International Journal of Science Education

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/tsed20

'I didn't know what I was doing, until I went there': a case study exploring the range of student STEM internship experiences during the COVID-19 pandemic

John Ruppert, Jennifer Ayala, Claude Bamaba, Yosra Badiei & Jeanette Wilmanski

To cite this article: John Ruppert, Jennifer Ayala, Claude Bamaba, Yosra Badiei & Jeanette Wilmanski (2022): 'I didn't know what I was doing, until I went there': a case study exploring the range of student STEM internship experiences during the COVID-19 pandemic, International Journal of Science Education, DOI: 10.1080/09500693.2022.2159776

To link to this article: https://doi.org/10.1080/09500693.2022.2159776

INTERNATIONAL JOURNAL OF SCIENCE EDUCATION
https://doi.org/10.1080/09500693.2022.2159776

Routledge
Taylor & Francis Group

'I didn't know what I was doing, until I went there': a case study exploring the range of student STEM internship experiences during the COVID-19 pandemic

John Ruppert [a], Jennifer Ayala[b], Claude Bamaba [c], Yosra Badiei [a] and Jeanette Wilmanski [a]

[a]School of Arts and Sciences, Saint Peter's University, Jersey City, NJ, USA; [b]Caufield School of Education, Saint Peter's University, Jersey City, NJ, USA; [c]Saint Peter's University, Jersey City, NJ, USA

ABSTRACT

The COVID-19 pandemic has accelerated a transition to flexible remote and hybrid work arrangements. This shift presents a challenge to colleges and universities as they prepare the next generation of STEM professionals in the knowledge economy. This case study of student experiential learning during the time of critical change from the Spring of 2020 through Spring of 2022 focused on how students, typically aged 20–23, contended with their professional development amidst changing patterns in workplace community, culture, and activities. We expected that students would struggle to achieve a greater understanding of situated workplace community practices; however, the data problematised these general assumptions. The findings highlight the variation in student experiences around these themes and are discussed in the context of scaffolding of student internships in intrapersonal, interpersonal, and cognitive domains.

ARTICLE HISTORY
Received 15 July 2022
Accepted 14 December 2022

KEYWORDS
Professional competencies; context-based learning; higher education

Introduction

Spring 2020, Northeastern, USA. Marcelo[1] was a student in an internship with a pharmaceutical company when the COVID-19 pandemic began. He had been working in the lab for ten days following others and learning techniques for himself. Then, everything stopped. The university closed and moved online; his internship went on pause; the region went into lockdown. Two months passed, and he was finally able to start work in his internship again with the same employer, only this time, remotely. For the first time in his daily reflection, he described his struggles at the internship in a different way, expressing uncertainty on what to do: '[I] Was unable to determine necessary instructions at first but was able to resolve on my own. Awaiting supervisor's response for assignments.'

The COVID-19 pandemic accelerated existing trends toward more flexible remote and hybrid work arrangements that are predicted to continue despite current pushes for

CONTACT John Ruppert jruppert@saintpeters.edu School of Arts and Sciences, Saint Peter's University, 2641 Kennedy Blvd, Jersey City, NJ 07306, USA

'normality' (Gallup, 2022; Molla, 2022). This shift presents a challenge to colleges and universities as they prepare students for the next generation knowledge economy. Despite many challenges associated with the pandemic, this time of critical change afforded an opportunity to explore emerging patterns in student internships and gather insight for supporting 21st workplace readiness. What were originally in-person experiences in a variety of workplaces abruptly changed, having a significant impact on the nature of students' experiential learning. The case study described in this paper explores student internships from the Spring of 2020 through the Spring of 2022. We specifically focus on how students contended with their professional development amidst changing patterns in workplace practice, community and culture.

Theoretical framework

While experiential learning has been considered an important way for students to enhance their academic learning, particularly for underserved students (e.g. Christian et al., 2020) contextually situated features (i.e. intersectional contexts) make this argument not entirely true (Holyoak, 2013; Hora et al., 2021). Effective learning requires developing more than students' conceptual science understandings. For traditionally underserved students, it particularly involves supporting technical and professional skills as well as students' agency and network (Basu et al., 2009; Hora et al., 2021). In the following sections, we unpack these elements, first exploring what employers view as important workplace skills.

Reframing and valuing 'soft skills' as workplace practices

Much of the literature points to employers seeking more than technical knowledge and skills from entry-level university graduates. The terms used to describe these capacities vary, commonly referred to as 'soft skills', but also professional skills, social skills, and twenty-first century Competencies. These are not clearly defined, encompassing a range of skills (e.g. Finley, 2021), competencies (e.g. Parlamis & Monnot, 2019), and attitudes (e.g. Byrne et al., 2020), yet are viewed as critical to success in the workplace. In business management literature, Parlamis and Monnot (2019) made the case for shifting from the framing of soft skills which, contrasted with 'hard skills', denote something secondary and less rigorous to CORE skills: Competence in Organisational and Relational Effectiveness. They described this as a fundamental skill set that focuses 'on the human side of business' inclusive of critical thinking and social skills, noting that one 2012 study found integrity, interpersonal skills, responsibility, teamwork, and work ethic to be among the top ten attributes in today's workplace (p. 226). A more recent report on employer views of college and university student workforce preparedness by the Association of American Colleges and Universities (AACU) found that employers valued applied and experiential learning for students, particularly in the form of internships, as well as characteristics like the ability to work in teams, critical thinking skills, leadership, and creativity, among others (Finley, 2021).

Pelligrino and Hilton (2012) moved from a more nebulous list of skills to *competency clusters* divided into intrapersonal, cognitive, and interpersonal domains. This three-dimensional framework (Intrapersonal, Interpersonal, Cognitive) has gained traction in Science Education as "Twenty-First Century Competencies" (National Research

Council, 2012a), where the measurement of these competencies has been established through a lens of 'practice' (National Research Council, 2012b). Research in Science Education has long pointed toward the interwoven nature of knowledge and skill, wherein learning general reasoning strategies (e.g. mechanistic reasoning and critical thinking) is linked to domain knowledge and awareness of situational features (e.g. Ruppert et al., 2019; Schauble, 1996; von Aufschnaiter et al., 2008), challenging a 'skills' framing for workplace readiness. Following suit, we might look at workplaces in a similar way applying *competence* to context; that is, centring focus on workplace practice (verb). Importantly, however, application of knowledge and skills that make up the twenty-first century Competencies to professional as well as civic contexts is likely not straightforward; development and expertise is highly situated.

