

Chapter 7. The Learner-Teacher Portfolio Journey: Developing Self-Efficacy and Self-Determination in the Medical Sciences

Patsie Polly

UNIVERSITY OF NEW SOUTH WALES

Kathryn Coleman

UNIVERSITY OF MELBOURNE

Thomas Fath

MACQUARIE UNIVERSITY

Thuan Thai

UNIVERSITY OF NOTRE DAME AUSTRALIA

Jia-Lin Yang

UNIVERSITY OF NEW SOUTH WALES

The integration of learning and learner-centered tools such as an ePortfolio requires modeling and *scaffolding of folio thinking* to support *reflection, metacognition*, and digital literacy in order to develop skills and experience in reflective practice, career awareness, knowledge of graduate employability, and professional identity (see Sanborn & Ramirez, this collection). We have found through a number of studies that ePortfolios can assist learners in higher education to reflect upon the evidence of their claims to learning and demonstrate the development of skills that are life-long and life-wide. Anecdotal feedback from academic staff and students in this program suggested that high academic student performance did not always correlate with a strong understanding of professional skills development, career capability, and graduate employability. Career awareness and employability building were needed in tandem with disciplinary knowledge for assurance of graduate employability. Therefore, an *outcome-based design* was implemented in various Undergraduate Medical Science courses, where pathology, medical research practice-specific knowledge, and career development learning (CDL) were established (see Dellinger & Hanger, this collection). Importantly, reflection and CDL were integrated into the ePortfolio pedagogy. Through this unique approach, an “apprenticeship”-style professional knowledge and skills and career intervention were delivered, recorded, and reflected in a learning-centered ePortfolio. At the end of the program, the students were significantly more confident with career-associated

self-efficacy and demonstrated autonomy (see Sanborn & Ramirez, this collection). Teachers also experienced a greater sense of student engagement with *assessment* and reflection on skills building as well as more meaningful professional development. This chapter explores this learner-teacher ePortfolio journey and the role that creative thinking, teaching, and collaboration have played in developing self-efficacy and self-determination in the Medical Science degree program (BMedSc) at the University of New South Wales (UNSW), Sydney (Australia).

Reflections on Our Learner-Teacher Journey

Our team is an interesting one. We are an inter- and multi-disciplinary team of educators, researchers, and academics who place the learner at the heart of our learning and teaching design. As a professional learning community, we once found ourselves working closely together, navigating new pathways of portfolio practice for our students and ourselves. We have now developed these practices that grew from this early work (explored in this chapter) in new species and sites with new students and teaching teams. This reflective practice chapter captures a moment in time, as we paused to reflect on what we had learned and achieved. Our learner-teacher connection and collaboration began many years ago as we embarked on this journey together to develop and design new learning approaches for Medical Science students at UNSW Sydney. To do this, we iteratively designed an ePortfolio curriculum that developed reflection, identity, and digital literacy through folio thinking and the lens of the professional scientist (see Day, this collection). These skills and practices were developed across the program, transferable across program assessment and key employability capabilities. Our work was and has since been based on developing folio thinking through ongoing critical reflection (Allen & Coleman, 2011) and developing habits of mind (Costa & Kallick, 2009) in our learners as they progress through their learning journey.

This chapter is its own reflection, a space to practice what we have been teaching. A reflection on our learning journey as a multi-disciplinary team, designing a learner-centered curriculum and developing ePortfolio pedagogy that is now a cross- and inter-disciplinary active research space at UNSW Sydney. Here, we reflect on our academic and researcher journeys through published and chronicled papers that serve as milestones in our process, and how we have continued to ideate and design together despite such varied backgrounds through a commitment to both teaching and learning. In this chapter, we describe an important point in our practice at UNSW Sydney as a result of that body of work—to align assessments in the BMedSc program with graduate capabilities. In particular, this chapter explores standards-based criteria (UNSW¹) and its relationship to folio thinking to

1. UNSW Standard-based assessment: *Standards-based* assessment depends on a set of predefined statements outlining different levels or standards of achievement in a program, course, or assessment component, and normally expressed in terms of the stated

explicitly teach and assess teamwork capabilities as well as our approach to aligning assessment tasks across a program that facilitate teamwork skills development over time. We also document the student and staff experience and describe our approach to facilitating skills and capability in capstone courses that build on skills such as teamwork and research practice. These courses continue to introduce and support work-integrated learning (WIL) (see Day, this collection), and integrative and experiential learning for undergraduates in the sciences.

What Is an ePortfolio at UNSW?

ePortfolio use and implementation in the Medical Sciences at UNSW has been a mechanism for supporting development of reflective practice on skills building and capabilities acquisition since 2012. Reflective practice in this sense, is the ability to reflect upon practice as a science professional in an iterative, ongoing, and systematic way. Developing this action takes time and needs to be *scaffolded* and modelled within *authentic* experiences. Reflective practice is an essential component of responsible professional practice (Coleman & Flood, 2016). Teaching reflective practice embedded within academic courses has been the co-curricular method of developing professional skills through an aligned and *backward designed* curriculum, supported by authentic curricular assessment. This integrated system of learning design and teaching has enabled students to develop their professional identities as medical scientists while developing the necessary skills and capabilities to provide evidence as graduates of this program of their leadership, scholarship, global citizenship, and professionalism (UNSW Sydney 2011, 2016).

In the School of Medical Sciences (SoMS) at UNSW, our pilot study implemented ePortfolio use as an educational tool for promoting student learning through reflective practice in a third-year undergraduate pathology course. We found that ePortfolios were an effective way to support student learning outcomes that aligned with the UNSW graduate attributes (Polly, Thai et al., 2013). Program-wide implementation and longitudinal use of ePortfolio has previously been suggested to facilitate learning, attainment of graduate attributes, employability skills, and professional competencies, as well as life-long learning (Clarke et al., 2009; Hallam et al., 2008; Polly, Thai et al., 2013). Since this initial trial, we have implemented ePortfolio pedagogy across other science courses in a four-year degree program curriculum as well as across various disciplines within SoMS at UNSW.

