# A Brief Guide to Researching and Writing for CSEE&T
## (Conference on Software Engineering Education and Training)

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## 1. Introduction

The Conference on Software Engineering Education and Training (CSEE&T) is an international peer-reviewed conference, sponsored by the IEEE Computer Society. This guide is intended to help you, as a researcher/writer, maximize your chances of having your paper accepted.

CSEE&T publishes papers in all areas related to software engineering education, training and professionalism. For links to information about previous CSEE&T conferences, see http://conferences.computer.org/cseet/

## 2. Criteria for acceptance of papers

Criteria used to judge submitted papers include:

**a) Relevance to the conference:** To be accepted for CSEE&T, a paper must address issues relating to software engineering education, training, or professionalism. Papers describing novel ways of teaching known software engineering techniques are welcome. Papers that introduce *novel* software engineering techniques are also welcome as long as they also deal with the teaching of those techniques.

As is suggested by the conference's name, topics relating to both college- and university-level software engineering *education* and industrial software engineering *training* are germane to CSEE&T. Both types of paper must adhere to the standards, described in these guidelines, that are typically associated with scientific papers.

In addition to pure software engineering education- or training-related topics, topics of interest include education and training in the mathematical, computer science, and engineering backgrounds required for the successful pursuit of software engineering. Papers may also relate to software engineering standards efforts, software engineering curriculum initiatives and similar themes as long as they discuss lessons learned from such initiatives. Finally papers may relate to software engineering professionalism, i.e., ethics, certification, licensing, etc.

Examples of topics of interest to CSEE&T attendees may be found in proceedings of previous CSEE&T conferences (see URL above.) as well as below.

**b) Originality and interest:** The paper must say something that will be of interest to attendees. The most interesting information should be highlighted in the abstract and introduction, and also summarized in the conclusions. You may automatically think what you have to say will be interesting because it is interesting to you, however, it may be less interesting than you expect if it is well known in the community, or merely a 'variation on a well-known theme'. Reading related literature will help you determine whether your ideas are 'fresh' or not.

You should explain to the reader why your research problem is important, and indicate what is entirely new and what is related to the prior art.

Note that replications of experiments done by others are automatically considered original and interesting, as long as other criteria in this document (such as appropriate methodology) are fulfilled. Replication of results, typically in slightly different contexts, is essential to the advancement of science since it builds confidence in truth of the results. Replication papers should highlight any differences in methodology from the previous research, and attempt to explain any differences in results.

**c) Focus:** The paper should have a consistent message. The reader should be able to mentally summarize the message in a sentence or two after finishing the paper. The focus should be evident in the abstract, introduction and conclusion. Everything in the body should also directly relate to the focus of the paper. Avoid trying to mix together too many different ideas, perhaps just to make your paper longer; two short papers may be better than one long one.

**d) Citation of appropriate references:** The paper must, as much as possible, build on the existing body of literature in computing education, software engineering and related fields. Authors must cite appropriate background material (particularly other refereed papers), and explain how the cited material relates to their work. Often, a background literature section can be included after the introduction, but this is not essential – a perfectly acceptable style is to cite references throughout the paper as ideas are introduced.

**e) Appropriate methodology:** If the paper is reporting on research, then the methods used in that research must follow well-understood best practices for research methodology. Whole books have been written about research methodology, so we will not describe all approaches here. We suggest the reader look at the work of Bouma [1] and Shaw [2] to learn more. Thoughts about certain methodologies commonly used in CSEE&T papers is found in Section 4, below.

**f) Convincing and objective evaluation of all claims:** It is critical to provide convincing evidence of the validity of each claim made in the paper. The first step in achieving this is to clearly state the research question you address and all the claims you make. Then:
If you are claiming to make an improvement, compare the original with the improvement.
If you are using an analysis technique, apply the analysis technique correctly

If a paper is reporting experimental data, then appropriate experimental design and statistical analysis should be used. If the paper is describing an innovative technique using a case study format, then the evidence expressed will not be as rigorous, but must nevertheless be convincing to the reader; it must not just appear to be the opinions of

authors. Often convincingness can be established by logical deduction from other well-accepted knowledge. Convincingness can be enhanced in some cases by appealing to the opinions of third parties: For example, quotes of survey results from students or other educators.

