EDUCATION BRIEF

Utilization of a High-fidelity Clinical Environment to Train Student Pharmacists in Medication Dispensing and Checking

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ABSTRACT

Objective. To describe the implementation and student experience of high-fidelity training on medication dispensing and checking processes and procedures in an undergraduate pharmacy programme.

Methods. A live dispensary of a large teaching hospital was used to provide undergraduate pharmacy students the opportunity to develop skills and knowledge on the process and procedures of medication dispensing and checking. The sessions were facilitated and delivered by a member of the hospital pharmacy team, and were overseen by an academic member of staff. Students were required to undertake legal and clinical checks and process anonymised hospital prescriptions in a busy, live hospital dispensary. Students recorded their experiences in their professional portfolio as blogs, which were then discussed with academic staff on a bi-weekly basis. These blogs were subject to content analysis to investigate the student experience.

Results. In total, 48 students attended 30 hours of dispensing sessions across a 20-week period from September to April. Content analysis of 102 blog entries retrieved from the professional portfolios demonstrated students reporting observations and experiences mapping to the three components of
communities of practice: the domain of pharmacy practice; the working dynamics of a community of professionals within the workplace and the commonality of practice and shared repertoire of resources.

**Conclusions.** The high-fidelity teaching of students about the dispensing and checking process in a live dispensary environment supports knowledge and skills development. The work-based nature of this approach also provides experiential learning opportunities for students to observe and participate in the professional community of practice.

**Keywords:** dispensing, work-based learning, simulation teaching

**INTRODUCTION**

Over recent years, the profession of pharmacy has evolved dramatically, with many pharmacists now working within wider multidisciplinary teams and undertaking specialist patient-focused roles. Despite this shift, there are still core skills and competencies that remain crucial to the role of a qualified pharmacist, with one example being the clinical checking and supply of medication. As such, the regulatory body in the UK for pharmacy, the General Pharmaceutical Council, stipulates that pharmacy schools must ensure that undergraduate pharmacy programmes include teaching and learning opportunities for students to develop the knowledge and skills of dispensing and checking medication.\(^1\) As a competency, dispensing and clinical checking of medication requires the application of specialist knowledge of drug action and therapeutic use, practical and behavioural competence and judgement that is underpinned by appropriate professional ethics and values.\(^2,3\) The integrated nature of knowledge, skills and behaviour can be developed across professional activities and decision-making opportunities that students encounter during undergraduate pharmacy programmes in the UK. However, this will potentially only achieve the learning of component parts and preliminary development of ethical and professional values. Consolidation for higher-level skills are usually acquired through continued professional practice following graduation.\(^4\)

Most pharmacy schools, in the endeavour to maximise the development of competency and professional identity against a backdrop of limited work-based learning opportunity,\(^5\) can explore the employment of simulation strategies wherever possible. Within the practice of dispensing, these can range from the low-fidelity mock patient prescriptions in a classroom setting to higher-fidelity...
simulation activities, as exemplified by the recently reported simulated learning environment, MyDispense, created by Monash University. This online, authentic learning platform provides the opportunity for students to engage with the entire process of dispensing with the availability of interactive explanations and feedback on performance. This approach can be described as high in psychological fidelity if users temporarily suspend disbelief and interact as they would in the real world. The other two dimensions of fidelity are the equipment and the environment. The former relates to the similarity in appearance and feel of the simulator, and the latter considers the extent to which the simulator duplicates motion cues, visual cues, and other sensory information from the task environment. One approach that aims to achieve high-fidelity in all three dimensions would be to provide or tailor work-based learning to ensure students are able to gain experience and competence in this aspect of pharmacy. However, opportunities to provide such practical, experiential learning are challenging and limited, due to increasing demand and finite student support resources. Work-based learning is recognised to allow workers to learn by collective action and skill as well as by rational thought as it blends theory with practice. Work-based learning also provides the opportunity for the development of a community of practice. Lave and Wenger describe this using three specific components; where workers evolve and come together united (the community) in a common enterprise (the domain) to develop a shared history, repertoire of values, beliefs, ways of talking and doing things (the practice).