In 2013, our collaborative paper on use of ePortfolio in the sciences to support reflection of skills development in research communication discussed folio thinking and began to define an ePortfolio for our context and purpose (Polly, Thai et al., 2013). The definition of an electronic portfolio as “a digitized collection of artifacts including demonstrations, resources, and accomplishments that represent an individual, group, or institution” (Lorenzo & Ittelson, 2005, p.1) was

developed as part of our practice as a professional learning community. We were keen to explore what a digital repository for a range of learning and teaching materials—including those produced for course-based assessment such as videos, images, and text-based reflections—might look like for learners at different year levels. Our platform at that time was Mahara ePortfolio in Moodle. Taking the Lorenzo and Ittelson (2005) definition further, we developed our assessment tasks to integrate ePortfolio pedagogy and practice on the notion that an ePortfolio is a personal digital space, a student-centric monitor of learning across disciplines that enables learners to both document learning and put themselves in a position where they can take charge of their own learning (Butler, 2007) through the selection of the *artifacts* for viewing or presentation to selected audiences.

Our further definition of the Lorenzo and Ittelson (2005) electronic portfolio is both contextual and purpose-driven, given that we found ourselves teaching in contemporary digital places of learning. As ePortfolio presentations are planned, designed, and curated by students rather than by the educator, they start to play an active role in developing life-long skills of reflection; selection of memories, experiences, and knowledge; and collection for students rather than simply serving as collections of static learning artifacts. Our collaborative research and practice led our team to investigate how ePortfolios have been utilized in many areas of international and national higher education spaces, spanning across assessment to career development. We were particularly interested in how they provide a space for learners to evidence their acquired attributes and capabilities for graduation. Our learning design and curriculum development have been influenced by this research and built on the evidence that reflection on learning has been found to facilitate both life-long and life-wide learning that enables learners to learn from their collections of evidence (Batson, 2015; Cambridge, 2008; Chen & Penny Light, 2010; Eynon & Gambino, 2015; Penny Light et al., 2012).

Our national research has focused on the use of ePortfolios in Australian higher education, which is characterized by portfolios for learning, assessment, and reflection (Australian ePortfolios Project, 2008; Oliver, 2015, 2016) and for professional development and graduate recruitment (Hallam et al., 2008; Leece, 2005; Oliver & Whelan, 2011). These national studies have indicated that the development of an ePortfolio for learning and assessment is supported by the life-wide approach to the technology because after submitting their ePortfolios for assessment, students “take” their learning with them after graduation as a career development tool (Leece, 2005). Interestingly, more than a decade after many of these studies were first published, we are still developing our own work towards the transformation of ePortfolios and enhancement of the curriculum in Australian universities. Our scholarly approaches continue to demonstrate to students and educators the connections among their learning, assessment criteria, program outcomes, and graduate capabilities (Barrett, 2005). A number of recent Australian studies explored the relationship between portfolios and graduate employability (Oliver, 2015, 2016; Vozzo et al., 2014; Watty et al., 2016). These studies, along with our own,

have found that the clear alignment of assessment with learning outcomes encourages students to document their learning journey while reflecting on how the course assessment relates to the program of study and how the portfolio as both a collection and presentation of learning can be used beyond the course as a digital repository or collection space (Polly, Cox et al., 2015; Polly, Thai et al., 2013; Yang et al., 2015). Our practice is based on the important role that an ePortfolio plays in developing sustainable assessment (Boud, 2000) that goes beyond the unit of study as it enables students to present themselves in a number of ways, to a range of audiences, by empowering learners to shift identities in many instances.

Graduate Attributes and Professional Skills

Higher education has become increasingly interested in how students attain graduate attributes, how we can embed these skills and capabilities across programs of study and how these are evidenced and warranted. At UNSW Sydney, students must demonstrate proficiency in professional skills in order to satisfy the university graduate attributes. Currently in Australia, as well as globally, frameworks for university graduate attributes emphasize knowledge and skills that support graduate employability and global citizenship (Bosanquet et al., 2010). Furthermore, there has been a growing global desire to evaluate graduate generic and transferable skills such as communication and teamwork (Oliver, 2013, 2015). In Australia, several universities have begun to implement course-wide ePortfolios as a way for students to collect and evidence their achievement of university and discipline-specific graduate attributes (Hallam et al., 2008). In the BMedSc program at UNSW Sydney, we developed a mechanism for ePortfolio implementation and use to support students in reflective practice. In becoming reflective practitioners, students are able to recognize and build professional skills that underpin graduate attributes such as communication and teamwork. WIL through our research-intensive undergraduate courses has assisted, enabled, and engaged undergraduates in thinking and developing research practice skills and career learning.

Making Medical Science Students Employable Graduates and Competitive Professional Postgraduates

Within the Medical Science faculty, we recognize that students entering science undergraduate programs, such as the BMedSc, are generally unaware that professional, co-curricular skills such as communication are developed alongside academic curricular course requirements. It is these professional skills that will likely enhance their prospects for employability upon graduation in addition to increasing their competitiveness when applying for postgraduate programs (see Day, this collection).

The professional skills building journey in the BMedSc at UNSW Sydney started by scaffolding the development of research communication skills for undergraduates in the discipline of Pathology (Polly, Thai et al., 2013). Since this

initial trial, we have moved toward a program-wide approach (Polly, Cox et al., 2015). The strategy was to begin this professional thinking and skills development early on in the first year, transfer these skills into the second year and then into third-year courses, in particular—including a third-year multidisciplinary biomedical research internship (School of Medical Sciences Research Internship—SOMS3001) that serves as a capstone course in the BMedSc program. Students were taught co-curricular skills by integrating activities such as skills-enabling workshops as part of their curricular academic assessment tasks (Jones & Polly, 2013; Polly & Jones, 2013). Embedded within courses, a series of academic literacy workshops focused on communication and research practice. Transfer of these communication skills (disciplinary and cross cutting transferable attributes) was longitudinal within the program and aligned across disciplines as research thinking and practice became the common thread. This teaching rationale enabled students to learn research practices and the associated professional skills attributed to the field and the needs of the professions they would enter.

We began our journey as a team to build ePortfolio pedagogy and reflective practice in research communication skills development throughout the undergraduate program. We aimed to align professional skills development with UNSW Sydney strategic priorities for graduates as global citizens, scholars, leaders, professionals (UNSW Sydney 2011, 2016). When considering the professionalization of the UNSW BMedSc, the focus was on self-directed learning to cultivate the students' sense of their professional identities as emerging medical scientists. Facilitating self-directed learning by undergraduate students has been foundational for “thinking, speaking and doing” like a professional in the medical science discipline (Polly, Cox et al., 2015; Polly & Jones, 2013; Polly, Thai et al., 2013).

