Pressures, Pathways, and Practices: Learning as a First-Year International Research Candidate

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Contents

Abstract

The chapter examines the in situ learning of international higher-degree research (IHDR) candidates in their first year of enrolment. This initial year of a research degree is characterized as one of the intense institutional, disciplinary, and research learning (Brown, Navigating international academia: Research student narratives. The Netherlands: Sense Publishers, 2014). Candidates' learning is examined in the context of broader pressures on doctoral pedagogy as well as in the context of local orientation and academic practices and disciplinary pathways. Learning is understood as "an outcome of participating in practice" (Boud and Hager, Studies in Continuing Education 34(1): 17–30, 2012, p. 23).

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Progress in IHDR candidates' learning is investigated through an extensive ethnographic study supplemented by findings from a precursor evaluation survey. Theoretically the studies draw on practice-based views of learning and knowledge (Gherardi and Strati, Learning and knowing in practice-based studies. Gloucester: Edward Elgar Publishing Limited, 2012; Schatzki, Introduction: Practice theory. In The practice turn in contemporary theory, eds. Schatzki, T.R, K. Knorr Cetina, and E. von Savigny, 1–14. London: Routledge, 2001) and trends in the growing importance of (scientific) knowledge itself in our everyday lives (Knorr Cetina 1999. Epistemic cultures: How the sciences make knowledge. Cambridge: Harvard University Press; Nerland Research & Occasional Paper Series: Center for Studies in Higher Education, University of California, Berkeley 14: 12, 2012).

The aim of the chapter is to highlight how and why participating broadly and proactively in research actions and activities (nested in practices Green, The primacy of practice and the problem of representation. In Understanding and researching professional practice, ed. B. Green, 39–54. Amsterdam: Sense Publishers, 2009b) make a difference to first year IHDR learning. Recommendations are made regarding the importance of attending to the frequency and kind of candidate, supervisory, and disciplinary practices (Maton, Canons and progress in the arts and humanities: Knowers and gazes. In Social realism, knowledge and the sociology of education, eds. K. Maton, and R. Moore. London: Continuum International Publishing Group, 2010) maximizing participatory involvement within disciplines. The depth and richness of the empirical data are likely to provide useful insights useful for international research candidates, their supervisors, and academic staff alike.

Keywords
Higher education · Research pedagogy · International candidates · Learning · Epistemic and research(er) practices

Introducing the Chapter

While there has been extensive research into higher education (HE) pedagogy, it is only relatively recently that attention was paid to how learning happens in situ in the context of epistemic cultures (Nerland 2012). This chapter pursues this "turn" to ways knowledge is (re)produced in specific settings as practice-based views on learning and knowledge gain prominence and the importance of (scientific) knowledge itself in our everyday lives grows (Gherardi and Strati 2012; Knorr Cetina 1999; Nerland 2012; Schatzki 2001).

Using these trends as a starting point for investigating research learning, the chapter draws on and extends research on PhD learning and candidates' practices involved in the "doctoral enterprise" in Australia (Cumming 2007). Cumming's study, part of an ARC Project entitled *Reconceptualising the Doctoral Experience*, drew on a practice-based approach investigating what doctoral candidates (learn to)

do. He illustrated how candidates were required to navigate, synthesize, and enact considerable social, material, and situated know-how in a range of settings as they progressed in their candidatures. Cumming examined cross-disciplinary research learning and categorized a set of generic practices progressively enacted by research candidates into four domains: curricular, pedagogical, research, and work (2007, p. 116). This chapter shifts the focus from Cumming's generic practices to specific ones looking at how candidates participate in and learn to enact these in disciplinary contexts.

The chapter unfolds as follows. It begins by situating IHDR learning as part of "an ecology of practices" (Kemmis et al. 2014) illustrating how the context of research learning is impacted on by global shifts in research pedagogy as well as by local university and faculty arrangements. These contextual factors are shown to play a significant role in how learning progresses for new candidates. This is followed by an analysis of the broader and more site-specific pressures, pathways, and practices revealing how they intersect in situ – in practice – in learning research. Research itself is examined as a practice, and learning is conceptualized as (progressively) knowing how to enact the practice of research (Gherardi 2008; Kemmis et al. 2014; Schatzki 2001).

In describing and analyzing research learning in situ, a focus on the social and material aspects of research learning makes visible epistemic, relational, and professional features of HE pedagogical practices that support or limit first year IHDR study. Actions and activities, nested within pedagogical practices (Green 2009b), are categorized in a participatory framework of integrating, initiating, imitating, and incubating, which are represented diagrammatically and glossed in the chapter. These are broad categories framing the diversity of praxis surrounding research candidates, including their agency, their supervisors' relational and professional care, and the learning afforded by their epistemic cultures. Praxis is understood as the complex of intelligible actions and activities unfolding with regularity and familiarity, in situ – i.e., in a social and material setting.

Finally, the concluding comments of the chapter propose that participating (broadly and proactively) in research practices is identified as the basis of first year IHDR learning. While this proposal may appear self-evident, it is supported by empirical data in the study and equally by practice-based theoretical underpinnings. As "[l]earning is directly implicated in practice, [it] can be represented as an outcome of participating in practice" (Boud and Hager 2012, p. 23). The empirical data support the contention that, embedded within the broader contexts of their candidatures, participating is facilitated in three principal ways. These are through:

- Agency by candidates
- Proactive relational and professional "care" (Gherardi and Rodeschini 2015; James and Baldwin 1999; Jones 2013; Noddings 2003) by supervisors and others
- The social and material features of disciplinary knowledges themselves

The chapter ends with a challenge for the academy to understand more deeply how agency and care *matter* in the first year and how these can be fostered rather

than limited. It adds an additional challenge to those responsible for research learning: take lessons from disciplines whose social and material features inherently facilitate participating and encourage similar practices in disciplines whose epistemic settings are structured in ways that minimize participating. The final comments presage that challenges are ever more pressing as external pressures now impacting on research learning – foreshadowed in the final quote of the chapter – are increasing.

Researching Research Learning

Researching research learning has been approached through two studies: an extensive ethnographic study supplemented by data from a precursor evaluation survey. The survey, undertaken in 2014, was a pilot study of 11 supervisors and 26 IHDR candidates who took part in an evaluation of early learning in their research candidatures. Candidates and supervisors responded to questions on their early learning experiences in focus groups and one-on-one interviews during July and August 2014 in a project entitled *International [Post Graduate] Research Student Experience* (Integrating and Improving the International UTS HDR Experience – UTS HREC REF No. 2014000337).

The in-depth ethnographic study, undertaken between April 2015 and June 2016, recruited a further eight IHDR candidates from a range of disciplines and their supervisors. Candidates nominated to participate in this project (An investigation of International HDR students' first year of study at UTS – what are the factors that best support their learning? UTS HREC REF No. 2014000331) that would follow them in their first year and explore their learning and experiences orienting to the university. Focused and linguistic ethnographic methodologies (Kornblauch 2005; Rampton et al. 2015) were used including observations and audio-recordings of candidates in supervisory meetings, in seminars, in laboratories, at their desks, and at the Confirmation of Candidature presentation. Candidates' and supervisors' actions and sociomaterialities in these settings were the focus of the observations and analysis. Candidates and supervisors were also interviewed to ascertain their experiences and conceptualizations of IHDR first year research learning.

Although the number of participants in both studies is relatively small, pedagogical progress (or not) was impacted on significantly by candidates' own agency but, perhaps more importantly, by supportive (or otherwise) supervisory practices. This supports existing research on the importance of professional and culturally attuned supervision for research candidates in HE contexts (James and Baldwin 1999; Jones 2013; Manathunga 2014; Noddings 2003). In addition the social and material features of disciplines as epistemic sites were shown to *matter* in first year learning. These findings also reflect emerging research in this domain (Fenwick et al. 2011; Nerland 2012; Parry 2007; Perrotta 2013) (Table 1).

