



Content Requirements for Chemical Education Research Manuscripts

(Revised December 2013)

Focus

The *Journal of Chemical Education* seeks reports of research pertaining to teaching and learning chemistry in high school, undergraduate, and graduate formal environments as well as informal settings. Although the *Journal* is situated in the United States and is co-published by the American Chemical Society, research contexts of an international or global nature are welcome. Appropriate areas of research include all of teaching and learning chemistry, including but not limited to, pedagogy, laboratory learning, conceptual change, assessment, achievement, field studies, technologies (broadly defined), and curriculum development.

It is expected that the focus and relevance of the manuscript will be situated in chemistry education. Thus, the hypotheses tested or questions posed should be significant and applicable to chemistry education. The best criteria of research are the novelty, impact, and influence of the findings. Authors need to help readers understand the results and findings of their research in terms of these three criteria.

Literature Background

Every chemical education research (CER) manuscript needs to situate its study in the appropriate research literature. It is expected that some of this background literature be from CER, but discussion of research from other discipline-based education research (DBER) fields, science education, cognitive science, or relevant fields is also appropriate, although the exact proportions are left up to the author. A well-written literature background reveals a clear mandate for the study presented in the manuscript. Driving the field forward will require building upon previously published findings and making explicit how this new work adds to our understandings. The results are useful to the field if and only if researchers and practitioners can understand how the current study is related to the research that has come before it. In the absence of an appropriate literature review, there will be little potential to understand how the current study fits into the larger body of knowledge that constitutes CER and allied DBER disciplines, and the paper will be returned without review.

Research Questions

In each study there are specific research questions, and within the manuscript the research questions need to be clearly stated and enumerated. The audience should not have to infer the research questions addressed by the study from the literature background. The research questions may or may not lend themselves to testable hypotheses. They may be questions pertaining to “how” and or “why”.

The research questions should have relevance beyond the local context of the author. Moreover, it is the author’s responsibility to demonstrate this relevance based on the background literature. Consideration of the potential impact and influence of the results should guide the development of appropriate and meaningful research questions. Reviewers will consider whether the questions asked and the findings generated impact research or practice and drive forward change.

Methods and Frameworks

The methods used in the study must be valid and appropriate to answer the research questions. CER is a field that uses both quantitative and qualitative research

methods because questions can be posed that require one or both approaches. Innovative research designs, methodologies, or theories that contribute to CER are welcome as long as the authors establish that they are valid and appropriate to the research questions.

Researchers use particular theoretical and methodological frameworks to inform their work. Discussion of these frameworks and why they are informative is very helpful to readers. Further, these frameworks should be used to guide the analysis of data and interpretation of results or findings.

The methods used to collect and analyze data must be clearly explained. This allows the work to be replicable and the methodology to be understood. The sample and the sampling process must be described. IRB approval (or [informed consent](#)) must be obtained for all studies involving human subjects and the manuscript should indicate that such approval was obtained. Data gathered with instruments intended to measure any aspect of students' thinking, attitudes, or skills (e.g., conceptual understanding, attitudes, or lab skills) within a population of students must be evaluated for evidence of reliability and validity. Just as it is important to regularly check calibration curves for instruments in a laboratory setting, it is important to provide reliability and validity evidence for data gathered with instruments for educational research. Whether researchers choose to develop new instruments or to use existing instruments, evidence of reliability and validity is required. As reliability and validity are functions of the data itself, not of the instrument, it is up to the researchers to gather evidence with their study population.

For qualitative studies it is important to report how the data are collected, to include protocols in either the manuscript or supporting information, and to describe how the data were coded, analyzed, and interpreted. Examples of coded data and the entire coding scheme (if of appropriate length) can be included in the manuscript or supporting information. In qualitative studies it should be clear how the frameworks used in the study inform the data collection and analysis.

Findings

The findings of the research must rest upon compelling evidence, logical reasoning, and analyses based upon the previously described frameworks that are made clear to readers. Claims made must be supported with appropriate evidence from the research. In explaining the results or findings, clear tables and figures help the reader understand the outcomes of the research and support the narrative text. If such tables and figures are included, they must be discussed in the text—tables and figures do not speak for themselves. If quantitative findings include statistical analyses, enough information should be presented (in the body of the manuscript or supporting information) such that the reader can evaluate results (e.g., factor loadings, normality). Determinations of statistical differences (p -values) should be combined with measures of effect size.

Limitations

Every study has limitations; they must be clearly stated within the manuscript. The findings of a particular study may have limited generalizability or applicability based upon design, sampling, subject population, or location of the study. Overstating of findings is inappropriate, and should be avoided.

Implications

Finally, a section on implications for research and for chemistry learning (e.g., teaching practice, curricular design, etc.) should be a part of each manuscript. If CER is to have an influence on chemistry learning and professional development of faculty, researchers must address the relevancy of their research to practitioners.

