

RESEARCH ARTICLE



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Promoting equity in the peer review process of journal publication

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Abstract

While there is evidence to support the existence of identity-based disparities, inequities, and biases in the academic journal peer-review process, little research supports the presence of this bias in the peer-review process for academic journals in science education. Through an analysis of six leading journals in science education, we aimed to investigate the extent to which diversity, equity, and inclusion (DEI), as well as the presence of bias in the peer-review process, are addressed by these journals. We analyzed trends in the gender/sex, geographical affiliation, race/ethnicity, and the presence of equity-centered research focus for members of these journals' editors and editorial boards. We found that although gender/sex is well-balanced in these journals' editors and editorial boards, they are typically North American centric, and White individuals are overwhelmingly represented. Four journals had a quarter or more of individuals who pursue equity-centered research. Only two journals provided detailed information on how manuscripts are reviewed in their author submission guidelines. All used a double-blind approach to peer-review. One of the journals includes an explicit position on DEI. Based on the analyses and reflections on our own experiences, we recommend science education journals consider ways to probe whether bias does exist in their peer-review process, diversify their board to be more inclusive of scholars from communities historically marginalized, and move to a triple-blind

approach to their peer-review process as mechanisms to mitigate bias in the journal peer review.

KEYWORDS

academic journal peer review, diversity, equity, inclusion

1 | INTRODUCTION

Many scholars with marginalized identities research topics of equity out of a necessity to highlight their lived experiences within an educational system embedded with social injustices normalized by their majoritarian colleagues (Ridgeway, 2019). Within the United States, scholars with historically marginalized identities include, but are not limited to, people who identify as cisgender women; members of the LGBTQIA + community; people from Black, Indigenous, Latinx, and Asian communities; people with disabilities; and/or people who are non-native English-speakers. Scholars with marginalized identities are creative, innovative, and advance alternative frameworks for conceptualizing identity-based differences in learning outcomes (Ridgeway & McGee, 2018). Yet, it can be very difficult for them to successfully navigate their research agendas through the journal peer-review process to publication.

Dissemination of research in peer-reviewed journals is often a key component to success in the professoriate. Therefore, this paper explores the potential for bias in the peer-review journal publication process and the struggle it may present to scholars with marginalized identities in science education. This struggle may deny them access to academia and other spaces in which knowledge is created and advanced, because their necessary work can be unwelcomed by scholars who operate and are invested in mainstream knowledge.

2 | PUBLISHING AND THE PEER-REVIEW PROCESS

Publishing in peer-reviewed journals is crucial to tenure and promotion within academic institutions (Miller et al., 2011). Although the tenure and promotion process varies across institutions, tenure-track science education faculty typically feel some pressure to disseminate their research through journal publications. The pressure includes placing these publications in high impact journals as the impact factor of the journal is currently one widely accepted measure of a scholar's impact on their field. It also builds a reputation for the scholar and their institution in the wider academic community (Jana, 2019). This positions journal editors and reviewers as central gatekeepers of a scholar's career advancement as they have "ultimate authority over a manuscript's fate, with editors primarily directing manuscript management and reviewers conducting manuscript assessment" (Benos et al., 2007, p. 145). Unbiased manuscript evaluation is, therefore, a core concern for scholars.

Unbiased evaluation of the manuscript can be promoted in the peer-review process when editors assign reviewers who use similar epistemologies and methods to those used by the manuscript authors. It can also be promoted when reviewers have a broad perspective on rigorous scholarship and who is capable of such scholarship (Barton & Johnson, 2002; Eisenhart, 2002). Given a limited pool of reviewers, this ideal match of reviewers and authors can be a near-impossible task for editors (Eisenhart, 2002). Thus, despite the best efforts of editors, journal peer review is susceptible to disparities, inequities, and bias. We draw on Murray et al. (2018) operationalization of the latter three terms. Disparity refers to "unequal composition between groups" (Murray et al., 2018, p. 3) such as more males submitting manuscripts for journal peer review. Inequity refers to "unequal outcomes" in the review process between different groups despite evidence of equal merit (Murray et al., 2018). Bias describes evidence of partiality, conscious or implicit, in favor or against one group compared to another—"it is a violation of the

impartiality expected in the evaluation of a submission" (Lee et al., 2013, p. 4). The identities of authors, reviewers, and editors are key to exploring the potential for disparities, inequities, and bias in journal peer review. Our paper, consequently, centralizes identities of people in these three roles and the potential for interactions among them to produce biased journal publication outcomes.

3 | PEOPLE AND THEIR ENGAGEMENT IN JOURNAL PEER REVIEW

The journal peer-review process is reliant on scholars volunteering their time and expertise to journals. A primary incentive to volunteer is the opportunity to shape the direction and quality of research in their field (Isohanni, 2005). The principal responsibility of reviewers is to provide an unbiased evaluation to authors and editors of a manuscript's originality, reliability, accuracy, and relevance to the journal's readership (Benos et al., 2007; Jana, 2019). Throughout the process, a reviewer should communicate honestly about the quality of the scholarship in a formal and polite tone and with specific, reasonable feedback on how identified weaknesses can be improved (Mavrogenis et al., 2020; Osborne & Brady, 2002; Wiley, 2021). Similarly, it is poor form for a reviewer to use an unfriendly tone, not thoroughly read a manuscript from the title page to references, or personally attack authors (Mavrogenis et al., 2020; Osborne & Brady, 2002; Wiley, 2021). This section describes how different identities of reviewers and authors can interact and influence the outcomes of the journal peer review process.

