QUALITATIVE RESEARCH IN PHARMACY EDUCATION

Using Artifacts and Qualitative Methodology to Explore Pharmacy Students' Learning Practices

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Objective. To explore the use of artifacts and material objects in accessing what learning means to pharmacy students, what their learning practices are, and their assumptions about what it means to master the pharmacy curriculum.

Methods. Data collection was qualitative and took the form of individual semi-structured interviews with students in a Master of Pharmacy program. Participants were asked to select three artifacts (a photograph, an object, a song, a picture, or something else) that represented what learning as a pharmacy student meant to them and bring them to the interview. The interviews were conducted using both the abstracts and a semi-structured interview plan constructed as a mind map. Flexibility was applied to changing the sequence of themes, and additional probing questions were asked. Data were analyzed thematically using mind mapping and, subsequently, theoretical constructs were applied to make sense of the analysis.

Results. Nineteen interviews were conducted. Findings were grouped into five distinct themes: study practices or strategies adopted, rituals associated with learning and studying, pharmacy knowledge, motivation for learning, and ways of learning. Each of these identified themes was summarized and illustrations from the data given. The affective dimensions of learning were a strong emergent theme throughout the data.

Conclusion. The use of artifacts in the research process afforded in-depth insight into the specific study practices adopted by a group of pharmacy students. Qualitative methods can be useful in surfacing students' learning practices and difficulties faced in their negotiation of the pharmacy curriculum.

Keywords: learning, pharmacy, qualitative methods, artifacts, practices

INTRODUCTION

Contextual changes to both the profession of pharmacy and to higher education in the United Kingdom have had, and will continue to have, a significant impact on how pharmacy students are educated.[1] The contours of the professional landscape in pharmacy worldwide are moving rapidly, with changes happening to how pharmacists practice, how they are perceived by the public and by other health professionals, and how they acquire knowledge.[2] As a result of these changes in practice, it is important to understand how pharmacy students negotiate[3] the curriculum to inform future changes to pharmacy education. In recent decades, since the introduction of pharmaceutical care,[4] there has been a paradigm shift towards a patient-centered focus in pharmacy. Pharmacists are involved in rational drug therapy[5] and spend much more time communicating about the benefits, risks, and potential adverse interactions of medicines[2] than compounding drugs. It is the diverse and changing nature of pharmacy knowledge that creates the challenge for pharmacy educators, who need to ensure the future workforce is able to adapt to new roles,[2] and these conceptual changes to pharmacy knowledge and practice have profound pedagogical implications for how pharmacy education will change in the future. This combination of new knowledge and practice brings new questions that require new and different research tools than have traditionally been used in pharmacy to answer. The aim of this study was to explore pharmacy students' learning in order to understand their learning practices. The study raises significant methodological, theoretical, and ethical questions with regard to the use of qualitative methods for researching students' induction into the pharmacy profession.

There is limited literature on learning in the context of pharmacy students. Current discourse in the wider

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educational literature on understanding student learning is diverse, as it was written from several different philosophical perspectives. Fenwick[6] explains that the term *learning* "has come to be applied to a vast range of processes from information transmission to individual development to emancipatory transformation [and that] there is no unitary definition that can adequately represent the multiple and contested perspectives." In contrast, much of the pharmacy literature is written from a single perspective, such as that on learning as transmission or cognitive development, ie, acquisition (eg, research by Peeters[12]) or that on individual skills development (eg, research by Langley and Aheer[13]). There are a very small number of studies in pharmacy education which are underpinned by learning as participation.[14-16]

Hodkinson and colleagues[7] offer an interesting critical account of the body of literature on learning. They describe many of Fenwick's[6] contested perspectives as the "cognitive learning" versus "situated learning" debate, in other words, the contrast between learning as acquisition and learning as participation.[8] Furthermore, Hodkinson and colleagues believe that authors tend to sit within only one "camp," unable to focus equally on the individual and the situation. This, they argue, results in a "different and partial version of what learning is."[7] They assert that there are important limitations in the literature on student learning and that no current theory of learning overcomes all, and argue that individual learning can be addressed from within a socio-cultural perspective.[7] In socio-material approaches, Fenwick believes that entities are understood to be mutually constituted and the material world is treated as continuous with and embedded in the immaterial and the human.[6] In anthropology, which this study draws on, the relationship between humans and artifacts has long been recognized and researched.

Plumb[9] uses the metaphor of "learning as dwelling" as a 'powerful way of characterizing human learning processes.' In his discussion of learning as dwelling, Plumb relates Ingold's anthropological theories[10,11] to education and explains how learning for dwellers is not a process of incorporating external knowledge into their minds. Rather, learning is best conceived as a process through which learners forever weave themselves into the fabric of their natural, social, and cultural worlds,[9] thus addressing the tensions highlighted by Hodkinson and colleagues.[7] This concept of learning as dwelling appears to offer a resource for thinking differently about pharmacy students' learning. The dwelling perspective and the use of artifacts gives access to conceptual resources for re-thinking pharmacy education in response to some of the dilemmas and tensions within the field of learning theory that are highlighted in the literature.

Much of the pharmacy education literature does not engage with the changes in learning theory that are being debated in educational literature as a whole. This study is a response to this disconnect and uses a socio-material approach to engage differently with pharmacy education.

