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A process-environment model for mentoring undergraduate research students

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ABSTRACT

Undergraduate nursing student engagement in research remains much contested. The debate centers on whether undergraduate education is preparation for application of research findings to practice versus early exposure and engagement to discovery of new knowledge focused research as is done in graduate education. We take the position that involvement in research is beneficial but mentorship is required if the endeavor is to be meaningful. In the absence of a model to guide effective mentorship for undergraduate co-researchers we synthesized the available undergraduate mentorship literature and relevant pedagogy to develop a mentorship model for use by nurse educators who undertake research with nursing students. This was applied and refined through active engagement in, and reflection on, the execution of a research project exploring peoples' experiences of mental illness. Synthesis of the evidence and reflections led to the development of a process-environment mentorship model. This model provides an evidence- and experientially-based framework for mentoring undergraduate student co-researchers.

Introduction

Nearly 20 years ago, the Boyer Commission on Educating Undergraduates in the Research University (1998) argued that undergraduate students were frequently isolated from the research activity that is highly valued by higher education institutions. The commission argued that research-intensive universities should “make the baccalaureate experience an inseparable part of the whole” (p.7). That position is somewhat in tension with the trend in healthcare professional undergraduate education, especially nursing, away from individual student engagement in empirical research. Increasingly, nursing students are encouraged to undertake secondary data analysis, or literature-based projects, as the basis for individual summative assessment. The reasons for this are many, but not least is the safety of participants in human subject research (Richman & Alexander, 2006) for what could be deemed futile research (Evans, 1997).

Nevertheless, the arguments predicated in the Boyer blueprint that students should expect, and have opportunities to work with, “talented senior researchers” (Boyer Commission on Educating Undergraduates in the Research University, 1998, p. 12) are powerful. The salience of research exposure has become embedded in many national policies that recognize the benefits of research capability and capacity building (see for example, National Institutes of Health, 2017). Likewise, the strategic visioning of many universities across the globe, particularly those that promote themselves as research focused, talk of the research-enriched student experience (Hordern, 2013). Although nursing research has matured and some higher education institutions are at the forefront of nursing scholarship, not all nursing students are similarly exposed.

In Qatar, where work for this project was undertaken, the Qatar National Research Fund has prioritized undergraduate exposure to research by creating a funding stream that requires the involvement of undergraduates as co-researchers. While preparing a funding application for this program on people's experiences of mental illness in Qatar, we were unable to identify an adequate model to guide our own mentorship efforts. Thus, we undertook a concurrent project to develop a mentorship model that could enhance the research learning environment. This article reports the development of a process-environment mentorship model that resulted from our synthesis of the

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literature and our own experiences as mentors and mentees.

Context

The mentorship model described in this article was developed within the context of a primary research project on service users' experience of mental illness in Qatar. This project aimed to investigate the challenges people face in the community and the strategies they use to overcome these challenges (Hickey et al., in press). We conducted 28 interviews with 21 participants. Six second-year undergraduate nursing students were engaged as co-researchers for the project. They spent approximately 2–5 h per week on this project during active stages. The project lasted just over two years, from the initial funding application to public dissemination of results. We applied to have students receive academic credit for their efforts, but were not able to get this approved. The University of Calgary in Qatar provided funding to support this work. This funding provided a stipend to each of the undergraduate researchers. It also enabled two undergraduate researchers and a faculty member to present results at an international nursing conference.

Methods

Two undergraduate students, two faculty mentors, and a service partner reviewed the literature on undergraduate mentorship, with a focus on nursing mentorship. We extracted data on the benefits and challenges of mentorship, development of a researcher identity, and mentorship strategies. Students and faculty concurrently wrote brief reflections on these same topics over a period of several months while planning and implementing the original study. During a lull in the original project, we held face-to-face meetings where we synthesized the reviewed literature and our own reflections into the mentorship model described in the following sections. We used this model throughout the remainder of the project using specific strategies described later. We did not formally evaluate the model; however, students and faculty researchers involved in the main project reported the experience as a positive one.

