Experience-based learning: a model linking the processes and outcomes of medical students' workplace learning

Tim Dornan,[1] Henny Boshuizen,[2] Nigel King[3] & Albert Scherpbier[4]

OBJECTIVE To develop a model linking the processes and outcomes of workplace learning.

METHODS We synthesised a model from grounded theory analysis of group discussions before and after experimental strengthening of medical students' workplace learning. The research was conducted within a problem-based clinical curriculum with little early workplace experience, involving 24 junior and 12 senior medical students.

RESULTS To reach their ultimate goal of helping patients, medical students must develop 2 qualities. One is practical competence; the other is a state of mind that includes confidence, motivation and a sense of professional identity. These 2 qualities reinforce one another. The core process of clinical workplace learning involves 'participation in practice', which evolves along a spectrum from passive observation to performance. Practitioners help students participate by being both supportive and challenging. The presentation of clear learning objectives and continuous periods of attachment that are as personal to the student(s) and practitioner(s) as possible promote workplace learning.

CONCLUSIONS The core condition for clinical workplace learning is 'supported participation', the various outcomes of which are mutually reinforcing and also reinforce students' ability to participate in further practice. This synthesis has 2 important implications for contemporary medical education: any reduction in medical students' participation in clinical practice that results from the patient safety agenda and expanded numbers of medical students is likely to have an adverse effect on learning, and the construct of 'self-directed learning', which our respondents too often found synonymous with 'lack of support', should be applied with very great caution to medical students' learning in clinical workplaces.

KEYWORDS education, medical, undergraduate/*methods; *workplace; problem-based learning; England; physician–patient relations; interprofessional relations; clinical competence/standards.

*Medical Education: 2007; **41**: 84–91*
doi:10.1111/j.1365-2929.2006.02652.x

INTRODUCTION

The teaching of medicine in clinical workplaces has not kept pace with change in higher education. Today's students learn practically relevant theory in seminar rooms using well theorised methods[1] supported by empirical evidence of effectiveness.[2] They learn skills through high-fidelity simulation.[3] However, they integrate their knowledge and skills in workplaces through a process for which there are no better descriptors than 'senior surgery', 'clinical teaching', or 'primary care placements'. The workplace is where competence has eventually to be applied; it is the 'theatre' for much of a doctor's undergraduate and postgraduate education; workplace education is self-evidently important. However, the published literature mostly pertains to specific contexts (hospital firms,[4] community settings,[5] ambulatory education,[6] day surgery units[7]) and fails

[1]Hope Hospital, School of Medicine, University of Manchester, Manchester, UK
[2]Open University of the Netherlands, Heerlen, The Netherlands
[3]Department of Psychology, University of Huddersfield, Huddersfield, UK
[4]Department of Educational Development and Research, University of Maastricht, Maastricht, The Netherlands

Correspondence: Dr Tim Dornan, Hope Hospital, Stott Lane, Salford, Manchester M6 8HD, UK. Tel: 00 44 161 206 1384; Fax: 00 44 161 206 5989; E-mail: tim.dornan@manchester.ac.uk

Overview

What is already known on this subject

Descriptions of clinical workplace learning are usually tied to specific contexts and disciplines in which it is delivered ('firms', 'paediatrics', 'ambulatory care education') and concentrate more on teaching ('clinical teaching') than learning.

What this study adds

This study identifies a set of outcomes that acknowledge emotional as well as practical learning, 'supported participation' as the core condition for workplace learning and some prerequisite conditions for workplace learning. It presents a model linking process and outcome.

Suggestions for further research

Future research might test the model's applicability in a range of contexts and explore the nature of emotional learning.

to identify causal links between the processes and outcomes that are expected of a contemporary, integrated curriculum. We have synthesised students' narratives of how they learn in workplaces with a detailed literature review presented elsewhere[8] into a testable model of workplace learning.