Research Practice Learning and Transfer

The student learning journey within the program was supported by implementing a longitudinal approach to ePortfolio pedagogy so that skills transfer could be achieved by scaffolding skills development not only longitudinally but also transversely across years. This scaffolding would ideally result in transfer of skills from first- into second-, then second- into third-year (capstone) undergraduate stages and beyond into fourth-year honors. We focused on the transfer of communication, teamwork, and research practice skills as these skills cut across disciplines and result in graduate attributes desired by employers. In the discipline of pathology, for example, we targeted the oral and written research communication skills that had been initially developed in the second year by cultivating research thinking and communication in the third year. (Jones & Polly, 2013; Polly & Jones, 2013; Polly, Thai et al., 2013). As third- and fourth-year courses in the BMedSc program are designed to develop these skills through various assessment tasks, we recognized that year three was the critical point at which students would crystallize their skills development and use all of these research-related skills that they

had acquired along the way. Those research skills could then be aligned across disciplines, despite having been learned in different contexts (Figure 7.1).

We made this longitudinal and cross-disciplinary approach explicit to students to show them how they were using the same skills across disciplines and in different contexts, which proved very powerful. Discussing this approach with students helped them to realize that the ways of thinking they learned in their second year could be transferred into the third year (for example in the medical science discipline of pathology), then across courses (for example between the disciplines of anatomy, physiology, and pharmacology), and beyond. The pinnacle of bringing these skills together was in the capstone third-year, cross-disciplinary biomedical research internship course, the School of Medical Sciences Research Internship (SOMS3001). This research internship is considered a pre-honors course in the BMedSc and is based on WIL, through which students get hands-on experience in real-world research lab settings. In other words, SOMS3001 is a course in which all of their research practice skills come together. These skills are based on elements of self-directed and transferable learning and are further developed according to their lab placements. In addition, students learn co-research practice within WIL, including aspects of working in a lab that has restraints in terms of work health and safety practices, research integrity, and working within a team.

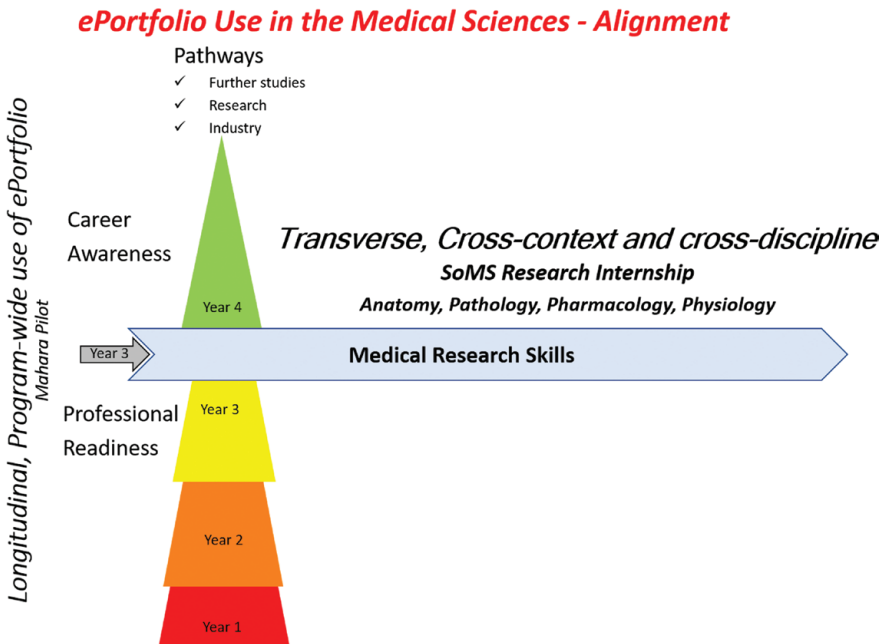


Figure 7.1. ePortfolio use to support research skills awareness in the medical science degree program at UNSW Sydney. The SoMS research internship requires integration and use of cross-context, cross-disciplinary medical research skills.

Scaffolded Reflective Practice and Building Awareness of Teamwork Skills

Although most Australian universities have included teamwork as a graduate attribute for the past 20 years, there is currently no way of evaluating or formally recognizing this attribute (Resort, 2011). Outside of validation and recognition of skills, capabilities, and competencies as a team member by peers, we felt that at the heart of the issue of teamwork was the explicit teaching of teamwork skills to students for *effective and affective* group work by the team leader (the research scientist in the lab). Ways of facilitating these communication skills include self-awareness, reflective practice, and authentic assessment. Authentic tasks offer students the opportunity to collaborate and reflect on real-world, ill-defined, and problem-based tasks (Herrington et al., 2003). However, reflective practice takes time—time to learn the necessary skills to reflect on the self and time to see what the individual has learned, time to evaluate and make appropriate revisions. In the team environment, self-reflection is an important skill and capability. Keeping this in mind, our aim in the learning and assessment design was to develop a system whereby we could collect learning analytics on undergraduate student teamwork capabilities in the biomedical sciences.

Our approach involved the program-wide alignment of assessment tasks that build teamwork skills through reflection and are easily quantified. Courses in the BMedSc program with assessment tasks that required and focused on explicit teamwork skills were identified, mapped, and aligned. Students' teamwork skills and performances against common standards in course-wide *rubrics* were standardized across courses and captured as students progressed through the program. The effect of this program-wide and cross-discipline approach for teamwork skills building through student reflective practice coupled with assessment was two-fold: 1) highlighting our teaching of teamwork and effective group work; 2) the potential for teaching reflective practice to scientists for self-awareness and self-efficacy in ePortfolios. This approach and ideology involved the wider establishment of the ePortfolio community of practice that was cross-disciplinary for the medical sciences by engaging disciplinary experts, academic developers, and educational designers (see Balthazor et al., Coleman et al., and Summers et al., this collection). Hence, teacher professional development in ePortfolio pedagogy, implementation, and use was enabled (see Day, this collection).

Based on our previous implementation of ePortfolio pedagogy, we recognized enhanced technical and transferable skills awareness in research practices by science students (Polly, Thai et al., 2013). Therefore, we proposed that ePortfolio use would also facilitate students' critical reflection on their teamwork skills development. In particular, students were asked to reflect on their teamwork skills development in their ePortfolio using WordPress, or any other online web creation tool. We believe scaffolding this process of ongoing and deep reflective practice via assessments is a key, a first-stage approach to building professional skills for

science students that will have life-long benefits. This approach can be easily adopted and applied in other programs to support related skills development (Polly, Cox et al., 2015; Polly, Thai et al., 2013).