3.1 | Assigning identities in journal peer-review bias research

Research exploring group-based outcomes of journal peer review typically use author and reviewer gender (e.g., Edwards et al., 2018), geographical region (e.g., Walker et al., 2015), and institutional prestige (e.g., Tomkins et al., 2017) and, much less typically, their race/ethnicity (e.g., Silbiger & Stubler, 2019) as identity-based categories through which disparities, inequities, and biases can be explored. Institutional prestige was easily garnered in studies exploring the role of this aspect of author identity and the journal peer-review process from authors' stated affiliation on publications and prestige was inferred based on national and international ranking systems of the institution. Geographical region was similarly straightforward in determination as it is based on institutional affiliation stated on publications and subsequent national (e.g., Brazil) or continental location of the institution (e.g., South America).

Gender and race/ethnicity, conversely, are highly subjective labels based on a combination of how people self-identify and identities imposed on them. Several studies we cite used an algorithm alone or an algorithm in combination with human assessment of gender to assign a code of male or female based on the sex typically associated with their first name, the pronouns their first name is typically associated, and their gender presentation in pictures on institutional websites (e.g., Edwards et al., 2018; Murray et al., 2018, 2019; Walker et al., 2015; West et al., 2013). We use gender/sex in the rest of the paper to recognize the complexity of sex and gender identity in the absence of self-identification. There are much fewer primary studies investigating the potential for racial bias in journal peer-review process compared to gender, author and institutional prestige, and geographical region. The scarcity of studies exploring racial bias is likely attributable to the elevated difficulty in using an algorithm to accurately assign race/ethnicity to authors solely from publicly available information for tens of thousands or even millions of journal articles and conferences abstracts/proceedings. The legacies of colonization and slavery make such third-party identification of race/ethnicity highly susceptible to error as surnames, geography, and even appearance may not align with how an individual self-identifies (for more on the complications of third-party identification of race/ethnicity see Gordon & Bell, 1993; Stephan & Stephan, 2000).



3.2 | Identities and disparity, inequity, and bias in peer review

As we read articles and federal agency reports on diversity and potential bias in peer-review processes, it became clear much of the literature focused on male dominated disciplines from science, technology, engineering, mathematics, and medicine (STEMM). Subsequently, most literature we draw on in this section relates to STEMM rather than the discipline of education or the field of science education.

3.3 | Gender/sex

Contrary to STEMM, women have been overrepresented among people earning a doctorate in education for decades (National Center for Science and Engineering Statistics, 2021). This disparity in gender/sex has grown from 57.6% to 69.1% between 1990 and 2020. Further, women represent 75.5% of 2020 doctoral recipients in the field of science education (National Center for Science and Engineering Statistics, 2021). Across all disciplines, 55.7% of tenured and tenure-track faculty are men and men outnumber women two-to-one among the rank of full professor (National Center for Education Statistics, 2021). An overrepresentation of earned doctorates in a discipline does not necessarily translate to majority or even equal representation in academic rank; rank often being tied to research productivity and impact. In the absence of data specific to science education, we, therefore, caution readers from presuming female faculty in science education are likely thriving compared to their male counterparts in disseminating their research in venues where peer review acts as a gatekeeper.

The National Institutes of Health (2018) recognizes despite women earning most doctoral degrees in the biological sciences for over a decade, female faculty are a minority among biomedical tenured and tenure track faculty and feel less supported by their institutions to pursue research. Thus, even in a discipline where women are overrepresented among those earning doctorates, the evidence is compelling that securing tenure track positions and tenure is more difficult for women of all ranks because they face more institutional barriers to pursue and publish research by their institutions. These challenges likely influence the gender/sex disparities in journal peer review observed in several studies.

Recent large-scale studies demonstrate that although women are less likely to submit manuscripts for journal publication, acceptance of their manuscripts are as likely as similarly qualified male counterparts (Edwards et al., 2018; Holman et al., 2018; West et al., 2013). They have, subsequently, concluded there is little direct evidence of a generalizable trend of gender/sex bias in manuscript acceptance. Instead, they have concluded there are clear inequities likely undermining the occupation of the prestigious authorship position—first, last, or corresponding author depending on the publication—and submission rates.

Women are less likely than men to occupy the prestigious authorship position when coauthors are mixed gender (Edwards et al., 2018; Holman et al., 2018; West et al., 2013). Further, one study demonstrated when women occupied the prestigious author, they were likely to be displaced as corresponding author when there was a male coauthor; female first authors were six times less likely to be the corresponding author compared to when men were the first author (Edwards et al., 2018). Women were also far less likely to have single authored publications (West et al., 2013) and less likely to be commissioned by journals to write invited papers (Holman et al., 2018).

West et al. (2013) included education as a discipline in their investigation of gender/sex disparities in journals. Using the JSTOR database, 28,635 authors were identified in education journal articles published between 1990 and 2011; 46.35% of these authors were women. Education had the highest percentage of female authors of all disciplines investigated in the study. As noted earlier, however, education is a discipline in which women have earned most doctorates for at least 30 years. Yet, men still seem to dominate as authors in academic publications in the discipline. Plausible reasons for these disparities include women being less likely to be in tenured or tenure track faculty positions, meaning there are simply less women to submit manuscripts than men in academia (West

et al., 2013). Additional plausible reasons include: female faculty in these positions report spending more time on teaching than research in a typical week whereas men report more time doing research than teaching (Rissler et al., 2020), men being more likely to proactively negotiate with coauthors for the prestigious authorship position (West et al., 2013), bias in peer review toward manuscripts where men occupy the prestigious authorship position (Edwards et al., 2018; Murray et al., 2019; Walker et al., 2015; West et al., 2013), or a conflation of these factors. Disparities in success in the journal peer-review process have also been linked to the prestige of an author or their institution.

