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Learning in the circumstances of practice

STEPHEN BILLETT
Griffith University, Australia

Learning in the circumstances of practice stands as the commonest and most enduring way occupational capacities have been learnt across human history, and, likely, are currently learnt. Yet, a comprehensive account of this means of learning remains absent, which limits the legitimacy of workplaces as sites of learning, the learning arising from them and understandings of how to organize, promote and evaluate that learning. When advancing this account, it is necessary to avoid being constrained by the discourse of schooling and orthodoxies of schooled societies, which can distort considerations of learning through practice on its own terms. When reviewed, anthropological and historical literature on learning occupational practices outside of educational provisions offers fresh suggestions including that such an account likely comprise elements of practice curriculum and pedagogies and personal epistemologies, albeit set within particular complexes of cultural, societal and situational factors. A key distinction arising from such a review is the emphasis on individuals' active processes of learning and how these are enacted in the circumstances of practice, rather than on teaching or instruction. Such a distinction runs deep in this literature and has consequences for conceptions of understandings and efforts to promote and improve learning through practice.

Keywords: learning; learning through practice; occupational knowledge; workplace learning

Learning through practice

Explaining how adults have and continue to learn through their occupational practice (i.e. work) is central to the project of adult learning and development. Not the least is that much of adults' lives are spent in work and work-related activities and work and occupational subjectivities are central to that learning and development. This paper is part of an ongoing project to understand more fully how people learn occupations through their work. It draws largely upon anthropological and historical literature to identify how that learning occurred before and/or outside of schooled societies and 'schooling'. That literature suggests that humans have lived in settled communities for up to 10,000 years and in cities for 5000 years, which has necessitated the development and learning of a range of occupational capacities required by such sophisticated societies. Over the vast majority of that time, the development and learning of occupations serving those communities has occurred in the circumstances of their practice

Stephen Billett is Professor of Adult and Vocational Education in the School of Education and Professional Studies at Griffith University, Brisbane, Australia and also an Australian Research Council Future Fellow.

Correspondence: School of Education and Professional Studies, Mt Gravatt campus, Griffith University, 176 Messines Ridge Road, Mt Gravatt, QLD 4122, Australia. Email: s.billett@griffith.edu.au

(i.e. places of work). Only in the last few centuries and in schooled societies has the preparation for most occupations come to be undertaken in specialized institutions established for the purposes of promoting this kind of learning. Yet, despite these longstanding contributions to advancing personal and societal needs, comprehensive accounts of how learning through practice progresses remains elusive. Such an account clearly needs to go beyond description and establish premises for the efficacy of these circumstances for learning and provide guidance for enhancing them are learning environments. Importantly, advancing such an account necessitates identifying and elaborating factors that inform these bases on their own terms, not on those of educational institutions and their discourses, which it predates. As we live in school societies (i.e. those in which schooling is comprehensive and ubiquitous) and where educational institutions are legitimized, the discourses, precepts and practices of ‘schooling’ are pervasive and privileged. Moreover, whilst having many strengths, educational discourse has limitations in its explanatory reach. It privileges particular accounts of learning and knowing, and overly emphasizes declarative forms of knowing and didactic transmission of knowledge. However, and importantly, the discussion here is not anti-schooling or critical of what occurs in educational institutions or the important contributions that schools and schooling processes make to individuals’ learning and development, and their communities. Instead, the concern is to open up considerations of other settings and circumstances where people learn and to exercise other premises than those of educational institutions. Indeed, this concern has also been the focus of inquiries in the United Kingdom, for instance, seeking to address issues of adult literacy (e.g. Tett, 2010) and considerations of circumstances outside of schooling in which children learn and achieve the kinds of outcomes that are desired for supporting their schooling (e.g. Tizard & Hughes, 2008).

Certainly, a central premise here is that there are no separations amongst doing, learning and the remaking of (i.e. occupational) practice. Hence, there is no inherent privileging of learning arising through participation in schooling. When humans engage in intentional goal-directed activity, such as those at work, the legacies arising are twofold: (i) changes within individuals (i.e. learning) and (ii) contributions to the ongoing remaking and transformation of cultural practices that comprise occupations (Billett, Smith, & Barker, 2005). As individuals engage in activities shaped by specific circumstances and at particular points in time they are both learning through these experiences and contributing incrementally to the continuity and evolution of the occupational (i.e. cultural) practices (Giddens, 1984; Lave, 1993). Importantly, before the advent of schooled societies and mass schooling, this form of learning through and remaking of occupational practice was almost solely responsible for ensuring human progress and continuity through those occupations (Billett, 2010). As noted, even now, within schooled societies, learning in workplaces is again being held as being central to individuals’ employability, including sustaining it across lengthening working lives through realizing personal learning and innovations within their work. Tertiary education provisions preparing graduates for specific occupations across countries with advanced industrial economies now routinely provide practice-based experiences (Organisation for Economic Co-operation and Development, 2010). Given these contributions to meeting human needs, an account of learning through practice is now warranted albeit informed by

what has occurred prior to or outside of schooled societies and schooling. Historical and anthropological accounts are key sources of this review because they offer perspectives that are different than much of what is provided in contemporary explanatory efforts that are often also constrained by disciplinary boundaries, if they have them.