Specific Considerations for Chemical Education Research Manuscripts

Communicating Your Intent

For a manuscript to be considered and reviewed as CER, the cover letter must state that the manuscript is intended to be CER. In addition, the keywords must include “chemical education research” in the manuscript itself and be selected in ACS Paragon Plus during submission. Note that simply choosing the keyword “chemical education research” does not make a manuscript CER.

Choosing a Manuscript Type

Chemical education research is published in the *Journal of Chemical Education* using two different manuscript types, as outlined below.

Article

Most CER manuscripts are best suited to the article manuscript type. An article describes a novel educational idea or approach, content for the classroom or laboratory, pedagogical advance, or educational research. Articles can target specific constituencies (i.e., precollege, or introductory or advanced college students), address a specific content area, describe a new pedagogy or teaching method, or provide results from an innovation or a formal research project.

Communication

A few CER manuscripts are suited to the communication manuscript type, particularly those providing brief, yet important updates to previously published material. Communications often do not have the novelty of an article, yet may provide the latest data or examples. Manuscripts of this type are not intended as precursors to articles; they may supplement previously published work with useful information.

Preparing Manuscript Components

Title

Increase the impact of your manuscript by crafting an effective title. Consider briefly indicating the level or setting (particularly if it is not college or university, i.e., graduate school, or precollege, or a nonschool setting), as well as what was studied, emphasizing the significant aspects.

Keywords

For CER manuscripts, the keywords must include “chemical education research” as well as other applicable keywords that accurately characterize the manuscript and aid others’ searches. A list of acceptable keywords and their categories is available at <http://pubs.acs.org/page/jceda8/topics.html>. The keywords in the manuscript must be the same as those in ACS Paragon Plus.

References

Include citations in the References section to relevant works in the chemical education literature. As discussed in the Literature Background content guidelines earlier, incorporating citations from other discipline-based education research fields, science education, cognitive science, or relevant fields is also appropriate; authors can determine the exact proportions for the mix.

Provide complete facts of publication in references, including page ranges and article titles.

Supporting Information

Survey instruments, tables, graphics, test questions, analyses, software and media files are all publishable as supporting information. To support implications for teaching practice, classroom materials may also be included. Mention what the supporting

information is in the manuscript text, and include a telegraphically brief description of the supporting information at the end of the manuscript.

Tables

Reporting information in tables is often the most concise and effective approach to supporting a claim or providing more detail. Considerations for preparing tables in your manuscript are offered below. Further information about tables is available in the [Journal of Chemical Education Author Guidelines](#), and examples can also be found in [JCE articles online](#) and in print.

Table Titles

Tables need to be self-explanatory; that is, understandable independent of the text discussion. Include a descriptive title that in conjunction with the column headings will make the table self-explanatory and the entries clear to readers. Place details in column headings or table notes as appropriate rather than the title.

Column Headings in Tables

Each column must have a heading.

Provide the values for N and p in the column headings, when appropriate. Likewise, include other necessary parameters in column headings, referencing a table note for additional details as needed.

Table Notes

When necessary, add table notes to provide information needed to comprehend the data: for example, indicating the scale for the averages or the possible range of the exam grades or survey scores; and reporting significance levels, confidence intervals, or ranges associated with explanatory or statistical power (such as effect sizes).

Give each table note a letter designation and cite the note using a superscript lowercase letter, a–z, in left-to-right order (moving from column to column, not row to row).

Table Formatting

Tables are produced and published without internal lines or shading, and without setting some text in boldface or italic type in lieu of table notes. Rather than using boldface or italic type, please include table notes for explanations and literature citations.

Tables are published at widths equivalent to one column of a page, two columns of a page, or rotated and presented in landscape format. Large, lengthy, and excessively complicated tables are discouraged in the manuscript. Multipage, extremely wide, and very complex tables are best published as supporting information.

Incorporating an excessive number of tables in a manuscript is discouraged. Often, a few tables can represent data supporting the claims and arguments in the manuscript, with references to additional tables provided in the supporting information.

Textbox Formatting

In some instances, material initially imagined as a table might actually be better suited to presentation as a textbox. Material that can be presented simply in a single column, such as a list or a question or statement, could be presented as a box instead of a table.

Suggesting Reviewers

Manuscripts that meet the requirements for content and appropriateness are assigned to an associate editor, who sends the manuscript to three or more reviewers for evaluation. CER reviewers evaluate the manuscript's scholarship, novelty, pedagogy, utility, presentation, and importance to the field. Including suggested reviewers helps identify qualified reviewers with expertise in CER or the specific subdiscipline. For CER manuscripts with particularly sophisticated statistics or modeling, suggesting reviewers is especially helpful.

Checklists for Successful Drafting, Submission, and Review of a CER Manuscript

In finalizing the CER manuscript and its components, determine whether the following critical elements have been adequately addressed. Authors can increase the likelihood of a successful outcome of editorial and peer review by checking the manuscript for compliance with these CER content requirements. Manuscripts that do not comply with recommended characteristics or components (e.g., missing required content sections, excessive length, excessive figures and tables, poorly written English) are returned to the author; they can be reconsidered once requested changes are made.