Work and Career Integrated Learning in the Medical Sciences

Interestingly, when developing professional skills either as part of a course-wide or even a program-wide approach, students ultimately see the linkage of skills development to career learning in courses that offer WIL. They are made aware explicitly through visible learning and teaching as they bring their professional skills development in core second-year subjects with them to new sites of learning and new contexts of knowledge in the BMedSc. This opportunity to teach themselves as reflective practitioners through the aligned learning of content and research practice in research-based capstone courses such as the School of Medical Sciences Research Internship (SOMS3001), Microscopy in Research (ANAT3212), and Honors Program (SOMS4001) has allowed students to link and integrate their skills and capabilities.

Research Internship

The School of Medical Sciences Research Internship (SOMS3001) is a third-year course presently offered to science undergraduate students throughout the year in semesters 1 and 2. Students who take this course intend and expect to experience “real-world” research laboratory learning in biomedical research techniques and associated research practice. This course has four key authentic assessment tasks that have been embedded to build research practice skills in oral and written communication (see Carpenter & Labissiere, this collection). The literature review, worth 20% of the course assessment schedule, facilitates development of capabilities in information searching, acquisition, evaluation, synthesis, higher order thinking, and contextualization regarding the student’s research question. The research report, worth 40%, asks students to document and write about their research findings and to contextualize these findings within their research field. The key skills developed in this document refer to the student research experience and their understanding of their findings. Critical evaluation, synthesis, and understanding of research data, as well as higher-order thinking in order to analyze and interpret findings are also developed. Reflective practice underpins all of these capabilities. Skills in written research communication and critical evaluation are also developed (Jones & Polly, 2013). Both the research seminar presentation worth 20% of the course assessment schedule and the research report ask students to communicate their research findings in two different genres. Importantly, both tasks facilitate reflective practice in not only evaluating research findings but also recognizing development of skills in collaboration and teamwork in

medical research (Polly & Jones, 2013; Polly, Thai et al., 2013). The researcher or academic in charge of the project assesses laboratory performance, worth 20%. This assessment item warrants academic endorsement of the undergraduate student's technical and analytic research skills and work ethic, as well as the student's development of workplace teamwork skills.

The skills developed through the SOMS3001 Research Internship have been foundational for undergraduate science students about to enter into workplaces and into postgraduate courses that require all of these professional skills. The driver of the ePortfolio as authentic assessment for/as/of learning was to facilitate an outward-facing professional self in order to become more attractive to prospective employers and increase the possibility of entry into competitive postgraduate programs such as medicine and dentistry. Students were able to identify the same practices in undergraduate subjects and the research internship. This awareness of skills and capabilities development was facilitated via reflective practice scaffolded within the ePortfolio space. This heightened awareness of their professional development also enabled them to view themselves as competitive candidates for entry into postgraduate programs such as medicine and dentistry as well as biomedical research apprentices to the profession or medical research upon entry into Honors.

Microscopy in Research

The School of Medical Sciences Microscopy in Research (ANAT3212) is a research-focused third-year course offered to science, advanced science, and medical science students. The majority of students have little or no practical experience in designing and performing experiments at the time they enroll in the course. The course combines the objective of providing students in-depth training in state-of-the-art imaging technologies with the aim of improving students' transferable skills such as teamwork, analytical thinking, and communication of research data.

Teaching methods in ANAT3212 encompass classic face-to-face lectures, an online virtual laboratory, and wet lab practical classes. The interactive environment of the virtual lab environment combined with the provision of ample online resources has been designed to stimulate students' self-directed learning prior to starting practical hands-on activities in a wet lab. Short research projects carried out in laboratories of active research-focused academics from different schools (including the School of Medical Sciences, the School of Biotechnology and Biological Sciences, and the Prince of Wales Clinical School) across the UNSW campus are a core feature of the current design of the course. This cross-disciplinary approach forms the basis of a strong research-integrated learning experience that inspires students to commence a research career and also embraces the graduate aspiration of training entrepreneurial leaders in research. Therefore, this course is ideally positioned to prepare students for a future workplace environment in the field of biomedical research. Assessments in this course are designed to foster a process of skills development equivalent to that described above for the Research

Internship program. To strengthen the learning process, oral presentations and report writing are scheduled in the first and second half of the course, supported by a feedback session of student performance after the assessment of the first oral presentation and report.

ePortfolio use and implementation were introduced in ANAT3212 in 2013 to facilitate students' reflection on the development of their skills during the course and consideration of how the skills developed in this course could be integrated into a life-long learning process. After successful implementation of reflective practice learning and doing in this course in 2013, the ePortfolio component became an assessable item in ANAT3212 the following year. The allocated total grade for the ePortfolio task contributed to 5% of the overall course grade. The value of ePortfolios in stimulating and supporting student engagement in reflective processes within ANAT3212 has been recognized both by students and those teaching the course over a period of three years in which ePortfolios have been used.

Honors Program

The School of Medical Sciences Honors Program has recently implemented ePortfolio use. The Honors program in the School of Medical Sciences (SOMS4001/4002) is a one-year program that aims to train students in research skills that are directly relevant to various Biomedical Science fields. The program runs as a fourth-year course and has an annual enrollment of approximately 60–80 students. The majority of the students have carried out undergraduate studies with a major in a biomedical (anatomy, pathology, physiology, or pharmacology) or related discipline. The Honors degree involves the following research-based assessment tasks: a literature review and an introductory seminar at the beginning of the project and a final oral presentation and a written manuscript at the end of the program. ePortfolios were introduced into the Honors program in 2015 to increase student reflection practice through an assessable, 500-word-long reflective essay, focusing on four key areas: 1. Building an awareness of skills learned, 2. Development of career awareness, 3. Identifying personal values, and 4. Self-reflective practice. Targeting students in the fourth year of their studies is important since this is the time when students are not only trained in skills directly relevant to their future workplaces, but are also increasingly engaging in career planning. Introducing ePortfolios into the Honors program is well integrated with the current practice of ePortfolio pedagogy in School of Medical Sciences undergraduate courses: in particular the research-focused third-year courses. Continuing reflective practices throughout the fourth year of their studies allows students to further refine their reflective skills.