In all cases, threats to validity of conclusions must be expressed. Threats to validity can include the following: a) The conclusions might not generalize well (i.e. they may be specific to a given institution or subject matter); b) the conclusions might be based on too small a sample, or c) the conclusions may be based on a sample with various kinds of bias.

g) **Quality of writing, of tables and of figures:** We expect papers to be written in top quality English. To ensure this is the case, we strongly suggest that all authors ask someone to proof-read their paper before initial submission, and again after revision of accepted papers. Even though you get a chance to make changes to your paper after the review process, poor writing will significantly reduce the chances of initial acceptance. This is because pointing out writing problems wastes the time of reviewers, and also there is no formal mechanism to ensure that you in fact make the changes that might be suggested by reviewers. Tables and figures must also be of the highest quality, with descriptive captions. Each table of figure must convey useful information in a succinct way.

# 3. Key categories of CSEE&T papers

Papers can fall into several different categories. Some of these categories have their own guidelines described below. This list is not intended to be exclusive; we do accept papers that fall outside these categories. Bear in mind that different research questions will require different techniques, so your selection of technique should be carefully considered.

a) **Papers reporting on rigorous experiments:** These papers are particularly welcome since, if the experiments are done well, they contribute lasting knowledge to the field Such papers must describe the independent and dependent variables, the hypotheses and null hypotheses, the research subjects, the experimental methodology, the data analysis methods used, the conclusions drawn (with statistical significance), and the lessons that can be learned from the conclusions. When reporting on data analysis techniques, it is appropriate to use either basic or advanced statistics, but remember that readers will often only understand basic statistics, so any advanced techniques and their benefits must be briefly explained.

b) **Papers describing educational innovations without rigorous experimentation:** These papers are generally in the form of case studies, expressing the experience of an educator at teaching a certain topic, or applying a certain technique. Papers in this category should give readers enough information so they could apply the innovation themselves (i.e. they should be operational, not merely guidelines). Papers should also carefully motivate the advantages and disadvantages of the innovation as compared to alternative approaches. Descriptive statistics are often a valuable addition to such papers,

but authors should avoid trying to give the impression that they have done a formal experiment if in fact they have only done an informal experiment. Research normally progresses from qualitative and empirical understanding to precise and quantitative models, therefore if there have been many less formal studies on your topic, it might be time to move towards category a), above.

Examples of topics in this category include the following. Some of these can be subjected to formal experimentation, and become category a papers.

Structural models that permit formal analysis or automation of some technique.
Tool, notations or methods that embody a model or technique; for example innovations in computer-based-training or on-line courseware.
Structures or taxonomies for an educational problem area.
Solutions to application problems that suggest how to teach software engineering principles.
Interesting observations or, "war stories:, based on real-life experiences in the classroom.

c) **Papers describing other types of experiences:** Sometimes authors have learned many lessons from being involved in standards bodies, accreditation agencies, or doing other tasks. Acceptable papers can be written to describe these experiences as long as they are not merely 'news reports'. Such papers will often summarize the experience, and then describe 'war stories', decisions made (with rationale), disagreements (with the opinions of both sides expressed), etc.

# 4. Thoughts about specific issues

**Surveys:** It is often appropriate to conduct surveys. However, beginners often make serious mistakes in the design of questions, rendering the results less valuable. For example, one of the most important guidelines for any survey is to conduct a pilot study first. This will help detect if any of the questions are ambiguous, difficult for respondents to understand, etc. Care should also be taken to ensure that each question has only one, unambiguous interpretation.