Situated cognition and the role of context in knowledge analysis

Science concepts 'are both situated and progressively developed through activity, and are not some sort of abstract, self-contained, substance. Instead, it may be more useful to consider conceptual knowledge as in some ways similar to a set of tools' (Brown et al., 1989, p. 33). For example, learning about Natural Selection as a concept is ineffective for deep learning; however, using Natural Selection as a framework for developing explanatory models and predictions showcase the use of the concept as a 'tool' to make contextually situated models and predictions (Passmore & Stewart, 2002). As students learn to use knowledge as a tool, situational features complicate the neat assumptions of conceptual science ideas and learners need multiple contexts to help parse the generalisations from situational features and learn to effectively use science knowledge as a tool (Duncan, 2007).

Both schools and workplaces are culturally entrenched in the idea that it is necessary to know 'the important' abstract knowledge before engaging in professional practice (Brown & Duguid, 1991; Orr, 2016). In workplaces, canonical training tends to fall short of helping novices develop situated awareness underlying workplace practices (Orr, 2016). Research regularly indicates that developing deep learning of science concepts is inseparable from practices using them (e.g. Ruppert et al., 2019), yet this cultural tradition leaves many students having 'learned' science concepts, while struggling to effectively use them as tools applied to situations. In real-world situations, science is used as a heuristic tool to unpack situational features rather than as a set of facts (e.g. Roth & Lee, 2002; Ruppert et al., 2022).

Prior research suggests that engaging in experiential learning itself does not directly mean students are developing those sought-after links between knowing and doing (Amin & Roberts, 2008; Holyoak, 2013). Given the often-contextualised nature of internships, it is still plausible that despite the immersive, active, and authentic learning of the internship, without exposure to different employees working on different projects, interns may not develop the desired situated cognition. This is particularly important to reflect on with a shift to a more remote workplace, where fewer individuals may be physically present to interact with.

Distributed cognition in a community of practice

As stated earlier, workplace immersion gives students opportunities to interact with different people working on different, but related projects. It also affords discussing

colleagues' roles in their collaborative enterprise as a community of practice (Alzen et al., 2020; Lave & Wenger, 1991). Such discussions may form a basis for learning about distributed cognition in the workplace such as gaining a better understanding of the roles interns might play and a more realistic expectation of knowledge needed for entry-level success (Winsor, 2001).

Like one's developing understanding of the role that science concepts play as tools in framing contextually situated reasoning, understanding the community of practice and the role 'I' might play in it also takes time to develop. As students transition from periphery to 'insider,' we expect to see a shift in their language and a movement toward richer insider identity, shifts that importantly require legitimate participation (Lave & Wenger, 1991). Importantly, interns should be constructively contributing toward innovation through authentic activities with deliverable outcomes to the organisation or community (McAdam, 2000; Popadiuk & Choo, 2006); however, peripheral participation can take many forms over the course of the transition to insider/master of craft. This might include initial observing/shadowing to working alongside a master on smaller, more concrete tasks, to more independent work though not necessarily as a linear flow of development.

Early research in Communities of Practice explicitly defined them as 'face-to-face interaction between members working in close proximity to one another, in which identity formation through participation and the negotiation of meaning are central to learning and knowledge generation' (Amin & Roberts, 2008, p. 355). Scholars have challenged this 'face-to-face' restriction, highlighting a phenomenon called 'online communities of practice' where joint-sensemaking and problem solving can still stimulate norms of reciprocity (e.g. Wasko & Faraj, 2005). This follows earlier work extending the traditional 'community of practice' frame. Hutchins (1995), for example, pioneered a novel view of distributed practice where the 'community' is no longer a physical member but stored in memories (as physical cards), which the current worker engages with to help land a plane. Similarly, on Wall Street, stock traders have a clear workplace interaction that is built into their trading floor with clusters of specialists at desks to whiteboards and clear sight lines to read reactions, but Beunza and Stark (2004) also challenged the notion that Wall Street is bound by the four walls of the building. Like the pilots in a cockpit, Wall Street traders interact with Bloomberg terminals and other elements of a sophisticated socio-technical network.

This 'hybrid' view of communities of practice is particularly relevant in a post-pandemic world where many workplaces are debating the merits of in-person office work (Gallup, 2022). Unfortunately, research in online 'communities' of practice has limited development related to novice *peripheral* engagement in more traditional communities where students might normally work alongside craft 'masters' and, as highlighted earlier, be given the opportunity to engage with others in the organisation to learn more about the distribution of labour. More traditional face-to-face observation/shadowing may be clouded in online communities of practice. Lacking or being limited in this phase of legitimate peripheral participation, the research question we explored is: *What is the extent to which students' understanding of distributed as well as situated cognition in communities of practice can change in the shift to online/remote internships?* This question, while more narrowly positioned in the context of the fully remote work that took place during the COVID-19 pandemic, has important implications for how we might

understand how learners' legitimate engagement may be affected as more members of the workplace community of practice spend more of their time working remotely.

Methodology

The larger project within which this study is based consists of longitudinal, design-based research (Leedy & Ormrod, 2005) investigating the process and outcomes of transformative STEM internships for third and fourth-year undergraduate students. Multiple methods were used to collect primarily qualitative data, including interviews with students post-internship, student daily and final reflections, artefacts from the internship, pre and post internship surveys with students, and supervisor interviews and surveys. For this case study, a subset of these data were used to capture a set of learnings from the experiences of students during and after COVID-19-related transitions in their internships.

Research design

We employed a qualitative case study methodology using Merriam's (1998) view that it is an 'intensive, holistic description and analysis of a single instance, phenomenon or social unit' (1998, p. 27). This paper uses an activity-focused case (Patton, 2002) centred on university student experiences in a programme during a critical incident, the COVID-19 pandemic. There are also two embedded temporal units within this case (Yin, 2012), corresponding to shifts in the pandemic, from a time when students experienced a sudden change in their internships due to COVID-19, to a time period where most if not all of their internship experience was completed virtually from the outset.

