Publishing Scholarly Practice in Engineering Education: Importance and Systematic Writing Tips

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Abstract

Scholarly practice articles in engineering education can be published in various places such as conference proceedings and numerous reputable journals. These articles contain descriptions of scholarly innovations in engineering education, such as in teaching and learning, curriculum development and implementation, as well assessment. Publishing this type of articles brings many benefits for the authors, institutions of higher learning and the readers, especially towards enculturation of quality and excellence in engineering education. In this paper, a systematic five-step process of writing, and structure of a scholarly practice article are explained to guide educators in publishing these papers.

Introduction

Scholarly practice papers on teaching and learning have wide acceptance worldwide. These papers contain descriptions on innovations in teaching and learning that is implemented in the classrooms or curricula, that are designed based on strong principles. Translating these principles into high quality implementations can be classified under Boyer's Scholarship of Application and/or Scholarship of Integration (Boyer, 1990). A well-written paper with proper assessment significant contribution can normally be accepted for presentation in conferences with indexed proceedings or book chapters. These innovations can also be coupled with action research. In some cases, the innovations can later lead to ideas and execution of rigorous education research, contributing to new knowledge, bringing the study into Boyer's Scholarship of Discovery (Boyer, 1990).

In engineering education, good scholarly practice articles that can illustrate significant innovations with proper underlying principles and design, and can be generalized across disciplines, can be published in indexed journals, even those in quartile 1 and 2. Examples of reputable journals in engineering education that publish scholarly practice articles include the IEEE Transactions on Education, the IChemE Journal Education for Chemical Engineers and the ASEE's Advances in Engineering Education. Just like research papers, scholarly practice publications sent to reputable avenues will undergo peer reviews. In engineering education, the quality, impact and contribution of the innovation will determine where the article can be accepted for publication. In this article, I will explain the benefits of writing, how to start, and parts of, a scholarly practice article, aimed at academics from science, engineering or other technical based disciplines, who are implementing innovations in their classes or curricula in general.

Why Write Scholarly Practice Articles

There are many benefits in writing a scholarly practice article. Apart from the obvious fulfilment of publication requirement in academia, writing a scholarly innovation implementation has far reaching benefits for both the authors, institutions and the readers or general community. Good teaching and innovative implementations should not be confined within the four walls of a classroom. These activities can be just as complex and impactful as the activities under the Scholarship of Discovery.

Authors tend to gain benefit on values, understanding and skill in teaching and learning. Writing will help authors to become reflective practitioners – it will lead us to reflect on our practice and explore related articles and theories. Deeper understanding gained will allow self-scrutiny of the practice, which will help improve future implementation. Feedback obtained from reviewers will also help to critically examine and improve, not only the writing, but also the implementation and assessment. Writing allows dissemination of the innovation to others who are interested, which provide opportunities for authors to connect with communities of practice. This will further provide authors with the opportunity to learn, develop expertise and contribute beyond own institutions, providing a wider horizon and views that can be used locally. Being part of a community can also motivate and energize authors to stay committed and sustain the practice, even when the local community is small or non-existent.

Beyond contributing to increasing the number of publications, scholarly practice articles can benefit the authors' institutions in many ways. Among them are having documentation that can be utilised to encourage, improve and train other academic staff within the institution, gaining detailed evidence of innovative practices, as well as getting recognition for the innovation implemented in the institution.

Recognizing the contribution of the authors can spark teaching excellence among academic staff institution-wide, resulting in high quality graduates (Biggs, 2001). Some institutions of higher learning identified by innovative teaching and learning become reference points for others to visit, learn and benchmark because of their well-written and recognized innovations.

Readers of scholarly practice articles can gain ideas and inspiration for implementation. Comparison can also be made in the practice and assessment. In addition to improving practice, these articles may also inspire readers to write and share their own innovations, creating additional knowledge and information on innovative practices that can help spur a culture of excellence in teaching in specific higher education disciplines. These types of articles are necessary in higher education because those who teach in these specific disciplines will be the best to understand the subject matter and the requirements of the field to better educate and develop future graduates.

How to Write Scholarly Practice Papers

Figure 1 shows the flow that I suggest on writing scholarly practice papers meaningfully. Similar to conducting research, academics should determine the problem background first and to then focus on a specific problem. For example, on students' difficulty in learning certain concepts or developing certain skills, not only in one's own class but also in others, that need to be improved. Then, search for literature on what others are doing on similar problems. While reading the literature, identify education principles and approaches that others are using. This will prevent us from reinventing the wheel and act as a springboard in deciding how to best overcome the problem. Once a suitable principle has been determined, design the instruction, approach and activities to be done in class based on the selected principle. Assessment should be made to see the impact on the innovations made. Deciding what to assess must be guided by the problem determined earlier - is the innovation helping to solve the problem?

If the steps in the diagram were followed, the writing part will logically fall into place. Of course, there are other approaches, but this is among the easiest. One of the most difficult, but unfortunately typical approach, is to innovate, collect data or use existing ones, and then try to do reverse engineering to find a theory that can fit, or a purpose or problem that makes sense. Although this may be doable, these types of papers are normally acceptable for conferences only. Identifying a principle after the implementation will normally lead to ill-fitting and mismatch in the detailed design and implementation. Nevertheless, for academics who want to learn and meet the community at good engineering education focused conferences, at least it's a start. So, go ahead and write!