In 2015, the reflective exercise was scheduled after the final oral presentation and the submission of the project manuscript to allow a reflective process that encompasses the entire journey from the start to the end of the students' Honors candidature. The reflective essay was then scored by members of the School of

Medical Sciences Honors committee, who are academics or biomedical research scientists. Approximately six to seven essays were assessed by each examiner, which allowed a comparison of the students' extent of reflective practice. This assessment technique allowed for a valuable level of benchmarking the students' reflective practices and comparison of students' performance. We then implemented a different approach in order to connect the assessment of the reflective practice with the assessment of the skills that were acquired throughout the candidature. To achieve this objective, the reflective exercise has now been incorporated as a reflective summary into the final manuscript. The examiners of the Honors students' research-based assessment tasks are School of Medical Sciences academic staff members. For each student, the same examiner marks all four assessment tasks (literature review, introductory seminar, final seminar, and project manuscript). Therefore, the examiner is able to correlate the student's reflection with the observed progression and performance of the student throughout the candidature. The new structure of the assessment process is expected to provide a more insightful assessment of the students' reflective practices.

Career Learning in the Medical Sciences

Connecting and Integrating Reflection, ePortfolio, Professional Skills, and Career Development

The development of career learning and professional identity interventions has been increasingly on our agendas in higher education. Career development learning (CDL) is a process that “empowers individuals to identify, develop and articulate the skills, qualifications, experiences, attributes and knowledge that will enable them to make an effective transition into their chosen futures, and manage their careers as life-long learners, with a realistic and positive attitude” (Stanbury, 2005). It is both a trans-disciplinary process and a subject discipline with its own history, evidence base, theoretical frameworks, and methodologies. The goal of CDL is to help students to acquire knowledge, concepts, skills, and attitudes that will equip them to manage their careers, and therefore their life-long progression in learning and work (Watts, 2006). Although there are different theories and developmental approaches to careers education, the most widely used framework by career centers around the world is the “DOTS” model (Figure 7.2). The basic assumption underpinning this model is that effective career learning is composed of a dynamic relationship between Decisions, Opportunities, Transitions, and Self (DOTS) (Watts, 2006). These four elements involve: **D**ecision making—being able to weigh up personal factors to make a sound plan, **O**pportunity awareness—knowledge of opportunities and the ability to research them, **T**ransition learning—understanding of how to seek and secure employment opportunities, and **S**elf-awareness—the ability to identify and articulate motivations, skills, and personality as they affect career plans (Figure 7.2).



Figure 7.2, DOTS, CDMSE, and ePortfolio model (Yang et al., 2015).

These stages build iteratively upon each other, so, ideally, students move through the cycle more than once during their program and are afforded the opportunity to do so. An ePortfolio enables students to document their learning journey through ongoing deep reflection as they collect the artifacts that the DOTS model provokes. The ePortfolio in this instance is a space where they can collect their experiences, reflect on the connections between theory and practice, and present evidence of development of their graduate attributes, so that upon graduation they are well situated to make a successful transition into their chosen employment (Figure 7.2; Polly, Cox et al., 2015; Yang et al., 2015).

We found that when embedded in a curriculum that used CDL interventions alongside the DOTS model and a program-wide portfolio to collect evidence of learning generated in assessment, learners developed a narrative of their new disciplinary knowledge. We have utilized the ePortfolio to serve a range of these purposes, from career presentations for professional identity development to tools of learning and experimentation. Our ePortfolios, when designed with both DOTS and CDL, record past and current practice, provide opportunities for reflection upon practice to effect change, and act as a change agent by enabling long-term ongoing evaluation of performance and associated learning outcomes.

As CDL requires the student to undertake self-assessment and perform an appraisal of the context of their learning in relation to their discipline, it lends itself to learning and teaching methods that require reflection (McIlveen et al., 2009). David Boud, Rosemary Keogh, and David Walker (2013) suggest that re-

flecting on learning transforms experience into learning as it allows opportunity for the student to reassess an experience and make decisions on how to change or improve on the learning outcomes. As Boud (2000) shows, such reflection also enables students to: 1. identify their learning, 2. make judgments about their learning, and 3. prepare them for more learning.

Developing Self-efficacy and Self-determination in the Medical Sciences

Career awareness and employability building better equipped students to compete for scholarships and/or jobs (see Coleman et al., this collection). From our previous experience and Michael Tomlinson's 2008 study, we know that student employability is not solely determined by academic qualifications. Other qualities are also important, including generic graduate attributes and the ability to properly package and present one's credentials and capabilities. After reflecting on these findings, we designed a new course for third-year science students in 2012: Cancer Sciences (PATH3208). We were the first to deliver integrated career development learning (ICDL) in which both professional knowledge and career development learning were introduced in a learner-centered ePortfolio (a teaching ePortfolio in Moodle plus student ePortfolios in Mahara) utilizing emerging technologies (Yang et al., 2013, 2015) (see Castaño and Novo, this collection). We used the internationally recognized assessment tool, the Career Decision-Making Self-Efficacy (CDMSE) Scale, which seeks to measure student confidence in pursuing their career goals and to assess the longitudinal impact of interventions in career development education. The results from all thirty-two students in PATH3208 indicated that students were significantly more confident in four of the five aspects of self-efficacy: self-appraisal, obtaining occupational information, planning, and problem solving. However, even after the career intervention, students were no longer confident in the fifth aspect of goal selection (Figure 7.2). The outcomes of this pilot study support the extension of this approach to other third-year undergraduate science courses (Yang et al., 2015).