This educational brief will describe the design and assessment of an innovative approach to deliver dispensing and clinical checking education in a high-fidelity live hospital environment (high environment, equipment and psychological fidelity). The goal of this strategy was to enhance knowledge transfer and usability in practical situations and provide students opportunities to develop professional competence, values and behaviours towards upholding patient safety. This combination of goals is challenging but careful configuration of the three dimensions of fidelity of the environment can facilitate success of the experience.

METHODS

In August 2017, the Masters of Pharmacy (MPharm) academic team at the School of Pharmacy, Newcastle University, UK, undertook annual review of the teaching, learning and
assessment within the programme. The MPharm is an undergraduate, Master’s programme, taught in line with the Quality Assurance Agency (QAA), Framework for Higher Education Qualifications (FHEQ) Level 7 learning outcomes. It is the only undergraduate route to registration as a pharmacist with the General Pharmaceutical Council.

Medication dispensing and checking teaching and learning is delivered in Stage 2 (year 2) of the fully professionally accredited MPharm programme. This educational provision had previously been managed in a medium-fidelity simulated dispensary (low environment fidelity) with a mixture of placebo (specifically for controlled drugs) or drug-filled medication boxes and bottles (high equipment fidelity). Students were provided with a range of mock prescriptions and tasked to assess for validity, legality, clinical appropriateness, and then resolve any problems identified before dispensing the appropriate medication; each teaching session was facilitated by a pharmacy technician (high psychological fidelity). In the UK, hospital dispensary environments are primarily staffed by technicians and technical assistants. Pharmacists, in the main, work on the hospital wards and clinics undertaking, amongst other things, the clinical check of prescriptions prior to dispensing. The technicians have primary responsibility for the technical dispensing process once a prescription has been clinically validated by a pharmacist. The use of a technician in these University-based sessions more closely aligned the experience with real-life practice. This previous teaching strategy posed its own challenges, which have previously been reported by McDowell et al, and include difficulty in accommodating large teaching classes as well as high operational costs in terms of space, staffing, provision, and maintenance of current medicines stock.4

The School of Pharmacy at Newcastle University, UK, is co-located and has close links with a major teaching hospital, the Royal Victoria Infirmary (RVI), which forms part of the Newcastle-upon-Tyne Hospitals NHS Foundation Trust. Members of the School of Pharmacy (SoP) academic team (AT and AH) commenced conversations with the Director of Pharmacy and his senior staff to explore potential work-based learning and clinical teaching possibilities. An official partnership agreement was established that described how students would be taught dispensing and clinical checking in the live hospital dispensary by a member of the pharmacy team funded by the School, but working in the hospital (high environment fidelity). Ten, three-hour dispensary sessions, delivered
over a 20-week period from September to April, were co-designed by the supervising SoP academic, also a qualified pharmacist (AT), and the hospital pharmacy technician (LR). These were framed by specific dispensing activities and the relevant processes and procedures and involved using real-patient prescriptions, which had been anonymised and grouped to ensure students could learn from specific therapeutic areas within each session. The final dispensed and checked prescription was not given to a real patient. Students were expected to engage and work with the integrated electronic pharmacy management and stock control system (JAC system, https://jac.co.uk/), and become familiar with the traditional “medicine boxes on shelves,” as well as the robotic dispensing approach for managing and dispensing medication (high equipment and psychological fidelity). Our approach was pedagogically informed by the evidence that high-fidelity clinical simulation provides a safe and supportive environment, which allows learners to develop skills and competence to enhance their performance without inflicting adverse clinical outcomes.12