Below, the learning experiences of the IHDR candidates who participated in this study in their first year are examined in the context of identified pressures, pathways, and practices. The participants included six female candidates, Margarita (all names

Table 1 Adapted from Table 1 (Manidis and Goldsmith 2017 p. 7) Lists the data collected across both projects

Research activities	Hours	Hours	Number of participants
Involvement of incidental bystanders	–	–	30 (approx.)
Interviewing candidates (evaluation study)	–	5	26
Interviewing supervisors (evaluation study)	–	4.95	11
Meeting one-on-one meetings or having catch-up discussions with candidates (ethnographic study)	35.91	–	8
Doing questionnaire interviews with candidates (ethnographic study)	4	–	–
Interviewing supervisors (ethnographic study)	4.75	–	8
Observing candidate presentations/other activities	2.5	–	–
Doing "lab" observations (ethnographic study)	9.95	–	–
Doing desk observations (ethnographic study)	9	–	–
Attending supervisory meetings (ethnographic study)	10	–	–
Attending team meetings (ethnographic study)	10	–	–
Attending Confirmation of Candidature presentations (ethnographic study)	4.8	–	–
Additional hours (one-on-one meetings)	8.559	–	–
Totals	99.96	9.95	83

are de-identified, and minor factual changes that do not impact on the findings have been altered for anonymity) (science), Sophia (science), Janita (engineering), Renata (education), Rosemary (health economics – business), and Narita (science), and two male candidates, Samuel (science) and Alsadi (engineering). Madeleina from the survey study and supervisors' comments are included at relevant junctures.

Learning as Participating, Participating as Learning

The focus on participating as central to research learning is connected to ways in which research pedagogy, knowledge, and in situ learning are progressively being conceptualized. Undertaking a research qualification means advancing new disciplinary (or cross-disciplinary) knowledge, yet processes for doing this, and what is understood by the term knowledge, are not straightforward. In educational and organizational terms, knowledge has been understood in either predominantly cognitive terms as a possession or as something that is done together, i.e., Cook and Brown (1999) and Gergen (2009).

What is understood by learning more generally and particularly in an organizational setting is equally contested with theoretical differences having evolved over several decades (Hager 2011; Sfard 1997). Sfard's seminal paper draws on the metaphors of *acquisition* and *participation* to explain the above educational debate on different understandings of knowledge and learning. Hager's paper traces

developments in learning theory, ranging from psychometric traditions to post-structuralist ones, including more recent practice theory approaches.

The practice-based perspective adopted here focusing on first year IHDR learning conceptualizes knowledge as knowing, enacted in doings, sayings, seeings, and relatings (Kemmis 2009), i.e., practices. Practices are made up of activities, "carried in and realised through the flow of action" (Green 2009b, p. 47), and are therefore not directly visible themselves. Rather they can be inferred from the performative aspects – i.e., the activities and actions – of candidates, supervisors, and others. In essence, practices go "beyond [merely] describing what people do. . . [p]ractices are, in fact, the creation of meaning, identity formation, and ordering of activities produced" (de Souza Bispo 2015, p. 314). In other words, practices reflect the expectations, rules, know-hows, and intelligible activities and actions required in a particular disciplinary setting, enacted as recognizable embodied and/or discursive performances.

And learning practices are understood to occur through participating in them (Boud and Hager 2012; Gherardi 2008; Schatzki 2001) with knowing understood as "a dynamic, emergent activity that is fluid and processual" (Manidis 2013, p. 30). Whether candidates are proactively taking part or participating through being inducted into faculty and/or university practices, participation is considered a pre-requisite for learning (Gherardi 2013; Gherardi and Perrotta 2010; Nerland 2012). As candidates progressively participate in disciplinary actions and activities in their new setting – interacting socially, materially, and in embodied ways (Hopwood 2016) – they are understood to draw on multiple knowledges in the environment on the way to "becoming" competent in research (Gherardi 2008).

Connecting Pressures, Pathways, and Practices

In locating candidates in "an ecology of practices" (Kemmis et al. 2014), it was necessary to examine how global shifts in research pedagogy as well as local university and faculty arrangements were already impacting on the context of research learning. In this regard, substantial changes to the purposes of research pedagogy elsewhere and in Australia have been shifting for some time. For example, the weighting of research pedagogical outcomes has been moving toward being more (globally) competitive, more important, and more industry-focused (Cumming 2007; DIISRTE 2012; Felt et al. 2013; Nerland 2012). While competition has been making it harder for IHDRs to get into selected Australian universities nowadays, other opportunities have seen them benefiting from internships and industry scholarships. Once accepted for enrolment however, they anomalously benefit from Australia's own goals for its research graduates designed to contribute to *this* country's national innovation, economic and social objectives (DIISRTE 2012).

As the PhD qualification in Australia progressively aligns with the Bologna Process Reform initiatives (EHEA 2010), IHDRs are benefitting from focused programs aimed at research skill development. Australia's desire is to prosecute a dual purpose for research education: advancing knowledge *and* developing "a researcher"

– an individual with particular research skills (DIISRTE 2012). Additional advantages are that Australia views "its" researchers as an embodied link to Asia, in particular, because of the country's geographical proximity to the ASEAN region. Asia's booming tertiary education markets have not gone unnoticed, and research and researcher ties can strengthen innovation, "political, economic, and trade links" with these countries (Hendrickson et al. 2013, p. 89).

Australian universities are taking in growing numbers of IHDRs (Norton and Cherastidtham 2014), a consequence which, in its turn, requires a more considered focus on how IHDRs are inducted and supported academically and pastorally (Commonwealth of Australia 2016).

At the faculty level, local and disciplinary actions and activities were expectedly reflecting social, material, and embodied ways of (re)producing knowledge (Nerland 2012) in those contexts. IHDR candidates, like all candidates, being in their particular and new spatiotemporal (Schatzki 2010) settings, were positioned to learn the discourses, practices, and identities of their disciplines (Maton 2010) as they (re) produced knowledge. Their new formal and informal learning spaces would be where they would be inducted into (Gherardi and Perrotta 2010) and/or would learn the disciplinary ways of doing, saying, seeing, writing, and relating, in particular faculties, as they progressed as researchers (Manidis and Addo 2017). As noted earlier, a particular, skilled kind of "researcher" is now required, one whose ways of enacting practices must be not only disciplinary but industry-focused and globally competitive as well (DIISRTE 2012).

The practice-based perspective provided a lens to focus on ways in which the IHDR candidates were required to progressively accomplish key "doings" of the pedagogy – a situated pressure. These included – among other activities – reading literature, collecting data, doing experiments, taking part in seminars, understanding theoretical concepts, receiving and using feedback to progress, starting to write a dissertation, and presenting their work in various forums. Significantly, participating in these – to a greater or lesser extent – was linked to the faculty and, principally, to the supervisor.

Supervisors are understood to play a significant role as each candidate's academic and pastoral care, and their learning is principally (but not completely) mediated through the university's supervisory practices. While supervisory practices share what Wittgenstein might term a "family resemblance" (1986, p. 34e), each supervisor/candidate dyad studied was unique. They varied from each other reflecting differences in the situated sociomaterial arrangements of each discipline and each supervisor or supervisory panel.

Arguably, different variations to learning practices would not automatically lead to the conclusion that, if candidates, supervisors, or others did "x," IHDR candidates would participate and would learn research practices. However, in order to accomplish key *doings* of the pedagogy, without participating, learning (and developing research(ing) expertise in situ) was not seen as possible (Gherardi 2013). In all aspects of the candidature, research(ing) expertise was found to be performative, involving progressive public displays – material and social – of knowledge.

As participating surfaced as a key mechanism enabling first year learning, it was understood in terms of what candidates, supervisors, and others did as regular

activities and through specific actions in situ. For the purposes of this chapter, activities have been incorporated into a non-exhaustive framework of four categories introduced earlier – *integrating*, *initiating*, *imitating*, and *incubating* – first described and then illustrated through empirical examples below. These types of activities resonate with findings from literature and institutional responses aimed at developing HE research cultures and tertiary knowledge (Cumming 2007; Nerland 2012; Ward 2013). They also reflect well-documented understandings of in situ learning from practice-based discourses and organizational learning literature (Gherardi and Perrotta 2010; Gherardi and Strati 2012; Kemmis et al. 2014; Nicolini 2013). Activities are represented in the following diagram as illustrative only (Fig. 1).