Case sampling

We used typical-case, purposeful sampling (Patton, 2002) based on qualitative profiles of student experiences, documented below, in order to illustrate typical patterns and characteristics from just before to during the COVID-19 pandemic. Several students experienced an abrupt shift in the period in March of 2020 when the U.S. began to recognise a forming pandemic and schools and workplaces began to abruptly change how they operated. Students were operating under one set of conditions, then had to pause and shift to another set of conditions and circumstances. As the pandemic progressed from the time period of the fall 2020 and spring 2022, most students began their internships under remote conditions and the expectations were in line with this type of experience; however, some had hybrid and in-person experiences toward the later part of this period.

Internship programme context

The internships described in this study were part of a United States National Science Foundation-supported programme supporting Hispanic Serving Institutions in Higher Education. This programme, TREX, short for *Tr*ansformative *Ex*periences, provides grant-paid internships in STEM. These experiences are funded for the first 60 h of

work. TREX targets students entering their third or fourth year of university education (typically ages 20–23) with a 2.8 or higher Grade Point Average on a 4 point scale, majoring in at least one of the following majors: Biology, Chemistry, Biochemistry, Biotechnology, Physics, Mathematics, or Environmental Science. Students participating in TREX internships identified as 22.2% male and 77.8% female. The largest self-identified ethnic groups represented among the TREX participants are 48.8% Hispanic/Latinx and 17.8% African American/Black. Students accepted into the programme complete an asynchronous welcome orientation, are invited to monthly group discussions called 'TREX Talks', and are given three mentors to support their experience. These include the workplace supervisor, a full-time faculty member, and a dedicated STEM internship coordinator. Faculty mentors are asked to meet at least three times with the students during their experience to develop students' intrapersonal, interpersonal, and cognitive capacities.

To stimulate student communication with their mentors as well as encourage self-reflection, they are required to complete daily reflections that can be reviewed by each of their mentors. These reflections ask them to tell stories of moments when they felt successful as well as struggled. After completing the first and last thirds of the internship, students are asked to reflect further on their experiences and respond to questions probing their understanding of the connection of their work to others in their community. Among the questions:

> What is the impact of these successes on your personal future? How do you believe you work is impacting others? What are limitations of your current work toward improving the future? How do you rectify these limitations or what ideas do you have about transforming your field of work to better address these limitations?

At the conclusion of the internships, students shared their overall insights in a final reflection, answering questions about areas of growth and change, from specific skills and strategies, to views of themselves as civic actors and STEM professionals, and their overall understanding of the STEM field.

Data sources

Data sources included: interviews with TREX programme participants, daily and final reflections, and workplace artefacts. The interview guide consisted of questions about intern's experiences at their respective sites, including what they learned about themselves, the workplace, and STEM careers more generally, their relationships with supervisors and mentors, and how prepared they felt going into the experience, as well as areas of programmatic success and improvement. Data were also drawn from products made by students in the course of their internships. These workplace artefacts varied, but included social media campaigns, public presentations, and website material. Taken together, data from each of these sources were used to compose a fuller picture of the case examples.

Data analysis

Data from these various sources were compiled and transferred into the qualitative data analysis software Dedoose. Through an iterative process, the research team reviewed a

subset of the documents fitting within the defined time period of the COVID-19 pandemic. A set of initial codes and analytic memos grounded in the data were developed. The research team compared coded materials, and after discussing areas of commonality and disjuncture, revised the coding categories. Themes emerged based on observed patterns within the subset of cases.

Credibility and authenticity

Rather than rely solely on one-time student interview data to inform this case study, we examined corroborating evidence across multiple data streams, including student reflections and other artefacts, over multiple time points. Specifically, student reflections were collected across, roughly, three-month periods, better capturing patterns of change and not only perspectives in a particular moment. In addition, we used collaboration and peer debriefing as tools to help establish credibility (Creswell & Miller, 2000). Specifically, early in the project, but after the research questions were developed, we enlisted undergraduate STEM co-researchers who both did and did not participate in the internship programme. They were involved in developing and providing feedback on the various research instruments, conducted the student interviews, and are part of the ongoing research meetings discussing data analysis and coding. Also built into the programme and study design is consultation with an external partner-evaluator, which functions as a peer debriefing. We confer with her regularly on the research, particularly with the development of the various data collection tools. With this feedback, we have revised our processes, questions and prompts over time so that overall, the tools we use can be more credible and authentic.

Findings

We present an analysis of shifting workplace practices around two analytical lenses for which significant changes emerged in the transition from in-person to remote internships. These include:

(1) Distributed cognition in a community of practice
(2) Situated cognition and context

These findings are nested in utterances from students who had either: (a) completed their internships during the Spring of 2020, during which they experienced a sudden shift in the nature of their internships as a result of the COVID-19 pandemic, or (b) spent at least a majority of their internship remotely. This critical incident in time presented unanticipated and unique challenges, not only because of changes to the types of internship activities but because we were in an area where the community suffered many losses. Nevertheless, these shifts also offered insight into both what students find meaningful as well as the ways in which different types of work and exposure to the in-person workplace may affect learning. Table 1 contains a brief portrait of the students highlighted in Findings. These portraits contain exerpts of their own STEM interests and aspirations as well as their focus of study (major) and type of internship.

Table 1. Student portraits.

Marcelo	**Major:** Chemistry **Internship & Modality:** Pharmaceutical company; in-person shifted to online **STEM interest and aspiration:** *I always wanted to learn how things worked and why. I hope to gain experience that will help shape me as a scientist, and to learn skills that will help me in the STEM field. I am exploring the STEM field attempting to find my place, and hope that the internship will help me find my interests and provide me with the knowledge, confidence, and tools necessary to further my career by exposing me to the workforce.*
Veronica	**Major:** Biology **Internship & Modality**: In-person veterinarian clinic lab to remote science education **STEM interest and aspiration**: *I would like to try out new skills in a real lab or even an office involving lab skills or observing how some employers in medical/pharmaceutical/forensic establishments work. I do not have much experience that are [sic] practical and would like to explore that part of a career in an internship.*
Adriana	**Major:** Chemistry **Internship & Modality:** Urban biology inventory; remote, independent **STEM interest and aspiration**: *I am interested in science mostly because it is all around us, and in order to improve the world we live in, we need to understand the science that makes it. I want to expand my perspective in the STEM field. I hope to learn things and explore subjects that could enhance my future opportunities and path.*
Jeremy	**Major:** Biology **Internship & Modality:** Veterinary clinic; in-person **STEM interest and aspiration**: *I have experienced a lot of struggle and seen other people close to me experience the same. I have always hated that I cannot do much for them and I feel this way including animals. That is why I am following a career in science so I can in some way gain knowledge and eventually help people or animals around me.*
Sophia	**Major:** Biology **Internship & Modality:** Urban biology Inventory; remote, independent **STEM Interest and Aspiration**: *From a young age I knew I definitely wanted to work within the scientific field. Partaking in a career path where I am constantly learning, discovering, and problem solving is a major goal I am working on achieving. I am hoping to gain knowledge not only on laboratory techniques, and I would also like to be able to get pointers on how to effectively apply for positions and be able to use the individuals conducting the internship as potential mentors.*
Rachel	**Major:** Biology **Internship & Modality:** Science Museum; remote **STEM Interest and Aspiration:** *I have learned that there is a great need for educating our community – specifically, teaching about human impact on the environment. Positive change for the environment or any other aspect of life starts with educating others. I plan to pursue a career in science to raise awareness of climate change's detrimental consequences.*