METHODS

Context

The context was the Salford Sector of the University of Manchester Medical School. The curriculum is of a contemporary type with a spiral, fully horizontally integrated design that uses problem-based learning (PBL) methods through all 5 years. After limited clinical exposure in Years 1 and 2, students continue thematic learning in Years 3 and 4, but now with clinical skills training and simultaneous community and hospital attachments to provide access to a breadth of clinical problems and contexts.[9] In Year 5, they have one-to-one attachments to clinicians and continue to attend group tutorials, but now use real patients as triggers for PBL.[10]

Study design

Students at the end of Year 3 were chosen as index respondents because they have had nearly a year's clinical experience but are still junior. A tutorial group of 8 students on a 7-week attachment to 1 firm took part in a semistructured group discussion. Following the interview template used in a previous survey of staff,[11] they discussed how successfully they had learned from clinical experience, what factors had helped or hindered their learning, ways by which their learning might have been improved, and the roles of their teachers. A provisional analysis of their narratives provided the starting point for a 'complex intervention',[12] which included more comprehensive briefing, mentoring, and reflective debriefing on experience as described in detail elsewhere.[13] All 8 clinically naïve students non-purposively allocated to the firm at the start of the next academic year gave informed, verbal consent to take part in a group discussion after experiencing the modified firm for 7 weeks. To triangulate and extend those observations, a group of 9 Year 5 students and a mixed group of 3 Year 5 and 8 Year 3 students who had spent 20% of their time in primary care and experienced a variety of hospitals gave a senior student retrospect and compared senior and junior student perspectives on clinical learning.

Roles of the researchers

Having become experienced as a 'participant observer',[11,13] the first author conducted the index discussion and complex intervention with students attached to the firm on which he was 1 of 5 consultants. He kept daily field notes and students kept daily written records of their learning. His co-researchers helped him identify preconceptions and biases that might colour his interpretation,[11] supervised the study to identify bias in its conduct, and compared his evolving interpretation against the original narratives. A second author and a clinical academic (not an author) observed the discussion with intervention group students to identify undue influence on their opinions. Unlike the Year 3 students, who were all taught by the first author, few of the Year 5 students had been placed with him and some had never met him. A third author, who never met the students, supervised the study. A fourth author, naïve to the conduct of the study, critiqued a provisional interpretation against the original transcripts.

Analytical methods

Each discussion was analysed in enough detail to inform the next, but the grounded theory analysis was

'abbreviated' in the sense that definitive analysis took place after data collection had finished. All discussions were transcribed verbatim. They and the field notes were entered into nVivo software (QSR, Doncaster, Victoria, Australia) and analysed using procedures proposed by Strauss and Corbin to identify causally related 'actions and interactions'.[14] The index discussion was coded and the interpretation critiqued. A core theme and coding structure were agreed, the transcript was recoded again, and the coding structure was applied to the other transcripts and field notes. Once the authors had agreed that theoretical saturation had been reached, they integrated the findings with a detailed literature review published elsewhere[8] to develop a theory and graphical model. 'Results' adheres to the model, following a narrative sequence chosen to make the concepts and relationships as clear as possible. Verbatim extracts are cross-referenced between the text and Table 1 (Table published online as supplementary material), which identifies the source of each extract.

RESULTS

1 Participation as the core condition for learning

Despite their exposure to primary care, respondents spoke mostly about hospital experiences (1.1). They learned best by participating in practice but their workplace experiences were not all participative. As they became more senior, learning activities had to be close to the role of a practitioner to be experienced as participative.

2 The nature of participation

2a Observation as participation

Observation could be active or passive. Passive observation allowed respondents to glean knowledge and encounter realities they had learned about in theory but which gave, at best, a transient sense of participation. Interaction with doctors and nurses made observation a more participative and instructive experience and respondents became frustrated when that interaction was lacking. (2a.1).

2b 'Acting' as participation

Performing clinical tasks made students participants by changing them from the status of observers to that of actors (2b.1). However, even acting could be more or less participative. Clerking a patient who had already been clerked by a doctor was rehearsal (2b.2). An act became performance and a respondent's sense of participation increased when the task contributed to patient care (2b.3). There were, of course, some tasks that had to be rehearsed before respondents could perform them but there were others, such as calling a patient into a consulting room or completing a request form (2b.4), that could give even junior students a sense of participation.

3 Factors affecting participation

3a Interaction with patients

The wish to benefit patients had led many respondents to study medicine (3a.1) but their early attempts to participate were hampered by fear of doing just the opposite (3a.2). Doctors made participation easier by introducing respondents to patients as 'doctors-to-be' and recognising the quality of their early rehearsals (3a.1). Building social relationships with patients increased inexperienced respondents' sense of participation (3a.3) and success gave them more confidence to participate on another occasion. Being taken to the bedside in a large group, by contrast, could be a very negative experience of non-participation because respondents were not just observing passively but invading a patient's privacy. (3a.4).