Integrating candidates into social and academic networks was identified as a key component of research learning as candidates were invited – and integrated themselves – into the research community in different ways and to varying degrees. This finding on the benefits of inclusivity into the research network is supported by extensive research on the role and significance of integrating candidates culturally, academically, and socially into the university (CAPA (Council of Australian Postgraduate Associations) 2012; Cumming 2007; Manathunga 2014; Marginson et al. 2010). Integrating practices also reflected those anticipated within duty of care parameters in providing support for domestic and particularly international candidates (Commonwealth of Australia 2016).

Initiating was also identified as a learning process underpinned by rituals or acceptance into the university community and into disciplinary activities. All candidates were welcomed into their faculties and into other workshops and were initiated into specific activities such as the faculty workshops and local practices. Faculties initiated candidates into their local doings, seeings, sayings, and relatings in keeping with traditional academic and epistemic traditions (Kemmis et al. 2014). In this sense, initiating was found to have a social as well as a ceremonial connotation, lending substance to stages of development in which candidates were

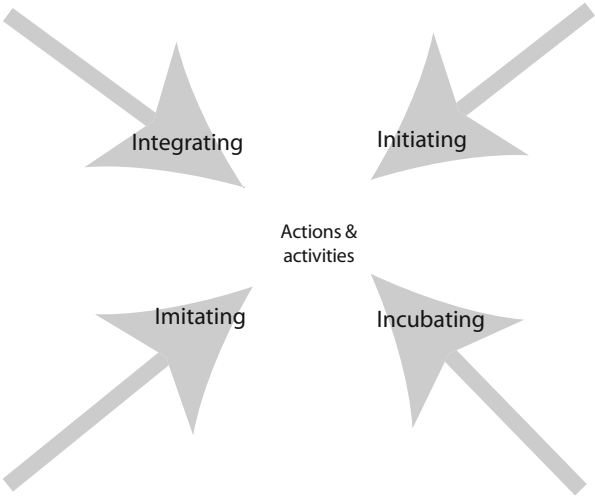


Fig. 1 Framework for participating and learning of PhD practices

required to progress through their candidates, marked by milestones such as the Confirmation of Candidature.

Imitating was made visible as a double-sided activity: it was something a candidate was noticed as actively doing but also as something that happened to them without them noticing (Bourdieu 1977). *Imitating* has long been well-theorized as a mode of learning (Gherardi 2009) recognizing people copy others in learning what to do and say. Imitating has been particularly important in the context of the university as an institution (Sieweke 2014) and in candidates' learning as illustrated further on.

A practice-based approach also recognized learning research as emergent, hence the concept of *incubating*. Learning to do research was shown to take time and occurred in very specific locations under very specific conditions. When asked what lessons had been learned after 6 months, Margarita (science) explained: *Make mistakes early on as later your supervisors expect you to know more, to be more independent*. Disciplinary understandings took time to develop and drew on candidates' pasts, presents, and futures. Candidates entered their current research program with appropriate disciplinary formation (their past qualifications) and progressed (in the present) within a field, which motivated them (their future). Practices were learned and perpetuated in relationships and contexts bound together over space and time, connected through histories of epistemic knowledge and the teleoaffectivity (motivational desires) of disciplinary scholars (Green 2009a; Schatzki 2006).

Learning Research Practices: A Look at the Data

Sociomaterial Aspects of Learning

The sociomaterial features of disciplinary settings played an important part in the frequency and kinds of opportunities candidates were afforded for participating (in activities). For example, the science and engineering candidates in the study had more opportunities to engage socially with others because of the collective working arrangements built into the nature of research in the discipline. Five of the six STEM (science, technology, engineering, and mathematics) candidates worked on joint projects in larger teams. Materially, their daily activities took place in laboratories and in seminars. Their knowing was fostered collectively, they were frequently co-located in space, and they spent time together sharing projects and experiments.

This relational base to their ways of working had an impact on reducing the isolation of these IHDR candidates. Candidates were integrated professionally, materially, and socially into the faculty. If one was in a team, one belonged voiced by one science supervisor: *Science is a team thing; we work in teams* – a feature of the discipline (natural sciences) connected to candidate retention (Spaulding and Rockinson-Szapkiw 2012). The team structure of Sophia's and Margarita's projects extended to regular seminars and meetings, based around their projects. Margarita was given the chance to chair a team meeting. She managed input from fellow candidates and supervisors as their reports were given in turn – a task delegated to her by her supervisor. Collaborative work and epistemic integration were a consequence of this

initiative. A further two candidates in the study, Samuel (science) was doing computational work on one project so was peripherally part of a project, but he participated in weekly team meetings with other science research candidates. Alsadi (engineering) was not in a team-based project initially but participated in weekly seminars and was soon to be joined by another doctoral student. Once the doctoral partner joined him, his confidence, socializing, and learning – *we can help each other* – transformed immediately. Alsadi had known the candidate from their masters' degree days, and they immediately began a supportive integrated work pattern that extended to problem-solving together and to their tutoring roles: *We're going to prepare for tutoring mat lab tomorrow afternoon, so we will be working together*…. Working together meant learning together.

This collective learning experience was not always a feature of the sciences as one candidate did not have a collective learning project. This was Narita, who sat alongside another doctoral candidate (who was nearing completion) for 4 months without a word exchanged between them. Narita's isolation was exacerbated as she worked alone on her microbiology samples for the full first year. Her supervisor was overseas for much of that time, and a promised "postdoc" coresearcher was not appointed. This isolation significantly impacted on her social and academic integration and consequently on her learning. *(I haven't been to any conferences) because everything has been delayed, I don't have results…and if I don't have results what I'm going to do there?* While her co-supervisor supported Narita, this co-supervisor was not able to write the laboratory protocol. In the end, being alone for this period of time held up Narita's learning as she worked in a vacuum without feedback and without peers recognizing her presence or actions. According to Hager and Johnsson, if others are not present, the social process of learning is hampered (2012).

The comparative isolation of the education and the health economics candidates on the other hand was reflected in the way they worked on their research question alone with their supervisors and/or supervisory panel. Both candidates were initially located in isolated settings, with only occasional interactions with peers and other supervisors. Rosemary was joined in her allocated sitting space later on by other research candidates, although her project was not connected to them. Renata was relocated to a faculty space in a restrictive environment (peers only) with no talk and no collegiate or faculty interaction. One education candidate in the precursor study shared how her supervisor had recognized the benefits of collective learning and its relational benefits even though this was not a typical disciplinary model. This supervisor required her candidates to participate in seminars where they *[had] to present*, and as a consequence, they were initiated into the practice of presenting, which they then perpetuated as a way of learning to do presentations:

> My supervisor had this idea. I don't know if people do it in [the other departments], but she used to hold meetings with all her students twice a month where we would **have to present** a research [paper], like in an informal setting, just to familiarise with the… [unclear] presentation and to share ideas and also to create that community of research… that was a very, very good idea and actually we students used it a couple of times before conferences for example. (Madeleina in Focus Group 3)

Renata (education) overcame the usual solitary work on a research question, which she achieved through her own agency, but it was an agency fostered by the supervisor's professional and caring supervision. Agency here is used in a common sense way as the capacity to enact or effect things in a given context, occasionally conceptualized as "confidence" (to do) (Edwards 2017, p. 135) as identified by the supervisor below. Renata's supervisor identified the relational component that enabled her to participate, an observation Renata concurred with:

> I think she felt supported . . .feeling supported has given her the confidence that she can be proactive . . .and I guess that it's a safe environment to be proactive and without my involvement and knowledge she's made friends with other research students. . ..

In both examples above, whether it was the supervisor or the candidate, a disciplinary paradigm of solitary learning was overturned by proactive supervision fostering actions and activities (participating) for IHDR candidates. In each initiative, participating in the research community (and learning practices) was enhanced.

Beyond the social aspects of learning, the materiality of different disciplines and its relationship to (re)producing knowledge impacted differentially on the IHDR candidates (Parry 2007). There were differences in how candidates were initiated into ways of seeing in the material sciences and in education, for example. Even though education and the material sciences both drew on rhetorical and material ways of seeing, the practices differed at a more fundamental level. In understanding the differences, the argument here draws on the works of Bernstein (1999), Maton (2010), and Knorr Cetina (1999). According to Maton, in the arts and humanities, "pedagogy [ ] initiates learners into ways of knowing rather than explicit states of knowledge" as it does in the sciences (2010, p. 171). Although Maton and Bernstein's work references *group* inclusion and exclusion and is based on curricula in school education, their theorizations are relevant here.