In October 2017, students received introductory lectures on patient confidentiality, standard operating procedures and checking processes of prescription validity and legality. By the end of October, students, in groups of four, were then assigned three-hour sessions every two weeks to attend the hospital dispensary. From October to December 2017, students also had a series of teaching sessions on the specifics of UK Pharmacy law, specifically the Medicines Act 1968 and the Human Medicines Regulations 2012 that further consolidated law concerning medicinal products for human use.13

Students were provided with guidance on the requirement to record their engagement with the dispensing sessions within their professional portfolios in the form of blogs. Blogs are recognised as an information sharing technology that engages a dedicated readership in knowledge sharing, reflection and debate. They have also been used to foster small virtual groupings of interested individuals to co-construct knowledge around a common topic in a community of practice.14 In associated reflection seminars, students were provided with instruction on how best to record a blog that would provide the basis for building a formal reflective account. Students in Stage 2 are required to write a reflective account as a formative assessment. To accomplish this reflection, students are provided with instruction and encouraged to use experiences such as the dispensing sessions as an
opportunity to reflect on practice, perspective, and understanding. To further support the dispensing sessions, students were required to attend small group review with academic staff on a biweekly basis. These tutorials were open for students to share their experiences and observations of their teaching and learning. The academic team used these encounters to discuss the student learning experience of the novel dispensing teaching and learning strategy. This was regarded as an opportunity for elaboration, where discourse can help learners to relate new information to existing knowledge, enhancing deeper learning, richer understanding and better use of knowledge.\(^{15}\)

As part of this study, content analysis was employed to systematically and objectively explore the student-reported experience of the dispensing sessions from their blog entries. Content analysis is used to interpret text data from a predominantly naturalistic paradigm. The conventional approach was adopted here which aimed to inductively develop categories through immersion in the data allowing the insights to emerge.\(^{16}\) Blog entries from October to December 2017 were downloaded from the electronic professional portfolios of the 48 (total cohort) Stage 2 students. An inductive approach was adopted where blogs were openly coded, categories created, and abstractions formed, so specific findings could be combined into a larger whole that describes the student experience.\(^{17}\) Two researchers (HN and LL) independently analysed the blogs, and discussed first impressions, thoughts and initial analysis. The two researchers then derived codes from the data and sorted into categories. Where discrepancies in findings and abstractions occurred, a third researcher was consulted who had consensus on the final categories (AT). An advantage of this approach is that information is gained directly from the participants rather than imposing \textit{a priori} categories or theoretical perspectives. However, a challenge to this methodology is the limited ability to develop a complete understanding of the context reducing credibility of the findings.\(^{16}\) Lincoln and Guba recommend further activities including peer debriefing, member-checking, triangulation, and persistent observation as strategies to establish credibility.\(^{18}\)

This study was submitted through the Newcastle University, Faculty of Medical Sciences electronic ethical review. This process deduced that full ethical review submission was not required due to the non-invasive research design and non-sensitive research question. However, all students
were provided with a participant information sheet to explain the research study and blogs were only obtained from consenting (completed consent forms) students.

RESULTS

The electronic professional portfolio was accessed at the beginning of the second term, Jan 2018. By this point of the academic year, the Stage 2 students (n=48) had attended four dispensing sessions and therefore (4 x 48) 192 blogs should have been entered onto the portfolio. On January 10, 2018, 102 blogs (53.1%) had been submitted by consenting students (n=48, 100% of the Stage 2 cohort), and each student had recorded at least one entry pertaining to a dispensing session. There was a general homogeneity in the types of observations and experiences captured across the student blogs. The codes generated by the two researchers reached saturation and were found to align to categories mapping to the three components of a community of practice: domain, community, and practice. An excerpt of illustrative quotes, derived codes, and categories has been included in Table 1. The findings are explained below under the three categories and illustrative student quotes are detailed in Table 2.

Domain

Lave and Wenger posit that a community of practice has an identity defined by a shared domain of interest and membership to the community implies a commitment to the domain. In the blogs, students shared experiences of learning about the dispensing and checking process and procedures (the domain of interest) as they undertook the session activities. Many of the blog entries demonstrated an appreciation of the cognitive and mechanistic steps in assessing the validity, legality, and clinical appropriateness of the patient prescriptions.