Literature review

Benefits of undergraduate research experiences

Undergraduate research projects (URPs) illuminate the research process through exposure to many, or all, aspects, thereby facilitating the transference of classroom theory to practical application (Aponte et al., 2015; Taber, Taber, Galante, & Sigsby, 2011; Wells & Cagle, 2009). In effect, students are exposed to an experiential learning environment whose authenticity cannot be conveyed in the classroom (Kennel, Burns, & Horn, 2009). This hands-on experience enables the development of professional communication skills, project management skills and, critical thinking abilities (Schaefer, 2013). Our undergraduate researchers conducted face-to-face interviews with mental health service users, which provided a rich opportunity to develop their communication skills. They were also involved with scheduling recruitment and interview to fit within their already busy schedules.

Wells and Cagle (2009) suggest that URPs can also have macro-level benefits. One is the contribution to the development of a research culture among students and faculty. Others include better engagement between the institution and the participant population (Zandee et al., 2015), contribution to a body of scientific knowledge (Burkhart & Hall, 2015), and improvements in patient care (Taber et al., 2011). In our project, we harnessed students' creativity and produced anonymized participant narratives, based on interview transcripts. These have been used at the macro level as a teaching tool, presented at a local mental health conference, and are publically available on a website we created.

The involvement of undergraduates can ensure that sociodemographic characteristics of the research team match the target population (Aponte et al., 2015). This is commonly acknowledged as beneficial for increasing access to participants and improving the reliability of data. From our experience with this project, that diversity influenced many other aspects of the process. The faculty were all Western expatriates whereas the undergraduate researchers included Qatari Nationals, and long-term residents with Pakistani, Syrian, Palestinian or other Middle Eastern heritage, who all spoke Arabic. The students' insights on culturally appropriate aspects of the research process were of significant benefit throughout the project and, especially, when developing interview questions and protocols for interactions with participants. Other authors suggest that students bring fresh perspectives, computer skills, (Taber et al., 2011) and an increase in capacity to undertake research (Klemm, 2012).

Development of a researcher identity

Conn (2007, p. 255) asserts that “fundamental nurse researcher characteristics” develop as an undergraduate student. Even for an undergraduate who does not pursue a research career, these skills can be valuable in other settings (Naylor, Hanson, Evely, Little, & VanEker, 2014). This highlights the importance of providing thoughtful and meaningful supported exposure to research early in a nurse's education. Faculty should seek to promote the perception among students that research can be interesting, rewarding, and enjoyable (Fowler, 2014). This can be challenging particularly if the only exposure to research is gained in the classroom. We did this by intentionally involving students in all aspects of the research, by being flexible and working around competing demands as much as possible, and by discussing what the students thought was missing and trying to provide exposure to these things (e.g., attending a conference).

Establishing a sense of community within the research team enables students to feel included, and closely working alongside peers and faculty can create opportunities to develop a better comprehension of the research process, roles, and responsibilities (Aponte et al., 2015; Zandee et al., 2015). Traditional power imbalance between students and faculty can be redistributed through research collaboration (“Hickey et al., 2015; Schaefer, 2013). Creating a structure where interdependence is necessary for success minimizes power imbalances and may help students come to see themselves as equal, valued members of the research team.

While true equality may not be achievable, particularly in cases where the faculty member has a current or future role in evaluating the students' academic performance, it is important that effort is directed towards reducing the power imbalance. We did this through frequent small group discussion, ensuring that everyone had the opportunity to speak, and implementing changes that the students suggested. This seemed to demonstrate to the students that their opinions and feedback were equally as important as faculty members' contributions.