In the sciences, knowledge is based on "shared criteria" (Maton 2010). This creates a "vertical grammar" where one set of observations forms the basis largely in uncontested ways, for the next layer of knowledge. Ways of seeing are established through *shared observation*. If one shares knowledge, one is a (relatively uncontested) "knower." In the arts and humanities, knowledge has a "horizontal grammar," and "knowers" take a position on a horizontal plane – arguing a perspective – adopting "a gaze" not directly adding shared knowledge vertically as they might do in the sciences (Bernstein 1999). A "gaze" might be "acquired" by birth, social status, or training which Maton described as "born, social, cultivated and trained gazes" (Maton 2010, p. 165), each requiring a different membership facility. A gaze is a perspective, and to convey this viewpoint, candidates draw on argumentation and rhetorical know-how in English.

Thus, candidates in the material sciences were inducted into "ways of seeing" that were visual and material (based on observation), while those in education and health economics, with exceptions, were encouraged to look at their data from a predominantly rhetorically based perspective. Qualitative data were "seen"

metaphorically not observationally, whereas in the material sciences, "ways of seeing" were literal. Each discipline had its "different machineries of knowing" (Knorr Cetina 2007, p. 363).

Renata (education) was initiated into "seeing" that "knowers" on the topic in question – climate change – would not necessarily share the same perspective as each other. Her supervisor pointed this out early on in her candidature: *It would be useful to think about who the theorists are – educationalists, sociologists, psychologists, etc.* (Manidis and Goldsmith 2017, p. 8). Renata's supervisor suggested to her: *Establish clearly and early your orientation and perspective. . .establish where you're coming from, your epistemological position* – i.e., the "trained gaze[ ]" (Maton 2010, p. 165). This supervisor provided different readings to satisfy Renata's range of interests, permitting (encouraging?) different "gazes," long before (selected) data were collected.

On the other hand, Samuel (science) was initiated into seeing in a literal sense how knowledge could be (re)produced on the *observed* evidence. Examining computerized data with Samuel early in his candidature, his supervisor pointed out:

> . . .in the optical when you cut back the optical properties you should **see** a transition from there to there . . .so what I'm expecting. . ..and the main transitions will be across the band gap. . .so you'll **see** . . ..[. . .] go up there. . .but there'll also be a peak down here somewhere . . .. (Science supervisor) (Manidis and Goldsmith 2017, p. 8)

Although interpretation was involved, the supervisor explained how Samuel was being initiated into scientific ways of seeing (Perrotta 2013):

> [The candidate learns] how to interpret stuff. . .graphs and data. . .that's just the way we [scientists] work. . .that's the main skill we are trying to transfer is the ability to be able to interrogate data and **see** the important bits. (Science supervisor) (Manidis and Goldsmith 2017, p. 8)

These ways of seeing are recognized as impacting on learning in more substantive ways, although this was not observed in the early candidature setting of these studies' participants. For example, "extrinsic" and "intrinsic" differences between the epistemic knowledges of the sciences and the arts have been attributed to the relatively easier impact of some of the sciences on candidates' psychological equilibrium as it involves "objective phenomena which can be seen as being outside the individual" (Wright and Cochrane 2000, p. 192). Conversely, in the arts, subjectivity, emotional maturity, and judgment have been required for navigating its ways of knowing, and this internal focus has been considered in earlier studies as having the potential to impact adversely on candidates with them requiring more support at particular times in their candidatures (ibid).

Embodied Aspects of Learning

All research practices are embodied and material (Hopwood and Paulson 2011) but, in the sciences and engineering, greater involvement in practices such as laboratory

work, provided *earlier* formative opportunities for IHDR candidates to participate in learning research practices than those afforded to the humanities candidates. An exception in the arts and humanities may be found in a creative arts degree where candidates may be writing books and producing films or artworks early in their candidatures.

Laboratory work enabled earlier opportunities for the science and engineering candidates to participate in and develop "practical understandings" (Schatzki 2009, p. 117). Janita's engineering supervisor utilized early laboratory work on a related project – a frequent practice of his – to "orient" her to the learning environment before she began her own project. In his words, this familiarized her with the setting and gave her in*sight* and confidence to proceed: *You can't make a blind person independent*. Referring to blindness metaphorically, he felt he was developing her independence through contextual awareness. While it would be fair to say that laboratory work might only be a part of a science and engineering academic or work life once they graduate, in the study this early embodied opportunity played a part in providing an expedited way of involving the science and engineering candidates early on in (re)producing knowledge.

Observing Margarita (science) as she examined the impact of heat on her materials in the vacuum oven in the laboratory she was enacting an embodied practice, working with data early on in her candidature:

> Now I see it – there was nothing there before. . .I need to look at my previous [notes]. . .you don't need to remember [leafing through her notebook]. (Margarita)

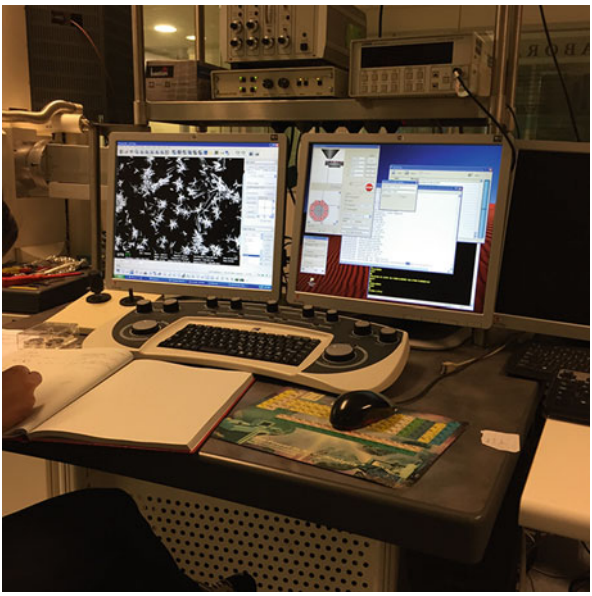
Sophia too spent time looking at nano-samples on her computer screen. As she did so, she magnified the focus on her equipment. She looked for a number on the sample, found it, magnified it, focused, zoomed in, selected a spot, made a note, focused, contrasted, zoomed in again, focused, took a "photo," saved the "photo," typed, then zoomed in again, focused, contrasted – all visual hand-eye coordination – and took another "photo." She moved between the iPhone, pen, book, computer controls, screen levers, and computer mouse controls – the artifacts of her discipline – constantly; she notated again, moved the mouse, typed, made a mistake, refocused, and recalibrated.

> It's easier if you're just watching but it's different, better to do it yourself. . .if you didn't feel confident. . . .

> I haven't seen it before [these shadows]. . . .

Sophia re-snapped the "photo" mumbled *humph*, saved the file, returned to the notebook, and zoomed out. These *humphs* confirmed patterns she was looking for and ones that could be detected with the naked eye. She had been initiated (enrolled) into the practices of looking for and seeing them (Photograph 1).

Sophia constantly watched and worked from the visual "seeing," using an embodied process to make sense of what was going on. The formative learning



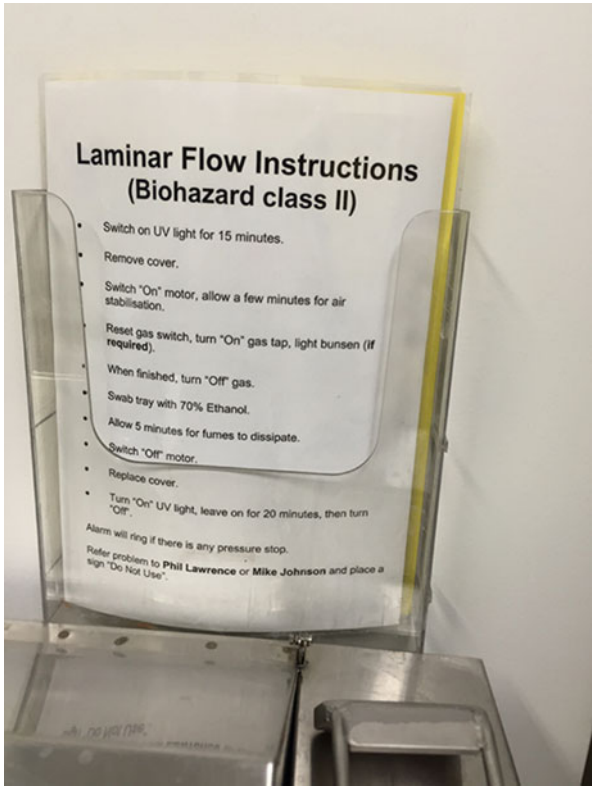
Photograph 1 "Seeing" the data – visuals and written notes, computer screens

of enacting the embodied practice in physics enabled her to participate in and engage in collective doings that "form the 'machinery of knowledge construction'" which in physics (for Sophia) "make up how we know what we know" (Knorr Cetina 1999, p. 1). As Sophia participated in these epistemic practices, it was possible to study these as "situated processes of knowledge production…" (Perrotta 2013, p. 164).