Distributed cognition in a community of practice

Before the pandemic began, interns commonly reflected on the nature of the workplace and how it operates as an important aspect of their learning. For example, when responding to an interview question about the most important learning from the internship, a Biology major, Veronica, expressed learning about the community of practice, specifically how the different members of the community engaged in *distributed* roles that together made the whole:

> I learned that there's, like, every workplace has […], a set list of tasks for different positions to take care of. But even though there's, like, different, like, such as the technicians and the physicians, as well as the secretaries, they all have different tasks, but they also need communication. […] I thought that was very educational to see how, like, the different, I would say, parts of the workplace were together, right?

Veronica, like many, found these in-person experiences, where they could observe the larger community of practice in action, rewarding. A common theme before the pandemic was a widening scope of the opportunities available to students. Importantly, we are not implying that this widening scope was not achieved in internships following

the shift to more hybrid and online experiences, which is discussed later; however, we are pointing out the nature of how this student highlighted the breadth of different roles that everyone plays. As students shifted to remote work in March of 2020, we saw an abrupt change in the qualitative nature of their reflections regarding their community of practice; however, the shift was not associated with a universal trend. Some students had enhanced experiences that made them feel more a part of the community of practice. Marcelo, like Veronica, began his internship in-person prior to the start of the pandemic; however, unlike Veronica, Marcelo's workplace was able to continue offering a remote internship opportunity. Like Veronica, Marcelo highlighted learning about distributed practices he noticed about the workplace community as well as about the use of analytical machines. After shifting to remote work, the focus of his tasks changed:

> … especially at home during the COVID-19. [supervisor] sent us a lot of the remote work and a lot of it was revising and editing, revising and editing. I feel like I was trying to publish a paper. But it really was a great experience to learn a little bit about what they do if they weren't in the lab all the time.

Marcelo felt engaged in a level of professional science that might often be thought of as reserved for only the well-seasoned employees. His supervisor offered an accelerated path to more legitimate participation in the community of practice, something that the intern found to be very meaningful and rose to the challenge, so much so that he was offered a full-time role at this location upon graduation.

While Marcelo had a very positive experience staying at the same organisation while shifting to remote work, Veronica had a very different situation. She had gone from working in a clinical laboratory to an internship developing and refining science education materials. Her daily reflections had a fundamental shift. Prior to the pandemic, she described workplace-specific features like those described above. In her new role, there was little discussion of the workplace community; rather she focused primarily on science content. For example, when responding in her daily reflection about a good moment she shared:

> One good moment was learning the effects of evolution over time through snake embryos. That they once had limbs long ago but over time and through mutation in the gene pools, the species evolved to be what they are today.

Interestingly, in her interview, she didn't mention any of the remote experiences; rather, she highlighted her learnings about workplaces themselves and the nature of laboratory work.

Another student that also started remotely, Adriana, found some connection to the community of practice. A Chemistry major, she had an internship inventorying biology of the local urban environment. When describing what she learned about working with others, she said

> I know this dude [who was] very detailed on their post in the website. And it kind of, like, motivated me to do the same […]. I saw him like, kind of like a role model like, 'Oh, he's like, you know, being very detailed. Like, let me be detailed. Let me put in my best work as well'. Not that I wasn't, but I was putting, like, vague details, but when I saw his work, I'm like, 'Oh, okay, then we're doing that' […] And then I also saw things that I was like, 'Okay, then I don't want to do that', because I saw things that were like, 'Oh, just identifying

> species without any comment'. Like, I didn't like that. So I would like see their work as both something I didn't want to do, and something I did want to do, and just, I guess, adjust to that.

In this quote, she described engaging with an online community of practice, learning from peers in a remote work environment by looking at good work. This good work inspired her to engage in emulative practices that allowed her to leverage her learnings generatively, spreading her sphere of influence to others in the community.

Unlike the previous students who were tasked with mostly independent work, a group of students were accepted into an internship at the local department of health that began and ended remotely, but tasked students to work in teams to successfully complete their projects. One student described this team focus as beneficial:

> Working with my partner and communicating virtually gave me a … feeling that I'm not doing this alone.

And another:

> One thing I was nervous about in the beginning was working online with strangers, and how we would use different devices to communicate and actually get the work done. I am happy to say that I adapted quickly to our weekly meetings with our supervisors … [and] … work as a team …

While these students were not able to walk around the office to observe the larger community of practice at the department of health, they developed a community of practice online, working together, distributing the tasks needed to complete their publication projects.

These examples illustrate the range of experiences students had with their professional development in the community of practice during this time of critical change. For some, a remote environment had little impact on their developing understanding of distributed cognition and the workplace community of practice. Others found ways to connect, even if not directly, and those who had already established a relationship with colleagues in-person saw new opportunities. This illustrates some important challenges to supporting either partially or fully remote internship as well as potential mentorship opportunities that we unpack in the Discussion.

Situated cognition and context

The Theoretical Framework discussed how professionals use scientific concepts as tools that help frame a simplified perspective that is iteratively unpacked to account for situational features. During their experiences, interns were asked to reflect on their use of scientific products in their work, specifically how they navigated the application of those products to the profession and broader community, and dealt with uncertainty.