METHODS

The main focus of this study was to investigate how pharmacy students negotiate[3] the pedagogical demands of a pharmacy curriculum. The data presented here are part of a larger body of data compiled by the first author for a doctoral project.[17] Hart[18] argues that it is one's *"stance on key methodological questions that shapes the character of a research study"* furthermore the methodological position taken in this study is interpretivist.[19] Interpretevism is underpinned by constructivist ontology,[20] and is principally concerned with meaning, understanding, and insight. This study was a considered response to the developments within the field of learning theory discussed in the introduction, taking a socio-material approach.

Data collection took the form of individual semi-structured interviews with undergraduate Master of Pharmacy (MPharm) degree students at Robert Gordon University (RGU), Aberdeen, United Kingdom, drawing on the use of artifacts in educational and anthropological research.[21]

Qualification as a pharmacist within the United Kingdom involves obtaining a General Pharmaceutical Council (GPhC) accredited MPharm degree, followed by one year of preregistration training during which a trainee demonstrates competence under the supervision of a preregistration tutor. Passing the GPhC registration assessment and meeting fitness to practice requirements complete these necessary stages.[22] The MPharm is a four-year, undergraduate master's degree that integrates the science and practice of pharmacy.[23] The majority of entrants come from high school; however, some students enter having completed a previous degree or other qualification.

For this study, a purposeful sampling method was used.[24] Students in each of the four stages of the MPharm program at RGU were invited to participate. An attempt was made to identify both male and female students with a range of educational backgrounds and academic abilities, including some who had previously had to "resit" for a module, indicating that they may have struggled with a subject area. Students were recruited by an email, which included an information leaflet giving details of the study. Initially the intention was to interview two students from each of the four stages of the MPharm program, but following the pilot interview, which only lasted around 30

minutes, a decision was made to increase the number to three students per stage. There were particular problems with recruiting students in stage 2. Part way through data collection, the invitation email was sent to all students enrolled in that year; however, no further students responded. As a result, the invitation email was sent to all students enrolled in stage 4 of the MPharm program. An additional 12 students responded positively, which exceeded the target number. Rather than excluding some, all students who expressed an interest in participating in the study were invited to be interviewed. Rees and Sheard[25] describe similar recruitment problems with medical students and argue that being responsive and changing recruitment strategies to increase participation part way through data collection is more ethical in terms of validity of findings than completing the study with pan insufficient number of participants.

The interview plan was piloted with one participant. The participant was also asked specific questions about the ease of interpreting the information provided prior to the interview and the process of choosing the objects. The pilot interview was included in the final data set.

Eighteen students were interviewed over a six-week period. Participants were asked to select three artifacts (a photograph, an object, a song, a picture, or something else) that represented what learning as a pharmacy student meant to them and bring that to the interview. Using artifacts in this way aligns with an increasing interest in connecting with socio-material practices.[6] These artifacts were then used, along with an episodic interviewing style,[26] to elicit participants' views about their learning process and to explore their experiences with aspects of the curriculum they struggled with, along with how assessment and feedback impacted their learning. The interviews were conducted using a semi-structured interview plan constructed as a mind map created using MindManager software (Mindjet/Corel Corporation, Dublin, Ireland), which enabled greater flexibility within the interview than using a linear text-based plan. The mind map contained themes to be covered along with a loose agenda of questions.[27] However, in conducting the interview, flexibility was applied to changing the sequence of themes and additional probing questions were used in response to the "stories" told by the participants.[28] Throughout the interviews, the artifacts were used in a flexible way. Each interview began by asking about the participant's first object. This led most of the participants to draw upon their other artifacts during the remainder of the discussion to illustrate their thoughts. In some cases, when dialogue on a particular aspect ended, the researcher prompted them to continue by asking about one of their other artifacts.

Interviews were recorded using a digital audio recorder, and digital photographs of the artifacts that the participants had selected were taken. Interview recordings were transcribed verbatim into MindManager software, which allowed the thematic analysis process to begin during transcription. Data analysis was then continued using mind mapping. Mind mapping is a thinking tool underpinned by the concept of *radiant thinking,*[29] where associative thought processes radiate from a central idea, allowing concepts to be integrated and connections to be made. Tattersall and colleagues[30] argue that using mind maps in research allows creative thinking, facilitating links being made between themes in real time throughout transcribing. An initial analysis map linking the student's artifacts and the meanings he or she ascribed to them was created for each participant. Following this, a summary mind map of the themes was created. Gibbs[31] describes the process of coding qualitative data, starting with descriptive codes, then moving to analytic codes. This process was applied in this study, taking a combination of data-driven and concept-driven approaches. In the analysis, the intention was to deliberately mobilize a range of theories in order to, as Woolgar and colleagues describe it, "cause trouble, provoke [and] be awkward."[32] Following the construction of the mind maps, the theoretical constructs of Law's concepts of practices[33] and collateral realities,[34] Ingold's concept of dwelling,[10,11] and Plumb's learning as dwelling[9] were applied to make sense of the analysis.