3.4 | Institutional and author prestige

In a controlled experiment, Tomkins et al. (2017) found when author identity is known by reviewers (single blind review), renowned authors and authors from top universities and companies were more likely to have papers accepted compared to when their identities were not known (double blind review). Seeber and Bacchelli (2017) in their analysis of 21,535 articles and conferences proceedings in computer science also found junior scholars to be underrepresented when reviewers were aware of authors' identities, which signals more established authors are favored by reviewers. In a study of articles published in 49 open access journals from the publisher *Frontier*, which uses a single blind peer review but includes reviewer names on published articles, found scholarship from authors from more prestigious institutions was more likely to be accepted by reviewers (Walker et al., 2015). With disparities in journal publication clearly linked to prestige, studies have attempted to determine whether social bias occurs because of an interaction between author and reviewer attributes.

3.5 | Social bias

There is evidence of two forms of social bias in peer review: cognitive particularism (Travis & Collins, 2016) and homophily (Murray et al., 2018; Walker et al., 2015). Both are characterized by an interaction between reviewer and author. Cognitive particularism is a tendency of reviewers to more positively review scholarship like their own (Teplitskiy et al., 2018; Travis & Collins, 2016). For example, Barton and Johnson (2002) found reviewers tended to use incompatible criteria of positivist methodologies as a reference point for what counts "as a good scholarly paper" (p. 209) to evaluate the quality of their scholarship. Even Nobel prize winners have described struggles with peer review, including manuscript rejections, when attempting to publish research countering the conventional knowledge of their field (Campanario, 2009).

Homophily is a tendency of reviewers to positively review scholarship of authors who are in their same social group (Murray et al., 2018). Murray et al. (2018) completed an exploratory analysis of nearly 24,000 submissions over 5 years within the journal *eLife* and found that males and people from North America and Europe were overrepresented among editors and peer reviewers. Correspondingly, there were higher rates of acceptance for authors who were male, or from these regions, or both. There was a significant correlation between who the reviewers were and the acceptance of work from people of similar backgrounds. In an analysis of 2.5 million research papers in which all authors had US addresses, Freeman and Huang (2014), found authors whose surnames signaled similar ethnicity were more likely to be coauthors than those with surnames signaling coauthors of mixed ethnicities. Lloyd (1990) found female reviewers were far more likely to accept female authored manuscripts than male authored work and male reviewers were much less likely to accept female authored manuscripts. Walker et al. (2015) found no interaction between author and reviewer gender/sex, but did find reviewers favored authors who were from the same geographic region. Social bias, therefore, alongside external disparities and inequities present a challenge to the peer-review process. Overall, it is not only challenging for women and scholars of less prestigious institutions to be accepted, but it is also challenging for scholars of color.

3.6 | Race/ethnicity

Silbiger and Stubler (2019) administered a survey open to anyone who self-identified as member of the STEM community and has published scholarly work in a peer reviewed system. Of 1106 individuals from 46 countries and 14 STEM disciplines, they found 58% of respondents had received an unprofessional review with 70% of these respondents indicating they had received multiple unprofessional reviews (Silbiger & Stubler, 2019). There were no racial/ethnic or gender/sex disparities in those reporting receiving unprofessional reviews. However, White males were the group most likely to report unprofessional reviews having *no impact* on their self-perceived scientific aptitude and their career advancement. Women of color, nonbinary people of color, White women, and White nonbinary people all reported moderate negative impact on their self-perceived scientific aptitude because of an unprofessional review. Women of color and nonbinary people of color were the most likely to report an unprofessional review also having a negative impact on their career advancement. From various STEM-related disciplines, there have been strong connections found with the lack of diversity in peer-reviewers and editors and evidence of racial/ethnic bias within the peer-review process (Pinholster, 2016; Seeber & Bacchelli, 2017; Silbiger & Stubler, 2019; Walker et al., 2015).

3.7 | The body of evidence in relation to science education

With this body of evidence from STEM, a general absence of an interrogation of the experiences of scholars of color, women, nonbinary people, junior scholars, and scholars from less prestigious institutions with the journal peer-review process leaves the science education academic community relatively blind to the potential disparities, inequities, and biases within it. There is little transparency on whether science education journals have systematically probed for evidence of these concerns in their peer-review process and how issues of bias are addressed if they are detected. Without self-interrogation, if the work and ideas favored by gatekeepers of the journal peer review process in science education are unevenly distributed across author demographics, we are nurturing conditions fostering Matthew Effects, where scholars accrue advantages through unearned benefits (Murray et al., 2018).