Students that had recorded consecutive blogs articulated an increasing awareness of developing a personal cognitive checking and dispensing process to improve the safety and efficiency of their practice. There was a high proportion of students reflecting on mistakes they made in the dispensing sessions as they undertook the simulated exercises. Students mainly expressed feelings of frustration with themselves.

However, there was acknowledgement that though the teaching session was simulated, it felt very “real,” and students appreciated the opportunity to practise without the threat or risk to patient
safety. Students often reflected on their errors in relation to the potential consequences on patient care and safety, which appeared to increase their internal motivation to improve their practice.

Community

A necessary component of a community of practice is that members of a specific domain interact and engage in shared activities, help each other, and share information with each other. They establish relationships that facilitate learning from each other.\textsuperscript{10,11} As students worked at their own pace, there were varying levels of completion of session activities. However, students demonstrated appreciation for the potential to learn from the practice from their peers in the session debrief, and to discuss their own performance within the group to further their understanding and address any knowledge gaps.

Many students also captured their observations of the working environment and team dynamic within the hospital pharmacy team. Students evidenced their realisation of the roles and responsibilities of team members, which did not always correspond to their preconceptions. They were able to appreciate the interconnectedness of the elements of labour and therefore the collaborative community.

Practice

The third component for a community of practice is that members are practitioners. They develop a repertoire of resources including stories, helpful tools, experiences and ways of handling problems.\textsuperscript{10,11} Students’ blogs recorded experiences of becoming familiar with the terminology, language, physical resources and technology that are all artefacts in the checking and dispensing procedures.

From the outset, the majority of students reported their experiences with orientating themselves physically within the dispensary environment, with many making note of the surrounding activities and observing the aspects of the context to the working practice. There were a number of students who reflected on their future where they pictured themselves working as a pharmacist in the hospital sector, where they would be problem solving, seeking information, contributing to practice.

DISCUSSION
The live hospital dispensary served as a high-fidelity teaching environment for students to learn about the processes and procedures of medication dispensing and clinical checking. Findings affirm that students experience high environmental, equipment and psychological fidelity with this teaching approach. Co-facilitation and design of teaching sessions between the SoP-employed, but hospital-located pharmacy staff and institutional academics can lead to the development of educational activities that are true-to-life. Undertaking such sessions in the hospital dispensary allowed students to develop skills and knowledge of key resources, terminology and technology that are used in this pharmacy activity. The reported student learning included the mechanistic processes of dispensing and checking relating to their task performance, e.g. operating electronic systems, registering prescriptions, and generating labels. There was also evidence of students demonstrating development of role performance through enhancement of professional understanding and identity. This latter achievement has been ameliorated by the immersive, real-life (high-fidelity) environment; a component of the new teaching and learning approach that was not previously afforded. The two specific typologies, task and role performance, were also reported by Wallman and colleagues as student reported learning outcomes from a six-month workplace learning experience. Authors also reported student perceptions of developing professional identity as they “learnt how to learn” in a professional setting. This resonated with content of the recorded blogs, where students were adapting their ways of learning from the resources, equipment and interactions within the workplace environment. The situated learning of the task and role performance can be considered to be organised and regulated by the social structure of workplace environment. In fact, Lave argues that it is the increased appreciation of the social practice that organises a workers’ or learners’ access to knowledge needed to sustain those practices. Applying this theory to our teaching strategy would mean that the workplace nature of the dispensing and checking processes and procedures is enhanced and informed by the immersive environment. Valsiner refers to this as the co-construction of knowledge: where individuals will elect how they engage and what they construct from that engagement, while social practices are able to provide different levels of pressure for the individuals to engage with particular knowledge.
There is a scarcity of research and reporting of the teaching and learning of clinical checking and dispensing in pharmacy education. MyDispense has been recently reported as an innovative strategy to integrate the relevant knowledge, critical thinking, technical activities, communication skills, and values necessary for developing dispensing skills. Shin and colleagues describe the main learning objective students achieved through MyDispense was that it allowed them to identify and gather relevant patient-specific information. Authors proceed to declare that MyDispense has a limited scope of simulation, as it does not simulate hospital pharmacy practice or an authentic interaction with other health care providers and patients (low environmental fidelity). However, given the aforementioned benefits of the MyDispense software, it could be incorporated within the current approach to supplement and consolidate learning from the live dispensary session.