In a study such as this one, ethical issues are a critical concern, and the project was subject to rigorous ethical scrutiny at two institutions. Ethical approval for the study was granted by both the School of Pharmacy and Life Sciences Ethical Review Panel at RGU, and by the University of Stirling Ethical Review Panel. The study was conducted in accordance with the British Educational Research Association's Revised Ethical Guidelines for Educational Research[35] and in line with Robert Gordon University Research Ethics and Governance Policies.[36,37]

In connection with ethical issues, DiCicco-Bloom and Crabtree[38] highlight ensuring respect for the interviewee and the information shared. This was particularly significant in our study given the first author's academic relationship with the students. Hammack[39] describes this positioning as potentially leading to a "dual role conflict." During the introduction to the interview, all respondents were informed that information shared during the interview would not be used for any other (eg, course related) purposes. Furthermore, students were also assured that their decision as to whether or not to participate in the study would not in any way alter what Hammock calls their "right to or quality of service."[39] DiCicco-Bloom

and Crabtree[38] also argue that social roles shape the interview process and that acknowledging and responding to the power differentials that exist requires reflexivity on the part of the researcher. Similarly, Higgins[40] specifically highlights the power differential that exists between tutors and students in the higher education context and argues that tutors have the "legitimate means to exert control over students through their academic authority." In light of this, awareness and acknowledgment of the power differential that existed between researcher and participants in this study was important, ie, as the participants' lecturer, the researcher was in a position to exercise influence upon both their educational and occupational futures.[39] Sensitivity to this was exercised, for example, by conducting the interviews in a "neutral space" rather than in the researcher's office so as to establish a safe and comfortable environment for sharing the interviewee's personal experiences and attitudes.[38] The specific method adopted and the use of artifacts that the participants' had chosen also acknowledged power issues in generation of the data in that participants' ability to choose the artifacts afforded them control over the direction that discussions took. Participant confidentiality was maintained by using numbers rather than names throughout the study. Throughout the study, these ethical issues were brought to the foreground in the research design and an explicit attempt was made to incorporate DiCicco-Bloom B and Crabtree's[38] "integrating reciprocity into the creation of knowledge" throughout the research.

RESULTS

Eighteen students were interviewed over a six-week period and each was given a number to protect their confidentiality. Table 1 gives the breakdown of participants' number, sex, stage in pharmacy school, age, and previous educational experience.

The affective dimension of learning was a strong emergent theme throughout the data. Findings were grouped into five distinct themes: study practices adopted, rituals associated with learning, pharmacy knowledge, motivation for learning, and ways of learning. Each

Table 1. Characteristics of Master of Pharmacy Students Who Participated in a Qualitative Study to Explore Their Learning Practices

Year in MPharm Program	Participant, No.	Sex	Age	Educational Background Prior to Pharmacy School	Artifacts
1	1	Male	51	Science degree	Calculator, RSC membership card
2	2	Female	19	High school graduate	iPod, 'achievements' folder, 'stress man'
3	3	Male	19	High school graduate	Song, desk & nuts, study notes
3	4	Male	29	Engineering degree	Mind map, Cosmos book, photo (him & partner)
4	5	Female	26	Science degree	Mind map, BNF, photo (family)
4	6	Male	21	High school graduate	Wallet, rugby ball/champagne, Facebook page
4	7	Female	22	High school graduate	BNF, spider's web, bath
4	8	Female	21	High school graduate	Sticky notes, photo (family), coffee cup
4	9	Female	28	Arts & humanities degree	USB stick, diary, results transcript
4	10	Female	26	Science degree	Mind map, BNF, colored notes
4	11	Male	21	High school graduate	Colored pens, iPod, coffee
4	12	Female	21	High school graduate	Coffee cup, diary, iPod
4	13	Female	22	High school graduate	Photo (friends), study notes, library silent study area
4	14	Female	27	Science degree	Assessment criteria, photo (family), highlighter pen
4	15	Female	24	Science degree	Green pen, mobile phone, mints
4	16	Female	25	Science degree	Paper/highlighter pens, photo (family), ear plugs
4	17	Female	23	High school graduate (overseas) & Further Education College (UK)	Music, highlighter pens, body language picture
4	18	Male	24	Science degree	BNF, external hard drive, study notes

of these identified themes is summarized below, with illustrations from the data presented in tables.

Study Practices

The majority of participants brought along objects that represented study or revision practices. For many of them, colored pens, sticky notes, mind maps, and summary notes were the objects that represented learning. One student considered his colored pens an essential tool for him (Table 2, quote 1) and described how the practice of color-coding different aspects of a subject made it a lot easier to understand. Another explained that color coding made everything more manageable and that it allowed her to visualize things with colors and in her own writing (Table 2, quote 2). Published assessment criteria was the artifact that represented study for another student who said she used these to help her focus on what she needed to learn (Table 2, quote 3). Two participants brought diaries as objects that represented their organizing practices. Being organized and prepared was really important to one student (Table 2, quote 3). For another student who described her motivation as coming from friends and family, the diary represented a link with the world outside her studies (Table 2, quote 5). For several participants, the objects chosen represented particular spaces that they associated with their learning. For one, the silent study area in the library was the place where she always studied, whereas another brought a pair of ear plugs to represent how she needed silence as a precondition for effective studying. One participant discussed how she and a friend had developed a practice of each learning a different half of a subject really well and then taking turns teaching each other the remaining topics. Another discussed how she and her friend "talk it all out" once they had created their individual mind maps or note cards and that they had developed this practice while studying together during a previous course (Table 2, quote 6). Several participants brought iPods and music as artifacts that represented learning for them and explained that they played music while studying. One student had discovered while preparing for high school examinations that the practice of listening to music while studying helped her to learn (Table 2, quote 7). She found that she was listening to specific albums when studying different subjects and realized that she now always associated those songs with a particular subject and recognized the soothing and emotional effect that music had on her (Table 2, quote 8). Another student had different playlists on her iPod (with different genres of music) for listening to while studying various subjects and she found this motivated her to study.