There was no opportunity to observe the two non-STEM candidates in this kind of early involvement in data. While all research learning is embodied, disciplinary contexts make a difference to the pace of learning. This is particularly pertinent in the doctoral undertaking – where embodied practices lead the way into the murkiness of "becoming" as candidates experiment, try out, try on, originate, and speculate in their fields of study. Embodied practices plus the protocols of scientific and engineering practices also rendered knowledge as collectively explicit and visible. Narita followed protocols relating to the location and bearing of her researcher body. For example, Narita washed her hands after being in the laboratory, following the protocols. Another protocol – a list of "dos" and "don'ts" – about what was required when working with active agents and cells was written out and was very visible (Photograph 2).

Narita also followed protocols in her dress and was attired in specific ways, months before any results were forthcoming. She donned the apron, the gloves, and the covered shoes. From very early on in the candidature, Narita "looked" like a scientist. This embodiment had a social benefit, as it indicated recognizable membership of a community and "presentation of self" (Goffman 1959) (Photograph 3).

As scientific knowledge is based on "shared criteria" (Maton 2010), Sophia and other candidates in the cohort of IHDR candidates could access this shared



Photograph 2 Local learning aimed at the collective

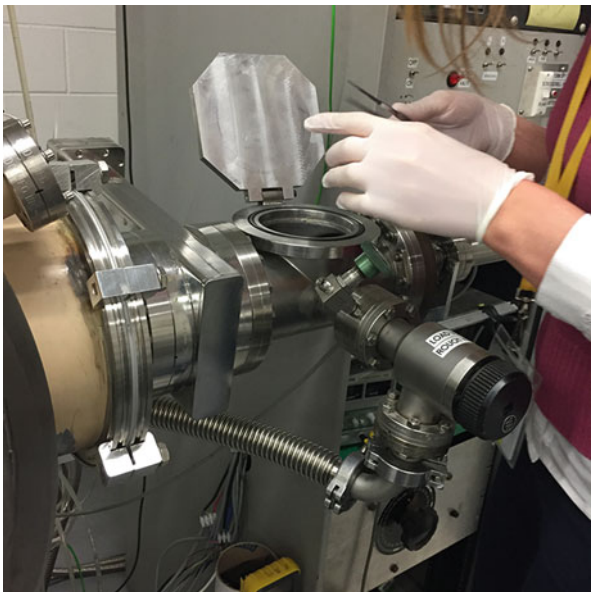
knowledge in other languages. Making use of "translanguaging" (Garcia and Wei 2014) and technologies, Margarita read a Russian textbook online – both activities enabling her to reach "wider networks of knowledge" (Nerland 2012, p. 4). When Sophia was surprised by what Margarita was reading online, Margarita reassured her saying: *Yes because Russian books are very good, they explain more.* The shared materiality of science and engineering knowledge, and the capacity for knowledge itself to be decontextualized and recontextualized in information networks (Collier and Ong 2005) enabled Margarita to participate in a proactive way. Of course, accessing "wider networks of knowledge" could also be replicated in an education or arts-based project.

Even though science candidates might be stream-based, once in a stream, "knowers" still share criteria (Maton 2010) as claims on truth are made on available (and frequently immediate) data evidenced by what scientists collectively *observe* and understand. The relatively "non"material nature of the education and health economics candidates' projects meant they required more time to develop their "gaze" and took even longer to learn to communicate this drawing on advanced rhetorical know-how. The difficulties of developing a specific gaze were reflected in the wide coverage of Renata's and Rosemary's literature reviews, both of which required extensive reading and discussion.

Photograph 3 Protecting Narita's body in the microbiology laboratory

Learning to write in all disciplines in a specific way is essential to membership, identity development, and research degree accomplishment. Learning the discursive and rhetorical aspects of writing (and speaking) in the non-sciences – where learners seek to acquire a cultivated gaze – is consequently less straightforward than in the sciences (Manidis and Addo 2017). For IHDR candidates who have English as an additional language, developing in this area is even more time-consuming, difficult, and extensive than for candidates whose first language is English (Paltridge and Starfield 2007). For Sophia, Margarita, and Samuel, the scientifically theoretical focuses of their projects were less refracted. Generally, in the sciences the more linear structure of the dissertation with an introduction, methods, results, and discussion (IMRD) sequence of chapters reflects this shared logic and understanding.

The materiality of science and engineering (Photograph 4) facilitated early participating as actions and activities were more immediate and more embodied than those undertaken by the study's education and health economics candidates. This embodied learning in science and engineering provided an immediate connection with learning, not experienced by these and other humanities candidates as early in their candidatures (not counting candidates who might have required similar embodied activities in the creative arts, which the study did not include). The only performative opportunities afforded to the education and health economics



Photograph 4 Learning eye-hand coordination by doing

candidates were to deliver a presentation, but this did not happen until one would be halfway through her candidature and the other was at the end of the first year.

Narita (science), Margarita (science), Sophia (science), and Janita (engineering) progressively developed eye-hand coordination. Janita held the bottle of her samples delicately and then worked the pipette with the other hand. Margarita used dials and inserted samples into specific equipment. Narita used droppers to move liquids into containers. Sophia calibrated visual images with levers as outlined earlier. These were not usual, mundane movements. Rather they were specialized scientific procedures drawing on "practical understandings" (Schatzki 2009, p. 117). The body was a key "tool" in the learning. But learning also required an understanding of how the knowledge in the discipline was (re)produced. Margarita observed: *It's not so hard to train on the instruments – it's more difficult to understand what is happening atomically.*

The material (re)production of scientific knowledge had pedagogical benefits too. Janita (engineering) and Margarita and Narita (science) obtained "lab" supervision work in the first 6 months of their candidatures. They undertook laboratory tutoring where they carried out basic instruction to undergraduate students. This activity initiated them into an academic practice of teaching. This level of academic teaching was not available to the education and health economics candidates. In general terms in the non-sciences, unless a candidate was already experienced in a subject area with extensive theoretical knowledge, they would not be in a position to do tutoring or lecturing. Some candidates in the arts and humanities might undertake tutoring, but opportunities were not as plentiful as laboratory tutoring ones. The practical nature of laboratory work in the sciences rendered these disciplines as a ready, situated pedagogic platform.

In summary, the epistemic site of a discipline offered different opportunities for participating. Although there were evidently theoretical differences in the science and engineering disciplines, "knowers" shared criteria which had a consequential relational impact on how they worked.

Being Assisted to Learn Research Practices

What Supervisors Did

A key finding of the research was that while learning is understood to be a social and a material process, for both IHDR and domestic candidates, participating was essential, but the *relational* component of learning, while important for all candidates, was particularly so for IHDR candidates. It was evident that they faced additional challenges such as linguistic, cultural, and social dissimilarity from their domestic counterparts: for them, the rules of participating were more opaque than for domestic candidates.