As educators within the higher education domain, we are keenly aware of the need to develop in our senior undergraduates the graduate capabilities, skills, and attributes necessary for them to reach their full potential in the graduate employment marketplace. ICDL is an "integrated learning approach specifically focusing on integrating professional knowledge and skills, career awareness and employability with disciplinary learning. ICDL is a self-directed learning component in these science classes" (Yang & Polly, 2015, p. 71). *Integrative learning*, according to the Association of American Colleges and Universities (AAC&U), is an understanding and a disposition that a student builds across the curriculum and co-curriculum, from making simple connections among ideas and experiences to synthesizing and transferring learning to new, complex situations within and beyond the campus (AAC&U, 2010). ICDL is therefore a process that empowers individuals to iden-

tify, develop, and articulate the skills, qualifications, experiences, attributes, and knowledge that will enable them to make an effective transition into their chosen futures and manage their careers as lifelong learners, with a realistic and positive attitude (Stanbury, 2005). ICDL makes student learning more meaningful by helping students to make the connection between their disciplinary studies, professional skills, and career aspirations. Success of the pilot study in the PATH3208 course led to application of the ICDL in four of the five third-year science courses in 2013: PATH3208: Cancer Sciences; PHAR3101: Drug Discovery, Design and Development; PHAR3202: Neuropharmacology; and ANAT3212: Microscopy in Research; the remaining course, NEUR3221: Neurophysiology, was used as a non-ICDL control. This approach enabled more students in third-year courses within the School of Medical Sciences to be engaged in an ICDL process in order to develop career awareness, employability, and professional skills. In addition, this approach allowed us to evaluate the ICDL in larger sample sizes and with proper controls.

As a result of our evaluation, we now propose our new ISA model (Yang & Azouz, 2015; Yang et al., 2016)—Image of potential own career, Self-directed life-long and life-wide learning, Assessment and adjustment (see Figure 7.3)—as a mechanism for delivering ICDL. We developed this model as part of our study, as there have not been any previous single models that can comprehensively address this learning issue. The ISA model describes students' learning at the current time in which: 1. they can see their images of own potential career, 2. they can carry out a self-directed learning journey to pursue their career goals, and 3. they can assess and adjust their studies to get the most from them. Image pertains to professional and career goals and integrative learning tasks for obtaining knowledge, skills, and capabilities to achieve goals. Self-directed learning is a life-long and life-wide process since career goals may change in levels and/or directions due to opportunity or personal or socioeconomic reasons. The assessment and feedback from self, peer, and/or academic professional will frequently stimulate reflection and modification for appropriate personal learning (see Balthazor et al., this collection).

The ISA model stimulates students' intentional inquiry on personal learning issues, integration across isolated learning events, and reflection on previous learning experience. Therefore, it best describes this integrative learning and teaching approach and focuses on outcome-based active and reflective learning. The effective ICDL is composed of a dynamic relationship between self, opportunities, decisions, and transitions (Watts, 2006). Self-beliefs about career decision-making have been operationally defined using the concept of the CDMSE (Taylor & Betz, 1983), which highlights five relevant behaviors well matched with the DOTS model: self-appraisal, gathering occupational information, goal selection, planning, and problem solving. ICDL is part of integrative learning and focuses on professional knowledge and skills, career awareness, and employability learning. The ICDL is a life-long learning approach that is a "purposeful learning activity undertaken in an ongoing way with the aim of improving knowledge, skills and competence" (Eurostat, 2020) and thus it should be classified as self-directed and reflective learning.

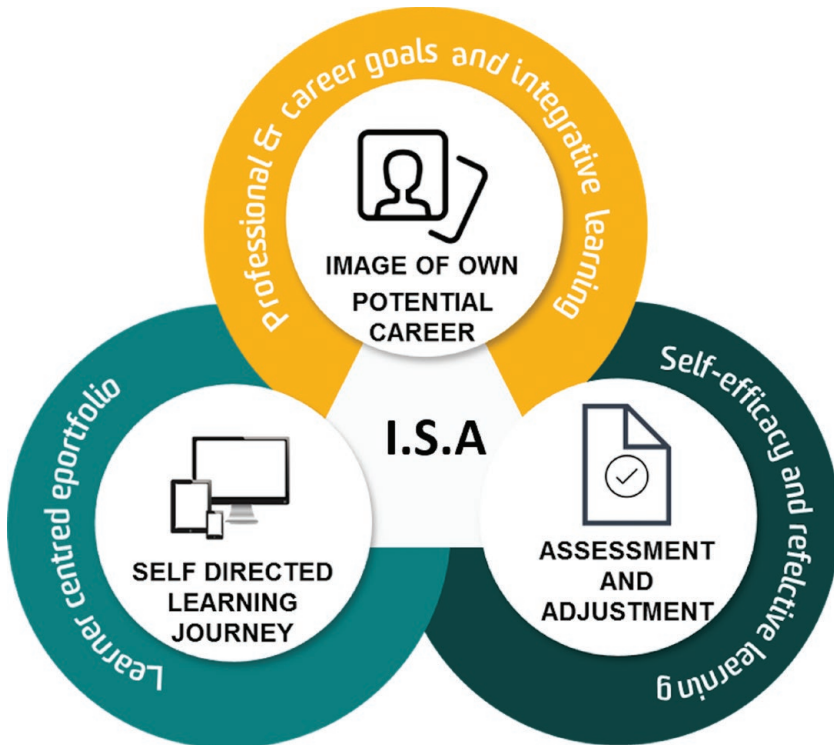


Figure 7.3: ISA Model: Image of own potential career, self-directed life-long and life-wide learning as well as assessment and adjustment model (Yang & Azouz, 2015; Yang et al., 2016).

Within the context of higher education, ePortfolios provide students with the opportunity to become owners of their learning as they collect, select, reflect, present, and curate their artifacts and evidence for assessment (Allen & Coleman, 2011) (see Coleman et al., this collection). ePortfolios also represent a useful vehicle for reflective practice—the process by which a student can transform experience into learning (Brookfield, 1995). Since effective ICDL requires the student to undertake self-assessment and perform an appraisal of the context of their discipline, ICDL lends itself to learning and teaching methods that require reflection (McIlveen et al., 2011). The capacity of ePortfolios to support reflection and selection makes their use a logical “best fit” tool for improving skills needed for graduate recruitment (Leece, 2005).

The ICDL intervention included but was not limited to following five broad areas:

- Guided and structured career development learning activities—including specific tutorials on how to use the Mahara/Moodle ePortfolio system; career opportunities associated with one’s own profession; job-search strat-

egies, goal setting, personal achievement recording, résumé writing, and interview techniques from video cases.