Irrespective of starting in-person or remote, students generally struggled to articulate the limitations of their work in the earlier part of their internships. Some began to transition from a focus on basic tasks and their own personal limitations to a focus on organising principles of the domain. For example, Jeremy's internship was able to take place entirely in-person at a veterinary clinic, despite the pandemic. He clearly described his

developing situated understanding as he navigated the uncertainty of not only his own knowledge but the limitations of basic procedures:

> Before I was basically shadowing everyone because I knew nothing and I didn't know where anything was or what it was called or any protocol. But now when an animal comes in I am asked to hold an animal and restrain it so they can draw blood or take vitals. While it is great that I can help now I still have ways to go. The limitations I have is taking the vitals of an animal myself and get it all correct because I still make some mistakes which are small, so my work is double checked. I am also limited to being just an assistant and I haven't been taught how to draw blood yet or clean wounds. There are also certain things I haven't been taught yet because it hasn't come up, like what to do if an animal has an infectious disease or something. Or what to do if an animal has to be rushed to the surgery room.

While the limitations communicated in the quote above were organised more around Jeremy's personal practice, he was able to quickly recognise limitations, which positioned him toward developing a more nuanced understanding of situated cognition in the workplace. That is, when taking vitals/drawing blood, there are some standard practices, but situations in which those practices are modified. Similarly, he already recognised that practices could change for animals with 'infectious diseases or something'. The student's framing is set up to learn to more effectively deal with situated features of a context.

Interestingly, while one might predict that learners would encounter more difficulty in developing situated cognition in a remote work environment, this was not necessarily the case. For example, Sophia, who had a fully remote internship, was at first unable to answer the question, 'What are limitations of your current work toward improving the future?' Over time, however, she began to develop insights about both the core organising heuristics of the field as well as limits to the cannon and support features currently offered:

> Potentially, the plant identification app we use. Comparing the things were first blossoming to when it fully blossomed it would not accurately identify what it was so later on when the plant was fully matured the data had to be corrected. Plus there is not many images of the different phenophases of the different plant species.

In this quote, she identified canonical resources (Brown & Duguid, 1991) that were insufficient to support practice, offering perspective on key phenological ideas that could serve as better support. Her offering on how to improve workplace resources was indicative of her developing ability to parse situated versus generalisable knowledge as well as have a greater influence on her field – a boost to her science agency.

Similarly, in another fully remote internship that involved developing science education materials, Rachel began to think about some key domain ideas for education:

> Being around the students helped me understand how scientific content can be presented. For example scientific information needs to be presented differently from a child to an adult. This gives me insight for the personal project they have assigned me which was to create experiments for kids.

This transition to recognising that explanations have audience context is a key idea in education and communication broadly. Another student referenced that one of the students she was working with had an Individualised Education Plan (IEP), and was uncertain about how to navigate the adaptation of instruction to diverse learners, an indication of her growing situated awareness.

Importantly, however, while gains were seen in the intern's understanding of concepts associated with professional teaching, the situated nature of science concepts themselves was not seen to develop. This appeared to be rather common, where for example, in the quote earlier Veronica's description focused on 'the' story about the evolution of snakes as opposed to using natural selection as a tool for developing those stories as described in Passmore and Stewart (2002). This poses a classic issue for education; that the domain practices for education generally are distinct from those of the subject of the teaching, yet intertwined in practice, challenging teaching expertise development (Driel, Berry & Meirink, 2014).

Though the first student, Jeremy, who completed his internship entirely in-person, more clearly communicated his developing professional situated cognition, it is difficult to generalise that such learnings are more likely in-person as opposed to remote. The development of situated awareness was rather variable. That said, remote work environments require interns to engage in a greater degree of not only self-regulation for time management but also individualised learning with less exposure to contexts. This was particularly challenging for internships requiring creativity, where students commonly expressed being given 'too much creative freedom' without direction and structure. For instance, during one of the Spring 2022 TREX talks, students described ambivalent feelings about being given creative control over producing materials. While one student expressed that she 'loved the freedom,' others shared that they were feeling 'lost' initially and were expecting more structure and instruction. They questioned themselves: 'how do I go about it?' 'Am I doing this right or wrong?' This brings to bear an important caveat that emerged in this study: without broader engagement in a community of practice (as highlighted earlier), independence may limit interns' developing situated cognition. The structure interns craved was directly related to seeing how their projects fit into the context of the workplace, well encapsulated by one student's statement: 'I didn't know what I was doing, until I went there [to my work site]' (field notes).

Discussion

The time of critical-change that served as the context for this study helped visualise some important insights into supporting experiential learning that we frame using the twenty-first century Competencies described in the Theoretical Framework: cognitive, intrapersonal and interpersonal. Our data showed certain shifts in overall workplace practice related to each of these domains that may represent a lasting change. The goal of this Discussion is to make informed inferences about shifting workplace practices and what institutions of higher learning might do to better serve the next generation of students.

Cognitive

Pelligrino and Hilton (2012) described the cognitive domain as competencies related to processes and strategies, knowledge and creativity, including: critical thinking, problem solving, and adaptive learning, among others. These cognitive competencies are deeply embedded in the context of the workplace in which the competencies are practiced (Brown et al., 1989). Therefore, when making inferences about the cognitive domain

toward twenty-first century readiness, it is important to account for the nuances of cognitive reasoning in different workplaces, something that presents a challenge for learners in predominantly remote workplaces. As noted earlier, this was evident in our discussions with students, when they expressed both a desire for and anxiety over expectations of independence and creativity. Creativity is better developed with guidance and context (Hathcock et al., 2015; Kind & Kind, 2007). One student's comment that he only fully understood the scope of his work when he physically went to the work site and was able to observe the space in context as well as interactions between people, captures this. This presents a challenge for supporting the cognitive domain in remote and hybrid experiential learning environments.

We found that remote experiences restrict situated and distributed learning; however, learner support was critical to success. The nature of this support can vary depending upon the unique requirements and levels of creativity required in workplaces; however, this support should involve structured engagement with other members of the workplace community, whether on site or through structured virtual interactions. When appropriate, mentors should help learners understand the different roles that individuals play.

In some of our students' experiences, the introduction to the organisation was provided by the supervisor with limited interaction with others. This type of support can offer learners a general sense of the organisation's product, but it may lack the richness of situated and distributed cognition necessary to really understand *how* a product comes to bear and the specific role that the individual plays in this creation (e.g. Brown & Duguid, 1991). This was seen in Sophia's evaluation of the identification app that lacked appropriate scaffolds. For learners to better grasp the scope and context of the work, particularly for remote and hybrid environments, they should be given structured time to meet and shadow members of the workforce (in person or remotely) and gain a richer understanding of the work that each person does. As seen in the data earlier, some students do this on their own, and it might be easier to do this on site; however, for broader success in student cognitive development in experiential learning, we recommend explicit structuring of learners' engagement with the larger community of practice.

