

Broadening conceptions of learning in medical education: the message from teamworking

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BACKGROUND There is a mismatch between the broad range of learning theories offered in the wider education literature and a relatively narrow range of theories privileged in the medical education literature. The latter are usually described under the heading of 'adult learning theory'.

METHODS This paper critically addresses the limitations of the current dominant learning theories informing medical education. An argument is made that such theories, which address how an individual learns, fail to explain how learning occurs in dynamic, complex and unstable systems such as fluid clinical teams.

RESULTS Models of learning that take into account distributed knowing, learning through time as well as space, and the complexity of a learning environment including relationships between persons and artefacts, are more powerful in explaining and predicting how learning occurs in clinical teams. Learning theories may be privileged for ideological reasons, such as medicine's concern with autonomy.

CONCLUSIONS Where an increasing amount of medical education occurs in workplace contexts, sociocultural learning theories offer a best-fit exploration and explanation of such learning. We need to continue to develop testable models of learning that inform safe work practice. One type of learning theory will not inform all practice contexts and we need to think about a range of fit-for-purpose theories that are testable in practice. Exciting current develop-

ments include dynamicist models of learning drawing on complexity theory.

KEYWORDS *education, medical; *group processes; *learning; models, educational; interprofessional relations.

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INTRODUCTION

In 1970, George Miller¹ wrote: 'It may require ... a century of educational research to produce any significant response in an educational system as vast and ponderous as that which serves medicine.' Almost a third of that century has passed, marked by a recent themed issue of *Academic Medicine* (2004; 79) surveying the current state of medical education research, allowing for a considered review of Miller's pessimism. Are we any closer to understanding how learning theories may best be applied to medical education? Particularly, which learning theories best inform safe practice of health care teams?

Medical education does not simply borrow from learning theories but has contributed to their development through research in areas such as problem-based learning, development of professional expertise and psychometric approaches to assessment. However, with notable exceptions,^{2–7} these approaches to learning have not generally addressed a major development in clinical practice: learning in teams as systems that are dynamic (operating through time as well as in space). For example, in Regehr's⁸ critical overview of trends in medical education research, references to theories of learning that stress the importance of dynamic socio-cultural context are notable by their absence. Further, where medicine is an apprenticeship system, it is ironic that models of

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Overview

What is already known on this subject

Learning theory has generated a large literature across a variety of disciplines. In medical education, however, what is sampled from learning theory is biased to individualistic, psychological models aligned to andragogy (adult learning theory).

What this study adds

Andragogy provides limited understanding of how learning occurs in complex, dynamic systems such as teams, where socio-cultural learning models provide a more powerful alternative. Bias towards individualistic learning theory may be ideological rather than evidence-based.

Suggestions for further research

There is a need for empirical investigation of how medical students learn through placements on multiprofessional clinical teams. Sociocultural learning theories can provide exploratory, explanatory and predictive frameworks for such study.

learning specifically developed from studies of work-based apprenticeship^{9–12} have not been more widely employed in mainstream medical education. It may be that there are unexamined ideological reasons for this oversight.

The most commonly applied learning theories in medical education continue to be those that focus upon an isolated individual rather than the socio-cultural context for learning. The former include varieties of adult learning theory,^{13–15} experiential learning¹⁶ and reflective practice.¹⁷ In these approaches, the learner is viewed as an active agent, resonating with medicine's tradition of autonomy. Such a notion of personal agency is challenged in sociocultural models of learning, where the learner is viewed as subject to social and historical discourse, and cognition is described as distributed across people and artefacts making up a community of practice, rather than situated 'in' persons.

Individualistic learning models have also been critically reviewed in the wider education literature for their epistemological claims, such as status as 'theory'.^{18–21} The validity of the descriptor 'adult learning theory' was challenged nearly 20 years ago in an influential article by Davenport,¹⁸ who concluded that the distinction between 'andragogy' (adult learning) and 'pedagogy' (child learning) was unfounded, lacking both a conceptual basis and empirical evidence. Davenport concluded that where research evidence did 'not appear to support ... andragogy as a theory or proven method', this had led some educationalists to 'simply drop the word'.¹⁸ Within medical education, Norman²² describes adult learning theory as a flimsy association of educational strategies that fails to gain the status of a theory open to empirical investigation.