- Apprenticeship-style professional skills learning—including knowledge and experience gained through involvement in a real research group meeting and experiments; knowledge gained through invited seminar presentations by professionals; or knowledge gained through visits to research and practice facilities within or outside of the campus during which students had opportunities to talk with working professionals in fields of interest to them, or knowledge acquired from lectures, tutorials, and practicals. The “to do as a scientist does” approach to the practicals exposes students early in an apprenticeship/internship learning stage, which is critical for building independent research ability. Through the curriculum and co-curriculum activities, students, like scientists, construct cancer-specific knowledge, building upon previously obtained general knowledge to form a schema or brain knowledge network. Students work together to review current literature and identify a valid cancer research question in a group and, through collaborative learning, they design their project with hypotheses/aims, methods, and expected outcomes. Students then present and discuss their project with peers and write a literature review and project report.
- Student directed ICDL, using ePortfolio records and reflection on personal achievements in professional and career development learning through the completion of various written assignments, experiential activities, self-explorations, and group or class discussions.
- Development of a personal career plan in the ePortfolio “view” and a tailored résumé in Mahara, as well as participation in a mock interview.
- Participation in the pre- and post-course CDMSE surveys to further increase career awareness.

We then compared CDMSE subscales effects across four ICDL courses. Results indicated significant improvement in three or all five CDMSE subscales in all four ICDL courses. In contrast, there was no improvement in any CDMSE subscales in the non-ICDL (control) course. Comparing the ICDL group and the control group, a significant improvement in all five subscales was observed in the ICDL group but not the non-ICDL control group.

Outcomes from this study suggest that the incorporation of ICDL with the ISA model focusing on goal setting, ePortfolio career learning and reflection, and graduate capabilities can engage students in learning, teaching, and assessment to encourage and develop an understanding of professional identity in undergraduate science courses. This program-wide project proved successful in improving students’ confidence in their abilities to seek positions of their choice as assessed by the Career Decision-making Self-efficacy Scale, and supports the extension of this approach to other senior undergraduate courses or programs in higher education.

Conclusion

The implementation and use of ePortfolio pedagogy to facilitate thinking, skills development, and research practice in the medical sciences is an important way to build reflective practice within a digital space. It has developed a program of learning, teaching, and assessment underpinned by a team who have in turn developed their own reflective practice and skills as learning designers. We have found that ePortfolio pedagogy that explicitly models and scaffolds authentic reflective practice is a foundational skill, developed over time as practice for preparing students to think critically and creatively as career aware, employable, and ready to enter postgraduate programs beyond their undergraduate medical science degree program. Linking ePortfolio thinking and assessment tasks that are authentic to the discipline has had the effect of improving student capabilities in research communication and practice, as well as teamwork and career learning as they develop their identity and sense of self as apprentice biomedical research scientists and future employees.

Acknowledgments

The studies presented here were funded by multiple UNSW Learning and Teaching Seed Grants and a UNSW Innovation grant and have received UNSW Sydney Human Ethics Approval, Ethics numbers HC13005, HC15134.

References

- Abrami, P., & Barrett, H. (2005). Directions for research and development on electronic portfolios. *Canadian Journal of Learning and Technology/La revue canadienne de l'apprentissage et de la technologie*, 31(3), 1-15.
- Allen, B., & Coleman, K. (2011). The creative graduate: Cultivating and assessing creativity with eportfolios [Conference presentation] *Changing Demands, Changing Directions. Proceedings ascilite Hobart*, 59-69. Australian Society for Computers in Learning in Tertiary Education.
- Association of American Colleges and University. (2010). Integrative and applied learning VALUE rubric. <https://www.aacu.org/value/rubrics/integrative-learning>
- Australian ePortfolio Project. (2008). Final Report. <https://research.qut.edu.au/eportfolio/australian-eportfolio-project-final-report/>
- Barrett, H. (2005). Researching electronic portfolios: Learning, engagement, collaboration, through technology. <http://electronicportfolios.org>
- Batson, T. (2015). The significance of ePortfolio in education. Batson Blog, AAEEBL. <http://www.aeebl.org/blogpost/1008436/229349/The-Significance-of-ePortfolio-in-Education>
- Bosanquet, A., Winchester-Seeto, T., & Rowe, A. (2010, July). Changing perceptions underpinning graduate attributes: A pilot study [Conference presentation]. Research and development in higher education> Reshaping Higher Education, 33,

- 105/115. https://www.researchgate.net/publication/272026146_Changing_perceptions_underpinning_graduate_attributes_A_pilot_study#fullTextFileContent
- Boud, D. (2000). Sustainable assessment: Rethinking assessment for the learning society. *Studies in Continuing Education*, 22(2), 151-167.
- Boud, D., Keogh, R., & Walker, D. (2013). *Reflection: Turning experience into learning*. Routledge.
- Brookfield, S. (1995). The getting of wisdom:.. *Becoming a critically reflective teacher*. Jossey-Bass..
- Butler, P. (2007). A review of the literature on portfolios and electronic portfolios. <https://uncw.edu/cas/assessment/docs/resources/eportfolioprojectresearchreport.pdf>
- Cambridge, D. (2008). Audience, integrity, and the living document: eFolio Minnesota and lifelong and lifewide learning with ePortfolios. *Computers & Education*, 51(3), 1227-1246
- Chen, H. L., & Penny Light, T. (2010). *Electronic portfolios and student success, effectiveness, efficiency, and learning*. Association of American Colleges and Universities.
- Clarke, T., Housego, S., & Parker, N. (2009). Positioning ePortfolios in an integrated curriculum. *Education + Training*, 51(5/6), 408-421.
- Coleman, K. S., & Flood, A. (Eds.). (2016). *Enabling reflective thinking: Reflective practice in learning and teaching*. Common Ground Publishing.
- Costa, A. L., & Kallick, B. (2009). *Habits of mind across the curriculum: Practical and creative strategies for teachers*. Association for Supervision and Curriculum Development.
- Eurostat, Adult Learning Statistics. (2020, May 12). https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Adult_learning_statistics
- Eynon, B., & Gambino, L. (2015). *The high impact eportfolio practice: A catalyst for student, faculty and institutional learning*. Stylus.
- Hallam, G. C., Harper, W. E., McCowan, C. R., Hauville, K. L., McAllister, L. M., & Creagh, T. A. (2008). ePortfolio use by university students in Australia: Informing excellence in policy and practice. Australian ePortfolio Project final Report <http://www.eportfoliopractice.qut.edu.au/>
- Herrington, J., Oliver, R., & Reeves, T. C. (2003a). "Cognitive realism" in online authentic learning environments. In D. Lassner & C. McNaught (Eds.), *EdMedia world conference on educational multimedia, hypermedia and telecommunications* (pp. 2115-2121). Association for the Advancement of Computing in Education.
- Herrington, J., Oliver, R., & Reeves, T.C. (2003b). Patterns of engagement in authentic onlinelearning environments. *Australian Journal of Educational Technology*, 19(1), 59-71.
- Jones, G., & Polly, P. (2013). Scaffolding student learning by managing the development of academic literacys through an oral presentation assessment. In K. Coleman & A. Flood (Eds.), *Marking time: Leading and managing the development of assessment in higher education*. The Learner Series.
- Leece, R. (2005). The role of e-portfolios in graduate recruitment. *Australian Journal of Career Development*, 14(2), 72-78.
- Lorenzo, G., & Ittelson, J. (2005). An overview of e-portfolios. Educause learning initiative, 1, 1-27. Educause Learning Initiative Paper 1: 2005. <https://library.edu->