4 | AUTHORS' POSITIONALITIES

All three authors are women of color from diverse backgrounds. The first author is in her sixth year on the tenure-track at a rural, mid-western Research II university. She has a joint appointment in schools of education and chemical and biomolecular sciences. She identifies as a heteronormative, immigrant cisgender woman of color who is a native English speaker. Her research focuses on K-12 science teacher professional development and closing equity gaps in K-12 and higher education STEM education. Her work has been published in *Journal of Science Teacher Education* (JSTE), *Science Education* (SE), *Journal of Research in Science Teaching* (JRST), *Journal of Chemical Education* (JCE), and *Multicultural Education*. She has reviewed multiple manuscripts for JSTE, SE, and JCE.

The second author, an associate professor at a research I university, is an immigrant cisgender woman of color who speaks a language other than English as her primary language. Her research focuses on how to design and use technologies to promote equity for multilingual learners (MLs) in linguistically diverse classrooms at Title I schools. Through partnerships with science and English as a Second Language teachers, her research explores how different forms of visualizations and automated feedback can engage all students, including MLs, in discourse-rich science practices to make sense of scientific phenomena. Her work has been published in JRST, *International Journal of Science Education* (IJSE), *Journal of Science Education and Technology* (JSET), *Chemistry Education Research and Practice*, *Journal of Educational Psychology*, *Theory into Practice*, and *Science*. She reviewed manuscripts as an ad hoc

reviewer for several journals, including JRST, SE, JSET, *Instructional Science*, *Educational Researcher*, and *Review of Educational Research*. After serving on the JRST Editorial Board team, she is currently serving JRST as Associate Editor.

The last author is a chief diversity, equity, and inclusion (DEI) officer and chief research officer for a national health profession association. She is a Black woman raised in Buffalo, NY, which is an old industrial city in the northeast. She is an interdisciplinary race scholar who explores STEM and Health Profession majors in K-12 and higher education. She explores the role of identity, racialized experiences, and marginalized individuals in education spaces. She seeks to promote solutions for creating inclusive physician assistant education environments for underrepresented students and faculty. With nearly 20 publications, her scholarship and research centers cultivate inclusive environments that promote a sense of belonging for marginalized individuals and their allies. She has published her work in STEM education journals: JRST, JSTE, *Cultural Studies for Science Education* (CSSE), *Journal of Engineering Education*, SE, and *Sustainability*. She reviewed manuscripts as an ad hoc reviewer for CSSE, JSTE, and *Journal of Women and Minorities in Science and Engineering*.

As scholars who were trained and have been practicing in US institutions, we have only published in English and primarily US and European based academic journals. We acknowledge that our experiences with diversity, equity, and bias in the journal peer review process is US centric. It, therefore, limits our ability to speak to how scholars outside of the United States experience the journal peer review process and its career consequences.

5 | PURPOSE

The purpose of this paper is to explore the journal peer review process within the specific context of science education journals through (i) describing the peer review process of six leading journals in science education, including JRST (3.870 impact factor), SE (3.50 impact factor), JSTE (1.465 impact factor), IJSE (1.485 impact factor), CSSE (0.437 impact factor), and *Research in Science Education* (RISE, 2.248 impact factor), (ii) comparing those processes relative to best practices for journal peer review in the literature, and (iii) weaving the authors' experiences with the journal peer-review process within this comparison. Based on the themes from comparing the peer-review processes, the paper provides recommendations for journals to increase self-awareness of potential biases during the review process. The research questions (RQs) guiding this paper are:

1. How does the described peer-review process compare across well-established science education journals?
2. What is the extent of the diversity of the editors and editorial boards across well-established science education journals using peer review? To what extent are scholars who pursue equity-focused research represented?
3. How do the included journals support reviewers' ability to provide a fair review?

6 | SELECTED SCIENCE EDUCATION JOURNAL WEBSITE CONTENT ANALYSIS

To answer RQ1, the content of each journal's website was analyzed to evaluate how information about journal goals and mission, diversity/equity statements, editorial team information, guidelines for authors and reviewers, approaches to peer review (e.g., double blind), and ethics statements was presented. Content on website was retrieved and analyzed between May 1 and June 4, 2021. The authors individually memoed and quoted text from the websites. The authors then met and discussed their observations, trends, and potential areas for further exploration. The evaluation categories were determined based on the literature review, as well as the authors' own experience with the peer-review process, including deciding which journal to submit a manuscript for review, reviewing for journal manuscripts, receiving and using peer-review from journals, and editorial experience.



To answer RQ2, we assessed the composition of the gatekeepers in the peer-review process, including editor-in-chief, associate editors, and editorial board members, across the six leading journals in the field of science education. Data on editors and editorial board members was obtained from each journal's website, individuals' official and personal websites, and Google Scholar pages, including their names, pronoun choice, gender/sex, ethnicity/race, country of affiliation, and research interests. We collected information about editors and editorial board members, including names, pronoun choice, gender/sex, ethnicity/race, country of affiliation, and research interests. From each journal's website, individuals' official and personal websites.

Data (e.g., names, pronoun choice, and research interests) on editors and editorial board members was obtained from each journal's website, individuals' official and personal websites, and Google Scholar pages. Each variable was coded as 1 for: female (gender/sex—individual presented as female gendered in pictures, pronoun choice, and/or first name); institutional affiliation from countries other than the United States or Canada (country of affiliation); not White—Black, Indigenous, Latinx, Asian—(ethnicity/race—individual did *not* have features typically associated with European only ethnicity, i.e., the individual would be assumed to be White unless they self-identify differently); and equity-centered research (research focus—explicit research focus on equity issues related to race/ethnicity [e.g., Black students], culture [e.g., culturally relevant pedagogy], socioeconomic status [e.g., students from under-resourced schools], language [e.g., emergent bilinguals], gender [e.g., students in STEM], sexual orientation [e.g., LGBTQIA + STEM persistence], disability [e.g., students with an autism spectrum], and/or geography [e.g., science learning in a developing nation]). Descriptive statistics were used to identify trends in the diversity of the gatekeepers.