As a means of advancing this account, the paper commences by outlining some contributions to human progress realized through learning in the circumstances of practice from historical accounts. Then, some distinct premises and practices for work and its learning are briefly outlined by comparing European and Sino traditions. Drawing on a review from anthropological and historical literature, a conceptualization of foundational elements of learning through practice is then advanced. These are categorized as being threefold: (i) practice curriculum, (ii) practice pedagogies and (iii) personal epistemologies for practice. Each of these elements is illustrated and discussed in turn with their particular qualities and characteristics tentatively outlined. In conclusion, it is suggested that given the pervasiveness of the educational discourse that for an account of learning through practice to be legitimized and given credence for informing policy and practice that a science of learning through practice may well be required to counter the pervasiveness of the existing educational discourse.

Historical perspectives

Across human history, learning in the circumstances of practice comprises the most common and sustained mode of learning occupations. Throughout that history and, seemingly, consistently across continents, regions and cultures, learning through practice has been the most common and central means for developing the occupational capacities that is central to the existence and progress of societies and communities (Billett, 2010). There are similarities in how this learning occurred across Europe, Asia and likely elsewhere. Family or local workplaces stand as the commonest site for that learning in Europe, Scandinavia and Asia. For instance, when referring to learning to make pottery in India (Menon & Varma, 2010), Japan (Singleton, 1989) or China (Barbieri-Low, 2007; Ebrey, 1996; Ledderose, 2000), localized family and community settings were the sites of this learning. In Europe, this mode of occupational preparation had lasted a millennium before being destroyed by industrialization (Greinert, 2002). This change saw family and small community businesses being displaced by factories as sites of production and the re-organized of production that often broke occupations into small units of work (Kincheloe, 1995), thereby reshaping learning through work. Moreover, as elaborated below, within the circumstances of practice, the majority of that learning seems based on mimesis: observation and imitation, then practise (i.e. rehearsal). Importantly, this process of learning is premised upon novices' active learning, rather than being taught. So, learning through practice is learner-initiated, directed and enacted by the learners themselves, rather than being premised on didactic or taught processes such as those characterizing how learning is promoted in educational institutions.

Although limited in number, early accounts from distinct cultures offer some tentative premises for understanding this process of learning. In ancient

Mesopotamia, the Talmud (i.e. Jewish book of law) suggested to family members that “as it is your duty to teach your son the law, teach him a trade”. The tradition was for the son to go to the rabbi’s school in the morning, and in the afternoon learn his father’s trade (Bennett, 1938, p. 3). In Hellenic Greece, Plato noted that:

The son learned his trade by growing up in his father’s family and participating in the family activities, imitating what he saw his father doing. At first, the imitation would be playful and childish, carried out with such toy tools as a child could handle. Later, it would become more deliberately purposive. Practice produced technical proficiency in details and the growing boy would act first as his father’s ‘helper’, then as his associate, and would eventually himself become the head of a family, and the centre from which further training in the family craft would radiate (*sic*). (Lodge, 1947, p. 18)

In ancient India, similar practices seemingly occurred with pottery production (Menon & Varma, 2010). Here, tiny and rough versions of pottery artefacts have been found in locations where pottery was manufactured, leading to conclusions that they were fashioned by potters’ children. These accounts also point to a curriculum of practice and pedagogic strategies. Why, for instance, did the boy go to the rabbi’s school in the morning and work with his father in the afternoon? Moreover, Plato’s account provides a detailed description of the pathway (i.e. curriculum) along which children progress in their activities and learning whilst advancing towards becoming a skilled practitioner. The pedagogic devices included access to making small artefacts and activities that progressively develop capacities required for occupational practice. Hence, the evidence from Hellenic Greece and ancient India points to children engaging in activities comprising increasingly mature approximations of modelled tasks (Gott, 1989). That is, they engage in tasks that progressively provide opportunities to shape, approximate and hone capacities along a pathway of activities referred to by Lave (1990) as the learning curriculum.

Also, the role of personal epistemologies is evident in Plato’s account of physician’s training, including the personal experiencing the goals and capacities required for this occupation.

The best physicians are those who have treated the greatest number of constitutions good and bad. From youth up they have combined with the knowledge of their art the greatest experience of disease. It is better for them not to be robust of health themselves, but to have had all manner of diseases in their own persons. For it is not with the body, but with the mind, that they cure the body. And, thus they infer further bodily diseases of others from the knowledge of what has taken place in their own bodies. (Lodge, 1947, pp. 42–43)

These early accounts emphasize the sequencing of experiences (i.e. curriculum of practice), the purposeful direction of those activities as directed towards enriching novices’ learning (i.e. practice pedagogies) and the salience of learners’ active

personal epistemologies in construing and constructing what was learnt. These bases are helpful for establishing premises for an account of learning through practice. However, it is also useful to understand the nature of the occupational tasks to be learnt and how cultural and societal factors shape how this work and learning is valued and organized. The following section compares how concepts of occupational practice and their engagement were enacted in Hellenic Greece and in the Middle Kingdom of Imperial China to make this point.

Societal shaping of occupations and learning through practice

Many Western traditions and precepts about work and education for work emanate from Hellenic Greece and its key philosophers (Billett, 2011b). In a highly socially segmented and gendered society owing its existence to slave labour, it is not surprising that occupations were categorized hierarchically, as were the means of their learning. Plato distinguished among three kinds of work: artisans, artists and professions. Artisans engaged in activities such as building, carpentry, pottery and weaving that led to the creation of tangible products or services. Artists comprise musicians, painters, poets and those who produced things which were concrete and also aesthetic. The professions were those associated with medical, legal, theological and military activities. For Plato, “artisans’ and artists’ work belonged to that side of life that the average free born Greek citizen regarded as ‘banausic’ and unworthy of his serious attention ...” (Lodge, 1947). These forms of employment were not deemed to be worthy of free-born Greek males’ efforts. Similarly, Aristotle proposed that ‘... citizens must not lead the life of mechanics or tradesmen, which is ignoble and far from conducive of virtue (*sic*)’ (cited in Elias, 1995). Moreover, Plato considered the lowest level of education was to be for those who worked with their hands and not with their minds (Lodge, 1947), categorized as technical from the Greek *techné*—to make. So, cultural and societal values shape the worth of kinds of work undertaken, their conduct and arrangements for how they were learnt.