Interpersonal

The interpersonal domain focuses on teamwork and collaboration as well as leadership (Pelligrino & Hilton, 2012). For those students whose work was mostly independent, fewer opportunities emerged for direct contact, calling for a much more deliberative practice in this domain. In contrast, we saw some students were placed in teams by their workplace. Students in these teams could support each other in developing their interpersonal practice. These students were more likely to discuss the role of communication between supervisors, peers and themselves, and how these interactions functioned as models for their own sense of place in the work. Working collaboratively also combated feelings of isolation, suggesting that internships organised in small groups or cohorts collaborating on a project, as a community of practice, would be particularly beneficial in remote contexts where interpersonal interactions may otherwise be limited.

Building teams among new-hires in remote environments, however, does present challenges, particularly around building social connectedness (e.g. Rodeghero et al., 2021). As workplaces in the knowledge economy employ a more hybrid format, there are opportunities for university experiential learning programmes to support teams of interns and social connectedness among the team. While some of those students whose internship was in a team environment expressed nervousness seeking help and getting started, they quickly overcame these issues, relying on their teams. Working with peers can afford seeing and sharing similar struggles with others as well as supporting group-level learning. That said, benefits like this are not automatically inherent in unfacilitated teams (Fisher et al., 2020; Hogan, 1997). Appropriate support is still needed, particularly when considering the sociocultural complexity of group work in science learning (Anderson et al., 1997) and where the social status of students impact participation in higher level thinking (Bianchini, 1997; Wieselmann et al., 2021). Groups can perform poorly as a collective if the members of the group do not work well together (Bandura, 2000). In our case, those students who worked in teams had clear task structure and individual deliverables but also a collective efficacy (i.e. Bandura, 2000).

Students whose tasks did not have clearly defined structure expressed anxieties longer into their internships. This was particularly challenging given that they could not walk around the workplace to informally talk to others and build a broader awareness of workplace activities that they could participate in (Teng et al., 2022). In general, but more importantly for more independent work, interns need communication and task scaffolding. This includes problematising the meaning behind commonly-used but rarely explained career language phrases like 'taking initiative' and 'working independently'. Clarifying that though these terms connote an individualistic frame, particularly for complex workplace products, they can still involve collaboration, communication, and asking questions of team leads and peers.

Intrapersonal

The intrapersonal domain draws from personality psychology theories to describe characteristics including: intellectual openness, self-regulation, awareness, and general positive core self-evaluation, among others. The TREX programme asks learners to reflect regularly on their struggles as well as how their successes were bettering their own and others' futures. Most students, despite the pandemic, reported positive core self-evaluations to these questions. When describing their struggles, students commonly referred to basic issues of self-regulation related to time management and organisation, at least initially. For example, initially Sophia had not mentioned struggles or issues with time management, but as time progressed, she reported struggles related to finding motivation to continue (e.g. 'Researching on why being out in nature is important'), and more detail-oriented tasks (e.g. 'I struggled with filtering through the data over the two apps, making sure I did not record something twice or inaccurately.'). It was clear that over time she had engaged in more self-regulated learning. This points to an important caveat we arrived at in our analysis of the data related to the intrapersonal domain. In more private settings (focus groups and interviews) it became clear that students did not always convey a broader sense of their struggles in their daily reflections.

Learners commonly rely on peers, can feel emotionally threatened by professors, and feel a need to be more prepared before approaching their professors (Payne et al., 2021). These issues present challenges to supporting learners' intrapersonal domain. That said, it appeared that asking learners these questions and having regularly scheduled, structured conversations with their mentors appeared, at least in some cases, to shift their comfort over time. Creating this structure appears to require extra scaffolding and a welcoming environment that helps to deconstruct these barriers between students and their mentors. This was particularly important during the pandemic when interns were not working directly and in-person with their mentor network, completing tasks on their own.

Finally, there was a sense of openness to new understandings of their experiences, as exemplified by participants who described moving from uncertainty about the experience and its relation to their future STEM career, to achieving further clarity on their career targets. Similarly, Sophia's investigation of why nature is important, described earlier, hints at a developing openness to care for ideas that she may not have previously focused on. The growing awareness of other ideas is an important part of developing openness toward nature (e.g. Dunlap & Van Liere, 2008). This expansion of perspective was good to see as not all students were placed in internships that were directly within the specific discipline of their career goals. Awareness alone, however, is not sufficient for supporting the development of intellectual openness; that is, it is less a property of the individual gained through awareness than a practice in which they engage (Ruppert et al., 2022). These students were guided to more critically reflect on their learning about themselves, their work, and their contribution to society, being scaffolded through the practice of opening their awareness and thoughts to a broader set of ideas and opportunities.

Conclusions and recommendations

While this paper has emphasised the distributed and situational nature of cognition in workplaces, there is a spectrum in the role of individual and collective praxis in real-world situations (Billett, 2004). The findings of this paper emerged in the context of learners struggling with the nature of this individuality in the context of distributed and situated cognition in the workplace. The findings and recommendations point to a need to support learning of distributed and situated cognition in a way that may afford learners with a greater capacity for individuality, agency, and service to their community.

One approach to supporting this is to focus mentorship across the three areas of the twenty-first century Competencies rather than limiting their mentoring to simply one area. A second recommendation is to assign small groups or cohorts of students to the same site in project-based work. With this format, students have the opportunity to collaborate and benefit from peer-to-peer interaction. In essence, they are able to build community, even if it operates in a virtual space, which can make the experience less isolating. However, cohort-based groupings, though an initial strategy for TREX, have been a challenge to implement due to pandemic and other logistical issues. Moreover, not every site has the capacity to offer these types of internship experiences as they face their own staffing challenges.

While there is still benefit to in-person direct experience, our case analysis showcased a rather broad range of outcomes. What we can recommend for supporting remote or hybrid experiential learning is working to develop better online communities of practice. This means fostering a community of 'peers' across the organisation as well as of direct support, in order to contextualise tasks. If that community is missing in the workplace, institutions of learning can serve to offer these support structures, nurturing community development and helping students learn those workplace practices they might not observe behind a computer. These supports might help students develop a stronger sense of agency as they step into the workplace community.