To answer RQ3, we explored the most robust reviewer training resource provided by the publisher of four of the six journals, Wiley. The first author completed the training provided on the Wiley website on May 19, 2021. She took notes documenting the experience as she completed the modules and the exam that followed. Attention was given to how and to what extent the training addressed issues of bias and/or fairness during the peer-review process.

7 | DISCUSSION

7.1 | Journal website information on the peer-review process

All journals explicitly stated their use of a double-blind peer-review process. Each of these approaches to peer-review and their advantages and disadvantages are presented later in the paper. JRST presented one of the most comprehensive and specific description of their peer-review process. The journal's website also describes their referral policy for manuscripts not accepted, but are perceived as more suitable for other journals, such as *SE* and *School Science and Mathematics*, to be transferred without a need for author resubmission. As with all other journals, formatting expectations and the logistics of the submission process are also well-described. The “external review process” and time to review is described as follows on JRST's (2021) website at the time:

Following the initial review, the Co-Editors will assign an associate editor the duties of overseeing the review process. Two or more reviewers will then be secured to read your manuscript and provide comprehensive blind reviews. The associate editor and at least one of the reviewers possess expertise in the domain of the manuscript. All manuscripts are evaluated for their significance to science education and on their technical quality for the type of scholarship represented. Please see the Information for Reviewers page for more information. All submissions are acted upon as quickly as possible, and the review process normally takes approximately 6–10 weeks after preliminary review.

A sample review specific to science education is included as a resource for reviewers. JRST (2021) also includes a DEI statement:

The Journal of Research in Science Teaching (JRST) seeks to work with scholars from a range of institutional affiliations, nationalities, and career stages. We are committed to increasing diversity and inclusion in research and publishing from applicants of all ethnicities, races, religions, sexes, sexual orientations, gender identities, national origins, disabilities, ages, or other individual status. We encourage all authors to engage with and cite sources by scholars and other writers from groups that are often excluded or ignored within academia. Additionally, we ask reviewers to consider, among other evaluation criteria, whether the citations for a given submission reflect the journal's commitment to diversity. We are committed to eliminating the influence of bias in our editorial and review processes and continually work toward identifying and implementing equitable practices for publishing in JRST.

SE primarily provided information on expected content and formatting such as manuscript structure, funding, and research reporting guidelines. Authors are provided with the following information on the peer-review process:

The acceptance criteria for all papers are the quality and originality of the research and its significance to journal readership. Except where otherwise stated, manuscripts are double-blind peer reviewed. Papers will only be sent to review if the Editor-in-Chief determines that the paper meets the appropriate quality and relevance requirements.

Like all journal websites analyzed, RISE provided clear formatting and logistics submission guidelines to authors. Like JRST, the journal's website also provides a detailed description of the journal's peer-review process. The website describes a two-phase review process in which phase 1 involves an initial screening of the manuscript by a coeditor in chief to determine whether the manuscript meets the submission guidelines and the journal's focus. Phase 2 is described as followed:

If the paper is passed to Phase 2, this process will be managed by either a co-editor or will be assigned to an Associate Editor. Following this, two members of the RISE reviewer pool will be assigned to review the paper. Our pool of reviewers, including an Editorial Board, comprises researchers and practitioners drawn from previous RISE contributors and other experienced researchers in the science education community, nationally and internationally. Reviewers selected to review an article are chosen on the basis of their experience, expertise, and interests aligned to the focus of the article based on identified key words. RISE, like other journals, uses a "double blind" review process. This means that reviewers are not given the names and institutional affiliations of the authors, and authors are not given the names of the reviewers assigned to their article. If an article is found suitable for peer review, the author(s) could expect to be notified of the outcome of the process within 3 months from time of submission if all aspects of the process go to plan.

The description of phase 2 also includes that revisions are often necessary after the peer-review process and provide authors with information about what is typically expected in the revision process post-peer review.

Like SE, CSSE, JSTE, and IJSE provide authors with formatting and logistical information in their submission guidelines. Generic information about the peer-review process is provided to authors and peer reviewers by referral to publisher Springer and Taylor and Francis's information.

As part of our analysis of each journal's website, we also read each journal's aims and scope and ethics statements. At the time of analysis, only JRST provided a DEI statement. Only SE and CSSE, in their journal aims and

scope statement, explicitly signaled to authors that equity focused research studies are welcomed. For example, SE includes in their Aims and Scope statement in relation to manuscripts addressing Science Learning in Everyday Life that:

Papers should investigate experiences in settings such as community, home, the Internet, after school settings, museums, and other opportunities that develop science interest, knowledge or practices across the life span. Attention to issues and factors relating to equity in science learning are especially encouraged.

7.2 | Diversity of gatekeepers

Table 1 presents an overview of the population of gatekeepers across the six journals. On average, 54.3% of the editorial leadership were female, and most of the gatekeepers (71.31%) were identified as White, see Table 1. The patterns were similar across the six journals. However, noticeable differences were observed for the diversity of institutional affiliations. The results show that JRST, JSTE, CSSE, and SE consisted of more than 50% of editorial members from institutions in North America, while approximately 80% of the population for IJSE and RISE were from other countries, including China, South America, Spain, and Turkey. In terms of the gatekeepers' research interests, only 27.89% had equity-centered research.