3b Interaction with doctors

3b.1 Doctors' behaviour towards students

Some doctors showed their unwillingness to support participation by failing to greet respondents when they arrived, providing no timetable, cancelling teaching, failing to turn up, or allowing themselves to be bleeped away (3b.1.1). Others actively supported participation by providing ready access to their practice (3b.1.2), sharing their clinical expertise (3b.1.3), and creating tasks for respondents to perform (3b.1.4). The pressures of practice amplified doctors' (un)willingness to support student participation, with some becoming unfriendly and relegating students to the role of passive observers (3b.1.5), and others asking them to help out (3b.1.6). There was a dynamic between doctor and respondent such that students who were clear what they wanted to learn, unafraid to ask questions and practically competent had the best chance of participating (3b.1.7). Challenging respondents with a question or task increased their participation provided the challenge was appropriate to their level of experience and made in a supportive way (3b.1.8). Teachers could strike the right balance between support and demand by amicably 'grilling' respondents (3b.1.9) and the

wrong balance by asking questions in a belittling way or using a respondent as a menial pair of hands (3b.1.10).

3b.2 The climate of the medical team

The personalities of doctors had a pervasive influence on the learning climate of a firm. Some seniors helped respondents participate by increasing their juniors' interest in teaching (3b.2.1), whereas others left their juniors unsupported, unaccountable and unrewarded (3b.2.2).

3b.3 Doctors' knowledge of the curriculum

Doctors' familiarity with the curriculum also affected respondents' participation. A common obstacle to participation was the misconception that teachers should not divulge answers or share their expertise in a PBL curriculum (3b.3.1).

3c Interaction with nurses

Nurses had a powerful influence for good or ill on respondents' participation (3c.1) They could leave respondents feeling passive, unskilled and unconfident by claiming they had arrived unannounced. Sometimes they even denied respondents access to the workplace. At the other extreme, they could be welcoming, supportive, willing to share their expertise, and able to offset the 'scariness' of doctors (3c.2). Respondents' experiences with nurses were more positive in outpatient than ward settings, in district than teaching hospitals, with specialist rather than generalist nurses, and as senior rather than junior medical students. Respondents contrasted their situation unfavourably with that of student nurses, who wore uniforms, had one-to-one relationships with trained nurses, had their own patients, had defined responsibilities, were a useful part of the workforce, and 'were training to be nurses rather than pass exams'. Returning to a ward where they had found it hard to participate as juniors, senior respondents found they were now welcome because they were useful (3c.3).

3d Interaction with peers

Depending on their individual personalities and the climate of the peer group, respondents could be spurred into active participation or rendered passive by peer interaction (3d.1). Greater numbers of students on firms and shorter, more discontinuous attachments reduced participation by making respondents' interaction with doctors less personal (3d.2, 3d.3).

3e Organisational factors

A well structured curriculum with a clear timetable, defined learning objectives, and space in the hospital they could call their own (3e.1) helped respondents participate, particularly when they were most junior and vulnerable.

4 Students' states of mind

Participation was influenced by, and influenced, respondents' emotions, which reached their highest peaks and lowest troughs in the earlier years of the curriculum (4.1).

4a Building a sense of identity

Junior respondents grappled with whether they had any right to be in the workplace (4a.1). Simple things like making tea for a friendly registrar (4a.2) or having a safe haven where they could write up notes (3e.1) helped. Being in workplaces where students were 'new and exciting' increased their sense of identity (4a.3). However, they more often felt like 'spare wheels', or like unskilled, anonymous members of large groups who got underfoot (4a.4) and had no responsibilities (4a.5). A junior respondent described feeling stigmatised by ward nurses as 'the lowest of the low' (4a.6). Students could, however, develop an identity as a 'member of the team' when they interacted on a one-to-one basis with doctors and nurses continuously over a period of time and contributed to patient care (3d.3, 4a.7), all of which became easier as they became more senior. Simply to be addressed by name boosted their sense of identity (4a.8).

4b Becoming more confident

Participation made respondents more confident (4b.1). Some were naturally self-confident (4b.2) and found it easier to be confident if they were clear about what they were expected to learn, but their confidence was very sensitive to how doctors behaved towards them. Lack of confidence made it hard for junior students to communicate with doctors, although doing so made their learning more participative (4b.3). Confidence was dented by failed performance and bolstered by positive feedback from a practitioner (4b.4).