It is instructive to compare these values and practices with those in China which comprises the most advanced and continuous instance of human culture (Barbieri-Low, 2007). Whilst there were commonalities in occupations’ standing of across these two cultures, the form and character of skilled work and its origins differ. To initiate that comparison, it is worth noting that when the Domesday book was published in 1086 AD it estimated Britain’s population to be between 1.75 and 2 million. Yet, contemporaneously China’s population is estimated conservatively to have been between 80 and 100 million (Ebrey, 1996). It comprised a highly organized society with many major and highly populated cities that had piped water, sewerage and street lighting. It was already a complex and mass society requiring commensurate amounts and quality of goods, buildings and services. To demonstrate this demand, in 1085, the Song government’s mint is estimated to have produced over six billion coins a year (Ebrey, 1996). These coins were produced through three different forms of production (Ledderose, 2000), each requiring high levels of work organization, skilled workers and resources for producing and distributing these coins across a vast empire. Such was the demand for these coins that by 1114 AD, the imperial mint began printing paper money and, through this innovation they were able to close 50 copper mines. So, the size of

population and demands of society meant the requirement for mass production of artefacts and goods arose far earlier in China than elsewhere, and also the need to innovate in response to this demand.

Because of this demand, modular approaches was adopted for the manufacture of artefacts, manufacture of building materials and the construction of buildings (Ledderose, 2000) that were commensurate with requirements for mass manufacture. This approach developed over time and extended to writing. Indeed, between the Shang (1600 BC) and Qin (220 BC) dynasties there was movement from craft to industrial production. It was during the Qin dynasty, the so called 'terracotta army' was manufactured to accompany and protect the first Emperor in the 'after-life'. Analyses of clay from these warriors reveal high levels of consistency in its composition across the cohort, indicating high levels of work organization. Moreover, each warrior is unique in some way and great differences are evident across the cohort. Yet, apparently, only eight different moulds were probably used to make them (Ebrey, 1996), and by workers who were, probably, beforehand water pipe makers (Ledderose, 2000). Each warrior was manufactured by teams of workers, possibly contracted from nearby villages and whose activities were overseen by a supervisor, whose initials were marked on each warrior. A strict hierarchy of responsibilities underpinned their production. There were a range of skills associated with forming the warriors uniquely, then glazing and painting them in unique ways (Portal, 2007).

An account is available of this kind of production work at the Jingdezhen Kilns in the Ming dynasty (1368–1644). This city was famous for its white porcelain which created huge sets of items for the imperial palace (Kerr, 2004). These sets had to be uniform and made to a very high standard of finish. A French missionary, visiting the kilns in the eighteenth century, reported watching a cup pass through more than a dozen hands, one worker giving it an initial shaping on the wheel in a matter of seconds, another setting it on a base, another pressing it into a mould to make sure its size was uniform, another polishing it with a chisel, and so on (Ebrey, 1996). As many as 70 people were involved in the production of a single item. From a contemporary Western perspective, this kind of work might be described as being mere production work. Yet, a more considered account suggests that these highly skilled practices arose from a need for manufacturing large number of intricate artefacts requiring high levels of uniformity. Indeed, the processes and concepts of skill work being exercised in these accounts are more consonant with what occurs currently in manufacturing aircraft and quality automobiles, than the work undertaken by trade workers in Western countries, for instance. Hence, the conception of Chinese craft workers seems distinct from European traditions. That is, one less the independent artisan and more the artisan as having specific skills and capacities, and working interdependently with others. This distinction is not surprising given European trades workers likely worked in communities with small populations and with little requirement to mass manufacture artefacts, until in relatively recent times. Instead, they created individual products and entire artefacts. The point here is that the kinds of circumstances in which work is undertaken and its purposes shape the mode of production and also what constitutes skilled work, and conceptions of its worth.

There are similarities, and also distinctions in the valuing of skilled work in Imperial China, and Hellenic Greece. Both were intensely hierarchical societies,

with elites who would never engage in these kinds of work. Yet, in Imperial China merit was valued and access to senior bureaucratic positions were based on it, in ways unimaginable in Hellenic Greece. Also, competence in manual skills such as calligraphy was required for the merit-based public examination for access to employment and promotion in the public service. The valuing of skilled work also seems to be sufficient to warrant a questioning of the kinds of knowledge privileged by elites: declarative kinds. The Daoist philosopher Zhuangzi (369–286 BC) used a parable of a wheelwright talking to a learned general to describe the power of personal knowledge over what is found in books.

I see things in terms of my own work. When I chisel at a wheel, if I go slow, the chisel slides and does not stay put; if I hurry, it jams and doesn't move properly. When it is neither too slow or too fast, I can feel it in my hand and respond to it from my heart. My mouth cannot describe it in words, but there is something there. I cannot teach it to my son, and my son cannot learn it from me. So, I have gone on for seventy years, growing old chiselling wheels. The men of old died in possession of what they could not transmit. So it follows that what you are reading are their dregs. (cited in Ebrey, 1996, p. 49)

This parable provides an early questioning the power of declarative or discursive knowledge that is privileged in contemporary educational discourses. It also emphasizes the importance of knowledge, such as those exercised through haptic and sensory capacities not addressed or promoted in discourses of schooling, with its emphasis on declarative forms of knowledge and knowing. Yet, these capacities are central to effective performance in occupational practices. Importantly, most of these capacities are not easily taught didactically, they have to be learnt. So, how did this learning arise?

