Learning Scientists in Academia and Industry: Building Bridges and Expanding the Potential of our Community

Mamta Shah, Elsevier, m.shah@elsevier.com
Erica Snow, Independent Researcher, elsnow4@yahoo.com
Ryan S. Baker, University of Pennsylvania, rybaker@upenn.edu
Christine Gouveia, Elsevier and University of Pennsylvania, c.gouveia@elsevier.com

Abstract: The goal of this paper is to spur new conversations and deepen existing ones around how learning sciences (LS) professionals can build bridges through our work in academia and industry and expand the potential of our community. First, we briefly describe the evolution of LS education programs which includes the skill sets needed, and the career roles and pathways graduates are prepared for. Next, we propose a role definition of an applied learning scientist (ALS); that is, a learning scientist working outside of academia. We also chronicle a partnership between four learning scientists working in academia and industry. Our paper concludes with reflections and implications for what academics and practitioners learn from one another when they collaborate to promote impactful and scalable environments for learning.

Introduction

Leaders in education and technology industries have shared their vision for building a better future in research and practice. This involves "making progress by building bridges, funding common ground and finding linkages" (Bayazit, 2019). Twenty years ago, the National Research Council (Donovan, Bransford, & Pellegrino, 1999) made a similar call, urging partnerships between researchers, practitioners, and professionals in industry to spur innovations in learning. These calls have never been timelier. A sizeable percentage of learning scientists have reported working outside of academia in formal and informal settings, with a wide range of disciplinary interests, research and practice foci, and methodological approaches (Yoon & Hmelo-Silver, 2017). Our paper attempts to spur new conversations and deepen existing ones around how learning sciences (LS) professionals across sectors can make progress collectively through partnerships in academia and industry.

The making of learning scientists (Then)

Nathan, Rummel, and Hay (2016) led a workshop at the 2010 International Conference of the Learning Sciences (ICLS) conference. They facilitated participants to review of characteristics of graduate programs that self-identified as LS and to reflect on the ramifications of graduate education programs in preparing the next generation of learning scientists. Discussions from the workshop resulted in shared understandings. First, the extent to which programs situated themselves on the spectrum of basic and applied research is imperative to the effectiveness of a LS graduate education. Second, the focus of study in LS is emergent and may evolve over time through the disciplinary perspectives and interests that individuals bring to the discussion. In addition, one thing that stood out was the lack of diversity in the career pathways LS programs offered for its graduates back in 2010. The beneficiaries of these programs included professors, researchers, teachers, and "people working in special design industries." These discussions were timely for a maturing field. Nathan and colleagues (2016) recommended that a discussion on the changing nature of LS education and emergent central themes for the field should become prominent and a continuing activity within the International Society of the Learning Sciences (ISLS)

The making of learning scientists (Now)

Recently, Sommerhoff and colleagues (2018) conducted a document analysis of 75 LS graduate programs across the world to identify what we teach when we teach the LS. The top six concepts taught in more than half of LS programs included the following: using technology to support learning, cognition and metacognition, designing learning environments and scaffolding, disciplinary learning, learning in formal contexts, and learning in informal contexts. The top three methods addressed by LS programs were design-based research, basic statistics, and linear models. Lastly, the top three disciplines included computer science (48%), psychology (35%), and science and science education (35%). When examined in relation to Nathan, Rummel, and Hay's (2016) findings, these developments continue to underscore the hallmark of our graduate programs, which are driven by multidisciplinary theoretical approaches and methodological tools.

Around the same time, Yoon and Hmelo-Silver (2017) surveyed members of the ISLS community to get a comprehensive understanding of what learning scientists do and the contexts in which their work is situated. Graduates from masters programs were engaging in positions related to education and learning in a variety of contexts (e.g. K-12, information technology) through roles such as teachers, consultants, data analysts and game designers. Graduates from doctoral programs predominantly chose academic positions, but there was a sizeable percentage of respondents that indicated other professional roles (e.g. researchers in non-academic settings, leaders in digital media startups or multinational companies in the learning technology and higher education industries). Yoon and Hmelo-Silver's study (2017) is a testament to the growing applied direction the field of LS has taken. It is imperative to continue examining the roles, foci, domain expertise, and approaches of learning scientists in emerging areas of practice to obtain a sense of the skill set, knowledge base, and the research interests that are in demand.