4c Sustaining motivation

Respondents' motivation was strongly influenced by their workplace experiences. They were demotivated

by practitioners refusing to interact with them (3b.1.1), keeping them as passive observers (2a.1), or having low expectations of them (4c.1). By contrast, doctors' and nurses' enthusiasm (4c.2), accessibility, and supportively challenging behaviour (3b.1.8) were powerful motivators.

4d Feeling rewarded

Respondents were rewarded by achieving a relatively high level of participation for their stage of training (4d.1) particularly when they adopted the role of doctor (2b.1, 3b.1.6). Their feeling of low status could be counteracted by a doctor's recognition, which made hard work worthwhile (3a.1, 4d.2), strengthened their sense of vocation for medicine and motivated them (4d.3). Teaching more junior students on behalf of a doctor was particularly rewarding.

5 Students' competences

5a Study skills

Respondents spoke articulately about how their study skills had evolved: how they had learned what to learn; what activities to attend (5a.1); how to access those activities; how to behave in hostile and unfamiliar workplaces; what expectations to have of doctors and nurses; how to manage time proactively (5a.2); how to balance time spent on book-learning against time in the workplace (5a.3), and how to identify reflectively what they had learned (5a.4). They learned through their own and their peers' experiences (5a.5) how to 'pitch in' (5a.6), although the support of doctors and nurses made it easier to do so (5a.7).

5b Knowledge

Entering workplaces made respondents lose confidence in knowledge they had spent many years acquiring (5b.1) and required them to learn new ways of learning (5b.2). Private study made them more confident to participate (5b.3) and participation made their learning more tangible and increased their confidence in it (5b.4). Doctors were able to help them by asking questions relating theory to practice (5b.5).

5c Clinical skills

Respondents acquired clinical skills through acting (4b.1). Practitioners could help by 'throwing them in at the deep end' (5c.1), training, supervising, giving feedback, expecting them to achieve quotas of skills, and ensuring they had opportunities to do so (5c.2). Developing clinical skills built respondents' levels of confidence and motivation and enhanced their sense of both reward and identity, which in turn made it easier to participate.

DISCUSSION

Principal findings

Figure 1 assembles the findings into a model of 'experience-based learning'. In addition to the knowledge and skills of medical practice, students need to acquire confidence and a sense of professional identity and sustain their motivation. Those various learning outcomes are attained together in a complex amalgam. Attaining them reinforces the learning process, and failing to acquire them weakens it. The educational climate and behaviour of individual practitioners – nurses as well as doctors – has great power to enable or disable workplace participation that brings students closer to their ultimate goal of helping patients. As they progress through the curriculum, the outcomes students achieve and the activities through which they achieve them became closer to those involved in the role of a practitioner. An effective workplace teacher is someone who can simultaneously support students and challenge them in a way that builds practical competence and a positive state of mind.

Strengths and weaknesses of the study

One of the study's strengths is the coherence of the model that results from subjecting the narratives to lengthy and detailed grounded theory analysis by a deliberately mixed team of researchers, teasing out interactions between process and outcome and systematically seeking coherence and incoherence in the data. A second strength is the potential for generalisability that results from asking students to narrate experiences spanning hospital wards, outpatient clinics, primary care, and other settings. A third strength is the combination of observational research with experimental strengthening of students' experiences. Although the sample of narratives was sufficient to achieve theoretical saturation, our students all came from 1 medical school and might not be representative of students elsewhere. For example, our curriculum was not vertically integrated when this research was carried out. The balance and timing of practical and emotional competences might have been different if participants had been exposed to