Rituals Associated with Learning and Studying

Several participants identified specific "rituals" that they associated with their learning. In most cases, the students had not been aware of these rituals prior to being invited to the interview.

Table 2. Participants' Quotes Regarding Study Practices Shared During Interviews in a Qualitative Study to Explore Pharmacy Students' Learning Practices

Artefact	Quote No. (Participant No.)
Colored pens	1. 'You can't beat a good set of colored pens.' (#11)
	2. 'I kind of visualize things with colors and in my own writing.' (#10)
Assessment criteria	3. 'If I know what I'm . . . going to be examined on then I can zone in quicker on what I need to learn.' '. . .I can [. . .] see exactly what [staff] are looking for . . . to know that if I've kind of hit on all of those points, then I'm going in the right direction.' (#14)
Diary	4. 'I try to be really good and take a balanced approach in doing a little bit of everything every week.' (#9)
	5. 'You can't just learn, you can't just, like, struck yourself off from the whole world, just to physically study for four years . . . I can honestly say that I've not forgotten . . . no I've forgotten one person's birthday over the four years.' (#12)
Note-cards/"talking it all out"	6. 'It's less boring I suppose that you're actually having a conversation with somebody about it and it's a way of remembering it better . . . well we found it is.' (#10)
Music	7. '. . . it was kinda accidental when I was studying for standard grades ... but then I thought oh, that's quite a good way of me managing my time for each subject.' (#2)
	8. '. . . human physiology was the subject that I hated in first year pharmacy . . . well I was most interested in it but I just found it the hardest so I chose my favorite album because it was the most, like, calming thing that I had.' (#2)

One participant only used the desk in his bedroom for studying and it had to be completely clear to enable him to become really focused. On probing further, he reflected that he only used his desk for assessments, which he linked with examinations, and he compared this ritual to a different practice he had when working on other types of assignments (Table 3, quote 1). He also admitted he had not realized this practice before considering what to bring to the interview.

Another participant brought objects that she felt she could not do without when studying. She felt she could not take an examination without her green pen and said she always wrote out the question in green at the start of the examination (Table 3, quote 2). She reflected that this was her way of focusing on reading the question and explained that this was a strategy that she developed early on in high school. One student only ate nuts when he was studying and another only ate mints during examination time, often using them as a mini reward for accomplishing a goal while studying (Table 3, quote 3). A student who had brought her iPod as an object described how having music on while studying had become like a ritual for her (Table 3, quote 4).

A more mature student brought his old calculator, which he had bought when he had first studied in the 1970s, and described it as an amulet which he had always had with him. He said the calculator summed up his whole educational life. He described how, when he started to get distracted or lose faith in things, he looked at his "trusty friend," the calculator, and knew he would get through the difficulties (Table 3, quote 5). He also laughed about no longer being able to read the data card without his reading glasses.

Coffee was an artifact that represented learning for several participants but held several different meanings for them. Some saw the practice of drinking coffee with friends as a ritual or distraction associated with studying for examinations (Table 3, quote 6).

Pharmacy Knowledge

Five participants brought along their copy of the British National Formulary (BNF)[41] as an artifact that represented learning as a pharmacy student. One described it as her "trusty old BNF" and felt that it would represent learning for the rest of her life (Table 4, quote 1). For the second student, the BNF was a more negative representation of what was not a very good kind of learning. For her the BNF represented knowledge she acquired only by rote learning, which she did not enjoy (Table 4, quote 2). For the third student, the BNF represented a condensed source of information which she found useful in learning about drugs, while also recognizing that the black and white text was less useful than a summary textbook which used color to categorize, linking to her practice of using color. The fourth student brought the BNF to represent books in general, explaining that he used books a lot in learning, with the BNF being the text he currently used the most (Table 4, quote 3). The last student used the BNF to represent how her learning had progressed during her studies. Now in her final year, she relied much less on it as a source of information than she had earlier in her studies (Table 4, quote 4).

Motivation for Learning

Several participants brought along objects that represented where their motivation for learning came from, and this was a strong theme in the data. An important motivator for many participants was their family. Four of them brought a photograph of their family, which they said they often pinned up above their study area to keep them focused. For some participants, the motivational phenomenon was the love and support that their family provided, which helped when they were struggling with their studies (Table 5, quote 1). For others, it was remembering the sacrifices their family had made to send them to university that kept them motivated (Table 5, quote 2). One participant described a very close

Table 3. Participants' Quotes Regarding Rituals Shared During Interviews in a Qualitative Study to Explore Pharmacy Students' Learning Practices

Artefact	Quote Number, Quote (Participant Number #)
Desk	1. '[For an essay] I'll take my laptop through to the kitchen and I'll sit with my mum or dad or whoever's through. I'll sit and read through there but if it's for an exam, I am in my bedroom by myself, sort of at that desk.' (#3)
Green pen	2. 'I can't do anything without a green pen…even in an exam…I always write out the question in green pen.' (#15)
Nuts/mints	3. 'If you learn this paragraph or if you go through this, then you can have the sweet' (#15)
Music	4. '…kinda become like a ritual when I'm studying now. I have to have it on.' (#2)
Calculator	5. 'when I start to get distracted or…lose faith in things, I look at this and think well this trusty friend has been with me all…this time; it will get me through again.' (#1)
Coffee	6. '…we'll go for a coffee in the morning, we'll get a coffee at 11 o'clock, then we'll have coffee after lunch and it's a ritual. It's just a distraction to get out…' (#1)

Table 4. Participants' Quotes Regarding Pharmacy Knowledge Shared During Interviews in a Qualitative Study to Explore Pharmacy Students' Learning Practices

Artefact	Quote Number, Quote (Participant Number #)
BNF	1. 'This is our Bible and this is the whole reason I am here.' (#5) 2. '…this is not a very good kind of learning for me.' (#7) 3. '…you can't beat a good book.' (#18) 4. 'the BNF shows how much I have learned since first year…I hardly ever use it now.' (#16)

relationship with her parents and sisters and felt that she did not want to let them down.