Postscript

2 years later. It's May of 2022 and we are now at a moment where masks are coming off, and people are considering a second booster. Marcelo is back in the lab and has been working in the field since his graduation shortly after completing his internship. He returned to his alma mater to share his experiences with the STEM faculty and offer advice (drawn from field notes):

> At first, I was intimidated by everyone else – imposter syndrome hits people at different stages of their life. Asking for help is important … make it clear to students that it's a no judgment [sic]. Mistakes happen. We're human, not robots. I make lots of mistakes and I learn from my mistakes. Not to say mistakes can't be an issue, but to know how critical it is to come clean when you make a mistake […] Honesty is key. I would also say to the students: speak up for yourself […] sometimes supervisors put more expectations on us than possible. In my case, I learned that it's really important to learn how to communicate where I was and express my concerns when I needed help. Being part of a team means [supervisors and mentors] also need to do their part to manage my workload [to be fair in what they ask of us]. It's important to nurture curiosity [Help the students own their voice]. Listen to what students want to do. Encourage them to guide on their own path. No one needs to know what they're going to do tomorrow because it could change.

Note

1. All student participant names are pseudonyms.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This work was supported by the National Science Foundation [grant number 1832464].

ORCID

John Ruppert http://orcid.org/0000-0002-9184-406X
Claude Bamaba http://orcid.org/0000-0002-8916-3193
Yosra Badiei http://orcid.org/0000-0002-7230-4869
Jeanette Wilmanski http://orcid.org/0000-0002-1681-803X

References

Alzen, J. L., Edwards, K., Penuel, W. R., Reiser, B. J., Passmore, C., Griesemer, C., Zivic, A., & Murzynski, C. (2020). Exploring the connections between epistemic agency and a commitment to the collective enterprise of sensemaking in the science classroom. In M. Gresalfi & I. S. Horn (Eds.), *The Interdisciplinarity of the Learning Sciences, 14th International Conference of the Learning Sciences (ICLS) 2020, Volume 4* (pp. 1879–1886). International Society of the Learning Sciences.

Amin, A., & Roberts, J. (2008). Knowing in action: Beyond communities of practice. *Research Policy*, *37*(2), 353–369. https://doi.org/10.1016/j.respol.2007.11.003

Anderson, C. W., Holland, J. D., & Palincsar, A. S. (1997). Canonical and sociocultural approaches to research and reform in science education: The story of Marcelo and his group. *The Elementary School Journal*, *97*(4), 357–381. https://doi.org/10.1086/461871

Bandura, A. (2000). Exercise of human agency through collective efficacy. *Current Directions in Psychological Science*, *9*(3), 75–78. https://doi.org/10.1111/1467-8721.00064

Basu, S. J., Calabrese Barton, A., Clairmont, N., & Locke, D. (2009). Developing a framework for critical science agency through case study in a conceptual physics context. *Cultural Studies of Science Education*, *4*(2), 345–371. https://doi.org/10.1007/s11422-008-9135-8

Beunza, D., & Stark, D. (2004). Tools of the trade: The socio-technology of arbitrage in a wall street trading room. *Industrial and Corporate Change*, *13*(2), 369–400. https://doi.org/10.1093/icc/dth015

Bianchini, J. A. (1997). Where knowledge construction, equity, and context intersect: Student learning of science in small groups. *Journal of Research in Science Teaching*, *34*(10), 1039–1065. https://doi.org/10.1002/(SICI)1098-2736(199712)34:10<1039::AID-TEA5>3.0.CO;2-S

Billett, S. (2004). Co-participation at work: Learning through work and throughout working lives. *Studies in the Education of Adults*, *36*(2), 190–205. https://doi.org/10.1080/02660830.2004.11661496

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher*, *18*(1), 32–42. https://doi.org/10.3102/0013189X018001032

Brown, J. S., & Duguid, P. (1991). Organizational learning and communities-of-practice: Toward a unified view of working, learning, and innovation. *Organization Science*, *2*(1), 40–57. https://doi.org/10.1287/orsc.2.1.40

Byrne, Z. S., Weston, J. W., & Cave, K. (2020). Development of a scale for measuring students' attitudes towards learning professional (i.e. soft) skills. *Research in Science Education*, *50*(4), 1417–1433. https://doi.org/10.1007/s11165-018-9738-3

Christian, D. D., McCarty, D. L., & Brown, C. L. (2020). Experiential education during the COVID-19 pandemic: A reflective process. *Journal of Constructivist Psychology*, 1–14. https://doi.org/10.1080/10720537.2020.1813666

Creswell, J. W., & Miller, D. L. (2000). Determining validity in qualitative inquiry. *Theory Into Practice*, *39*(3), 124–130. https://doi.org/10.1207/s15430421tip3903_2

Duncan, R. G. (2007). The role of domain-specific knowledge in generative reasoning about complicated multileveled phenomena. *Cognition and Instruction*, *25*(4), 271–336. https://doi.org/10.1080/07370000701632355

Dunlap, R. E., & Van Liere, K. D. (2008). The 'New environmental paradigm'. *The Journal of Environmental Education*, *40*(1), 19–28. https://doi.org/10.3200/JOEE.40.1.19-28

Finley, A. (2021). *How college contributes to workforce success: Employer views on what matters most*. Association of American Colleges and Universities. https://dgmg81phhvh63.cloudfront.net/content/user-photos/Research/PDFs/AACUEmployerReport2021.pdf

Fisher, D., Frey, N., & Almarode, J. (2020). Student learning communities as builders of collective efficacy. *Reading Psychology*, *41*(6), 559–582. https://doi.org/10.1080/02702711.2020.1783139

Gallup. (2022). *Will the coronavirus prompt long-term adoption of remote work?* https://www.gallup.com/workplace/316313/understanding-and-managing-remote-workers.aspx#ite-316436

Hathcock, S. J., Dickerson, D. L., Eckhoff, A., & Katsioloudis, P. (2015). Scaffolding for creative product possibilities in a design-based STEM activity. *Research in Science Education*, *45*(5), 727–748. https://doi.org/10.1007/s11165-014-9437-7