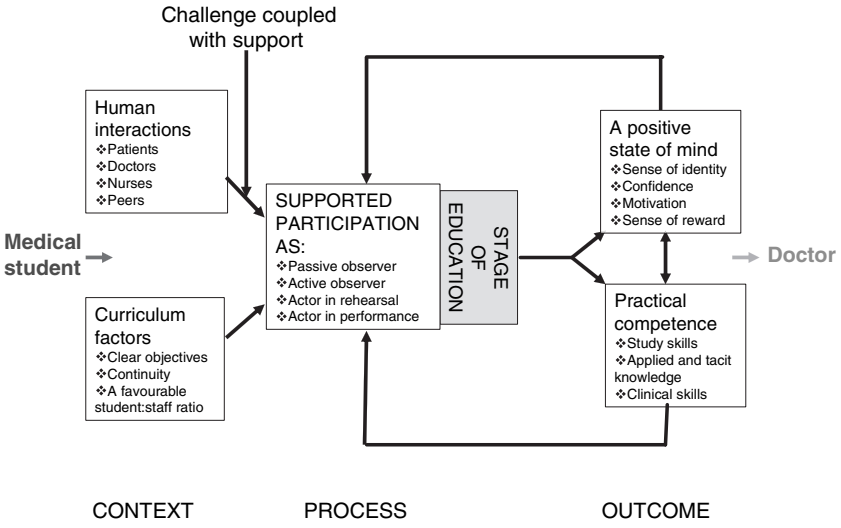

Figure 1 Progression from medical student to doctor through participation in practice: an experience-based learning model of how a medical student becomes a doctor. The model considers the context, process and outcome of clinical workplace learning. The central condition for learning is supported participation in practice to a level that is appropriate to the student's stage of education. By participating, learners develop competences and an appropriate state of mind. Greater competence leads to a more positive state of mind and vice versa. Developing competence and a positive state of mind makes it easier for learners to participate, but the ability to participate is strongly modulated by the behaviour of people the learner meets in the workplace, whether their experience is diluted by being part of a large group, and whether what they should learn is made clear. The cycle can be virtuous (learning begets learning) or vicious.

early practical experience,[15] and the applicability of our findings to a traditional curriculum cannot be taken for granted. Our model assumes that students, as in Manchester, enter the clinical workplace having had basic training in a clinical skills laboratory.

Although our synthesis is novel, it is consistent with previous research into clinical teaching and learning, which is spread across a large number of publications reviewed elsewhere.[8] That students quickly become bored if they remain as passive observers for too long has been described,[16,17] as has the fact that the more actively they are involved and the closer their involvement comes to caring for patients, the more highly they value it.[18–21] Students' discomfort at the harm they and their teachers can do to patients creates a tension between their feelings of empathy and the need to acculturate to their new professional identity.[22,23] The highs of forming collegial relationships with practitioners and their clinical teams in a 'teaching–learning alliance' and the lows of being taught by humiliation are well documented, although the dominant place of nurses in students' workplace experiences has received less attention.[19–21,24] According to a 'relational' model of education, the teacher–learner relationship is important in just the same way as the doctor–patient relationship, and teachers can use it to good effect if they couple challenge with support.[25] The emotionally charged nature of clinical learning is well reported, particularly in relation to stress at times of transition. The constructive place of positive emotions[26] is now receiving more attention, particularly in research into the effect of educational climate.[27–29]

Meaning of the study

Our findings fit well with contemporary social theories of learning, according to which expertise is not simply a property that passes from teacher to learner, but a dynamic commodity that resides within communities of practice; learning, according to the theory, is a process of absorbing and being absorbed into the culture of such a community.[30–33] Developing a professional identity is so fundamental to the process of becoming a doctor[34] that having to be credible in the eyes of practitioners causes young medical students more stress than encountering illness and death.[35] Stress levels peak when students first start learning in workplaces because they become acutely aware of their own incompetence and unimportance beside the practitioners they strive to emulate.[36–39] They feel discomfort as they 'try on' new professional identities that fit more or less well.[36] Their individuality can find expression through seeking out practitioner role models, developing relationships with

them, and negotiating the right to participate in their practice.[19,40] Thus, relationships between practitioners and learners can both facilitate learning and generate high emotions. Learning medicine as a process of social enculturation has been very thoroughly explored in the important participant–observer research of Sinclair,[41] albeit in a more traditional system of teaching and learning than ours.

Unanswered questions and future research

We suggest research to explore how curricula can more explicitly acknowledge the emotional dimension of workplace learning and help learners and teachers learn reflectively from the significant events that arise there. Curriculum leaders and individual teachers need to identify ways of helping students participate in workplace activities appropriate to their stage of training. 'Task-based learning' is such a pedagogy, whose place in contemporary medical education needs to be more thoroughly explored.[42] As the education of doctors, nurses, and allied professionals responds to conflicting pressures to make graduates more fit for practice, strengthen the academic content of curricula, increase the output of health professionals, and treat large numbers of patients,[43] studies comparing the basic education of different health professionals would be informative. The contribution of trained nurses to the climate of basic medical education also seems to need further investigation. The model depicted in Fig. 1 needs to be turned into an instructional method, taught to learners and practitioners, field-tested, and evaluated. Finally, as argued in a recent review, 'the compelling, but, to date, merely intuitive, model of progressive independence in training' on which clinical education has been based for the last century needs to be subjected to good empirical research if it is not 'to be lost in an unreflective attempt to ensure efficient health care, quality of care and patient safety in the short term'.[44]

Contributors: all authors contributed to the conception and design of this study and the acquisition, analysis or interpretation of data. All authors participated in the writing of this paper and reviewed the final manuscript.
Acknowledgements: the authors thank Ed Peile for extremely constructive criticism of the original manuscript and the students who participated in the study.
Funding: none.
Conflicts of interest: none.
Ethical approval: not required.