7.3 | Training for reviewers

Website analysis of selected journals indicated that only JRST and SE, both published by Wiley, provided any information on their website about the peer review process. Wiley provides three modules on peer-reviewer training, including the role of reviewers in peer review, the peer review report, and the outcomes of peer review. The modules emphasized eight attributes and five responsibilities of peer-reviewers, see Table 2.

A central focus of Wiley's (2021) training is providing reviewers with guidance on how to construct a review that can help authors improve the quality of the manuscript and providing editors with insight to make a judgment on whether to accept, reject, or request revisions. The extent to which peer-reviewers were "trained" to address

TABLE 1 Summary of editor and editorial board background.

Journal	Journal impact factor	Gender/sex (%)		Nationality of affiliation (%)		Ethnicity/race (%)		Equity-centered research focus (%)
		Male	Female	United State/Canada	Other	White	Not White	
JRST	3.870	47.06	54.41	64.71	35.29	66.18	35.29	27.94
IJSE	1.485	51.43	44.76	23.81	76.19	80.00	16.19	13.33
CSSE	0.437	38.00	62.00	50.00	50.00	66.00	34.00	44.00
SE	3.50	41.67	58.33	80.56	19.44	75.00	25.00	41.67
JSTE	1.465	39.47	60.53	82.46	17.54	66.67	33.33	26.32
RISE	2.248	52.94	47.06	11.76	88.24	80.39	19.61	19.61

Abbreviations: CSSE, *Cultural Studies for Science Education*; IJSE, *International Journal of Science Education*; JRST, *Journal of Research in Science Teaching*; JSTE, *Journal of Science Teacher Education*; RISE, *Research in Science Education*.

TABLE 2 Summary of peer-reviewers attributes and responsibilities in Wiley training.

Attributes	Responsibilities
Well qualified scientifically to assess manuscript	Provide critical and constructive evaluation
Independent	Provide recommendations to the editor
Free of conflict of interest	Meet deadlines
Have suitable subject matter knowledge	Declare conflicts of interest
Active in publishing research	Maintain confidentiality
Participate in editorial boards (desired, but not necessary)	
Inquiring mind	
Able to meet deadlines	

what the first author interpreted as issues of bias was an emphasis on being constructive (e.g., be critical, but give specific feedback on how to make the manuscript better), fair (e.g., do not expect authors to do more than what is addressed in the manuscript), and reasonable (e.g., recognize that some researchers may not be as well-resourced as the reviewer is, so be reasonable in suggestions for improvement). In providing feedback, the peer reviewer should take “great care” in reaching conclusions and making assumptions and should use moderate and dispassionate language that is confined to the research and not the researcher (Wiley, 2021).

Although such training can potentially guide reviewers to provide useful feedback to help authors improve an “improvable” manuscript suitable for a journal, the training does not attend to implicit bias related to gender/sex, institutional prestige, geographic location, or race/ethnicity (Wiley, 2021). The term bias, in fact, was never mentioned to Author 1’s knowledge at any point in the training.

The training is currently voluntary, and much of what was addressed generally applies to science education research. Reports of investigations of matter, energy, and nature, however, do not necessarily translate to human subjects research that addresses overtly sensitive and political issues such as gender/sex, race/ethnicity, income, nationality, immigrant status, and so forth. While there seems to be efforts moving toward training reviewers to provide professional actionable, useful feedback to authors and reviewers, little seems to be done to address bias (implicit or explicit beyond the use of blinding).

8 | RECOMMENDATIONS: MOVING TOWARD UNBIASED PEER REVIEW

8.1 | Provide a clear DEI statement and review criteria questionnaire

When I became junior faculty in 2016, the decision on where to submit my scholarship for publication suddenly became purely mine. This was freeing and terrifying. I did not know what to look for in a journal as a sign that my equity-focused scholarship would be unbiasedly considered. So, instead I looked for “fit” based on the journal’s aims/scope and types of papers the journal described it welcomed. At the time only SE and CSSE, under the type of manuscripts they welcomed, signaled being open to my explicitly equity-focused research. Looking back, I think how useful and stress relieving journal diversity, equity, and inclusion (DEI) statements, explicitly integrated into their aims and scope, would have been in those first 2 years on the tenure-track. It would have mitigated, if not eliminated, the struggle to decide “fit.”



Providing clear DEI statements begins to frame and communicate to its audience that a journal seeks to disseminate a body of scholarship through a high-quality and unbiased peer-review process. Clear guidelines for the peer-review process aligned with the DEI statement can further help reviewers understand the expectations for both implicit and explicit biases to be monitored when reviewing a manuscript for its scholarship and relevance to the journal's mission. In addition, we encourage journals to provide reviewers with a review criteria questionnaire aligned with the DEI statement to ensure reviews focus on the merits (e.g., significance, importance, innovative approaches, etc.), rather than likely author(s) identities because of their choice of research focus.

Four of the six journals we reviewed in this paper have at least 50% representation of North American editors and editorial boards. Issues of equity and justice in science education are, therefore, increasingly difficult for these journals to ignore as an identity-driven divisive US political climate not experienced since the precivil rights era continues to be fueled (Maskovsky, 2017). We, therefore, urge SE, JSTE, and CSSE to follow JRST and be more explicit with authors, reviewers, and their readership about their position on DEI in science education research and policymaking.