Explaining learning through practice

Chinese sources provide highly detailed descriptions of the bureaucratic ordering of work (Kerr, 2004). Yet, few, if any, written accounts of processes for skill development appear to exist for China (or other pre-modern societies). Perhaps these processes were not of interest to those who wrote¹. Consequently, apart from the accounts referred to above, to date, no others have so far been identified reporting the processes of learning for occupational purposes and support for that learning. An archaeologist specializing in excavating ancient kilns² advised that rhymes and mnemonics may have been used within communities such as those producing pottery and porcelain. But, beyond that little else is known.

However, there may also be another explanation. That is, this learning occurred as part of individuals' everyday involvement in work activities. It was not the subject of any teaching or direct guidance as we might expect today. Instead, it was an outcome of novices' engaging in work and where they had the responsibility to learn through their work. Indeed, it is impute that much of this learning arose through observation and imitation (i.e. mimesis), opportunities

to practice and, occasionally, direct guidance of more experienced co-workers. These conclusions arise from a review of historical and anthropological literature presented below that identifies learning practices for occupations across a range of cultures and countries. These accounts provide instances of how intentional learning activities occurred outside of educational programs and institutions. Certainly, prior to the 'era of schooling', largely arising after the various industrializations and formation of modern nation states in Western countries, institutionalized educational provisions were limited to a few occupations (e.g. medicine, law, military and philosophy). Yet, even then, much of their learning occurred through practice and in practice settings. Indeed, within Hellenic Greek medical education the need for anatomy classes and production of textbooks arose because of limited practice opportunities for medical students (Clarke, 1971). So, despite these students acting as assistants to medical practitioners and directly taking care of patients, there were limits in opportunities to observe qualified practitioners engaging in performing operations. These restrictions led to the need for anatomy classes. Similarly, a lack of interactions with them necessitated the codification of medical knowledge into the forms of textbook. These texts, although comprising the dregs to which the wheelwright referred to above, whilst very necessary, were substitutes for engaging in actual practice.

These accounts suggest that when considering how individuals learn outside of educational provisions, the need to be wary of uncritical acceptance of the discourse of schooling. Indeed, a critical consideration of this discourse, its precepts and emphases is necessary when considering the forms, contributions and potentials of learning through practice.

Going beyond the discourse of schooling in schooled societies

Given societal emphases, expenditure of resources and, in part, its compulsory nature, it is not surprising that schooled societies have discourses, orthodoxies and assumptions that promote the inherent value and privileged status of 'schooling' as the legitimate premise for realizing intentional learning. In these societies, educational institutions, their goals and processes used to instruct and assess have arisen from the interests of governments and religious orders, economic and social imperatives. For generations now they have become the ubiquitous and orthodox experience of members of these societies from infancy through to adolescence and adulthood (Billett, 2011b). There are good justifications for such discourses. Educational institutions perform important roles, are highly generative of worthwhile learning and are essential in securing some outcomes for students, not the least for those disadvantaged by circumstances of birth. As noted above, there is no intent here to critique schooling per se or the activities of educational institutions. Instead, the case made here is largely about providing space to consider, legitimize and understand and evaluate learning through practice in its own terms. For instance, because of its privileging, schooled societies tend to ignore, deny or, even worse, patronize learning experiences outside of 'schooling' settings, ordering and experiences. These experiences are described dismissively and erroneously as being informal or non-formal. When considered and engaged by educational program and systems, experiences in work settings are often only viewed as opportunities for

students to practice or contextualize what they have learnt within those programs, rather than them generating potentially important learning in their own right (Billett, 2009b).

Yet, there are limits to the scope and focus of educational discourses that have implications for how learning through practice is viewed. Firstly, whilst education practices and 'schooling' experiences have brought many unquestioned benefits, its discourse offers narrow accounts of: (i) human knowing (i.e. that which can be observed/measured), (ii) learning (i.e. that which can be declared), and (iii) knowledge (i.e. conceptual accounts). Scholars from a range of disciplines note that much human knowing is not accessible through observation or easy forms of measurement (Bourdieu, 1977; Lakoff & Johnson, 1999) such as those means used within educational institutions (i.e. teaching and assessing declarative knowledge). The very iterative process of learning—of construing and constructing knowledge—moment by moment as in micro-genesis (Rogoff, 1990) is almost impossible to capture and categorize, because it cannot be articulated by those processing it (Anderson, 1982). Moreover, when engaged in demanding activities, many aspects of human performance, similarly cannot be captured through observation or measurement. Then, the enduring societal bias towards conceptual knowledge and its learning has long privileged it ahead of procedures and dispositions (Perkins, Jay, & Tishman, 1993; Ryle, 1949). Yet, despite the privileging of declarative forms (i.e. that which can be declared speech or writing) these are not comprehensive bases for human knowing and acting (Ryle, 1949), as the wheelwright's parable above illustrates, and others note (Downey, 2010). Furthermore, in contemporary times, these declarative accounts are increasingly those now being emphasized within prescriptive occupational standards and educational provisions that are increasingly pervasive within vocational and higher education, despite long-standing educational concerns about their efficacy for these purposes (Hogben, 1970; Jackson, 1993; Stenhouse, 1975; Stevenson, 1992, 2005).

