

Science/education portraits II: Pre-tertiary and undergraduate research mentors should consider publication as project endpoint

Abstract

Scholarly publication is a common productivity metric for researchers of all levels. Despite the benefits of publications to pre-undergraduate and undergraduate research students, they tend to be less productive in terms of publication counts than graduate research students. Here, I narrate my personal experiences as an attempt to try to convince fellow pre-tertiary and undergraduate research mentors to consider publications as a suitable endpoint for any research projects, as they can have lasting mutual benefits to the student / mentee, and project mentors.

Keywords: research projects, publications, mutual benefits, project closure, computing

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Introduction

Research experience is an important component of science education due to its many benefits¹⁻⁴ from the perspective of the student or mentee; including better understanding of research process,⁵ increased motivation⁶ and active learning,⁷ higher cumulative grade point averages,⁸ and a platform for developing analytical skills and a deeper understanding of theoretical principles⁹ and context.¹⁰ Besides the mentee, mentors had also reported substantial benefits,^{11,12} which has been supported by my own experiences.¹³ One of the mutually beneficial research outcomes is in the form of research publications. Although it can be challenging to quantify overall research productivity in terms of publications from graduate and undergraduate research separately, it can be generally safe to expect lower publication counts from undergraduate research compared to graduate research. A survey study by Morales et al.¹⁴ on 536 faculty members showed that 39% of undergraduate research students mentored in the preceding 5 years did not publish while a survey study by Hall et al.¹⁵ on 280 graduate students showed that 13.6% did not publish. It can then be plausible to conceive that pre-undergraduate/pre-tertiary research students are less likely to publish compared to undergraduate students. However, it had been shown that scholarly publications helps students / mentees in significant ways;¹⁴ including compete more successfully as applicants to graduate school,¹⁶ and more successful research careers.¹⁷

In this article, I narrate my personal experiences as an attempt to try to convince fellow pre-tertiary and undergraduate research mentors to consider publications as a suitable endpoint for any research projects. A successful scholarly publication signifies a strong recognition of the mentees' work and can be viewed by the mentees as an acceptance or rite of passage into the scientific research world.¹⁸ Personal narration, sometimes also known as storytelling,¹⁹ is autobiographic in nature with rich emotional and contextual cues²⁰ that are required to describe the human experience.²¹ Thus, personal narration puts the human into the story.^{22,23} Personal narration also overlaps with participatory action research where reflective self-inquiry is carried out with the intention to improve subsequent actions.²⁴⁻²⁶

Fighting for my doctoral scholarships

In many fields of science, one of the main highlights of an early scientist's career is acceptance into a doctoral program and the subsequent convocation or commencement of a doctoral degree, commonly known as a PhD. Gannon²⁷ argues that a PhD is "an award to an expert who has proven their scientific worth" and such "scientific worth" usually takes the form of novel research, which is evident by scientific authorship in peer-reviewed publications. This led to the question by Hagen²⁸ – *how many papers does it take to make a PhD?* By evaluating more than 400 PhD dissertations, Hagen²⁸ estimated a baseline of 1.6 publications per dissertation. Hence, it can be safely assumed that critical hurdle for a PhD award is a successful publication. This has led to a notable shift towards PhD by prior publications, which is the usual route for a higher doctorate (such as, Doctor of Science). PhD by prior publications is where the author or prospective PhD awardee must make a coherent, original, and meaningful contribution to a field of knowledge.²⁹ Hence, it can be safe to assume that the potential for applicants to graduate research programs; such as, a doctoral program; should demonstrate research and authoring abilities. As such, it is plausible to conceive that prior publications under the belt of the applicant will be viewed favourably.