Participation in a research team, attending conferences, and meeting other researchers may also help students come to see themselves, and the discipline of nursing, as part of the larger academic community (Kessler & Alverson, 2014). This socialization helps undergraduates to develop the necessary self-awareness and understanding to begin to appreciate themselves as a nurse scientist (Van Vliet, Klingle, & Hiseler, 2013). Spending time with research mentors, being involved from the beginning, and being immersed in the research can illuminate to the student researchers how they can engage in rigorous knowledge construction (Kennel et al., 2009). One of the undergraduate co-authors provided the following reflection:

Learning about research at an early age, has been a substantial benefit. It has shaped how I see myself professionally and increased my interest to continue doing research throughout my career. It has also helped me to better understand research related concepts I would have never thought I could.

Schaefer (2013) describes an evolving thought process as another key dimension in developing a research identity. The author highlights

how undergraduate researchers face repeated exposure to the unknown, ambiguity, research challenges, uncertainty, and unpredictability. Through this process, there is an opportunity for the co-construction of new knowledge and understanding (Hunter, Laursen, & Seymour, 2007). Schaefer (2013) explains that ongoing reflection is an important activity and one that helps to develop critical thinking and empower students by providing a space for rehearsing their decision making skills. We encouraged this learning by having regular team debriefing sessions where we reflected on our progress. These sessions often included role-playing new ideas (e.g., alternate interviewing strategies).

Mentoring strategies

A number of models for supporting undergraduate research projects are described in the literature. Wells and Cagle (2009) incorporated Bandura's (2001) social learning theory predicated on the notion that students gain knowledge to guide their intended actions, and this knowledge is best achieved through active learning and reflection. Effective learning occurs through "interaction, role modeling, rehearsal, reinforcement, and attachment of meaningfulness to information by the learner" (Bandura, 2001 as cited by Wells & Cagle, 2009, p.505) set within a collaborative learning environment. Hunter et al. (2007) adopted a more pluralistic approach, combining constructivist pedagogy with concepts from Vygotsky's (1978) zone of proximal development, Lave and Wenger's (1991) communities of practice, and Brown, Collins, and Duguid's (1989) cognitive apprenticeship theory. Hickey et al. (2015) similarly used a situated learning framework influenced by the work of theorists (Lave & Wenger, 1991; Vygotsky, 1978) and incorporated elements of situated cognition (Stein, 1998; Wilson, 1993), emphasizing the importance of providing meaningful learning experiences in an authentic environment. One of our undergraduate co-authors reflects on the value of this experience:

I believe mentorship has been such an important thing for undergraduate researchers because we need guidance and someone to direct us. Without a mentor I don't think I would have come as far as I have because I wouldn't have had someone to criticize my work. Thus, it never would have improved.

Table 1 below summarizes the most relevant examples of theory application found in the literature and those most helpful to structuring mentored learning experiences and lists examples of how the learning theories were translated into action.

Process-environment mentorship model

Our mentorship model used two existing models (Paige & Daley, 2009; Hickey et al., 2015) as a foundation. The original model was developed to guide simulated nursing practice (Paige & Daley, 2009); it synthesized principles of situated cognition to identify three necessary elements for effective knowledge transfer: people, activity, and ingredients. Hickey et al. (2015) adapted this model for application to research mentorship. The adapted model paired specific components of the research environment (e.g., data collection, meetings, technology) with the three original environmental elements (Fig. 1).

These models were further modified based on our current literature review and experiences of mentoring and being mentored. These original models identified and incorporated three components necessary to create an authentic research environment: community, ingredients, and participation. However, environmental components alone inadequately support effective mentorship. To address this limitation, our revised model includes four *processes* that facilitate mentorship. In our model, environment and process components are interconnected aspects of effective mentorship. All modifications were developed collaboratively by the authors (i.e., faculty, service partner and undergraduate students).