Structure of a Scholarly Practice Paper

A scholarly experience paper has similarities to a research paper, but there are differences because they are obviously not research papers with research methodologies. This type of paper has a design, plan and implementation section to describe the application of the principles in the innovation, such as intervention made on instructions, curricula, changes on an academic process, etc., instead of a section on research methodology. This is a very important section that determines the contribution and significance of the paper.

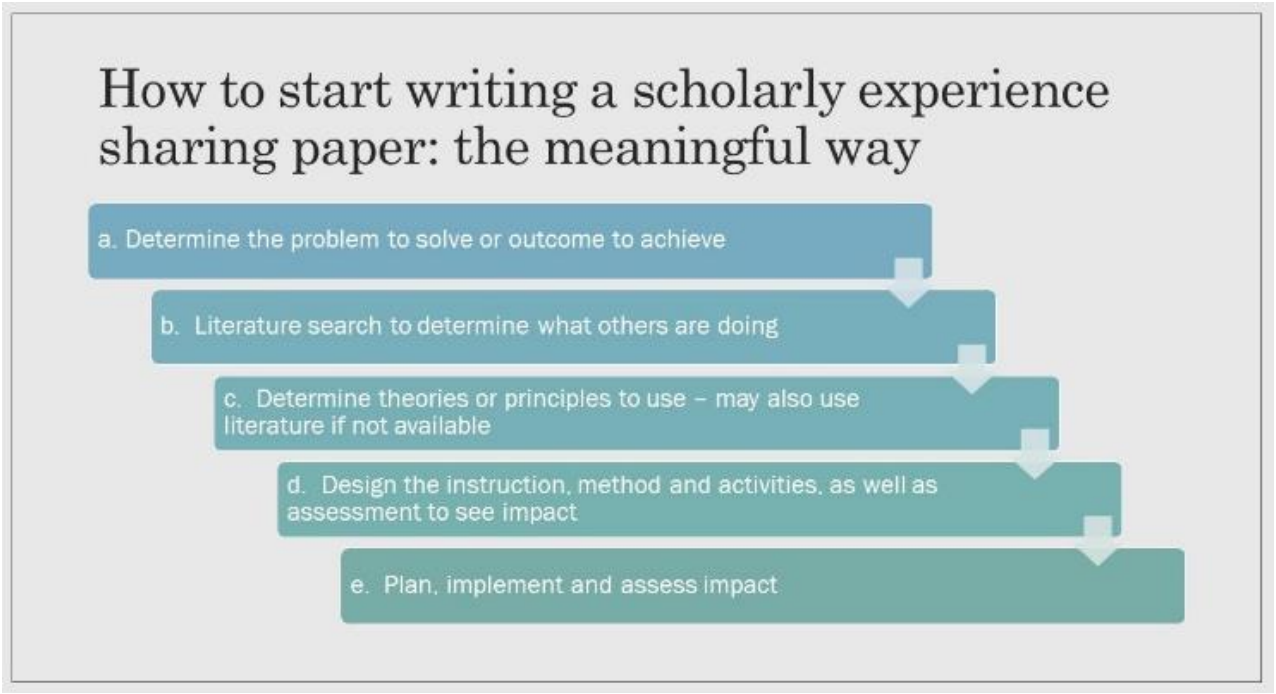

Figure 1. Steps in writing a scholarly practice article.

In the **Introduction**, just like in a research paper, we need to provide the context and the problem background before focusing on one or two aspects of the problem. This part is simple if the problem has already been defined during the instructional design stage as explained in the previous section. It is a matter of writing about the problem and the importance of putting effort to overcome it for others to understand. An example could be the difficulty of students to understand and learn at a deeper level certain challenging concepts in a course. This can also include what others say about learning the concept – are there other publications that talk about this problem? The importance of understanding the concept at a deep level can also be discussed, and the consequences of not having a strong understanding of it. Having references, especially strong ones, would be good to support statements to set the stage for the problem and the specific objective that will be focused on.

The **Literature Review** may contain more detail about the problem and what others have done to overcome it. Again, as explained in the previous section, this part is made easier if the authors had conducted even a brief review to help them in the design and implementation stage. A critical review that analyse the relevant literature would be the best. However, as a start, simple comparison and contrast would suffice. The review could be variations related to related concepts, as well as what others have done using the approaches considered to overcome similar problems. In addition to analysing activities and how they are implemented, education principles that underpin how the instruction or learning activities are designed should be scrutinized. Knowing the principles help others understand the design basis and implementation that was conducted by the authors. How others use the approach that was used and the variations in application is good to include. Lastly, the literature review should also show the gap in knowledge (especially on translating theory to practice) and on implementation aspects in different settings, which can be part of the significance of the paper.