One student described the motivational effect that a particular song had on him, and brought along a picture of his iTunes (Apple, Cupertino, CA) page showing how often he played the song as compared to other songs (Table 5, quote 3).

A majority of participants described social interaction and peer support with friends as a major motivating factor in their learning. Participants represented social interaction with various objects: a photo of friends, a photo of a rugby ball and bottle of champagne, a cell phone or a photo of their Facebook page. Those who brought a cell phone or Facebook page, felt it represented the practice of keeping in contact with their peers while they were studying and that such contact kept them both motivated and focused. One student always had her phone on silent on her desk and the other always had Facebook open on his laptop while studying (Table 5, quote 4).

One student represented social interaction and peer support with a photo of her friends, explaining that she learns a lot from other people. She and some of the other participants explained how supportive they found working as part of a self-selected group of motivated students, where they would compare their responses to case studies in problem-based learning. One participant commented how she would text friends to gauge their progress and described this practice of using friends' progress as a security blanket to motivate her in studying. She appeared to be using this as a yardstick to measure her relative speed of learning.

Coffee featured heavily in a number of participants' discussions about their study practices. For some, as described earlier, coffee was bound up with ritual practices, while for others, it was an important way of creating distinct phases of time. One student used coffee as a goal

Table 5. Participants' Quotes Regarding Motivation for Learning Shared During Interviews in a Qualitative Study to Explore Pharmacy Students' Learning Practices

Artefact	Quote Number, Quote (Participant Number #)
Family photo	1. 'it kinda reminds why I am here and the support that I have from my parents...my mother's always encouraged me to do what I want to do and to better myself' (#5) 2. '…Mum and Dad worked really hard to get to where they are now and to get to the point where they could afford to give me and my brothers and sisters this opportunity to go to college. When I'm struggling, I look at a photo of my mum or my dad...think how lucky I am to have this opportunity...and give myself a kick up the backside'' (#16)
Music	3. 'it's just a good song for me. It just makes me feel more enthusiastic.' (#3)
Social media	4. '…it's always there and every so often you can just kind of flick back to it and kind of read through whatever's happening…around exam time…everyone was on Facebook the whole time because…so it's just kind of a break to chat to more people who are studying and then motivates you to go back to your work' (#6)
Coffee	5. 'I'll get this amount done and then I'll go for a coffee break. I won't get that coffee until I've achieved that wee bit.' (#8) 6. '…it's one of the main things I've struggled with for four years by being able to balance money, being able to balance,…staying awake, so it's the two things combined together for this one...it's ridiculous how much a hot drink can, like, put you through Uni, but it is. It's crazy!' (#12)
Rugby ball	7. '…right, I just need to get this done right, no matter how bad it is, it needs to get done, I need to pass it and then...I can go play rugby on Wednesday and I can go out on Wednesday night' (#6)
Wallet	8. 'I just took a photo of my wallet…by the time you get to this stage anyway it's a real motivation that you're obviously wanting to earn money once you graduate and the whole point of going to university is to…especially coming to get professional degrees…is that you're going to come out, as a professional…and then you can actually start earning money' (#6)

to motivate herself (Table 5, quote 5). Others recognized the "pharmacological" effect of coffee, ie, the caffeine kept them going during intense periods of study. One student described the social aspect of having a coffee with peers, but for her, the coffee also represented the financial pressures associated with being a student. The local coffee shop sold a cup of carryout coffee at a discounted rate before 10.30 AM, and this student had brought a cup with her to the interview (Table 5, quote 6).

For another participant, the picture of a rugby ball and champagne bottle not only represented social interaction but also a way that he used sports as a goal to keep him focused on learning (Table 5, quote 7). Creating goals and markers of achievement were also important to other participants. For example, one student brought her "achievements folder," which contained all of her school certificates and awards, and explained how this gave her confidence to persevere. Another student brought a university transcript letter to represent her goals. One of the participants brought a desktop stress toy to represent how "super stressful" the pharmacy course was and how much work she felt she needed to do, but also to represent how much doing well was important to her.

For some participants, an important motivation for studying was the future. In particular, one student reflected on his future earning capacity as a professional and represented this with his wallet (Table 5, quote 8). Another likewise felt that one of his main motivators was wanting to be comfortable financially to allow him to have

a family. The mature student who had had a number of years career experience as a scientist before commencing studies in pharmacy, brought his Royal Society of Chemistry membership card to represent achievement as well as identity and belonging. Belonging to a professional body or organization did not feature in any of the other participants' interviews. Participants did not identify feeling part of a professional community as a motivator. Professional identity was only explicitly expressed in the mature student's case and, even then, it did not relate to a professional identity as a pharmacist but to his previous career as a chemist.