This was the case with my own doctoral application to The University of Melbourne, Australia, in 2004. As I did my undergraduate and honours project in the same university, there was a scoring scheme, known as PhD entry score (PES), in which applicants were scored for scholarship placements. PES comprised of one-third honours entry score (HES) and two-thirds of honours year result. The third year in the Bachelor of Science comprised of 8 subjects (4 subjects per semester), and HES is calculated as the average of the top 7 subjects out of 8 subjects in the third year. Peer-reviewed publications were added on as bonus points to PES, at the rate of 2 points per publication, up to the maximum of 2 publications. With these numbers, I can calculate the value and impact of a peer-reviewed publication to my PES. One publication is equivalent to 2 bonus PES points, which is then equivalent to 6 HES points. Since HES is the average of 7 third year subjects, 6 HES points can be equivalent to 42 marks in third year subjects. Therefore, a peer-reviewed publication during graduate application during my time could be valued at nearly

half of a third-year subject.

Although my case may be isolated, it does illustrate the potential impact of scholarly / peer-reviewed publications in the successful application to a graduate program.¹⁶ I was lucky to have presented my first publication on a project, which I did as partial fulfillment to the Advanced Diploma in Computing, in the inaugural Australian Undergraduate Students' Computing Conference (a peer-reviewed undergraduate conference); hence, able to claim 2 bonus PES points. If I had known of this way before my graduate application, I might be more diligent in my other research projects on hindsight. This experience made an impact on me.

Mutual benefits from publishing pre-undergraduate research

Due to my experience in fighting for my own doctoral scholarship and witnessing first-hand the value and impact of publications, I made a conscious decision to make publication as an endpoint during my subsequent years as a lecturer and project mentor. Over the 7 years (2009-2015), I had supervised 6 pre-university research projects, which generated 19 peer-reviewed publications as previously described.¹³ I do not side-step the fact that these publications contributed substantially to my career advancement and research goals. Yet, I do say that an equally important motive to publish pre-university research projects is to accumulate credentials and build their portfolio for their future use; even though at that point in time, I am not entirely sure if my determination to push for publications, whenever possible, is a right choice.

The following case strengthened my convictions. I had a student whom did his final year project with me in his pursuit of a Diploma in Biotechnology, in Singapore. However, this student had examination phobia due to his previous experiences and was constantly unable to do well despite being capable in other technical skills. Nevertheless, his grades put him at disadvantage when he was applying for admission into an arts degree in an Australian university. He had considered that science is his interest but not suitable as his career and I respected his decision. If I recalled correctly, his grade-point average (GPA) is nearly 0.5 lower than entry requirement into his university of choice. By then, his final year project had been published in a peer-reviewed journal (for anonymity, I am not able to cite this publication). He had contacted me for advice during his application and I suggested that he should make copies of his published paper to append to his university application. He was accepted and had since completed his Bachelor of Arts from a university within the top 100 of Times Higher Education World University Rankings. I believe that his peer-reviewed publication helped to grant him admission into the university. This is supported by another of my ex-student's recount,¹⁸ "Looking back, I think the series of papers we wrote with Maurice was certainly a great boon to my CV, and contributed to me getting into medical school."

Steve Jobs once said, "You can't connect the dots looking forward; you can only connect them looking backwards. So you have to trust that the dots will somehow connect in your future. You have to trust in something – your gut, destiny, life, karma, whatever. This approach has never let me down, and it has made all the difference in my life." This struck a chord in me – other than basing on my own experience with my own scholarship, I did not have other circumstantial evidence to triangulate^{30,31} the value or impact of publications to pre-undergraduate project students despite that being a logical conclusion.

Hence, I trust my own experience to forge ahead. With an ex-student evidently benefiting from having a peer-reviewed publication under his name and another ex-student's testament, I do have enough evidence for triangulation^{30,31} suggesting the value of publications to research students at the pre-undergraduate level.

Conclusion

The second habit in Stephen Covey's *The 7 Habits of Highly Effective People*³² is "Begin with the End in Mind". It is common for any academic research at the graduate level to have an end goal in mind, which is usually in the form of at least a peer-reviewed publication. My personal experience suggests that this objective should not be sole privilege of graduate research. As research mentors, we should consider peer-reviewed publication(s) as an aim in any academic research projects of all levels; graduate, undergraduate, and even pre-undergraduate. I hope that my experience is convincing enough for such consideration whenever possible – a peer-reviewed publication is a nice conclusion to an academic research project.

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Conflict of interest

The author declares no conflict of interest.

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