Another 'mantra'²³ of learning (readily invoked but rarely considered critically or empirically) is 'reflective practice'. Although Schon's account of reflective learning specifically addresses learning in contexts of uncertainty, uniqueness and value context, it does so only from the individual's perspective and not from the perspective of systems dynamic.¹⁷ This misses critical elements, including the flow of information between members of a team mediated by artefacts in daily use by that team (such as patients' drug charts). It has been argued that 'reflective practice' is a descriptor that could be refined within education,²⁰ where the term has been used loosely and uncritically to describe a variety of practices based on contrasting epistemologies.^{6,20,23–25} Schon's original model also fails to be reflexive about the values that inform it.²⁰ In the medical education literature in particular there is a lack of close and critical reading of such primary texts, and it is only recently that reflective practice has, for example, been systematically analysed for its component parts.²⁶ Reflective practice has, paradoxically, been employed unreflectively.

'Experiential learning' is another notion that appears to by-pass critical attention. Kolb's¹⁶ model of a reflective cycle of experiential learning has been criticised as a commonsense descriptor rather than a testable theory, and is again weakened in its range of explanatory power by its grounding only in the individual learner and not the team or system, where, as Rowland¹⁹ notes, it then fails 'to consider the ways in which such terms as "reflection" and "learning" derive their meaning from social relations of power'. Kolb's experiential learning cycle is then a model of 'experience' that paradoxically neglects the social context in which that experience occurs and which also serves to shape the experience.

Despite an emphasis in health care upon the benefits of interprofessional teamwork,^{27,28} systems-based patient safety^{2-4,7,29,30} and organisational learning,^{3,4,7,29,30} individualistic models of learning continue to be privileged within medical education.³¹⁻³³ For example, Rolfe and Sanson-Fisher³² describe how 'a search of the medical education and relevant behavioural science literature' provided 'the foundations' to develop a structured learning tool for clinical skills. The literature indicated that 'an individual focus to learning is appropriate ... consistent with the idea of adult learning'. However, such a search is not a transparent revelation of 'best evidence' but may serve to reinforce existing bias in the literature that then reproduces itself through citation. Where clinical skills are collaborative, such as resuscitation team activity, we need learning theories with explanatory and predictive power for such contexts. This is a health care imperative, where the majority of medical errors are systems-based³⁴ and quality of teamwork is linked with improving patient outcomes.³⁵ Again, learning in complex adaptive systems such as clinical teams and organisations cannot be fully informed by varieties of adult learning theory, but may be better understood socio-culturally as legitimate entry into historically mediated work practices.

TWO APPROACHES TO LEARNING

Creating an opposition between individualistic and socio-cultural learning theories is unhelpful as we may readily come to privilege one set of theories over another. Rather, we can consider theories as fit-for-purpose by their explanatory and predictive power and we can also draw out shared principles across families of theory, such as the value of reflection and of tolerance of ambiguity, and of understanding how tacit knowledge is organised individually and collectively. Differing approaches in learning theory can, however, be seen to be in productive tension. Sfard³⁶ outlines two helpful metaphors for learning: 'acquisition' and 'participation'. 'Acquisition' broadly describes knowledge *reproduction*, where learning is seen as information seeking and sedimentation of knowledge in individuals. Here, knowledge may be treated as private capital. 'Participation' describes collaborative knowledge *production* as an active process of legitimate engagement in a community of practice. Here, learning is reconfigured not as an act of accumulation but of participation (through role) in a process of identity construction such as movement to 'expert' status.³⁷

Sfard is careful to warn that neither approach should be privileged over the other as each approach will be fit-for-purpose. However, the privileging of models may not follow from a fit-for-purpose argument, but from ideological bias. Learning theories are not value-free. In a learning economy subject to what Max Weber described as a protestant-capitalist complex, knowledge is treated as commodity and private property, and learning is an individual enterprise linked to the protestant work ethic. 'Autonomy', 'self-directed learning' and 'self-assessment' are then legitimate currency in such an economy. Indeed, these approaches become naturalised (taken to be self-evidently 'good' and therefore 'true'), where value preference precedes evidence. For example, 'self-direction' is consistently applauded in a medical education culture that prides itself on a growing emphasis upon professionalism and ethical practice, yet poorly performing doctors can be patently self-directed. Autonomy in learning must be accompanied by a social conscience and peer feedback must temper self-assessment.