Processes to facilitate mentorship

The model incorporates four interrelated processes for effective mentorship in undergraduate research. *Communication* is an obvious element of any project. However, effective communication is difficult to achieve and time consuming. We used various modes of communication: face-to-face, email, text-messaging (e.g., WhatsApp), and, less frequently, phone calls. Face-to-face communication was helpful when mutual understanding is required or new information or skills are being introduced. We used email when detailed information (e.g., instructions, meeting summaries) was be communicated, but team members already had some knowledge of the content. Text-messages (e.g., WhatsApp, Facebook Messenger) seemed most effective when a prompt response was needed and seemed to have a better chance of being read immediately than email. Phone calls were used less frequently, but were helpful when an issue needed to be dealt with speedily or when mutual understanding was essential and where face-to-face communication was not possible.

The second process element, R*eflection*, can happen in many contexts within a URP. For us, it occurred through formalized team discussions and debriefing sessions, or as an individual process, where students and instructors were encouraged to reflect on personal learning, challenges, and performance. Reflective journals may enhance this, although we had low adherence to this process. Reflection may also be more focused, where mentors meet individually with undergraduate researchers and guide reflection to promote deeper learning. We did this once or twice per semester. Regardless of the context, reflection in URPs should focus on both learning and participation. Reflection on learning can help to ensure a gain in research-related knowledge and skills, while reflection on participation can contribute to the development of a more effective community of practice.

The third process element in *Dual*-focus. To ensure maximum benefits to the undergraduate researchers, a *Dual-focus* should maintained throughout the project: one focus related to the research question or primary outcome and one related to the students' learning. This focus on learning, and explicitly exposing it, seems especially important with inexperienced undergraduate researchers. However, this took time, and research schedules had to be extended several times to give enough time for knowledge development. Subsequently, the inclusion of learning as a primary focus may mean that the choice of research topic or design needs to be less complex or ambitious for an undergraduate research project.

The final process element is to *Fade Control* for research activities from faculty to students. We were able to do this as students gained more experience and confidence with project-related tasks. This seemed to increase the undergraduate researchers' ownership of the project and their sense of contribution to the team effort. The purpose of fading control is not to relieve faculty members of (some) project responsibilities, but change faculty roles from doing to monitoring, supervising and directing. We have found that gradually increasing task complexity and student responsibility for completing tasks independently, or with peer support, has allowed us to effectively fade control, but never absolve responsibility.

Environmental elements to facilitate mentorship

Three key environmental elements should be incorporated into the mentorship approach used for URPs. These elements are interconnected and will be enacted differently depending on the context of the research. They include, *Participation*, *Community*, and, *Ingredients*.

Efforts should be made to ensure the research environment allows a range of opportunities for *Participation*. It is through participation that students gain benefits that are not normally available in the classroom setting. Our undergraduate researchers participated throughout all stages of the project, including planning, implementing, and disseminating results. Expecting students to be consistently involved may

Table 1
Learning theories used to structure undergraduate research mentoring.

Author - theory	Summary of theory	How theory was translated into action
Wells and Cagle (2009) - social learning theory	Learning is an active process that depends on perception and interpretation. It is influenced by prior knowledge, attitudes, and social context. Incorporating learners' goals and expectations increases learning effectiveness. Knowledge is retained through reflection, which occurs primarily through social interaction.	1. Team building activities 2. Initial orientation 3. Extensive training during first two months 4. Role playing and reflection about practical aspects 5. Faculty available by phone throughout project 6. Control was faded to students over time
Hunter et al. (2007) - constructivist pedagogy	Knowledge is continually constructed and reconstructed. Students can learn beyond their knowledge level through close collaboration with more experienced mentors. Mentors engage with students in a two-way knowledge construction process on a task of mutual interest. Meaning-making is a negotiated social process where the mentor is a facilitator of learning.	1. Faculty interviews potential research student to ensure a good match 2. Negotiation & guidance in choosing a project 3. Intensive orientation (knowledge, skills, and environment) 4. One-to-one mentorship early in the project 5. Weekly meetings 6. Enable self-direction and independence 7. Collaborative problem solving 8. Encourage peer learning
Hickey et al. (2015) - situated learning	Learning environment, tasks, and interactions should be as authentic and realistic as possible. Knowledge and skills develop through close collaboration between students and teachers. Learning takes place through shared tools and language, and is socially- and contextually-dependent.	1. Give students responsibility at each stage 2. Set shared student-faculty tasks and activities 3. Hold regular meetings throughout the project 4. Scaffold student learning by providing coaching and role modeling 5. Set both individual and group work 6. Fade control of the project to the students as they gain confidence 7. Provide exposure to academic community (e.g., conferences)