Ways of Learning

Several participants brought along objects that represented how they learned. One student brought along a book on the cosmos to represent how he found enjoying a subject made it easier to learn, indicating that relevance, interest, and enthusiasm for a particular subject can impact on students' learning (Table 6, quote 1). For two participants, both graduate entrants to pharmacy (which is not the norm in the UK), online resources and the practices involved in accessing these had a significant impact on the way that they learned on the course. One represented this with her USB stick and the other his portable hard drive. Both reflected on how internet technology and access to electronic resources differed significantly from their previous degree and made learning easier for them. Throughout the MPharm curriculum but particularly in

Table 6. Participants' Quotes Regarding Ways of Learning Shared During Interviews in a Qualitative Study to Explore Pharmacy Students' Learning Practices

Artefact	Quote Number, Quote (Participant Number #)
Cosmos book	1. 'If I find something like, really interesting, then I find that a lot easier to learn' (#4)
USB stick	2. 'it's really handy because if you're at home when you're having a problem, you can just put something up on the forum...I could kind of get to a point with something and then maybe post my, my...questions or what I think and then totally leave it until the next day or two days later when I have more information. Sometimes I find that rather than getting really stressed out with something and trying to push through it like you know...it's good to do that.' (#9)
Bath	3. 'it's when you get a sudden and brilliant connection between things and suddenly [snaps fingers] everything falls into place...the 'gold standard...the best thing that happens when you are learning...it's brilliant when it happens. In pharmacy it often happens when I'm sitting being taught and...someone else is making connections that I could not have made for myself at that point...and they make them and it's amazing and you think, wow I get that now, that's brilliant!' (#7)
Spider's web	4. '...these, the out, the vertical lines of the spider's web are, ...how you build your knowledge and the connecting ones are your understanding between the knowledge. When I'm learning something that's purely in my head, I think the connections you make between the information are the same as when you are actually doing something physically in front of you, you're making the same jumps in understanding, it doesn't necessarily need to be in front of your eyes to do that, to connect things together, so I think that's what happens inside my head.' (#7)

the final year, there is a significant emphasis on learning materials and support being delivered online. Students work both individually and in groups on projects and case studies using a problem-based learning approach and are supported through discussion forums by academic staff members and external experts. Linking back to the social interaction practices described earlier, one of the graduate students found the online forums were really helpful to her in allowing her to post and move on from issues that she was struggling with (Table 6, quote 2). Another participant brought along two interesting pictures which represented how she learned. The first of these was a bath, which for her represented where she often had a "eureka moment," the point at which everything about a pharmacy concept discussed in class suddenly made sense (Table 6, quote 3). For her, one interesting aspect of this was that she could not remember the specific instances of when this had happened, but simply remembered that it had occurred. The second picture she brought along was of a spider's web, which she felt represented how she learned. The vertical strands were the knowledge she built, and the connecting strands represented her understanding of the connections between the knowledge.

DISCUSSION

The use of artifacts in the research process afforded in-depth insight into the specific study practices adopted by a group of pharmacy students. Findings from this study suggest that qualitative methods can be useful in surfacing students' learning practices in their negotiation[3] of a pharmacy curriculum. Participants' learning was constructed through a "meshwork"[10,11] of interconnected and interwoven practices,[33] with the focus of the study upon the multiple practices that together constitute pharmacy students' learning. The concept of "learning as dwelling," Plumb argues, turns our attention to the processes that shape the "temporal interweaving of our lives with one another and with the manifold constituents of our environment,"[9] and the findings in this study exemplify this. In particular, the use of artifacts as a means of investigating students' socio-material practices in relation to their learning afforded new insight into a number of learning and assessment practices that might otherwise remain invisible. A number of issues that emerged were unexpected and, indeed, might appear somewhat eccentric when compared with themes in the traditional literature associated with teaching, learning, and assessment practices in pharmacy. This is a strength of the qualitative methodology mobilized in this study. In particular, a series of "unnoticed practices" and collateral realities,[34] such as the rituals they identified, appeared to be significant in the participants' success, or otherwise, as

pharmacy students. Motivation, affective dimensions, and social interaction were important aspects of participants' learning in pharmacy.

The study aimed to present data about the way pharmacy students in one school of pharmacy progressively construct meanings about the world and their learning rather than attempting to generalize. By nature, the findings from qualitative research cannot be widely generalized to other people and settings; however, the data here do echo findings described in the literature by other researchers, which adds credibility to our findings. This study highlights the success of the methodology and the ethical issues to be considered when faculty members conduct research with individual students.

Study Practices

The use of color and summary techniques described by participants may be a study practice indicating complexity reduction, which is the grouping of ideas together to increase clarity and reduce the complexity of the concepts being studied. Other studies[43,44] have explored how mind mapping can help in exploring relationships between concepts and in finding meaning. In this study, some participants described their motivation for mind mapping practices, which they believed to be effective for them. The strategies represented by color and notetaking in this study may indicate ordering and sense-making practices, where the participants categorized different threads, and it is the inter-relationship between participants and these artifacts which generates these practices, linking back to learning as dwelling.[9] In contrast to the ordering practice represented by some participants, working towards published assessment criteria appeared to be one participant's way of aligning herself with a pre-given order, using the criteria to define her own learning practices. This finding challenges the commonly held assumption that assessment measures learning but does not influence it.[45] The diaries brought by several students represent the multiple influences on students' learning and links to Ingold's conception of a life lived along the multiple lines of a meshwork.[11] These complex influences and "strands" of students' learning practices may often be forgotten by those attempting to support students in their studies. Blocking out such noise and the possibility of distraction is a further example of a learning practice involving some form of complexity reduction. In other words, a strategy that serves to deliberately limit the meshwork or complexity of strands that might otherwise prevent sense-making from happening. Those participants who discussed working with others reflected on how the practice of peer learning seemed to work really well for them, allowing them all to contribute ideas, and