Writing the **Design and Implementation** section is straight forward if what was implemented had been thought out in terms of design based on strong principles, concepts or the literature (this is when a suitable principle cannot be found). Explain the design based on the principle, and how the activities are planned and executed. Provide justifications, which can be easily done with the underlying principles being used. Systematically describe the planning in terms of the overall view towards achieving the outcomes, and the detailed activities that support the attainment of outcomes. It is important to write from the perspective of the readers – someone who might want to try implement what is written. Thus, any illustrations or diagrams on the flow or timeline of the design and plan of implementation will be helpful for readers to have an overall picture that can connect their understanding with the detailed description.

The **Findings and Discussion** section should elaborate assessments made to see the impact of the intervention in alleviating the problem described earlier. Assessments should measure aspects related to the problem, such as students' marks to show effective learning of concepts. Did the intervention work? At times, the findings might not be straightforward. Although we can use written examination scores to show the impact of the innovation, some intervention may not really improve students' scores even though students may have deeper appreciation and understanding of the subject matter. In this case, a qualitative feedback or reflection may also be used as additional assessment. A good discussion should not only consider and make sense of the findings in relation to the design and implementation, it should also compare if what was found is in accordance with the principles and findings of others in the literature. Comparisons can be made to see if similar findings or something different were found, and provide explanations based on the comparison.

The **Conclusion and Implication** section draw out important findings that answers the "so what?" or the "so what does this mean?" questions based on the initial problem. The purpose is to point out exactly what was accomplished and its significance, without over-claiming or exaggerating, keeping in mind the conditions under which the intervention was made. The implication resulting from the implementation can also be written to provide insights or guidance for others interested in exploring the same option in their courses or programs of study. In addition, discuss if the approach can be generalized, and applied to other classes, courses or even other fields. What should be kept, and what should be adjusted to get similar outcomes?

Example Articles

Ismail, I. et al (2020) published an example of a scholarly practice article in a peer-reviewed indexed conference proceeding highlighting the innovation in a Digital Systems course for second year undergraduate electrical engineering students. The authors identified the problem in the course based on students' feedback and the literature, which supported that the concepts in the course were deemed to be difficult to learn and understand, resulting in low attainment of the course learning outcomes. To overcome the problems, Constructive Alignment (Biggs, 1996) was used as the underpinning principle. Based on this principle, innovation was made through the implementation of informal cooperative learning during class time, in parallel with a hands-on project to configure and program logic blocks using a low-cost kit. Students were given guided milestones throughout the project to scaffold their learning. The design and implementation of the course is described in detail in the article. To assess the impact of the innovation, the authors chose to directly assess the attainment of the course outcomes. Compared to the previous

semester's results, the implementation of active learning and hands-on project increased students' attainment of the course learning outcomes.

Sadikin, A. N. et al (2019) published an example of a scholarly practice article in a peer-reviewed indexed journal describing an introductory engineering course for first year students. The authors put forth the importance of this types courses to help students understand and motivate students to pursue engineering as a career whilst providing a review of the various forms from universities all over the world, supporting the importance of such courses. The article describes the detailed design and implementation of the Introduction to Engineering course for first year chemical engineering students. In addition to helping students learn about engineering, the authors highlighted that the course is unique in its aim to support students "to bridge the gap between learning in school and learning to be an engineer". To achieve the aims of the course, the How People Learn (HPL) framework (Bransford, et al., 2004) and Constructive Alignment (Biggs, 1996; Biggs and Tang, 2007) were used as the underpinning principles for the design of the course. The impact of the course was assessed through an exploratory study using qualitative data collected from students' learning and reflection journals, made four times as the semester progressed. The data was analysed systematically using thematic analysis, revealing that students were able to understand and appreciate engineering and reached the aim of the course to prepare and motivate them to learn engineering in the university.

Mohd-Yusof, K. et al (2011) published a scholarly practice article in a peer-reviewed indexed journal describing the Cooperative Problem-Based Learning (CPBL) framework for implementing problem-based learning in a typical class. The authors asserted that while the small-group medical-school model of problem-based learning (PBL) is powerful for learning, it is difficult to implement in a typical classroom. The article describes the detailed design and implementation of the CPBL framework, which support the implementation of small groups of three to five students in a medium-sized (up to 60 students) classroom with a floating facilitator. To guide effective learning and proper team functioning, Cooperative Learning principles (Johnson, Johnson and Smith, 2006; Felder and Brent, 2007) were infused into the PBL model (Tan, 2003), resulting in the CPBL framework. To illustrate the effectiveness of the framework, a sample implementation in a third-year chemical engineering course was described. Students' feedback as well as marks for assessment of coursework and final examination were given as evidence of student achievement in undergoing CPBL throughout the semester.

Conclusions

This article aims to unravel basic parts of a scholarly practice paper. This is of course, not the only way to write this type of paper, but since most academics are familiar with research papers, the structure explained here is among the easiest form for many to grasp. But if you have other ways of writing that is effective, then go ahead and use it! The most important thing is to write with a systematic flow so that readers can understand what we have done, how it was done and why we did it. Most importantly, it is essential to understand the need to write as part of enculturation of quality teaching and learning in institutions of higher education.

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