It is already well-documented that the social situates the relational component of learning as central to any pedagogy (Cook and Brown 1999; Gergen 2009; Hager and Johnsson 2012; Lave and Wenger 1991). This was extensively illustrated in the data, with findings showing that experienced supervisors of IHDR candidates understood it was *essential* for this cohort of students to be integrated into social and academic networks in supportive ways. Three supervisors explained this concern in relation to their candidates:

> I watch quite closely 'cos' I know that once they get connected I can tick a box, step back. (Science supervisor)

> You take a little more time to see that they're interacting with others – you don't want them to get isolated. (Science supervisor)

> [I] make sure they are on all the mailing lists etc. (Science supervisor)

> [We] have more frequent meetings just in the beginning [of their candidature] because they've moved from another country just to make sure that they're settling in and that they haven't got problems around accommodation or support. (Health Economics supervisor)

The relational and professional practice underpinning these activities was significant as both these supervisors displayed professionalism and caring. "Care" by these supervisors might be "framed as a collective knowledgeable 'doing' [of all teaching professionals], [care] is not an object or a quality that is added to work; rather, it is 'caring', an ongoing sociomaterial accomplishment" (Gherardi and Rodeschini 2015, p. 266).

Different "care" was extended by another supervisor (science) who organized his candidates and *their issues* into standard computer folders as follows:

- Progress and issues
- Computer "lab"/desk access
- Applications
- Scholarship
- Progress review
- Conferences
- "Lit" review
- Papers
- Sources
- Thesis
- Career

. . .and eventually they graduate from candidates into real people [chuckle]. (Science supervisor)

The supervisor's final comment on candidates becoming real people, although lighthearted, was a development the supervisor took seriously. He keeps in touch with these "real" former graduates, offering them ongoing support with references and sustaining links with them in their new workplaces. The university, the supervisor, and the IHDR candidates all benefit from this extended relational and now new knowledge network.

The relational aspect of supervision extended to ways supervisors related to their disciplinary knowledges. A practice-based approach recognizes practices are sustained through discursive and aesthetic attachments (Gherardi and Strati 2012) (see below). Academic practitioners – supervisors – talked about, and were attached to, their disciplines and professions as HE educators. Schatzki describes these as "teleoaffective" underpinnings incorporating motivations and goals related to the practice (Schatzki 2006) – of being a scientist and of being an academic. Candidates could thus be progressively initiated into ways of seeing in their disciplines, the language of their disciplines, the language of aesthetics, and the language of critique.

Supervisors thus played a significant role in initiating candidates into the excitement and pleasure of learning and aesthetics as a component of learning. Doing this could be considered one of the ways supervisors "mobilize passion" (Gherardi 2009, p. 544) for the object [of study]. This may be considered as "intuitive knowledge" (ibid.) – it is a "non-rational but emotional way in which knowledge is transmitted through evocative, expressive modalities. . ." (Gherardi 2009, p. 546). In doing this for or with the student, "at the same time [the supervisors] construct a vocabulary with which to speak about taste, to share an experience, and to refine the taste of the practice intersubjectively" (Gherardi 2009, p. 546).

Experienced supervisors across disciplines understood the need to instill in their PhD candidates the aesthetics of their disciplines, initiating them into respective epistemic ways of making choices and working. One science supervisor in the study recognized his candidates' need to develop their own passion in learning, and he cultivated this actively in their first year of candidature:

The first year I think I cut them a bit of slack and let them – like take some deviations from – let them explore – it's not my project – it's to instil that **feeling** [in them] that this is my

> [the candidate's] project and I can take this where I want it – so they're coming to you [saying] 'These are the measurements I've done and this is my plan. . .' I think it's a better experience for them and it's much more **enjoyable**. . . .

Rosemary's panel of supervisors (health economics) gave her an opportunity to set specific objectives for her candidature. They asked her if she wanted to acquire the skills of actually *doing* a systematic literature review or whether she wanted to *critique what is being done in which case you'd say, for example, are there systematic reviews in this area, what's the level of evidence, [and so on]?* In other words they gave her the option of doing a systematic literature review of the topic area (as the primary thesis) or undertaking a literature review of her subject area to support her thesis topic. This choice fostered ownership of the study as *Rosemary's project* similar to the decision made by the supervisor above.

(Re)producing knowledge together is another powerful way of enabling participation by candidates. Samuel's supervisor (science) indicated that he and Samuel

> are going to write a paper together soon as [Samuel's] already got some **nice** results – that follows on from work we published last year that he wasn't involved with but I got him to do some extension work on that. . .[we had it published]. . .and I helped him write that up. . . .

The aesthetics of disciplinary knowledge were conveyed overtly too. Looking at a screenshot of nano-samples with Sophia, her science supervisor commented: *I like it*, expressing what he felt as well as transmitting what good samples might "look like." This initiated Sophia into an emotional and visual experience of the knowledge and learning, based on shared criteria. Another science supervisor asked Margarita in a supervisory meeting: *Do you remember what they [the results] showed? How did you **feel** about the results?* The relational aspects of these sayings, seeings, and doings were once again paramount – ways supervisors related to disciplinary knowledge and learning these aesthetics were shared with the candidate.

What Candidates Did

Candidates themselves were proactive in participating by taking part in a faculty/activity or a social/work group. Margarita joined the basketball team, made friends, and got fit: *See I'm becoming social now. . .I'm doing this [playing basketball] instead of the PhD!*

Imitating was a key component of the collective learning that was observed. All candidates imitated the sedentary mode of academic work. When not in the laboratory or elsewhere, candidates transformed into focused, quiet, sedentary desk workers – enacting a collective, embodied practice. Doing deskwork was the thing to do as a burgeoning academic – both in its material and spatial connection to computer-based reading and writing and in its social teleology – it was one of the ways to become an academic (Photograph 5).

Photograph 5 Alsadi imitating learning practices

The corporeal presence – of turning up, sitting at desks, working in the laboratory – was a way of going on, of being there and even performing PhDness, '[a]cademic study [ ] itself a bodily practice' (Hopwood and Paulson 2011, p. 674). Candidates were going through the (bodily) motions until they engaged with the intellectuality of the enterprise. Using their bodies in this way could be understood as seeing "the body as body subject" (Keat 1982) – a body that is purposive and professional and is attaining its individual "habitus" (Bourdieu 1986). These bodies were attuned, active, and orienting to their surroundings as candidates oriented to "becoming doctor" (Vagle 2015, p. 9).

Bourdieu expounded the essential components of habitus were "transmitted in practice, [. . .] without attaining the level of discourse" (Bourdieu 1977, p. 87). While Bourdieu's theorizations focus more on the individuality of practices than their collective nature (Schatzki 1997), the relational, aesthetic, and taste aspects of *imitating* are recognized as essentially collective (Gherardi 2009). Candidates wanted to be like their supervisors or their peers. Margarita articulated this desire as she listened to feedback in the presence of her peers at the group meeting: *When you hear yourself and see reactions [in the team meeting] you can move in the right direction.*

As some of the research candidates were seeking to "become" academics, the attraction, the aesthetic, and the desirability of mimesis, what Bourdieu originally termed *imitating*, could be regarded as powerful (Bourdieu 1977). Candidates admired their supervisors, confirming there was an element of prestige in imitating others particularly those whose actions "[had] succeeded and which he [the actor had] seen successfully performed by people in whom he ha[d] confidence and who [had] authority over him" (Mauss 1973, p. 3). In the sciences in Australia, the lower

numbers of junior women in the discipline are attributed to the "lack of female role models, mentors and [respectively gendered] networks" (Bell 2010, p. 440). For junior female scientists, there are fewer women predecessors to imitate – although the percentage of women in this study's sample contradicted that trend.

Sophia and Margarita imitated the local methods of recording data in their science faculty. They, like all research students in the faculty, were given the same red notebook in which they recorded their observations, sample details, and other notes. The books were an artifact reflecting "a set of investigative processes" of how scientists studied the natural world (Nerland 2012, p. 2): their collective way of (re)producing knowledge. The notebooks, as a material artifact, carried a social value, as everyone owned one (Photograph 6).

The study's IHDR candidates instituted "work arounds" and came to terms with the "accidental pedagogy" (Ward 2013) of the PhD candidature. Candidates and supervisors adjusted to one another, making allowances for illnesses, busyness, absences, forgetfulness, and disorganization. In these instances, supplementary activities filled the gaps in the flow of events. Narita attended a *development workshop* where she was told to *talk to others*; Margarita was advised to email three people on her supervisory panel rather than one busy supervisor; she discovered there were social benefits going to lunch informally with the "postdoc" researcher: *he is different outside the "lab."* Narita realized she was becoming more social and, when asked if this was helping, replied: *Yes because you realise you are not alone*; she developed patience until her supervisor returned from overseas. Alsadi contacted the author of a journal article (advice he received while attending a workshop) as he was having trouble understanding her paper.