Another observable development in recent years is the surge in programs that specifically identify themselves as "Applied Learning Science." We identified four programs in North America, each one at a different level of education: bachelors (at the Illinois College of Education), masters (at Carnegie Mellon University and University of Miami), and doctoral (at the University of Miami). In terms of disciplinary focus and an overview of content, these programs are aimed at providing students with a foundation in LS with scholarship in areas such as education, psychology, business, law, and human-computer interaction. Little information is available about the specific research methods students would develop expertise in. However, broad foci such as qualitative methods, quantitative reasoning, and statistics to analyze large data sets are commonly mentioned. Interestingly, program descriptions focus heavily on the range of careers graduates would be ready for. For instance, careers such as teachers, policy makers, analysts, and professionals in government, healthcare, business, and nonprofit organizations are highlighted. There is an emphasis on preparing graduates to be able to "move beyond the traditional education sphere and consider professional learning design, training, organizational development roles in consultancies and training providers." As such, some programs target graduates with an entrepreneurial motivation who would benefit from a foundation in LS to be able to develop "learning products or technologies for education technology companies" and embrace "teaching and training roles in a range of industries."

Even beyond programs that explicitly identify themselves as applied LS, many LS programs have moved towards having a strong commitment to producing learning scientists who work in practice. For instance, the Learning Sciences and Technologies (LST) masters program at the University of Pennsylvania is designed as a terminal masters (i.e. although some students go on to Ph.D. or Ed.D. programs, most do not) and many if not most of the program's recent graduates go on to jobs in industry. While some courses have an explicit research focus, other courses such as Big Data, Education, and Society (where the final project is a proposal for SBIR industry/academic collaborative grant funding, and one of the class's project groups have started a company) and Design of Learning Environments are explicitly targeted towards practice. Students also complete an internship as part of the masters, and the majority of LST masters students choose internships in practice rather than research.

In light of the emerging developments in the field, both in terms of education programs and the broadening career pathways of learning scientists, it is becoming increasingly apparent that learning scientists' scholarship is always on a spectrum of being foundational (creating basic knowledge) and applied (addressing practical problems), operating within "Pasteur's Quadrant" (Stokes, 1997). However, it is unclear what truly defines the role(s) of learning scientists in applied settings (e.g. industry) and the ways in which they contribute to the examination, design, and optimization of existing and new technology-enhanced learning environments. Thus, below we define the role of an applied learning scientist (ALS) and provide examples within the context of Elsevier, a global information analytics business empowering knowledge in science, health and technology. We also illustrate how learning scientists in industry and academia can come together and learn from each other to enrich research and practice.

The role definition of an applied learning scientist

Internal and external knowledge-building

In many organizations in both academia and industry, applied learning scientists (ALS) have an interdisciplinary focus that enables them to detect points of intersection within and across disciplines. In this way, ALS working in industry are uniquely positioned to raise awareness and visibility of key developments and best practices from research to internal and external audiences. ALS can also support product and design teams in applying this knowledge to define, build, and support educational products that address challenges for educators and students. Furthermore, it is often beneficial for the ALS to more widely disseminate research on topics with broader relevance to other teams. The dissemination of information can take on many forms and levels of granularity. To give an example from our own work at Elsevier, a past webinar for administrators of nursing programs focused on academic research findings and strategies for fostering student engagement in online programs, with the goal of helping these administrators improve student persistence and retention outcomes in their programs (Gouveia, 2019). In another presentation at an intra-organization Data Science Summit, Shah (2019) discussed the symbiotic roles of learning scientists and data scientists. Shah (2019) presented ongoing and envisioned collaborations between learning scientists, data scientists, and product analysts such as (a) the use of predictive analytics to facilitate early detection and intervention for at-risk nursing students, (b) mining big data to ascertain the predictive validity of high-stakes specialty and exit exams in nursing education, and (c) integrating data across products to examine epistemic and social networks for nursing students over time.

Translating research into practice

The relatively new, yet critical role of the ALS (who often simultaneously serves as a researcher, teacher, and consultant) plays an important part in bridging research, teaching practices, and educational program design to improve student learning. In their roles, ALS gather, synthesize, and translate research findings on how people learn to the design, development, implementation, and continuous improvement of educational solutions and technologies. The ALS must also simultaneously balance this work with corresponding business or market needs, a somewhat delicate task. This can be seen in another example from our work at Elsevier. The field of nursing education is undergoing a massive change in the design and execution of its licensure exam, largely due to the adoption of a theoretical and pedagogical model known as the Clinical Judgment Measurement Model (CJMM). Existing and new products will need to address CJMM in its design and support customers (e.g. nurse educators) in adopting the product to meet their changing educational goals. As such, collaborative research may serve to produce a type of product that bridges the gap between theory and practice. Other partnership types may focus on primary research or co-applications to research grants while some others may result in curriculum design and prototyping new learning solutions.