Where the need for teamwork learning is recognised, paradoxically this may still occur within a climate whose main tacit theoretical reference is individual, rather than distributed, cognition. Where medicine is an apprenticeship involving work-based learning, Guile and Young¹¹ argue, 'individualist assumptions' cannot account for the relationships between socialisation, identity construction and learning of expertise that occur in the social contexts of team-based activity. In contrast to learning theories drawing on an 'acquisition' metaphor, collectivist learning economies have naturalised the metaphor of 'participation', where collaborative learning is privileged. Unsurprisingly, capitalist psychology privileges individual constructivist models such as those of Piaget and Kohlberg, where collectivist Russian (Soviet) psychology privileges social constructivist models such as those of Vygotsky and Leontiev.³⁸

As noted earlier, in answering the question: 'Where is mind?', socio-cultural models of learning assume that 'mind' is not just in the person, but distributed across persons and artefacts. For example, memory is not simply located in individuals but in computers and in collectively held practices and rituals into which new members of teams are socialised. In a study of consultant and pre-registration house officer interactions on wards,^{39,40} a consultant reported in interview that he knew of teams where a 'little book' was kept by junior doctors and passed on from one rotation to the next. This book contained descriptions of the idiosyncrasies of consultants who had led

the team. The interviewee suggested that the purpose of the book was to help the junior doctor to adjust to the particular climate set by the consultant. In a study of team talk on a paediatric ward,⁴¹ ‘common knowledge’ is permanently negotiated by members of the team through rhetorical strategies that persuade newcomers into adopting habitual team practices. Here, ‘common knowledge’ is more than the sum of any recollections individual team members might bring to the work situation. It is a property of the team’s conversational ‘rememberings’. Remembering is ‘a jointly realised activity’, thus conceived as distributed rather than individual cognition. A novice in the team must quickly gain ‘flexible expertise’, including attention to the historical aspect of the team’s character, which is transmitted as anecdote. Here, learning is not simply passive accumulation of skill and knowledge, but an activity of social participation in which knowledge is reconceptualised.

ACTIVITY THEORY

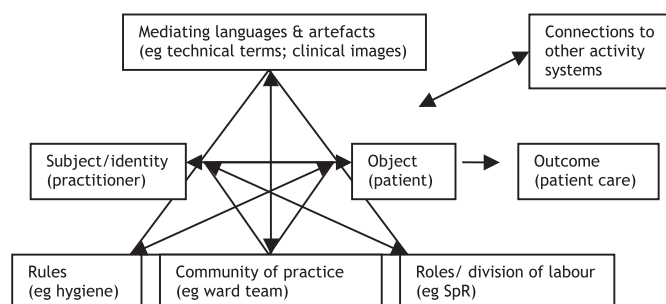
Individualistic learning theory places the learner at the centre of the activity, putting emphasis upon agency and choice. This model is grounded in traditional psychologies of personality and then aligns itself with models of invariant learning styles.⁴² Such models also tend to view learning developmentally so that certain approaches to learning may be appropriate for a developmental stage. For example, in the transition from novice to expert, analytic principles-based ‘building block’ learning may be encouraged as there is a lack of tacit knowledge upon which to engage with synthetic or holistic learning through pattern recognition. Socio-cultural approaches see the learner as one aspect of a more complex activity system and then reconfigure learning as sensitivity to context, where gaining access to an overall picture of activity, such as a team dynamic, is crucial. Here, as in problem-based learning, the developmental stage of the learner is considered secondary to a wider principle, that of gaining legitimate access to knowledge that is distri-

buted across persons and artefacts. This is an adaptive social process as much as a cognitive assimilation event and draws on generic communication capabilities. ‘Knowing’ is reconfigured as legitimate *participation*, such as engagement with the collaborative data gathering of a bedside ward team to update patient records. Further, the individual is seen as a product of social activity and accounted for in terms of fluid and multiple identities rather than fixed types.¹⁰

The most significant development in expanding learning theory from ‘acquisition’ to ‘participation’, accounting for learning in dynamic social contexts, is activity theory.^{6,38,43–47} A prominent version of activity theory, a group of models often referred to as cultural-historical activity theory (CHAT),⁴⁷ takes a discrete work-based social context (an ‘activity system’) as the basic unit of analysis. The components of an activity system are shown in Fig. 1. Yrjo Engeström,^{38,43–46} the central theorist in the field, has introduced the notion of ‘expansive learning’³⁸ to account for knowledge production rather than reproduction. The learner is not simply socialised into the knowledge held by a community or activity system in a passive manner. Rather, participation necessarily acts as a disturbance to an already unstable system that offers productive possibilities through change over time. High tolerance of ambiguity is demanded for practitioners to work creatively within such dynamic contexts and such tolerance is held both individually and collectively. Middleton notes that what on the surface appears to be ‘argumentative’ talk in a clinical team can be reformulated as negotiation of a ‘collective intelligence’. In this sense, such ‘dilemmatic’ talk becomes a resource rather than a problem to be solved, where ‘uncertainty is far from being the enemy of innovation’.⁴¹