REFERENCES

1 Schmidt HG. Foundations of problem-based learning: some explanatory notes. *Med Educ* 1993;**27**:422–32.
2 Tamblyn R, Abrahamowicz M, Dauphinee D *et al.* Effect of community-oriented problem-based learning curriculum on quality of primary care delivered by graduates: historical cohort comparison study. *BMJ* 2005;**331**:1001–5.
3 Issenberg SB, McGaghie WC, Petrusa ER, Gordon DL, Scalese RJ. Features and uses of high-fidelity medical simulations that lead to effective learning: a BEME systematic review. *Med Teach* 2005;**27**:10–28.
4 Seabrook MA, Woodfield SJ, Papagrigoriadis S, Rennie JA, Atherton A, Lawson M. Consistency of teaching in parallel surgical firms: an audit of student experience at one medical school. *Med Educ* 2000;**34**: 292–8.
5 Worley P, Esterman A, Prideaux D. Cohort study of examination performance of undergraduate medical students learning in community settings. *BMJ* 2004;**328**:207–9.
6 Regan-Smith M, Young WW, Keller AM. An effective and efficient teaching model for ambulatory education. *Acad Med* 2002;**77**:593–9.
7 Seabrook MA, Lawson M, Malster M, Solly J, Rennie J, Baskerville PA. Teaching medical students in a day surgery unit: adapting medical education to changes in clinical practice. *Med Teach* 1998;**20**:222–6.
8 Dornan TL. *Experience-based Learning. Learning Clinical Medicine in Workplaces.* Maastricht: Universitaire Pers Maastricht, 2006;9–40.
9 O'Neill PA, Willis SC, Jones A. A model of how students link problem-based learning with clinical experience through 'elaboration'. *Acad Med* 2002;**77**:552–61.
10 Macpherson R, Jones A, Whitehouse CR, O'Neill PA. Small-group learning in the final year of a medical degree: a quantitative and qualitative study. *Med Teach* 2001;**23**:494–9.
11 Dornan T, Scherpbier A, King N, Boshuizen H. Clinical teachers and problem-based learning: a phenomenological study. *Med Educ* 2005;**39**:163–70.
12 Mulrow CD, Pugh J. Making sense of complex interventions. *J Gen Intern Med* 1995;**10**:111–2.
13 Dornan T, Hadfield J, Brown M, Boshuizen H, Scherpbier A. How can medical students learn in a self-directed way in the clinical environment? Design-based research. *Med Educ* 2005;**39**:356–64.
14 Strauss A, Corbin J. *Basics of Qualitative Research. Techniques and Procedures for Developing Grounded Theory*, 2nd edn. Thousand Oaks, CA: Sage 1998; 96–115.
15 Littlewood S, Ypinazar V, Margolis SA, Scherpbier A, Spencer J, Dornan T. Early practical experience and the social responsiveness of clinical education: systematic review. *BMJ* 2005;**331**:387–91.