Checklist 1. Content Requirements for a CER Manuscript

Addressed	Not Yet	Content Elements
<input type="checkbox"/>	<input type="checkbox"/>	The hypotheses tested or questions posed are significant and applicable to chemistry education.
<input type="checkbox"/>	<input type="checkbox"/>	The research is novel.
<input type="checkbox"/>	<input type="checkbox"/>	The impact and influence of the findings are likely to be significant and meaningful.
<input type="checkbox"/>	<input type="checkbox"/>	The manuscript includes an appropriate literature review.
<input type="checkbox"/>	<input type="checkbox"/>	The research questions are clearly stated and enumerated; they are relevant beyond the author.
<input type="checkbox"/>	<input type="checkbox"/>	The methods used in the study are valid and appropriate to answer the research questions.
<input type="checkbox"/>	<input type="checkbox"/>	The methods used to collect and analyze data are clearly explained.
<input type="checkbox"/>	<input type="checkbox"/>	The sample and the sampling process are described.
<input type="checkbox"/>	<input type="checkbox"/>	IRB approval (or informed consent) was obtained for all studies involving human subjects and the manuscript indicates that such approval was obtained.
<input type="checkbox"/>	<input type="checkbox"/>	Evidence is presented demonstrating the reliability and validity for data gathered with instruments intended to measure any students' thinking, attitudes, or skills within a population of students.
<input type="checkbox"/>	<input type="checkbox"/>	For qualitative studies, a description is provided to report how the data were collected; protocols are included in either the manuscript or the supporting information.
<input type="checkbox"/>	<input type="checkbox"/>	For qualitative studies a description is provided on how the data were coded, analyzed, and interpreted.
<input type="checkbox"/>	<input type="checkbox"/>	For qualitative studies examples of coded data and the entire coding scheme are included in either the manuscript (if of appropriate length) or in the supporting information.
<input type="checkbox"/>	<input type="checkbox"/>	For qualitative studies, a clear description explains how the frameworks used in the study inform the data collection and analysis.
<input type="checkbox"/>	<input type="checkbox"/>	The findings of the research derive from compelling evidence, logical reasoning, and analyses based upon the previously described frameworks that are made clear to the reader.
<input type="checkbox"/>	<input type="checkbox"/>	Claims are supported with appropriate evidence from the research.
<input type="checkbox"/>	<input type="checkbox"/>	Clear tables and figures help readers understand the outcomes of the research, and support the narrative text.
<input type="checkbox"/>	<input type="checkbox"/>	Every table and figure present is discussed in the text.
<input type="checkbox"/>	<input type="checkbox"/>	For quantitative findings that include statistical analyses, enough information is presented (in the manuscript or supporting information) so that readers can evaluate results (e.g., factor loadings, normality).
<input type="checkbox"/>	<input type="checkbox"/>	Determinations of statistical differences (p -values) are combined with measures of effect size.
<input type="checkbox"/>	<input type="checkbox"/>	Study limitations are clearly stated within the manuscript.
<input type="checkbox"/>	<input type="checkbox"/>	The findings are represented realistically; overstatements are avoided.
<input type="checkbox"/>	<input type="checkbox"/>	A section on implications for research and for chemistry learning is included that discusses potential influences on teaching practice, curricular design, etc.

Researching and writing a CER manuscript is a major endeavor. To avoid frustration during submission, the next stage in the publication process, consult Checklists 2 and 3 below for additional guidance.

Checklist 2. Required Manuscript File Components Needed before Electronic Submission

Required Manuscript File Components

- Title of the manuscript, written to effectively convey the significant aspects of the manuscript
- Author list with the name and affiliation of each author, indicating the corresponding author with an asterisk
- Email address for the corresponding author
- Abstract, including the main results and findings of the research
- Abstract graphic (strongly recommended, but not required)
- [JCE-specific keywords](#), including "chemical education research"
- Body of the manuscript (including a mention of the supporting information, if any)
- Figures, tables, boxes, equations, and schemes, if any (including their captions and titles)
- Description of supporting information, if any
- Acknowledgment, if any
- References, including citations to chemistry education and discipline-based education research literature

Checklist 3. Required Files for Submitting a CER Manuscript in ACS Paragon Plus

File Description	Notes	File Designations in ACS Paragon Plus
<input type="checkbox"/> Manuscript (required)	Include any tables and boxes in the manuscript text. Check to be sure that the manuscript file contains all the required components. (See Checklist 2, above.)	Manuscript File (Uploading a Manuscript PDF File is not necessary.)
<input type="checkbox"/> Graphics (optional)	Each figure, structure, and scheme, including the TOC/abstract graphic, must be provided in a separate file. Collect all of these various files into one folder, and compress it to produce one .zip file for uploading. Tables and boxes are needed in the manuscript file only, not in separate files.	Supporting Information for Review Only
<input type="checkbox"/> Supporting information (optional)	All material for publication as an online supplement to the manuscript.	Supporting Information for Publication
<input type="checkbox"/> Permissions and releases (as needed)	For greatest ease in uploading, combine all forms into one .pdf file, if possible.	Journal Publishing Agreement