Hogan, K. (1997). *Thinking aloud together: A test of an intervention to foster middle school students' collaborative scientific reasoning*. State University of New York at Albany.
Holyoak, L. (2013). Are all internships beneficial learning experiences? An exploratory study. *Education + Training*, *55*(6), 573–583. https://doi.org/10.1108/ET-02-2012-0024
Hora, M. T., Huerta, A., Gopal, A., & Wolfgram, M. (2021). *A review of the literature on internships for Latinx students at Hispanic-serving institutions: Toward a Latinx-serving internship experience* (WCER Working Paper No. 2021-2). University of Wisconsin–Madison, Wisconsin Center for Education Research.
Hutchins, E. (1995). How a cockpit remembers its speeds. *Cognitive Science*, *19*(3), 265–288. https://doi.org/10.1207/s15516709cog1903_1
Kind, P. M., & Kind, V. (2007). Creativity in science education: Perspectives and challenges for developing school science. *Studies in Science Education*, *43*(1), 1–37. https://doi.org/10.1080/03057260708560225
Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge University Press.
Leedy, P. D., & Ormrod, J. E. (2005). *Practical research: Planning and design*. Prentice Hall.
McAdam, R. (2000). Knowledge management as a catalyst for innovation within organizations: A qualitative study. *Knowledge and Process Management*, *7*(4), 233–241. https://doi.org/10.1002/1099-1441(200010/12)7:4<233::AID-KPM94>3.0.CO;2-F
Merriam, S. B. (1998). *Qualitative research and case study applications in education. Revised and expanded from case study research in education*. Jossey-Bass Publishers.
Molla, R. (2022, June 10). Why the return to the office isn't working. *Vox*. https://www.vox.com/recode/23161501/return-to-office-remote-not-workingurn-to-the-office
National Research Council. (2012a). *Education for life and work: Developing transferable knowledge and skills in the 21st century*. National Academies Press.
National Research Council. (2012b). *A framework for K-12 science education: Practices, crosscutting concepts, and core idea*. National Academies Press.
Orr, J. E. (2016).*Talking about machines: an ethnography of a modern job*. Cornell University Press.
Parlamis, J., & Monnot, M. J. (2019). Getting to the CORE: Putting an end to the term 'soft skills'. *Journal of Management Inquiry*, *28*(2), 225–227. https://doi.org/10.1177/1056492618818023
Passmore, C., & Stewart, J. (2002). A modeling approach to teaching evolutionary biology in high schools. *Journal of Research in Science Teaching*, *39*(3), 185–204. https://doi.org/10.1002/tea.10020
Patton, M. Q. (2002). *Qualitative research & evaluation methods*. Sage.
Payne, T., Muenks, K., & Aguayo, E. (2021). 'Just because I am first gen doesn't mean I'm not asking for help': A thematic analysis of first-generation college students' academic help-seeking behaviors. *Journal of Diversity in Higher Education*. Advance online publication. https://doi.org/10.1037/dhe0000382
Pelligrino, J., & Hilton, M. (2012). *Education for life and work: Developing transferable knowledge and skills in the 21st century*. National Academies Press.
Popadiuk, S., & Choo, C. W. (2006). Innovation and knowledge creation: How are these concepts related? *International Journal of Information Management*, *26*(4), 302–312. https://doi.org/10.1016/j.ijinfomgt.2006.03.011
Rodeghero, P., Zimmermann, T., Houck, B., & Ford, D. (2021). Please turn your cameras on: Remote onboarding of software developers during a pandemic. In *2021 IEEE/ACM 43rd International Conference on Software Engineering: Software Engineering in Practice (ICSE-SEIP)* (pp. 41–50). https://doi.org/10.1109/ICSE-SEIP52600.2021.00013
Roth, W.-M., & Lee, S. (2002). Scientific literacy as collective praxis. *Public Understanding of Science*, *11*(1), 33–56. https://doi.org/10.1088/0963-6625/11/1/302
Ruppert, J., Duncan, R. G., & Chinn, C. A. (2019). Disentangling the role of domain-specific knowledge in student modeling. *Research in Science Education*, *49*(3), 921–948. https://doi.org/10.1007/s11165-017-9656-9
Ruppert, J., Infante, M., & Bartlett, P. (2022). vAIR – an epistemic model of socioscientific reasoning emerging from citizens engaged in a locally situated SSI. *Science Education*. https://doi.org/10.1002/sce.21782.

Schauble, L. (1996). The development of scientific reasoning in knowledge-rich contexts. *Developmental Psychology*, *32*(1), 102–119. https://doi.org/10.1037/0012-1649.32.1.102

Teng, C. W. C., Lim, R. B. T., Chow, D. W. S., Narayanasamy, S., Liow, C. H., & Lee, J. J.-M. (2022). Internships before and during COVID-19: Experiences and perceptions of undergraduate interns and supervisors. *Higher Education, Skills and Work-Based Learning*, *12*(3), 459–474. https://doi.org/10.1108/HESWBL-05-2021-0104

Van Driel, J. H., Berry, A., & Meirink, J. (2014). Research on science teacher knowledge. In N. G. Lederman & S. K. Abell (Eds.), *Handbook of Research on Science Education* (Vol. II, pp. 862–884). New York: Routledge.

von Aufschnaiter, C., Eruduran, S., Osborne, J., & Simon, S. (2008). Arguing to learn and learning to argue: Case studies of how students' argumentation relates to their scientific knowledge. *Journal of Research in Science Teaching*, *45*(1), 101–131. https://doi.org/10.1002/tea.20213

Wasko, M. M., & Faraj, S. (2005). Why should I share? Examining social capital and knowledge contribution in electronic networks of practice. *MIS Quarterly*, *29*(1), 35–57. https://doi.org/10.2307/25148667

Wieselmann, J. R., Dare, E. A., Roehrig, G. H., & Ring-Whalen, E. A. (2021). 'There are other ways to help besides using the stuff': Using activity theory to understand dynamic student participation in small group science, technology, engineering, and mathematics activities. *Journal of Research in Science Teaching*, *58*(9), 1281–1319. https://doi.org/10.1002/tea.21710

Winsor, D. A. (2001). Learning to do knowledge work in systems of distributed cognition. *Journal of Business and Technical Communication*, *15*(1), 5–28. https://doi.org/10.1177/105065190101500101

Yin, R. K. (2012). Case study methods. In H. Cooper, P. M. Camic, D. L. Long, A. T. Panter, D. Rindskopf, & K. J. Sher (Eds.), *APA handbook of research methods in psychology, Vol. 2. Research designs: Quantitative, qualitative, neuropsychological, and biological* (pp. 141–155). American Psychological Association.