16 Remmen R, Denekens J, Scherpbier A *et al.* An evaluation study of the didactic quality of clerkships. *Med Educ* 2000;**34**:460–4.
17 Kachur EK. Observation during early clinical exposure – an effective instructional tool or a bore? *Med Educ* 2003;**37**:88–9.
18 van der Hem-Stokroos HH, Daelmans HEM, van der Vleuten CPM, Haarman HJTM, Scherpbier AJJA. A qualitative study of constructive clinical learning experiences. *Med Teach* 2003;**25**:120–6.
19 Lyon P. A model of teaching and learning in the operating theatre. *Med Educ* 2004;**38**:1278–87.
20 Stark P. Teaching and learning in the clinical setting: a qualitative study of the perceptions of students and teachers. *Med Educ* 2003;**37**:975–82.
21 Ratanawongsa N, Teherani A, Hauer KE. Third-year medical students' experiences with dying patients during the internal medicine clerkship: a qualitative study of the informal curriculum. *Acad Med* 2005;**80**:641–7.
22 Brewster A. A student's view of a medical teaching exercise. *N Engl J Med* 1993;**329**:1971–2.
23 Branch W, Pels RJ, Lawrence RS, Arky R. Becoming a doctor: critical incident reports from third-year medical students. *N Engl J Med* 1993;**329**:1130–1.
24 Yonke AM, Lemon M. First-year medical students and longitudinal primary care. *Acad Med* 1993;**68**:779–80.
25 Tiberius RG, Sinai J, Flak EA. The role of teacher–learner relationships in medical education. In: Norman GR, van der Vleuten CPM, Newble DI, eds. *International Handbook of Research in Medical Education*. Dordrecht: Kluwer 2002;463–97.
26 ten Cate O, Snell L, Mann K, Vermunt J. Orienting teaching towards the learning process. *Acad Med* 2004;**79**:219–28.
27 Roff S. New resources for measuring educational environment. *Med Teach* 2005;**27**:291–3.
28 Roff S. The Dundee Ready Educational Environment Measure (DREEM) – a generic instrument for measuring students' perceptions of undergraduate health professions curricula. *Med Teach* 2005;**27**:322–5.
29 Roff S. Education environment: a bibliography. *Med Teach* 2005;**27**:353–7.
30 Wenger E. *Communities of Practice. Learning, Meaning and Identity*. Cambridge: Cambridge University Press 1998.
31 Woolliscroft JO. Medical student clinical education. In: Norman GR, van der Vleuten CPM, Newble DI, eds. *International Handbook of Research and Medical Education*. Dordrecht: Kluwer 2002;365–80.
32 Bleakley A. Pre-registration house officers and ward-based learning: a 'new apprenticeship' model. *Med Educ* 2002;**36**:9–15.
33 Swanwick T. Informal learning in postgraduate medical education: from cognitivism to 'culturism'. *Med Educ* 2005;**39**:859–65.
34 Niemi PM. Medical students' professional identity: self-reflection during the pre-clinical years. *Med Educ* 1997;**31**:408–15.
35 Moss F, McManus IC. The anxieties of new clinical students. *Med Educ* 1992;**26**:17–20.
36 Prince KJAH, van de Wiel MWJ, Scherpbier AJJA, van der Vleuten CPM, Boshuizen HPA. A qualitative analysis of the transition from theory to practice in undergraduate training in a PBL medical school. *Adv Health Sci Educ Theory Pract* 2000;**5**:105–16.
37 Radcliffe C, Lester H. Perceived stress during undergraduate medical training: a qualitative study. *Med Educ* 2003;**37**:32–8.
38 Seabrook MA. Clinical students' initial reports of the educational climate in a single medical school. *Med Educ* 2004;**38**:659–69.
39 Prince KJAH, Boshuizen HPA, van der Vleuten CPM, Scherpbier AJJA. Students' opinions about their preparation for clinical practice. *Med Educ* 2005;**39**:704–12.
40 Mutha S, Takayama JI, O'Neil EH. Insights into medical students' career choices based on third- and fourth-year student focus group discussions. *Acad Med* 1997;**72**:635–40.
41 Sinclair S. *Making Doctors. An Institutional Apprenticeship*. Oxford: Berg 1997.
42 Harden RM, Crosby J, Davis MH, Howie PW, Struthers AD. Task-based learning: the answer to integration and problem-based learning in the clinical years. *Med Educ* 2000;**34**:391–7.
43 Dacre J. Clinical work and teaching. In: Jolly B, Rees L, eds. *Medical Education in the Millennium*. Oxford: Oxford University Press 1998;188–191.
44 Kennedy TJT, Regehr G, Baker GR, Lingard LA. Progressive independence in clinical training: a tradition worth defending? *Acad Med* 2005;**80** (Suppl):106–11.

SUPPLEMENTARY MATERIAL

The following supplementary material is available for this article:

Table S1. Extracts of text.

This material is available as part of the online article from:

http://www.blackwell-synergy.com/doi/abs/10.1111/j.1365-2929.2006.02652.x

(this link will take you to the article abstract).

Please note that Blackwell Publishing is not responsible for the content or functionality of any supplementary materials supplied by the authors. Any queries (other than missing material) should be directed to the corresponding author for the article.

Received 28 April 2006; accepted for publication 1 September 2006