Photograph 6 Imitating recording practices: the little red notebook of the science candidate

He and the writer began communicating regularly until Alsadi was invited to attend her university in Italy for 6 months to work with her.

One candidate, who will remain anonymous, did not participate in activities like other participants. Despite enrolling in several researcher development workshops, this candidate did not "turn up" on the day and struggled to deliver a team presentation when called on to do so. While the candidate made satisfactory progress on reading and experimenting, when it came to presenting – in an embodied performative way – the presentation, in practice, was not accomplished. The candidate's talk was barely audible and it lacked cohesion. This undermined the performative aspects of the presentation as knowing in a socially recognized way – presenting an academic paper (Manidis and Addo 2017). However, in participating, a requirement of the faculty, the candidate saw the experience as formative and would make adjustments the next time round.

On the other hand, Janita (engineering) attended a range of workshops on researcher skill development, participated in the 3-min thesis competition (University of Queensland 2008) in her faculty, and won the competition. Janita delivered a fluent, coherent, graphically illustrated (science-specific), and learned talk. The comparison here is evidently more complex than attributing Janita's success to attending particular workshops. But she prepared the talk, received feedback on it, practiced it, and then delivered it. The social, academic, and networking benefits of participating in a range of activities, especially being a part of the *3MT*® competition and winning it, made a difference to Janita's academic integration and research learning. Over 30 faculty members – supervisors and peers – watched her presentation, and she progressed, literally, to the next stage. Her primary supervisor advised that Janita did not want to take part initially but did so on his encouragement – a pedagogical initiative that yielded a high return for her (and for him). The words of Boud and Hager (2012, p. 26) underline the importance of the participatory benefits afforded by Janita's (and the anonymous candidate's) respective pathways to their presentation events:

> These practices involve the practitioner operating in complex ways, often with others, in a particular environment that has attributes of its own. It is only this relational combination that reflects the practice, and it is the practice itself that ultimately matters in terms of getting things done in the world. It does not matter what the professional knows or can do if this is not deployed appropriately in a particular context with requisite others.

Long before the IHDR candidates were making the intellectual leaps of their unique contributions to knowledge, their embodied practices were being enacted collectively – from day 1. Hager and Johnsson identify collective learning as going "beyond participation to include judgement; [collective learning] requires an embodied, committed form of relational responsivity that implicates others who must be similarly committed" (2012, p. 262). Whether candidates were becoming used to sitting at their desks, quietly working, practicing with pipettes and samples in the laboratory, reading journal articles, or showing up at seminars, in all of these arenas they practiced with were guided (and led) by their bodies – its performativity – in the endeavors of research study *from* and *with others*.

Discussing the Findings

The data illustrate that governance and supervisory arrangements were "inextricably linked" with "doctoral arrangements" and "with learning…" (Cullen et al. 1994, p. 41). Local practices in turn were linked to wider "nexuses" of practice (Schatzki 2001) such as those of the faculty and the university, and they in turn were linked to those of national policy and research funders' priorities.

At the local-level supervisors, "peers, postdocs and technicians" (Cumming 2007, p. 25) were among the "constellation of others" (Cullen et al. 1994, p. 41) engaged in assisting the candidates in their research learning. IHDR candidates themselves were also central to the immediate social makeup of their disciplinary setting as discussed, through their own agency and experiences.

Materially, aspects of the disciplinary learning environments focused on in the observations included equipment, bodies, artifacts, facilities and technologies of the disciplines, space and time, and the material nature of the epistemic knowledges in question. Specific material aspects included technologies linking candidates to the outside world – inter alia – such as global libraries and scientific resources, in one case a supercomputer and the synchrotron.

The sociomaterial and embodied instantiations of candidates' and supervisors' actions outlined above reflect how knowledge was being (re)produced in situ. On a social level, all the candidates worked closely with their supervisors or supervisory panels – except the one who was overseas – with candidates in their cohort and with others. They worked either in teams on projects or alone and experienced varied social and/or knowledge connections networking with those in their discipline, their immediate vicinity, and beyond.

The material arrangements for Sophia, Janita, Margarita, Samuel, Alsadi, and Narita, in their laboratories, were replete with samples, equipment, bodies, chemicals, and organisms. These and their bodies combined in particular actions and activities and constituted the artifacts and practices of science and engineering. They worked with these "things" running experiments, dressing like scientists, and recording their data in similar ways – enacting collective practices. They used computers, read widely, and attended faculty and university workshops.

Renata and Rosemary in education and health economics had fewer disciplinary identifiers and artifacts than their science and engineering counterparts. Nevertheless they too used computers, predominantly read widely in their first year, and also attended faculty and university workshops. They and their supervisors generated social and academic activities typically not afforded by their disciplines. Renata joined a committee organizing a research conference and volunteered to present her work at a faculty conference, and Rosemary lunched weekly with other candidates in her faculty and also attended weekly seminars, which were compulsory. These gatherings significantly reduced her initial isolation. In Rosemary's faculty IHDR (and all), candidates were considered as essential to the research endeavors and outputs of the unit – and candidates were accorded commensurate status. This social and academic inclusion ensured Rosemary was supported throughout this time although her supervisor was also overseas for the first 6 months of her

candidature like Narita's. In her absence, the supervisory panel took responsibility for her progress.

In the caring (Gherardi and Rodeschini 2015) of proactive supervisory practices, through activities and actions, IHDR candidates were integrated and initiated into practices they could then imitate. This was evident in the examples above where special inclusions were made for the IHDR candidates such as ensuring they were part of social and academic networks. Where the IHDR candidates were treated as unique – not in a deficit way but in a practical sense – and adjustments were made, this was beneficial to that candidate.

Margarita's supervisor claimed he didn't think about international candidates as "different," yet his actions belied this as he assisted Margarita on many occasions with language. Using the expression *off the hook*, he then asked her if she knew what that meant. Then when he added *we are on the same page there* he rephrased to say *we are thinking the same way there.* At one point he provided cultural advice:

> if you're unhappy about anything in the team mode you must speak out immediately it's no good being cross with [supervisor] or me or [other supervisor] – just tell us – we are big men, we can handle it – if you are concerned about something, just speak out – this is Australia – you can speak out – everybody speaks out loudly – you can speak out loudly too. . . .

Where candidates and supervisors were in proactive and collective learning patterns, participating, changing – learning? – were facilitated. Margarita reflected: *I think that I would need to change* after her supervisor gave her feedback. Rosemary's supervisor requested a summary from her about what she had understood from their preceding discussion; both she and her supervisor were constantly calibrating key aspects of her thesis. Margarita talked about benefits of attending group meetings: *When I listen to [my supervisor's] corrections I can take something from that*.

Where candidates were initiated into the disciplinary practices, they could soon imitate these. Margarita's postdoc supervisor in the laboratory pointed out to her "See it's more green – we need to measure thickness. . .," initiating her into the visual practice, subsequent action and the capacity to make new connections in her doings. Where this did not occur, trial and error took place, also useful for progressing, but potentially more time-consuming as Sophia explained: *I marked it with a pen so I know what sample it is. I think this is the hardest part for me to find my marks. Is there a way to do it, I don't know?*

Where candidates were initiated into the discursive practices of their disciplines, they were able to start using new language and disciplinary rhetoric. In a supervisory discussion early on in her candidature, Renata's supervisor questioned: *What are you going to call this thing?* Then she gave her the actual wording: *I'm going to invent. . .that will be my contribution*. The supervisor first introduced the idea of the concept and then used specific wording Renata could use. Where candidates were not initiated into specific ways of seeing, doing, being, and relating in their discipline, they did not always know how to go on. Should they read first and then do experiments, or should they do experiments and then read? What would be the best

order to do things? Or should they do these simultaneously? Margarita relayed what her "postdoc" supervisor advised after she had spent her initial days in the laboratory: *An hour in the library can save you 6 months in the "lab."* The complexity of research learning was reflected in these comments: listening to those who know more (the "postdoc"), finding out the best way to sequence tasks, considering whether to precede material knowledge with reading or *vice versa*, juggling time and tasks, and, finally, becoming aware of the emergence (and multiplicity) of knowing in different ways.