Engeström focuses upon work-based learning within specific activity systems such as differing health and social care teams sharing a patient.^{43–46} Every activity system has an ‘object’ (the focus of interest – in

Figure 1 The basic activity system. There are interconnections between all points of the activity system (not all shown). Therefore, any change in any element of the system causes change to all other elements; the system is inherently unstable.



clinical teams this is the patient) and objectives (meeting the needs of the patient). They may share this object with other teams; activity theory is particularly interested in how learning occurs across teams sharing a 'boundary object' (common interest) and involving 'boundary crossing' (can teams understand each other's activities, although they may share a common concern such as patient care?).⁴⁴ Such models of learning can be readily applied and tested in the field of interprofessional care.⁴⁸ Teams may not, for example, be fully aware of each other's activities despite their common concerns (objects) and this is readily observed in health care. For example, a ward and operating theatre team, or teams from different agencies such as health and social services, may fail to communicate fully about their shared patients, and both duplicate and sequester information. Engeström's version of activity theory is a species of collaborative inquiry, tested and refined through cycles of action and reflection, that has been adopted by the health service in Helsinki as a fit-for-purpose model for informing inter-agency collaborative team care of chronic, multiple illness patients.⁴⁵

Learning has obvious use value (skills) and exchange value (expertise), but also has symbolic value (status), offering cultural capital through professional identity constructions. Activity theory considers how identities are constructed through work-based practices and how management of identity relates to historically determined roles and rules. Identity formation is not an aspect of simply 'doing' the job, or even 'thinking' the job, but also of 'recounting' or story, where the job is narrated to oneself and to others within a set of stories already circulating within the practice community.⁴⁹ In multiprofessional teams, practitioners use rhetorical strategies to confirm role and identity, not only for each of themselves but also for others, often serving to stereotype the role of the 'other' in the team.⁵⁰ This learning extends to a 'shaping' of identity as professional and ethical practice.⁵¹ Such models of ethical 'self-forming' offer supplementary approaches to conventions of 'reflective practice'.

Activity theory offers a testable model of how learning occurs not only in space (identifiable social contexts), but also through time (dynamic systems). The particular power of the model rests with its ability to predict how differing activity systems may interact where they share an object, such as a patient. While activity theory deals well with the outcomes of practice, it does not, however, adequately explain how practitioners first gain legitimate entry into activity systems (socialisation).

COGNITIVE APPRENTICESHIP AND DISTRIBUTED COGNITION

Lave and Wenger⁹ describe how, in apprenticeships, novices gain legitimate entry to a community of practice. Our wider understanding of apprenticeship has recently undergone a revolution.^{11,12} Old apprenticeship models stressed 'immersion' – learning by experience simply through exposure. New apprenticeship, or 'cognitive apprenticeship',⁹ models stress that novices do not simply learn how to 'do' the job as they gain expertise – they also learn how to 'think' and 'recount' the job. As noted earlier, doing, thinking and recounting are intimately linked as matrices for multiple identity formation.

In a medicine apprenticeship, all early work-based learning is necessarily short-lived in terms of membership of a clinical team. At first sight, the medical student and junior doctor would seem to have little impact upon the dynamic of an expert team. However, activity theory predicts that temporary members of teams can bring a fresh eye to habitual practices, initiating expansion of the activity system, and this has been empirically confirmed through videotape analysis of ward rounds.^{39,40} Ward-based learning has been summarised as 'the progressive acquisition of knowledge, skill and understanding', where 'the trainee is regarded as a competent practitioner when a given level of knowledge, skill and understanding has been achieved'.⁵² This is typical of conventional transmission-reception ('acquisition') views of learning. Such a view can be expanded to include socio-cultural elements, where learning is framed as an activity involving increased access to participating roles in expert performance.

DYNAMICIST LEARNING IN COMPLEX, ADAPTIVE SYSTEMS

There is a further chapter to unfold in this account, which concerns the contribution to understanding of learning made by complexity theory. This warrants a separate paper and here can only be summarised as a horizon of possibility in the contribution of contemporary learning theory to medical education. Understanding this contribution requires assimilation of a set of metaphors from disciplines such as information theory. A summary is offered in Table 1. While the metaphors of 'acquisition' and 'participation' have served a purpose in this discussion paper, a finer set of metaphors is needed to differentiate between kinds of participative learning.