Indeed, not captured, articulated or privileged in the educational discourse are: (i) much of the procedural (i.e. strategic and specific) capacities required for effective work performance, (ii) embodied forms of knowing and its learning (i.e. those through the senses), (iii) haptic qualities (i.e. feeling, tactile competence) that are central to a range of occupations such as physiotherapy, creative arts, clothing, occupational therapy, and (iv) dispositions (i.e. values, interest, intentionality) that are essential for the exercise of occupational competence generally. Whilst these capacities are not easily captured and are often difficult to quantify, the forms and discourses of educational provisions and practices often merely ignore them. Hence, narrow and limited views of knowledge are those adopted within the educational discourse and its practice.

Another key quality of the discourse of schooling is an emphasis on didactic teaching, often as transmission, and a de-emphasises learning processes directed by learners themselves, except when associated with teaching processes. Given long-held concerns about the efficacy of didactic teaching, its premises should not be used for considering and appraising qualities of learning experiences outside of institutions. Jordan (1989) raises these concerns about the mismatch between didactic teaching in the western model and the approach used traditionally by Mexican birth attendants.

Whatever the origins of the didactic mode, it has always been a minor mode of knowledge acquisition in our evolutionary history. In the West, however, the didactic mode of teaching and learning has come to prevail in our schools to such an extent that is often taken for granted as the most natural, as was the most efficacious and efficient way of going about teaching and learning. This view is held despite the many instances in our own culture of learning through observation and imitation. (Jordan, 1989, p. 932)

Similarly, Singleton (1989) in referring to means of learning pottery in Japan noted:

... it is expected that serious learning will proceed unmediated by didactic instruction. *Minarai kyoiku* describes an education which relies on principles of learning observation and refers specifically to apprenticeship education. Yet, it is the apprentice who has to discover even this. (Singleton, 1989, p. 26)

These propositions are intended to set out some premises for understanding learning for and through occupational practice. The elements introduced earlier are now advanced to propose what might constitute the foundations of an account of learning through practice.

Elements of learning through practice

From a review of literature largely comprising historical and anthropological studies, but extending to recent contributions from cognitive science, three key elements are identified as being foundational for an account of learning through practice. These are, firstly, curriculum practices comprising sets and ordering of experiences in which individuals engage as they practice and learn their occupation. Secondly, pedagogic practices comprising activities and interactions that can augment those experiences and that take learners beyond what they can learn through discovery alone. Thirdly, epistemological practices comprising bases through which individuals direct their efforts and intentions when engaged in practice and learning, and through these come to construe and construct their knowledge. Yet, as foreshadowed, these three elements are located in particular cultural, societal and situational circumstances shaping their utility, applicability and potency. In the following sections, some bases for and premises of these elements are briefly outlined.

Practice curriculum

The literature on individuals' learning to practice their occupations outside of schooling suggests much of it occurs through: (i) participation in that practice, and (ii) specific arrangements that assist securing experiences that otherwise would not occur. Consequently, practice curriculum can be found in the progression through the everyday lived experience within the particular practices of

a (work) community (Gherardi, 2009) or culture of practice (Brown, Collins, & Duguid, 1989), but also through some deliberate structuring of experiences in a particular circumstance of work.

When considering learning arising through engaging with the lived experiences within a community, there is much evidence of it being secured as outcomes of engaging in a way of life (Billett, 2011a; Bunn, 1999; Jordan, 1989; Marchand, 2008; Rogoff, 1990). Bunn (1999) discusses how learning within nomadic Kirgizstan communities progresses through being born into, living and participating in community activities and roles. Hence, riding horses, herding and milking animals, making use of their skins, making cheese and other food products etc. are learnt as part of living within the community. Similarly, Jordan (1989) refers to Mexican birth attendants' learning arising through growing up and living in the community and engaging with birthing women. Also, Rogoff (1990) refers to apprenticeships through participating in everyday tasks and activities. Indeed, such is its ubiquity, (Lave, 1993) suggests that whenever she encounters practice, she also finds learning. Certainly, in her work on learning to tailor, (Lave, 1990) describes learning progressing through circumstances where apprentice tailors were immersed in the practice of tailoring. The sequencing of novice tailors' experiences were shaped by its practice, with little or no direct instruction occurring. These apprentices commenced with and gradually worked through a particular pathway of tailoring activities shaped by the production processes in tailoring workshops, which also had inherent pedagogical qualities (Lave, 1990). Similarly, similar sequencing of activities by hairdressers within hairdressing salons and also in food manufacturing workplaces have been identified (Billett, 2006). In essence, there was a course to follow—the track to progress along—shaped by the workplaces' productive requirements and through participating in a workplace with its own particular norms and practices. It was experienced as part of the lived experiences in circumstances of practice.