The implementation of this approach to dispensing is facilitated in our particular situation, through the co-location of the hospital and the School of Pharmacy. Clearly, the availability of a high-fidelity environment, where students can experience the environment, without compromising patient safety is key to this approach. Equally, the amount of responsibility students are allowed to assume within the workplace is difficult to clarify given the legal and ethical requirements placed upon pharmacists who have overall responsibility for patients. Genuine peripheral participation is potentially difficult to achieve; however, this approach is the first step to developing a structure to allow students to learn dispensing and checking with thin the full operation of the hospital dispensary (ie, using real prescriptions for actual patients). We would argue that this approach requires substantial financial support and commitment from the University and the Hospital involved as well as thoughtful scheduling throughout the year to ensure that it is scalable to larger number of students.

Our report provides a valuable insight how relationships with healthcare providers in clinical settings can be used to design novel educational opportunities that facilitate professional and cognitive knowledge, skill and attitudinal development, otherwise not achievable in the classroom environment. Our study was limited to the in-patient hospital setting and thus is not generalisable to community-based environments. Equally, we did not evaluate the impact of the situated learning on student performance at summative assessment in comparison to the classroom. However, due to the fundamental change in the teaching approach, an appropriate assessment would need to be developed.
that should incorporate the same configuration of fidelity, therefore direct comparison to the previous classroom model may not be pragmatic.

CONCLUSIONS

Our study demonstrated how effective working relationships between a School of Pharmacy and a teaching hospital can facilitate innovative teaching and learning experiences that are of added educational and developmental value to the student body. The high-fidelity training on medication dispensing and checking in a live hospital environment demonstrate that students are learning within a community of practice. This situated education offers a learning experience that is continuous, active, engaging and identity-forming, rather than solely dedicated to mastery of a skill in a specific setting. This interaction will enable learners to progress towards full participation in the socio-cultural practices of their community; they become part of a community of practice.

ACKNOWLEDGMENTS

We would like to acknowledge the facilitative contribution of the Director of Pharmacy at Newcastle-upon-Tyne Hospital NHS Trust, Mr Neil Watson. Mr Watson played a key role in establishing the partnership between the Trust and the University and informing the design of the student experience.

REFERENCES

Table 1. The Codes and Categories Derived from the Conventional Content Analysis of the Student Blogs and Exemplar Student Quotes

<table>
<thead>
<tr>
<th>Category</th>
<th>Codes</th>
<th>Student Quotes</th>
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<tbody>
<tr>
<td>Domain</td>
<td>Clinically checking information</td>
<td>“I knew I had to check the appropriateness of the drug and the dose…” S32</td>
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<tr>
<td></td>
<td>Developing a cognitive process for checking</td>
<td>“I had to go through some mental steps in the right order to make sure I covered everything.” S</td>
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<tr>
<td></td>
<td>Technical process of dispensing</td>
<td>“After checking the prescription, it was about actually getting that medication and preparing ready to give to a patient” S65</td>
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<tr>
<td>Community</td>
<td>Peer review</td>
<td>“The group review allowed us to look at each other’s work and see how other people did it…like did they do it faster, or get less make mistakes…and how they did it” S86</td>
</tr>
<tr>
<td></td>
<td>Collaborative learning</td>
<td>“We were giving each other tips, like to remember the short codes for doses, and how to use some of the tabs on the system.” S43</td>
</tr>
<tr>
<td></td>
<td>Comparing/benchmarking performance</td>
<td>“I knew I was rushing, but I felt I was much slower than everyone else. I think I was just overthinking.” S12</td>
</tr>
<tr>
<td>Practice</td>
<td>Using resources</td>
<td>“You couldn’t really do it without the BNF [British National Formulary], so I made sure I had it or used the app.” S45</td>
</tr>
<tr>
<td></td>
<td>Using computer software</td>
<td>“It was difficult to remember what buttons to press in the JAC system, but I knew I just need to use it more.” S76</td>
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Table 2. The Categories Generated from Analysis of the Student Blogs and Illustrative Student Quotes