- cause.edu/-/media/files/library/2005/1/eli3001-pdf.pdf
- McIlveen, P., Brooks, S., Lichtenberg, A., Smith, M., Torjul, P., & Tyler, J. (2009, April). Career development learning and work-integrated learning practices in Australian universities [Conference presentation]. *Proceedings of the CDAA National Career Conference 2009*.
- Oliver, B. (2010, July 20-21). The role of ePortfolios in mapping, assessing and evaluating graduate capabilities [Conference presentation]. *Proceedings of the Association of Authentic Experiential and Evidence-Based Learning Conference*. Boston, United States.
- Oliver, B. (2013). Graduate attributes as a focus for institution-wide curriculum renewal: Innovations and challenges. *Higher Education Research & Development*, 32(3), 450-463.
- Oliver, B. (2015). Redefining graduate employability and work-integrated learning: Proposals for effective higher education in disrupted economies. *Journal of Teaching and Learning for Graduate Employability*, 6(1), 56-65.
- Oliver, B. (2016). Assuring graduate capabilities: Evidencing levels of achievement for graduate employability. Final Report. Office for Learning and Teaching (OLT), New South Wales. https://ltr.edu.au/resources/Oliver_Report_2015.pdf
- Oliver, B., & Whelan, B. (2011). Designing an e-portfolio for assurance of learning focusing on adoptability and learning analytics. *Australasian Journal of Educational Technology*, 27(6), 1026-1041.
- Penny Light, T., Chen, H., & Ittelson, J. (2012). *Documenting learning with e-portfolios*. Jossey Bass.
- Polly, P., Cox, J., Coleman, K., Yang, J. L., & Thai, T. (2015). Creative teaching, learning and assessment in Medical Science: ePortfolios to support skills development in scientists beyond just knowing their own discipline content. In K. Coleman & A. Flood (Eds.), *Capturing creativity through creative teaching: The Learner Series*.
- Polly, P., & Jones, G. (2013). Enhancing student learning in written literacy through assessment and community of practice in a second year pathology course. In K. Coleman & A. Flood (Eds.), *Marking time: Leading and managing the development of assessment in higher education*. The Learner Series.
- Polly, P., Thai, T., Flood, A., Coleman, K., Das, M., Yang, J. L., & Cox, J. (2013). Enhancement of scientific research and communication skills using assessment and ePortfolio in a third year pathology course. In H. Carter, M. Gosper, & J. Hedberg (Eds.), *Electronic Dreams. Proceedings Ascilite 2013* (pp. 711-723). Australian Society for Computers in Learning in Tertiary Education.
- Resort, R. (2011). Research and development in higher education [Paper presentation]. *Higher Education on the Edge 34*. 34th HERDSA Annual International Conference, Gold Coast, Queensland, Australia.
- Stanbury, D. (2005). *Careers education benchmark statement*. London: Association of Graduate Career Advisory Services.
- Taylor, K. M., & Betz, N. E. (1983). Applications of self-efficacy theory to the understanding and treatment of career indecision. *Journal of Vocational Behavior*, 22(1), 63-81.
- Tomlinson, M. (2008). "The degree is not enough": Students' perceptions of the role of higher education credentials for graduate work and employability. *British Journal of Sociology of Education*, 29(1), 49-61

- UNSW Sydney. (2011). Blueprint to beyond: UNSW strategic intent. https://www.unsw.edu.au/sites/default/files/documents/UNSW3268_B2B_Design_AW3.pdf
- UNSW Sydney. (2016). Our strategic priorities and themes—UNSW 2025. https://www.2025.unsw.edu.au/sites/default/files/uploads/unsw_2025strategy_201015.pdf
- Vozzo, L., Hatton, C., Reid, J., Pietsch, M., Bennet, M., Nanlohy, P., Moran, W., & Labone, E. (2014). Assessing professional teaching standards in practicum using digital technologies with Aboriginal and other pre-service teachers. Final Report. Office for Learning and Teaching (OLT), New South Wales. <https://researchdirect.westernsydney.edu.au/islandora/object/uws:26942>
- Watts, A. G. (2006). *Career development learning and employability*. The Higher Education Academy.
- Watty, K., Leitch, S., McGuigan, N., Kavanagh, M., Holt, D., Ngo, L., McKay, J., Davies, J., & McCormick, T. (2015). Realising the potential: Assessing professional learning through the integration of ePortfolios in Australian business education. Final Report. Office for Learning and Teaching (OLT), New South Wales https://eprints.usq.edu.au/30917/2/ID13-2888_eportfolios_Final%20Report_2016.pdf
- Yang, J. L., & Azouz, L. (2015). A blended learning strategy encouraging active, life-long and life-wide learning. UNSW Medicine Learning and Teaching Forum 2015. https://d2xknkjysn6lg7q.cloudfront.net/files/unswPDF/1444175788979-2015-Posters-Booklet_final.pdf
- Yang, J. L., Coleman, K., Das, M., & Hawkins, N. (2015). Integrated career development learning and ePortfolios: Improving student self-efficacy in employability skills in an undergraduate science course. *The International Journal of Adult, Community and Professional Learning*, 22(1), 1-17.
- Yang, J. L., & Polly, P. (2015, July 9–11). Career development learning across year three science courses—pedagogy and curriculum: Improving student self-efficacy in employability skills [Conference presentation]. The 22nd Learners Conference, Universidad CEU, San Pablo, Madrid, Spain.
- Yang, J. L., Polly, P., Fath, T., Jones, N., & Power, J. (2016). ISA model and integrative career development learning in year three science course. *International Journal of Science, Mathematics, and Technology Learning*, 23(3), 33-46.