**Research Ethics:** Each country, state, or institution has guidelines for research involving human subjects. However, not all software engineering researchers realize that they need to adhere to these guidelines. It is important therefore to inform yourself of the guidelines that apply to you. For example, in Canada, researchers must adhere to the Tri-Council Guidelines [3]. University-based researchers following these guidelines must have their research plans approved in advance by a Research Ethics Board.

Software engineering education research is almost always very low risk, nevertheless one is consuming the time of students or other human subjects, and in some cases the research methodology will result in changes, perhaps adverse, to the grades and learning of students. It is important as a minimum, therefore, a) to establish that the benefits of the research will outweigh the risks, however small; b) to ensure that all participants give informed consent; and c) to ensure participants have the option of declining at any stage from continuing participation. In order to remind others if this issue, it would be useful to mention in any paper that ethical approval was obtained.

**Classroom-based research:** It has been a long-standing practice to conduct educational studies in the classroom. One of the simplest techniques for this is to teach using a new technique and record detailed observations of its effects, preferably with the addition of a detailed survey of students. However, more controlled studies are preferable: The typical approach is to teach two sections of a course or laboratory using two different techniques and then measure various dependent variables, such as students' abilities to do tasks, their grades, their subjective responses to a survey, or the resulting software quality. The different techniques can be used in concurrent sections of the same course, or from one year to the next.

Classroom based empirical research can be used not only to measure the effects of educational techniques, but also *software engineering* techniques. Both run the gamut from individual case studies on one end to controlled experiments on the other [4,5,6,7,8]. A recent paper [9] by Shull, makes the point that some empirical studies require quantitative data while others require qualitative data, and that some require professional software developers as experimental subjects while others produce significant results with software engineering students as subjects.

Classroom studies of the software engineering techniques can be published in many types of software engineering conferences or journals, whereas CSEE&T is most appropriate for studies of educational techniques. CSEE&T will, however, consider the former as long as educational issues are highlighted. Some of the educational issues include the benefits of exposing students to particular research methods, and the benefits of having students feel they are "on the cutting edge" by participating in the research.

## 5. Conclusions

When preparing your submission to CSEE&T, you can use the following checklist:

Is the paper on a topic that is of interest to the conference?
Have you stated your problem and research question clearly?
Have you explained why the problem matters, and what is original about what you are doing?
Have you used an appropriate study technique (e.g. experiment vs. case study)?
Do you have solid evidence convincing the reader to believe your results?
Have threats to validity been addressed?
Have you stated all your claims clearly?
Have you validated your claims appropriately?
Have you cited appropriate background literature, and formatted your references correctly?
Have you ensured that the paper's focus remains clear?
Have you ensured that the interest-level of the paper is high throughout, and that the most important points are emphasized in the abstract, introduction and conclusion?
Has the paper been proofread so that it uses top quality English, that is well-structured and grammatically correct?

## References

[1] Bouma, G., *The Research Process*, Fourth Edition, Oxford University Press. 2000.

[2] Shaw, M. "Mini-tutorial: Writing Good Software Engineering Research Papers", proc. *ICSE, 2003*, pp. 726-736

[3] Interagency Advisory Council on Research Ethics, *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans*, http://www.pre.ethics.gc.ca/english/policystatement/policystatement.cfm

[4] Rombach, H.D., Basili, V.R., and Selby, R., "Experimental Software Engineering Issues: Critical Assessment and Future Directives", *Proceedings of Dagstuhl-Workshop*, September 1992, published by Springer-Verlag, #706, *Lecture Notes in Computer Software*, August 1993.

[5] Basili, V.R., Selby, R. and Hutchens, D., "Experimentation in Software Engineering", *IEEE Transactions on Software Engineering* (invited paper), July 1986.

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[8] Boehm, B., *Software Engineering Economics*, Prentice Hall, 1981.

[9] Shull, F. et. al., "Replicating Software Engineering Experiments: Addressing the Tacit Knowledge Problem", *Proceedings of the First International Symposium on Empirical Software Engineering*, 2003