Building bridges

Applied learning scientists collaborate cross-functionally with a variety of teams, including product managers, subject matter experts, content developers, technology, marketing, and other researchers (e.g. market, user, design, data science). This allows ALS to ensure product design and technologies are optimized to improve learning outcomes through the incorporation of LS research and principles. We engage in critical reflection and iterative dialogue to deeply understand practical problems to be solved, generate solutions with LS, and determine how to make them feasible with time, financial investments, and other practical constraints. Through joint work, all aspects of research are defined and 'evolve through interaction, rather than being planned fully ahead of time or defined by either researchers or practitioners independently of one another' (Penuel et al., 2015. p. 183). One such collaboration is focused on the co-development of an online prep course for graduating nursing students. Virtual tutors and a customized study program guide the students to help them pass the National Council Licensure Examination (NCLEX), a nationwide exam for the licensing of nurses. This is the first initiative at Elsevier where ALS are working with a cross-functional team of product and business managers, subject-matter experts, and academics to ensure that we have a rigorous and robust learning methodology to support our product design and execution. The learning methodology consists of an instructional framework for supporting students' content knowledge and test-taking skills essential for passing the NCLEX. In addition, the course contains student support in areas such as self-efficacy, anxiety management, and motivation. To ensure there is evidence to support the methodology, metrics were implemented to continually measure student outcomes. The authors are conducting ongoing pilot studies to determine the product's effectiveness and to increase the likelihood of successfully "scaling up" a solution for a wide variety of nursing school contexts (Dede, 2006).

Chronicles of a partnership

Over the last year, a group of learning scientists from diverse backgrounds (the four authors) collaborated within an industry environment (i.e. Elsevier). This partnership involved (a) establishing a LS approach, (b) crafting an efficacy research process/protocol, and (c) building capacity of the industry team through end-to-end LS support in the research and development process (across design, implementation, analysis, and reporting). Through this work we have established key takeaways and lessons learned that have informed our next round of collaboration. For instance, there are a variety of scientific and business constraints that we need to consider as we design empirical studies and develop protocols. While we may want to build perfect factorial designs, many times we have to adapt to the constraints of a specific group of learners and their learning context. This requires a feedback loop between the various stakeholders and expectation setting from the beginning. As each stakeholder has unique experiences and backgrounds, this collaboration has promoted cross disciplinary learnings and improvements. These learnings are not unidimensional and provide strong feedback loops where practitioners and academics are learning from each other and moving forward with increasingly shared understanding of the state of the field, the constraints of a business relationship, and the end goals of the research project. This partnership has prompted us to reflect on what academics and practitioners can learn from one another as a way to demonstrate how together we can widen the impact of our community.

What academics and practitioners learn from one another

Academics bring valuable theoretical perspectives and expertise in research methods that are critical to understanding and solving complex problems. These perspectives can stimulate and enrich an organization's research strategy by providing guidance on the development, planning, and implementation of its research agenda. Practitioners often attempt to solve critical problems for particular educational contexts within limited time frames. Problems faced in real-world settings often require that a practitioner apply subject matter expertise in one or more disciplines and varied methodologies. An organization can bridge knowledge gaps and improve their research capacity by establishing an interdisciplinary research team of academics and practitioners. This type of team has the vast expertise and experience needed to solve complex issues that would not have been possible alone.

One common view about collaborations between practitioners and academics is that such partnerships are unidirectional -- that the wisdom of academics is brought into industry and to practitioners (Hille, 2011). In fact, as Stokes (1997) notes, the flow of ideas goes very much in both directions. Learning what challenges are key to practice can inspire the next round of research by academics (Yohalem & Tseng, 2015). Within the current collaboration being discussed here, ideas around how a research team can enhance the capacity of a broader development team have already inspired this paper -- and further thought on models of collaboration between industry and academia. Many more such examples can be found -- the intersection between industry/practice and academia is full of potential.

Conclusion

Increasingly, learning sciences (LS) has become an applied field, with an increasing proportion of people trained as learning scientists conducting their research in contexts focused on practice. However, our field's thinking about itself still in many ways reflects its academic roots. Within this paper, we consider how one might define an applied learning scientist (ALS), chronicle a partnership between academic and industrial learning scientists, and discuss how this type of partnership offers benefits for both sides -- i.e. how industrial researchers and practitioners benefit from working with academics, and also how academics benefit from working with industrial researchers and practitioners. By better understanding the full growth of our field, we can better work together and learn from each other, to the ultimate benefit of the real stakeholders of the LS -- the students who learn and the educators who help them learn.

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