strengthened all of their learning. Topping[46] defines peer learning as "acquisition of knowledge and skill through active helping and supporting among status equals or matched companions," and this echoes the practices developed by participants in this study. Unlike those where a condition of effective learning appeared to involve a reduction in complexity, peer learning appears to multiply the relational complexity involved in the practices associated with their learning. Topping[46] refers to the "social and emotional gains" of peer learning, and this echoes strongly with some (but not all) participants' experiences in this study.

Those participants who discussed music, recognized the soothing and emotional effect that music had on them, in some cases matching favorite music to more challenging topics. These various artifacts representing study techniques suggest that participants have developed study practices to suit their own way of learning, and these practices help them in managing the relational configuration and "meshworks"[10,11] surrounding them. Participants described how these practices had evolved throughout their educational life (in some cases, consciously, and in others, unconsciously). Most of the literature on student learning generalizes about learning practices without inquiring further into how, in practice, students carry these out. The practices discussed by participants in this study emphasize that learning is a far more complex, managed, and emergent set of practices than is usually acknowledged in the literature, and that "learning as dwelling"[9] may be a helpful way of conceptualizing pharmacy students' learning.

Rituals Associated with Learning and Studying

Participants recognized their artifacts in the rituals they had come to associate with studying and used terms such as "always" (using green pen) and "only" (eating nuts or mints at examination time). They also expressed how emotionally attached they were to these ritual artifacts. There are similarities here with the unintended aspects of practice that Law has referred to as "collateral realities," ie, "all those realities that get done along the way, unintentionally."[34] In encouraging participants in this study to articulate and explain these practices, which they are doing along the way, incidentally, there was the opportunity to bring the material dimensions of their learning practices to the foreground and to acknowledge the significance of these practices. The idea of paying attention to what is being done unintentionally as a constitutive dimension of study practice is not addressed in the literature on studying or in "traditional" approaches on how to learn. Having an awareness of these seemingly insignificant aspects of individuals' leaning may help those supporting students to enable them to develop successful learning practices. Interestingly, all the artifacts brought to the interviews represented positive learning practices, ie, things that participants believed helped promote their learning. This may have been because of the researcher's dual role as researcher and tutor, ie, participants perceived they should bring something that helped them learn rather than something that distracted them from learning. This method may also be helpful in further research to identify practices that get in the way of students' learning, eg, when a ritual no longer fulfils its purpose, or where a student has been unable to mobilize a strategy to aid their concentration.

Pharmacy Knowledge

The symbolism of the object of pharmacy's knowledge, the drug or medicine, was an interesting finding, with some participants reflecting on this positively and some negatively. For the participant who had a negative representation of "not a very good kind of learning," this was described as rote learning of facts. Western education practices have downplayed the role of rote learning, linking this to "surface learning" approaches to study,[47] which are not usually associated with learning for understanding. However, research conducted in Asia[48] exploring the paradox of high-performing Asian students who rely heavily on memorization has shown that understanding can be facilitated through memorizing. Kember[48] argues that rote-learning is not always as negative a practice as it is perceived to be in western culture, highlighting the complexity of the interplay in learning processes, memory, and understanding.[49] For the participant who relied less on her BNF as a source of information, this book represented a marker of transformation within her ongoing development as a pharmacy student. In his discussion of the relationship between pharmacy knowledge and professionalism, Waterfield[50] describes the difference between information (facts) and knowledge, which requires "complex assimilation, cross referencing, and analysis of many different types of information." Participants use of the BNF may represent less reliance on information and more on integrated pharmaceutical knowledge practices, showing a level of professional development which could be anticipated in the final stages of the course that aligns with the development of practitioners ready for a rapidly changing professional practice. The participant's representation of the BNF as *"not a very good kind of learning"* may represent a frustration with the fixed and factual "information" aspect of pharmacy knowledge rather than the "knowledge practices," which she referred to positively at a later point in her interview.

Motivation for learning was a strong emergent theme in the data. Respondents recognized the relational and emotional effect these phenomena had on them and their learning practices. These affective dimensions of learning appeared to be a recurring theme with a number of participants. This has some similarity with the findings of Aggarwal and Bates[51] in their study exploring the relationship between approaches to study and life-long learning attributes in pharmacy students, which identified "pressures" as an extrinsic motivator towards learning. They note familial, institutional, and personal pressures as important, but their use of the term "pressure" implies a negative emotional force distinct from the more positive emotional effect expressed by most participants in this study.

A majority of participants described social interaction and peer support with friends as a major motivating factor in their learning, again illustrating how study practices are always nested within a more complex relational nexus. Aggarwal and Bates[51] describe competition as a motivator for learning in pharmacy students. They argue that competition with others can affect learning in both positive and negative ways, which resonates with findings in this study. Studying with peers and benchmarking by text message were related by participants in this study as being empowering and motivating experiences. This does not fit with Aggarwal and Bates'[51] more negative conception of competition but instead linked back to the "social and emotional gains"[46] of peer learning.