8.2 | Active editor role in screening for and reducing reviewer bias

I have been accused by reviewers without objective justification of “amateurish” writing, being “preachy” about race, and being unethical. These are just 3 reviewer comments among probably 200 or more I have received between 2016 and 2020 in the journal review process. Yet, these are most prominent when anyone probes me about my experiences with reviewers in the journal peer-review process. I wish I had never seen them, that a reviewer never thought it was permissible to say that to a peer, that an editor would not or could not remove them before they were sent to me, that I felt as a junior faculty that I could jeopardize my tenure and promotion prospects by professionally inquiring to the editor about receiving such comments, that I ultimately chose to not inquire to the editors because advancing my career was the priority at the time. Above all, I abhor that the system placed me in that position more than once and will likely place me there again in future. I have and continue to pay a psychological cost from the journal peer-review process that does not show up as “bias,” as defined in many studies we cite in this paper, because I persevered to publication despite the system. A cost my White male peers are much less likely required to pay.

Research has shown unprofessional, rude comments from reviewers can potentially have negative impact on career advancement for people of color, women, and nonbinary people (Silbiger & Stubler, 2019). However, there are inconsistencies in journal policies and codes guiding editors on how to manage such unprofessional comments from reviewers (Mavrogenis et al., 2020). Some journals allow editors the right to remove such comments, while others prevent them from altering reviewer comments in anyway (Mavrogenis et al., 2020). We encourage editors and journals to seek ways to evaluate the quality of reviewer comments and address those that are rude, biased, and personal attacks. We also encourage editors and journals to engage with these reviewers on the unprofessional nature of the comments and how to proceed more professionally moving forward. It may also be beneficial for journals to offer authors a transparent pathway to communicate concerns about unprofessional reviewer comments. Currently, science education journal offers authors very limited information on how or whether the journal handles concerns about peer review bias. This leaves authors unsure on how, if at all, to bring their concerns about bias to the journal.

8.3 | Diversifying editors and reviewers

We hope that seeking out and making public such a positionality will also move or reinforce these journals' position on encouraging research focusing on closing longstanding and emerging gaps in access to high-quality science learning. Coupled with crafting and adhering to similar positions with fidelity, we underscore a need for editors and editorial boards to consciously seek to become diversified in terms of racial/ethnic representation as White researchers are overwhelming among this groups of gatekeepers to the peer-reviewed publication process in science education.

8.4 | Equity and awareness training

Training has some small impact on improving quality of review, but its effect wanes over time (Schroter et al., 2004). Bornstein (2021) recommends both editors and reviewers use "debiasing strategies" for both manuscript reviewers and editors including (1) ongoing training in research and theories on reasoning and distortion in human decision making as well as on how specific forms of bias influence manuscript evaluation, which is a deeper and more long term approach than any current training available from any of the journal's reviewed, (2) self-monitor for fatigue, distraction, cognitive overload when evaluating manuscripts and composing feedback, and (3) mindfulness regarding self-presentation goals (i.e., ensure they are giving professional, politely toned, constructive feedback). Bornstein (2021) also recommends formalizing this training in doctoral programs so junior scholars enter the profession aware of how to give fair and useful reviews. That is, fair and useful peer review should be a "core competency" in doctoral programs and, thus, normalized in the academia.

8.5 | Triple blinding is a better option than double blinding

In reading the body of scholarship informing this paper's focus, there is a growing preponderance of evidence of social bias in the academic journal peer-review process. It was, therefore, encouraging that all six journals analyzed use a double-blind approach to their peer-review process. Double-blinding compared to single-blind and open-review, has several advantages including reducing bias and reviewer retention. However, use of double-blinding does not mitigate editorial bias as editors may look at the work from more established/prolific researchers, researchers from more prestigious institutions, and researchers with shared identities more favorably. Rosenthal (1982 as cited in Largent & Snodgrass, 2016) noted about his experience after moving to a more prestigious institution:

After I had been at Harvard a few years, most of those same articles were published in mainstream journals. My anecdote does not demonstrate that journal articles were biased against papers from UND and biased toward papers from Harvard. There are plausible rival hypotheses that cannot be ruled out. My belief, however, is that location status bias may well have played some role in the change in publishability of my stack of papers. (p. 235)

We, accordingly, urge each journal to explore whether such bias exists in their peer-review processes as the presence or absence of such bias and how they address them can level the science education research community for researchers who pursue equity-focused research or who have identities traditionally marginalized. Triple blinding may be one mechanism to support leveling the field as it further reduces editorial bias in the peer-review process.

We summarize the advantages and disadvantages of four forms of peer review from two recent systematic reviews of the journal peer-review process (Haffar et al., 2019; Largent & Snodgrass, 2016) and the Wiley publishing website (2021). Findings across the three sources are highly convergent with each other and much of the literature we have previously cited (Baker, 2002; Benos et al., 2007; Eisenhart, 2002; Hojat et al., 2003; Jana, 2019; Murray et al., 2015; Pinholster, 2016; Seeber & Bachelli, 2017; Walker et al., 2015). As summarized in Table 3, peer review typically has one of two approaches: open or blind. The open process reveals the identity of editors, authors, and reviewers to each other. It may also reveal reviewer names and comments and previous manuscript drafts alongside the published paper. Its primary drawback is lower reviewer retention compared to blinded forms of review.