<table>
<thead>
<tr>
<th>Categories</th>
<th>Student Quotes</th>
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<tbody>
<tr>
<td>The Domain</td>
<td>“I know that I have to check all the legalities on the prescription, from my law lectures, and also do all the checks of the drug in the BNF [British National Formulary], before I can use the system to make labels. Then I have to use the prescription, not the labels, to then select the correct medicine.” S41</td>
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<td></td>
<td>“I will try to develop a mental checklist of tasks that must be done with every prescription; I will be less likely to make these kinds of mistakes if I have a system to follow.” S21</td>
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<td></td>
<td>“I didn't like the fact that I have made so silly errors and overlooked some aspects of the work where minimal or no error is required. Looking back now at my mistakes, I have noted some common errors and how to avoid them.” S33</td>
</tr>
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<td></td>
<td>“If this had really happened and it hadn't been spotted and checked with the prescriber, the patient could have had a very bad allergic reaction to the drug, and in the worst case scenario, they could have died as a result of it. This was a very important learning point for me, as it has helped me realise to a greater degree how important accurate checking of prescriptions is, as this could easily have been missed.” S18</td>
</tr>
<tr>
<td>The Community</td>
<td>“During my time there, I got to witness the interactions between staff that were occurring and seeing the importance of this.” S6</td>
</tr>
<tr>
<td></td>
<td>“Furthermore, I expected the dispensary room to be hectic and the work load to be a lot because it was in a hospital setting and on a Friday, however it was calm and work load seemed to be handled smoothly.” S15</td>
</tr>
</tbody>
</table>
“Upon reflection I found that my expectations of what a hospital pharmacy was archaic. The pharmacists work on the wards and send their prescriptions to the dispensary meaning they are constantly patient facing, and the dispensing technicians were giving the responsibility of assembling the prescriptions.” S47

“In our debriefing session my colleagues and I also discussed how some parents would prefer using a syringe rather than a spoon (especially with young children) because it may be difficult otherwise to get the child to take their required medicine.” S18

“Later on I discovered in our debriefing session that my colleagues felt the same way, which was reassuring because I realised that everyone was in a similar position to me in the learning process.” S26

The Practice “However, once I had received the tour I felt a lot more comfortable as I felt I knew my surroundings a lot more and had become more familiar with the task I was about to carry out. It was also interesting to see a live dispensary in action whilst I was working” S15

“…it was a good experience and I’m excited to learn more working within a live dispensary with real work occurring around me so whilst I learn I can also see what happens in the normal day to day of a hospital dispensary.” S4

“I found myself making mistakes which were not made in the first week, things such as forgetting to request the robot to dispense a box as opposed to a single drug.” S14

“I felt that I quickly became accustomed to using the JAC system [electronic platform used in dispensing medications] to generate labels and was therefore able to get the robot to dispense the different medications. However, at the time I felt I wasn’t fully comfortable with using the BNF to generate counselling points that I would give to the patient.” S16

“I found the experience very enjoyable and started to visualise myself in a working pharmacy environment” S34

“This was very beneficial and interesting for me as it gave me an opportunity to see a running hospital dispensary, allowing me to have a taste of what working in hospital pharmacy would be like.” S6