Table 1 *Dynamicist and connectionist thinking compared***Dynamicist thinking**

Ecology

Sum of persons and artefacts affording opportunities for learning through time (e.g. a ward team)

Distributed cognitive system

Relations of team members and artefacts in a naturalistic setting where 'mind' is an emergent property of the system (e.g. the common intelligence of a ward team)

Intersubjective understanding

Degree of common understanding through a community of practice (e.g. shared knowledge and skill)

State space

Clinical space as a distributed cognitive system, where 'space' is defined as the set of all possible states that the system could pass through (e.g. a working day on the ward)

Emergent properties

Significant changes in the system resulting not from individual decisions but from critical shifts in states of the system, (e.g. an operating theatre team responding to a crisis)

Topology

Properties of all points of the state space contributing to an ecology (e.g. the pacing of an operation in relation to availability of resources)

Where are the hotspots in teamwork at any one time?

Attractors

Point or path in the state space towards which a trajectory will tend when in the neighbourhood of that attractor (e.g. attention of an anaesthetic team during equipment malfunction or an emergent interpersonal/communication tension)

Horizons of observation

Work space available to the attention of any one member of a team at any one time, making clear that only through co-operation can tasks be achieved as individual horizons are limited (e.g. a surgical ward sister checking a theatre list with the OT team)

Shared task knowledge

No single member knows everything necessary for the efficient functioning of the team
However members of the team hold differing conventions about how information can be used (e.g. a ward team deliberating a patient's possible transfer to ITU)

Trajectory

A particular succession of states through the state space, or the overall behaviour of the system (e.g. handover of a surgical patient to recovery)

Coupling

No part of the system changes without other parts also changing (e.g. a key member of a primary care team falls ill)

Transients

Uncertain, temporary elements that may or may not cause important perturbations as the basis for innovation (environment presents opportunities) (e.g. a new team member has a vital insight into habitual practices)

Affordance

The environment 'educates' our attention as 'situational awareness' (environmental cues indicate how we could respond with a view to other elements in our surrounds) (e.g. a scrub nurse picks up on emerging tension between surgeon and anaesthetist)

Connectionist thinking

Individual roles/identities

Practitioners operating autonomously
A team of individuals
Team insulated from environment

Individual mind

Mind in a 'vat'
Decisions are individual, not systems-based

Intrasubjective understanding

I do things my way

Clinical team setting

Individuals make up a team that is divorced from the context in which it works

Outcomes

Clearly defined goals for each person, divorced from uncertainty

Cognitive representations

Personal thinking

Where are the critical peaks and troughs in an individual's cognition in the day's work?

Attention

Personal interest

Focused attention

An individual refuses collaboration, to complete the task autonomously

Individual knowledge

Multiskilling can backfire

Motivation

Personal enthusiasms and rhythms not necessarily following the trajectory of the patient

Autonomy

Isolated, self-direction

Ergonomics

Environment offers obstacles to be overcome
Obstacles are problem-solved

Curiosity and habit

We cut down the overall environment and focus on our own work

Such metaphors describe a holistic 'dynamicist' model⁵³ to inform medical education, supplementing current interest in the application of complexity theory to management of health care systems⁴

Dynamicist models describe learning as a naturalistic, systems-based activity occurring in time. Learning is assumed to be 'situated' or specific to context and is therefore studied where it actually occurs and not in the laboratory. The basic unit of analysis is taken to be a functional team operating through time. Dynamicist thinking can be contrasted with connectionist thinking (Table 1), where the latter, paradoxically, tends to be the current dominant mode for making meaning of team activity. Connectionism works from the parts to the whole and abstracts from time. This is mirrored in curriculum thinking, where discrete modules make up courses and learning is atomised in terms of finer and finer outcomes. These outcomes define what can be legitimately learned (reproduction) rather than encouraging learning that may redefine such goals (production). In contrast, dynamicism attempts to grasp the system as a whole, concentrating particularly upon the emergent properties of the system, or what the occasion 'affords' (its potential). Outcomes are then less easily prescribed and must embody process learning as well as content.⁵⁴

CONCLUSIONS

No single learning theory has enough explanatory and predictive power to inform the range of practices found in medicine. However, the family of learning theories based on how an individual learns needs to be supplemented to inform safe practice in dynamic and often high-risk contexts such as teamwork. We need to know not only how established knowledge is constructed and reproduced, but how new knowledge is produced and held collaboratively in inherently unstable, complex systems. Socio-cultural learning theories are more powerful than those oriented to individual cognition when it comes to explaining how learning occurs in such systems. However, such models are not yet fully embedded in medical education in the way that individualistic learning theories are. This can be explained by the strong tradition of autonomy within medicine.

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