Yet, there is also deliberate structuring of learning experiences outside of the everyday activities of learners' communities. For instance, Bunn (1999) identified four occupations within Kirgizstan communities whose development occurred in this way: (i) blacksmith, (ii) a maker of Yurts (i.e. the tents nomadic people live in), (iii) a traditional storyteller and (iv) falconry (i.e. hunting using an eagle). Each occupation necessitated engaging intentionally in specific learning experiences outside of the everyday practices of that community. The apprentice blacksmith had to work and learn within the blacksmithery. The process of learning to make Yurts (i.e. tents) was structured in particular ways because of the equipment used and the tasks undertaken, albeit located within the family of the yurt maker. The craft of telling traditional stories required spending time living and travelling with the storyteller to learn those stories and know how to perform them. Being a falconer required the raising of an eagle chick and teaching it how to hunt and return to prey to the hunter. Marchand (2008) refers to apprentice minaret builders engaging in a process of intentional structured learning, albeit one where learners have to be highly agentic (as discussed later). So, when occupations have requirements that need to be met outside communities' everyday lived experiences, specific arrangements need to be enacted. Certainly, unlike earlier time, the requirements for most contemporary occupations are unlikely to be learnt through learners' lived

experiences. So, these requirements must be learnt through engagement in circumstances where those occupations are practised and appropriate experiences can be sourced.

As noted, the ordering of experiences within the circumstances of practice has been referred to as the learning curriculum (Lave, 1990). In her account of tailoring apprenticeships, the rationale for sequencing and progression of their experiences was from activities where the consequences of error were not great, through to activities where those consequences are significant. First, the apprentices lived and worked in tailors' workshops, and began their learning pathway by finishing garments. This activity permitted them to understand the goals for work (i.e. the standards of work which they had to emulate) and this experience provided them with explicit models to work towards. Then, they progressed through a series of garments commencing with children's underwear, adults' underwear, and simple outer garments, progressing on to ceremonial garments. These undergarments were made of cheap fabric and hidden from view, and like the children's garments, were held to be of low consequence if errors were made. Then, the apprentices progressed onto outer garments whose fabric is more expensive and where mistakes would be visible. Finally, ceremonial garments are made from expensive fabric and had to be well crafted. The pathways of hairdressing apprentices are structured for them to develop occupational capacities commencing with learning to engage effectively with customers through greeting and offering them hot beverages, and keeping the salon tidy, and progressing to engaging in hairdressing activities. This commences by first washing hair, then washing out dyes and chemical treatments, placing rods and curlers in clients' hair, before commencing the cutting of hair. In these salons, the practice was for apprentices to first cut men's hair before moving on to cutting women's hair. The principle of error risk is honoured here, as making a mistake in a man's haircut is held to be less critical than with a woman's. A path of learning activities was also identified in a food production plant progressing in the reverse order to the production process (Billett, 2000). New workers engaged in tasks at the end of the production line first, to understand the requirements for the finished product and its packaging and then progressed backwards to tasks associated with organizing, measuring and mixing food products.

Then, there are pathways of activities that junior doctors traverse in hospitals (Sinclair, 1997). They might initially engage in admissions and examinations of new patients, sometimes repeating tasks already performed by the admitting doctor, but checking for concurrences with the initial tasks. Having learnt these skills, they progressed to other kinds of activities but build upon these foundational capacities. Similarly, Jordan (1989) identified the ordering of skill acquisition for the Mexican birth attendants. They moved through phases of practice associated with developments within the prenatal phase, then onto the birthing process and postnatal support. A particular sequencing of activities was also identified in Japanese pottery production (Singleton, 1989). Here, the development of capacities was associated with apprentices' access clay to gain practice at making pottery items and the potter's wheel. This access often had to occur after the working day had finished when the wheel was not required for production. So, there are particular premises for progression of learning experiences in

these occupations based on skills to be learnt, the practices to be engaged and circumstances of practice.

These instances illustrate how practice curriculums can be organized, structured and needing to be progressed along. A key consideration in appraising these conceptions of curriculum is that learning and work co-occur, and specific opportunities for practice have to fit within the requirements for productive activities. Yet, when learning through the lived experience of the community or organized activities as a deliberate curriculum of practice, it may also be necessary to identify how to enrich those experiences so they can become more effective.

Practice pedagogies

Pedagogies here refer to means by which learning experiences might be enriched or augmented. Practice pedagogies refer to how interventions of different kinds, and not necessarily just by other workers can augment or enrich learning experiences in practice settings. A review of anthropological studies of learning in non-schooled societies and situations (Pelissier, 1991), identified instances where artefacts and direct instruction assisted practitioners' learning. Shells and other beach debris were used to assist Micronesian fishermen learn the patterns of stars by which they navigate at night, for instance. It was necessary to provide artefacts to assist this learning which might not otherwise easily occur (i.e. in a tiny boat at sea, in the dark at night). So, this review highlighted the importance of practice pedagogies: strategies, interactions or interventions occurring in the circumstances of practice that can enrich learning experiences. Similarly, storytelling by Mexican birth attendants assists novices' understand the community, the birthing process and circumstances that occur and need to be addressed by birth attendants (Jordan, 1989). Also, deliberate verbalization during work-related tasks was observed by (Gowlland, 2012) as assisting novices learn how to undertake pottery tasks that they might not otherwise learn. There are also particular activities within workplaces that are potentially pedagogically rich. That is, they have qualities lending themselves to promote learning. For instance, Billett (2010) has identified nurses' handovers as potentially rich learning activities. That is, when shifts of incoming nurses are briefed by nurses who are finishing their shifts provide opportunities for developing rich understandings about nursing work. The handover process engages nurses in verbalizing their understandings about: (i) the patients, (ii) their condition(s), (iii) their treatment, (iv) their progress with that treatment and (v) prognosis. These five interrelated considerations provide contextually rich bases for learning about nursing including developing factual understanding, the enrichment of concepts and building of causal links and associations amongst concepts, and formation of goals for nursing activities. Moreover, these experiences can be engaged with by learners at different stages or levels of nursing competence and their learning will be commensurate to what they experience. As discussed by Rogoff (1990, 1995), there are also the well-established traditions of close or proximal guidance, such as scaffolding (Kosslyn, 1980), modelling, coaching (Collins, Brown, & Newman, 1989) and guided learning (Billett, 2000). These practices exemplify the apprenticeship learning process with guidance by a more expert partner

who can assist the development of less experienced individuals through particular pedagogic practices.