Where proactive supervisory practices did not occur, candidates (and their learning) were negatively affected – as with Narita whose supervisor traveled overseas, while she was left to her own devices. She waited for the supervisor to return and write the laboratory protocol, and it held her up by several months. She finally sought counseling and external assistance but lost 6 months of her candidacy – while on a time-bound scholarship. *I'm very worried; I'm international student, if I don't finish on time, I can't finish. . .I'm very worried that [getting the faculty to intervene] will affect my relationship with my supervisor.*

Candidates felt more secure in their learning when supervisors responded to candidate requests, meetings, and other concerns. When this was not the case, the reverse happened. Margarita emailed all three people on her supervisory panel hoping someone would answer: *One of them will respond*, she told the researcher. This kind of responsiveness by candidates to particularities of their supervisory circumstances indicated how they were progressively learning to adapt to in situ social and material contingencies. Janita (engineering) demonstrated how she could tailor her knowledge to different audiences. She recognized her primary supervisor was the one who was negotiating her project at the strategic/funding level; her "postdoc" supervisor was closely monitoring (and wanted to be updated on) the details of her sampling and findings, while her overseas supervisor brought a European perspective to his discussions with her. Each time she prepared to talk to one of them, she ensured she had the right information for *that* supervisor's expertise and interest.

By the end of the first year, candidates were able to demonstrate epistemic and research learning in a collective practice. Seven of the eight (the remaining one candidate is yet to do so) candidates in the study submitted their finalized research stage 1 (Confirmation of Candidature) papers in disciplinarily appropriate proposals and formats. Through participating, these presentations were the outcomes of their integration, initiation, imitation, incubation, and more. These candidates had participated in doings, seeings, sayings, and relatings in their disciplines – to a greater or lesser extent – attuning to what was required, participating, and learning. It was not just one action, activity, person, or material thing that had brought them to this juncture. Rather it was the textured praxis – intelligible actions and activities unfolding with regularity and familiarity, in situ, making up the practices of the discipline – that had enabled them to accomplish stage 1 completion (Manidis and Addo 2017).

Concluding Comments

The IHDR candidates are in an international and national policy environment that is characterized by increasingly competitive exigencies. IHDR candidates are also in localized and disciplinary learning environments, where research learning is enabled by some epistemic traditions but also by the relational and embodied components of pedagogy. Candidates benefitted from their own and supervisor-led initiatives even though their participation was affected by sociomaterial and embodied aspects that were contextual and disciplinary.

The data also showed candidates' doings, seeings, sayings, and relatings – their practices (Green 2009b; Kemmis et al. 2014) – were responsive to the temporal, spatial, social, and material dimensions of their disciplinary settings, and beyond. In this, the learning ecosystem has been shown to be simultaneously complex and fragile, harboring multiple and shifting combinations of supervisory and support practices, disciplinary variations, and different sociomaterialities. IHDR candidates experienced the university landscape in unique ways particularly its "spatial and temporal properties" (Schatzki 2011, p. 70). IHDR candidates were very aware of their need to connect to others, particularly their supervisors. Candidates were acutely aware of their supervisors' whereabouts, including when they were on holiday, unwell, or at conferences. Margarita reported: *I know he [my supervisor] has coffee at 9am and goes home at 6pm.* Despite efforts to lessen dependency on supervisors – all candidates, without exception, saw their learning as intimately tied to their supervisors – and even in the context of their own agency, Narita (science) still continued to see her supervisor as the expert:

> I do lots of pre reading before I go there. . ..[supervisory meetings]. . .I prepare everything. . .by the time I get there I just ask the specific questions that I have [I learn] many technical things that I don't know myself. . .you know she's the expert. . . .

Pressures, pathways, and practices were not always consciously understood. Supervisors enacted practices based on disciplinary modes of working and on their own understandings of how they imagined learning happened for their PhD candidates. In this way practices became localized and embedded in what they or others in their faculty did (Boud and Brew 2017). Whether it was the supervisor who "cut his candidates a lot of slack" so they would get to enjoy their studies, or one who screened them carefully before admitting them, or another who saw learning as embedded in discursive exchanges through texts and talk, each did what he or she believed would lead to a successful candidature.

Learning has been shown as a multifaceted process at the heart of which are relational knowing and professional care by supervisors. Professional care could be considered a key *practice* of professional higher education educators (Green 2009a). They are motivated by long-held teleologies of tertiary pedagogy reflecting concomitant dispositions, values, and ethics (Green 2009a). Enacting these made a positive difference to this IHDR cohort's learning. The agency of candidates

themselves played a crucial role in their learning. Those candidates, who were proactive in joining sports groups, turning up for workshops, taking part in committees, and preparing for supervisory meetings, further enabled their own learning. Drawing on their multilingual and international connectivity – proactively translanguaging and networking internationally – they enhanced their spatiotemporal learning.

Various epistemic knowledges facilitated or constrained participatory opportunities for candidates, as disciplinary practices impacted on candidates' learning. The social nature of science, its material features, and embodied practices fostered participating, hence early research learning. Visible and intellectual membership and consequently engagement for first year IHDRs in the sciences and engineering and in project-based doctorates took place early on in the candidature. The reverse was the case for the health economics and education candidates. In education, Renata worked alone more often – although this happened in the sciences too to Narita – and Rosemary and Renata had fewer opportunities to engage materially and in embodied ways with the discipline early on in their candidature: it was taking longer to cultivate their theoretical "gaze." The latter process differentiated/isolated them from those with different theoretical perspectives – hence from broader social or interdisciplinary collegiality. Renata, whose co-supervisor was from another discipline to her primary supervisor, identified the theoretical distances between perspectives alerting her to the need to fine-tune her theoretical perspective:

> Then I had a question around social practice theory. I guess there's not just not one practice theory. . . there's many different practice theories and so I was interested in where you situate yourself in that space [ ] and there's a lot of other perspectives [ ] that you could draw on. . .. so [ ] I'm sort of interested in what you're drawing on there. . ..

Participating broadly and proactively in activities (of knowledge building) has been identified as the basis of first year IHDR research learning, facilitated through agency by candidates and proactive relational and professional "care" (Gherardi and Rodeschini 2015; James and Baldwin 1999; Jones 2013; Noddings 2003) by supervisors and others. Participating was also facilitated or hindered by the social, material, and embodied features of disciplinary knowledges.

The challenge for faculties, supervisors, and candidates is to maximize the relational and material aspects of IHDR participation in every disciplinary setting and at every opportunity. Relationally, collective learning arrangements and engaging with others early on foster participation. Materially, streamlining access to laboratories, engaging with data early on, and considering other physical arrangements – even seating – can foster participation. Learning proceeds (or not) amidst what candidates do, what supervisors do, and what faculty members responsible for professional learning and leading and researching in the faculty do – and how these connect to each other can either increase or limit candidates' participation. And as illustrated, participating is essential because "[l]earning is directly implicated in practice, and learning can be represented as an outcome of participating in practice" (Boud and Hager 2012, p. 23).

In seeking to understand in situ learning of first year international research candidates, pressures, pathways, and practices have been shown to intersect continually as the analysis of the data showed. Their confluence is evident in the context of increasingly competitive, global research pressures. As one science supervisor said when asked how he thought "learning happened" for his higher-degree research candidates:

> It's different . . . in every circumstance – there's no single answer to that. For us we've tried to set up a system where we have open discussions about scientific work. . .within our group – in that group there's probably four or five academics and probably 20 PhD students, and in that group we try and generate through Journal Clubs and so forth an ongoing scientific discussion. . .particularly around taking what we see – as academics – absolutely exemplary pieces of research work in the literature – get them to read it, understand it, dissect it – get them to see how – not really how the research work is done – we sort of teach them [that] the nuts and bolts of research – but the other part of that, the really tricky part of that, about, the communication of that research to the broader audience – which is **really** hard and **really**, **really** important – how to write a paper, and construct a scientific paper that is going to get in the absolutely top journals. . ..(partly reproduced in Manidis and Goldsmith 2017, p. 10)

Amidst the pressure of today's international research pathways, learning to do/knowing research in practice – as practice – has become a communicative imperative. Articulating research impact is now the priority.

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