The workshop would be suited for a group of 20 participants or less to ensure adequate time for
107 discussion and feedback. The instructor chooses a recently posted discussion paper and plans 3-4 group interactions
108 around the manuscript. The goal of the primary exercise is to submit an open review comment reflecting the
109 concerted efforts of the students and compiled by the instructor (who has an account with the open discussion
110 journal). Throughout the workshop, the students read the manuscript and come together to brainstorm on the merits
111 – or lack thereof – of the science (and data products) presented. We recommend that the instructor provides different
112 tasks for which the trainees can volunteer. Examples of tasks related to peer-reviewing for ESSD include
113 considerations of data accessibility, data organization, uncertainties, instruments, clarity of the writing, and
114 recency/relevance of references. Students are then responsible individually or in smaller groups to explore sections
115 of the manuscript and generate questions about the data, the data visualization, the data interpretation, etc. One
116 session is then dedicated to presenting these questions to the group and attempting to answer collectively. When
117 answers cannot be generated within the group, then these questions can be included in the reviewer document with
118 actionable recommendation to the authors. The instructor is then responsible for the final submission of the open
119 discussion review.

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121 We can also recommend an additional session within the workshop where students are asked to develop potential
122 applications of the data relevant to their interests. This element goes beyond the fundamental components of dataset
123 review and focuses on developing students' creativity, as well as their technical abilities and understanding of
124 statistical methods and other analytics. Consideration of potential applications, even as a proof-of-concept, can also
125 encourage closer examination of the precision, accuracy, or quality control of the dataset and manuscript under
126 review.

127
128 The outcomes of the workshop are for early-career scientists to learn how to ask critical questions, how to formulate
129 suggestions for improvement using a teaching tone, and how to summarize a research article. In sum, the goals are
130 to take part in the peer-review process, to learn about the iterative process of the scientific method and to appreciate
131 the value of constructive criticism.

132 133 4. Concluding remarks

134 **Call to use open-discussion forums for peer-review training**

135 There is an intrinsic benefit when experienced scientists are investing in the future of the peer review process. If all
136 reviewers go through a training program first, then we collectively raise the bar of the quality of the peer review
137 process. Overall, the exposure to both the review process and the concept of openly shared, quality-assured data is
138 important in training the next generation of scientists as well as promoting critical thinking among our trainees. We
139 see a win-win situation for the trainee and the author involved. The concept of open data is necessary to advance
140 knowledge more effectively and participating in all aspects of the open data review process – as a reviewer, student
141 trainee, and author – ensures continued high-quality datasets available in ESSD and other science products.

142 143 144 145 **References**

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