Other forms of direct guidance by more experienced co-workers include their providing partially worked examples or half complete tasks from which others to model and guide their activities, and the use of direct instruction. This guidance can also include the use of artefacts, such as notation systems used for making lace as a basis through which novices can learn lace-making relatively independently (Makovicky, 2010). For novice lace makers, the notation system became a form of distal guidance and scaffolding. Yet, in reviewing this literature, very few instances were identified in which direct inter-personal engagement and guidance by experts or co-workers actually occurred. Where they were identified they comprised experts assisting novice do something they might find difficult to learn independently. This form of guidance is perhaps best exemplified in instances of more expert partners engaging in 'hands on' interactions with novices, for instance to assist them get the feel for correctly shaping pottery. This support goes directly back to what the wheelwright, mentioned earlier in this paper, was referring to; that is, the difficulty of learning skills that are richly honed and difficult to articulate (i.e. share). There is also the sharing of 'tricks of the trade' or heuristics, for instance, to assist novices develop schemas for undertaking their tasks and mnemonics. Some of these mnemonics comprise a series of letters to remind doctors about a series of interrelated conditions (Sinclair, 1997). Also, junior doctors are advised to remember a particular kind of illness or disease through the name of the patients in who they first identified it. This device provides a reference points for recalling evidence of the disease later. Then, there was the use of healthcare events involving celebrities that are used as prompts and reminders of particular health care sequences and problems. So whilst these pedagogic strategies are associated and embedded within instances of practice, they play important roles in supporting the kinds of learning required for that practice. Yet, beyond the enrichment and augmentation provided through these pedagogic practices, the literature identifies personal strategies used to assist workers' learning through work. These are discussed below in terms of personal epistemological practices.

Personal epistemologies

In reviewing literature on how individuals learnt occupational capacities through practice, one factor becomes very apparent. Overwhelmingly, it presents as being largely a learning process, not one relying on individuals teaching or being taught (Jordan, 1989, 2011; Marchand, 2008; Pelissier, 1991; Rogoff, 1990; Singleton, 1989). The centrality of the personal epistemological acts of those who are learning becomes very apparent in this literature and, perhaps, most principally, processes of mimesis (e.g. observing and imitation), listening, and actively engaging in work tasks and interactions (Billett, 2009a). Repeatedly in anthropological accounts, it was the novices who had the responsibility to learn, not others to teach them. This responsibility commences by them putting themselves forward as wanting to learn the occupation, learning to engage in ways that permitted them to learn through observation and imitation and then actively promoting their learning through work. Therefore, it is necessary to

consider and account for the central role personal epistemologies play in learning through practice.

These epistemologies are bases by which individuals engage in construing and constructing knowledge from what they experience when engaged in activities such as work (Billett, 2009a). They are more than beliefs (i.e. values and intentions). They also include how individuals' capacities, including their ways of knowing, come to engage in the learning process, thereby having procedural, conceptual and dispositional dimensions. Hence, these epistemologies constitute and direct individuals' capacities and embodied knowledge, their sense of self (i.e. subjectivity) and gaze (i.e. how they view the world and how they believe the world is viewing them) (Davies, 2000). The salience of personal agency and intentionality becomes apparent for individuals' engagement in effortful processes of learning, such as their taking responsibility for it. This responsibility extends to them learning to know how to act in workplaces in terms of the kinds of activities and interactions in which they engage, how they should do so and with whom (Gowlland, 2012; Singleton, 1989). Essentially, they have to learn how to participate in these practice settings and also learn effectively through and from them. Marchand (2008) suggests that apprentice minaret builders needed to 'steal' the knowledge required for this occupation. Moreover, he notes it was the apprentices' responsibility to position themselves in ways permitting access to the required knowledge. There was a physical as well as a social dimension to this positioning, as it required apprentices to become competent enough to work with the minaret builders where the stones were being placed on the outside of the minaret. Unless they demonstrated the capacity to work alongside expert builders in this location, they would not be able to access (i.e. observe and practice) the understandings and procedures needed to perform this crucial task. Similarly, here as elsewhere was the need for apprentices to engage in the effortful and deliberate practice (Ericsson, 2006; Gardner, 2004; Sinclair, 1997) required for effective performance. Through such activities arises the important embodied knowledge (Jordan, 1989; Lakoff & Johnson, 1999; Reber, 1992) which, whether referring to haptic or other sensory forms of knowing. For instances, these include the capacities of midwives diagnosing the health of a foetus's heart by hearing and appraising its sound or the skilled artisan judging the line, organization or flow of some process, is an essential element for effective occupational practice (Billett, 1999).