Participants' reflections on previous successes link to the literature around threshold concepts and troublesome knowledge and how some students manage to negotiate their difficulties while others do not. Land and colleagues[52] describe a response from one of their respondents where "the next time she faced such troublesome knowledge, she asserted, she would 'hang in there' with greater confidence because she now knew she would eventually find a way of coming to understand." In the case of participants in this study, their past achievements and their ability to get through struggles appeared to motivate them with the confidence to approach a new difficulty.

Aligning with some participants' reflections on their future, Langley and colleagues[53] identified motivation for the future in pharmacy students and observed motivational differences between male and female students with male students more "interested in opportunities for independence, through ownership [of a pharmacy] or self-employment." Aggarwal and Bates[51] identified the need to meet defined goals as set by themselves (intrinsic) or others, such as financial and employment prospects, as

extrinsic motivators for pharmacy students' learning. However, given that in this study students identified multiple forms of motivation, it is questionable whether it is helpful to create a simple binary opposition between external and internal motivators in this way. The students' practices of studying would appear to be enmeshed within a broader set of negotiations than any simple categorization can capture.[10] Notably, most participants in this study did not single out qualifying as a professional as a distinct goal but instead appeared more concerned with the immediate hurdle of passing examinations (another motivator identified by Aggarwal and Bates[51]) and on finishing their degrees. Belonging to the profession of pharmacy did not feature in any of the participants' interviews. This may link to students not being positioned as members of a professional body at the time of the study.

Ways of Learning

The online learning practices reflected on by some participants form a significant part of current pedagogy. Many e-learning approaches to curriculum design are heavily influenced by a constructivist underpinning,[54] explained by Zhang et al.[55] as allowing learners to construct their own knowledge through "resource-rich, student-centered, and interactive learning". This appears to have been online learning experience of participants in this study. The social interaction mediated by digital technology is one that is unique to the current generation of students. While previous generations may have met up for a break and to chat face-to-face in the library, the current generation often catch up online

The findings around the student who brought two interesting pictures representing how she learned raises some interesting questions for pharmacy educators. Her description of "eureka moments" links to the idea of threshold concepts,[56] with crossing the threshold likened to moving through a door into "enlightenment." Land and colleagues[52] argue that these thresholds are often characterized as highly significant moments when they occur, but that it is often difficult to "gaze backwards across thresholds and understand the conceptual difficulty" being experienced. This description appears to echo with this student's experience.

In terms of the implications for pharmacy education, this study raises the issue that it would be useful to explore with students how their learning practices are nested within a broader socio-material "meshwork" and how acknowledging this can enable them to structure their practices more effectively. The findings of this study indicate that educators cannot prejudge the significance of these practices in advance and that looking at the role particular practices have within an individual students'

learning may be an important part of supporting students in their learning.

Limitations

The study had several strengths and limitations. Most of the participants in the study were in their final year of the MPharm curriculum, with only a small representation from students in other years. These participants were about to enter practice, and this timing more than likely had an impact on their views and practices, which is both a strength and limitation of the study. The researcher's dual role as lecturer and researcher was both a strength and potential limitation and required reflexivity about the impact of this on the data. In common with Wallman and colleagues[42] arguments, being close to the material and able to understand the "lingo and underpinning meaning" that the interviewees used contributed positively to the analysis. Things were said that they knew the researcher would implicitly understand but that an "outsider" would not have. In terms of the limitations of the researcher serving a dual role, where possible any negative impact of perceived power was reduced by the strategies previously described. Data saturation was reached during the analysis of the interviews. The method of analysis (using mind mapping) was a strength in analysing the artifacts; however, it became a limitation when analyzing other aspects of the data. The participants' "voice" and narrative were lost by using this technique, so a different method was adopted which will be discussed elsewhere. The intention had been to conduct a final focus group with all participants after the interviews were completed to validate the interview findings and check the interpretations. Because of time constraints, this proved impossible to organize, which could be considered a limitation. However, throughout the project, the attempt to adopt DiCocco-Bloom and Crabtree's integration of reciprocity into the creation of knowledge,[38] along with the use of artifacts and attending to participants' "voice" in analysis accounted for any limitations that resulted from this change in methodology. The lack of one coherent theoretical perspective or philosophy underpinning the research could be argued to be a limitation; however, this could also be asserted as a strength in that it allowed multiple ways to view the same data, which led to new understandings.

CONCLUSION

Pharmacy education within the terms of this study is not simply becoming socialized within an existing ordering, but becoming aware that further change is likely. This in turn will lead to new conceptualizations and orderings in the future. To use Ingold[10,11] and Plumb's[9]

concept of learning for dwellers, pharmacy education could move away from emphasis on "a process of incorporating external knowledge into their minds" and instead incorporate a "process through which learners forever weave themselves into the fabric of their natural, social and cultural worlds."

The use of artifacts in the research process and the use of qualitative methods, underpinned by social-material theoretical framing, has been highly successful in surfacing students' learning practices. It has also afforded insight into learning and assessment practices that might otherwise remain invisible. While the approach has been successful and may be useful for other researchers to apply in their own context, it must be acknowledged that the findings cannot be widely generalized. The findings from this study can be a resource for thinking about pharmacy education, for example, exploring with students the implications of "aha!" moments and how this might raise broader (ontological) questions that explore how their world is constructed, the intersection of people and things, and how these are conceptualized.

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