Blinding conceals the identity of one or more people involved in the review process. Some researchers argue true blinding in any of the three forms we discuss cannot be guaranteed as studies have shown that reviewers can sometimes accurately guess the identity of an author. For instance, reviewers in research areas that are so small and who have the disciplinary expertise to review the manuscript can sometimes accurately guess the author (or authors) identity when they fail to fully remove all traces of their identity in a submitted manuscript. Wiley (2021) training recommends reviewers who think they have identified an author and

TABLE 3 Summary of advantages and disadvantages of four common approaches to peer review.

Approach	Description	Advantages	Disadvantages
Open	Author(s) and reviewers are revealed to each other Manuscript drafts and reviewer comments sometimes published with accepted paper	Increases civility, accountability, and quality in reviews Reviewer knowledge of author and affiliation can give reviewer insight into previous research of author(s)	Loss of reviewers who feel compelled to give negative reviews Fear of retaliation when junior scholars give senior scholars negative reviews Publication of drafts and comments can be cumbersome and slow in the publication process
Blind			
Single	Author(s) revealed to reviewers Reviewers not revealed to author	Retention of reviewers	Allows potential for geographic, institutional, sex, and prolificity biases
Double	Author(s) and reviewers are concealed from each other	Reduces authors' perception of reviewer bias in peer-review process. Likely increases retention of reviewers compared to an open review process as reviewers feel more comfortable providing negative feedback Increases trust in peer-review process	Results are mixed on whether it impacts quality of the review compared to open or single blind process. Reviewers may not be able to easily identify potential conflicts of interest Author(s) concealment is not guaranteed particularly for established authors
Triple	Author(s), editors, and reviewers concealed from each other	Reduces authors' perception of editorial and reviewer bias in peer-review process. Increases trust in peer-review process	Editors and reviewers may not be able to easily identify potential conflicts of interest Author(s) concealment is not guaranteed particularly for established authors

suspect a potential conflict of interest to communicate that they are unable to provide a fair review to editors.

Single-blinding conceals the identity of the reviewers to the author(s), but not the reviewers' identities to the author(s). Editor identity is revealed to both reviewers and authors and the identities of reviewers and authors are known to editors. Aside from retaining reviewers as they feel they have the freedom to give honest, constructive criticism to authors, a single blind approach seems to offer no other advantages to the peer-review process while evidence seems to consistently show it makes authors vulnerable to reviewer bias.

Double-blinding conceals the identity of reviewers to authors and vice versa. As with single blinding, editor identity is revealed to both reviewers and authors and the identities of reviewers and authors are known to editors. Though requiring some minimal additional effort by authors and editors to ensure a manuscript is blinded to reviewers, a double-blind approach does mitigate some of the bias observed when a single-blind approach is used.

Triple-blinding retains many of the features and all the benefits of a double-blind approach. The identities of the authors and reviewers, however, is blinded to the editor. Depending on resources, this approach may require some significant efforts on editorial staff to conceal identities to editors as many current journal submission systems presume editors want these identities known (Richardson, 2017). For example, editors match an anonymized manuscript to reviewers, fully and explicitly place the burden of identifying potential conflicts on reviewers when an invitation to review is made (a responsibility already mostly placed on reviewers in the open, single-blind, and double-blind review processes), and a managing editor enters an editor's postscreening decision about a manuscript within the system. That is, editors working with reviewers handle only anonymized manuscripts within the system (Richardson, 2017). Currently used by *Philosophy and Phenomenological Research*, *Ethics*, and *Molecular Cell*, triple blinding has the additional benefit of mitigating social bias that may occur in editorial decisions.

9 | CONCLUSIONS

Successfully navigating the journal peer review process is crucial to scholars from marginalized identities advancing their scholarship, securing tenure and/or promotion, and ultimately diversifying the fields they seek to innovate through their scholarship. There is a preponderance of evidence these scholars are more likely to face additional barriers in the journal peer review process than their more privileged colleagues. Science education journals are not immune to the disparities, inequities, and biases that create these additional barriers. Although it is commendable all six science education journals examined in this paper use a double-blind peer review process, only one (JRST) published a DEI statement on their official website and two others (CSSE and SE) explicitly signaled in their aims and scopes equity focused studies were welcomed. Additionally, only these latter two journals had at least a third of editors and editorial board members who had conducted equity-focused research.

None of the journals described how or whether they addressed unprofessional reviewer comments nor explicitly described offering authors a retaliation-free pathway to report their concerns about reviewer comments they perceived as unprofessional. When combined with evidence unprofessional comments disproportionately negatively impact scholars from marginalized communities, these findings indicate the science education community has significant work ahead to develop and maintain a fair peer review experience for all authors. We, thus, encourage the science education journal community to (i) systematically probe their peer-review process for diversity, equity, and bias, (ii) expand the diversity of journal editors and editorial board members as guided by their systematic probe, (iii) explicitly communicate being welcoming of equity focused research, and (iv) put in place transparent systems to address unprofessional reviewer comments. We also encourage members of the community who teach doctoral courses to explicitly train students to use the debiasing strategies proposed by Bornstein (2021) to provide fair, polite, and constructive feedback to all authors. Collectively, these actions can initiate the normalization of a journal peer review process focusing on the merits of diverse scholarships and de-emphasizes

the interactions among the identities of reviewers', editors', and authors' known to lead to social bias in the peer review process.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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