Consequently, individuals' personal epistemological practices are a central element in understanding how learning in and through practice progresses. The literature provides a number of distinct processes briefly discussed below. As foreshadowed, the most central of these processes is mimesis (e.g. observation and imitation), (Gardner, 2004; Jordan, 1989; Marchand, 2008, 2010; Tomasello, 2004) or mimetic learning (Billett, 2013). As Jordan reminds us:

Apprenticeship learning is based on imitation and behavioural matching. It is ancient for the human species and is rooted in our evolutionary history. Learning through observation and imitation rather than following genetically programmed action sequences is important in all higher social animals, but it is humans who have developed this propensity into the primary modality for the acquisition of skills. (Jordan, 1989, p. 931)

Despite its centrality to human progress and individuals' development over time, mimesis is seemingly routinely misunderstood and even maligned in schooled societies (Downey, 2010), often being associated with mimicking (i.e. mindless copying) (Meltzoff & Decety, 2003; Tomasello, 2004). This sentiment exists despite strong and growing evidence that it comprises a process that is fundamental to human cognition and both requires and is generative of higher order capacities (Iacoboni et al., 1999; Meltzoff & Decety, 2003). Indeed, Byrne and Russon (1998) propose there are levels and forms of imitation some of which would be classified as higher-order cognitive activities. More than mimicry, mimesis comprises appraising a circumstance, deciding the most appropriate pathway of action, taking action and monitoring that action to see whether what is intended is achieved. Engagement in observation has particular purposes, such as understanding goal states (i.e. what needs to be achieved), and also is central to the process of monitoring progress and evaluating the effectiveness of what is being enacted. Observations can also be generative of cognitive representations and their deployment. These representations are increasingly held to be multimodal and sensory (Barsalou, 2008; Glenberg, Schroeder, & Robertson, 1998), and observation provides a key form of sensory representation in their organization and structuring.

Also identified in the literature are other epistemological processes founded in personal practices seem central to learning through practice. These include, processes of learning how to negotiate with others about working together and securing knowledge from them, analogously referred to as ontogenetic ritualization (Tomasello, 2004). However, fundamentally across this literature is the emphasis on individuals' active engagement and construction of knowledge identified widely (Marchand, 2008; Singleton, 1989; Webb, 1999). It is even suggested that the word 'apprenticeship' has its origins in the requirement for learners to apprehend or to seize knowledge, because it is not taught (Bourdieu, 1977). In all, these processes of learning are unlikely to be effective unless individuals engage and learn, including novices having to volunteer and express their interest in learning a particular occupation. Just being in the community, even within family, was not always sufficient to be invited to learn that occupation (Bunn, 1999; Singleton, 1989). Instead, learners had to volunteer and indicate their interest and willingness to engage in the effortful process of learning this knowledge. As Mishler (Kosslyn, Thompson, & Ganis, 2006) notes, individuals had to assent to engage and learnt in the occupational practice. In this way, it is important to add personal epistemological practices as the third element which is identified in the review of anthropological and historical literature, albeit using contemporary justifications from the literature.

Together, considerations of practice curriculum and pedagogies as well as personal epistemological practices stand as a framework through which the contributions of learning through practice can come to be understood, appraised, and measures adopted to augment its contributions and limit its weaknesses. However, given the pervasiveness and presumed legitimacy of educational discourses such a framework is likely to be treated marginally unless the kinds of evidence and critique offered here are engaged with and considered more widely.

Need for a science of learning through practice

In conclusion, this paper has articulated a need for and outlined some foundations for an account of learning through practice that has been central to human progress and individuals' learning and development, and meeting and advancing the needs of human society across its history. It has proposed that across human history and currently, much of adults' learning and development for the capacities required for work and work-related activities likely arises through their experiences in the circumstances in which they practice their work. Advanced here are the explanatory bases for its central role in individuals' learning and the remaking and also the transformation of occupational practices. These bases are largely drawn from anthropological, the developmental and historical accounts, augmented by selected sources reporting empirical and conceptual contributions. These perspectives have been emphasized within this paper because their contributions have not been greatly exercised within contemporary accounts of learning through practice and also they offer fresh insights. Consequently, the bases of practice curriculum and pedagogies, and personal epistemologies; and the interdependence amongst all of them have arisen through accounts provided through this literature. Yet, these bases also need to be set within and mediated by the range of particular cultural, societal and situational factors that comprise and shape the circumstances of practice. However, as noted above, the pervasiveness of educational discourses within schooled societies works against an acceptance and legitimize a share of such bases. It follows that without informed and evidence-based accounts about how individuals learn through their work and how workplace practices and occupational capacities can be transformed through everyday activities and interactions in workplaces, it will not be possible to influence policy and practice to the degree by which they deserve. To address this displacement by the educational discourse, there may even need to establish a science of learning through practice to re-legitimize this circumstance of learning in schooled societies such as those which most of the readership of this journal are drawn. Such a science is needed to counter the orthodoxies of schooled societies and the discourse of schooling. Certainly, there is a need to go beyond what educational science proposes and to counter the limits of the discourse of schooled societies, including the emphasis on declarative or discursive knowledge. Such a science would need to draw upon a range disciplines that together can inform about how the social and physical settings comprising the circumstances of practice shape that learning, including processes individuals use when learning through their work. The emphasis on this being a learner led and the central role of personal epistemologies suggest greater attention on intra-psychological processes (i.e. processes within the person).

However, in all of this discussion about learning through practice and the need for a science supporting that learning, there is no intention or interest in displacing educational institutions, teachers and practices in those institutions, which are held to be essential and legitimate in their contributions to learning through work in contemporary times. Instead, what has been proposed throughout this paper is a need for practice settings to be legitimized, understood more fully and on their own terms as environments in which individuals come to participate and learn. To achieve this goal requires a space, conceptions and

evidence of the ways in which individuals learn in practice settings and the range of factors which support that learning. This paper seeks to contribute to meeting that space and offering evidence to that effect.

Notes

1. This comment was made by the librarian at the Joseph Needham Centre at the University of Cambridge, John P.C. Moffett.
2. Prof Nigel Wood from the University of Oxford.

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