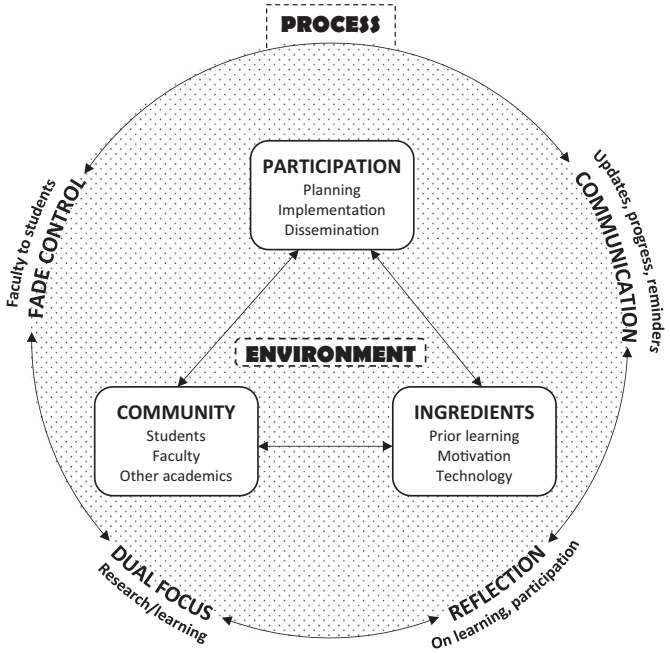

Fig. 1. Process-environment mentorship model for undergraduate research projects.

be unreasonable, so flexibility, accommodating varying levels of engagement, needs to be balanced with expectations. We took a team approach from the beginning and acknowledged that one of more team members may not be able to fully contribute at certain points, and that in these cases the remaining team members would temporarily share that additional workload.

Community is another important environmental element. Students should have the opportunity to contribute as equal members of the team and be exposed to stakeholders and other researchers and scholars outside of the team to feel a sense of inclusion. We used team-building activities (e.g., a half-day of fun, cooperative activities and challenges), collaborative discussions, and regular meetings to create and maintain a sense of community. Perhaps most importantly, we supported students to make meaningful contributions in shared work with other students and with mentors by ensuring everyone had a chance to share opinions and that these opinions were taken seriously.

The final environmental element consists of the *Ingredients*. Students and faculty bring a range of prior learning and skills, and different levels of motivation to a research team. We spent time at the beginning of our project to better understand each individuals' strengths and limitations. This understanding contributed to a more effective delegation of work and facilitated problem solving. Assessing the technology (e.g., voice recorders, computer software) and other resources (e.g., meeting space, local experts) available to support project activities and taking time to familiarize team members with these may was also helpful.

Conclusion

Participation in real-world research projects with undergraduates can reap benefits for both faculty and students and also provide opportunities for higher education institutions to provide research training exposure to undergraduate students. This paper has sought to emphasize how use of a model to provide the architecture for the endeavor can do much to ensure student needs are met. While we did not test our model, the literature and our anecdotal experiences suggest that students can develop as researchers and gain skills for qualified practice through mentored participation in research. What cannot be underestimated is that “faculty can learn from students as students are learning from faculty” (Boyer Commission on Educating

Undergraduates in the Research University, 1998, p. 15), which brings its own rewards. Effective, evidence-based mentorship have the potential to maximize this learning.

Disclaimer

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