

Cultural Historical Activity Theory for Studying Practice-Based Learning and Change in Medical Education

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Abstract: Cultural historical activity theory (CHAT) is a social theory which is useful as a methodological framework for the vital task of studying practice-based learning in complex learning environments. CHAT is an apparatus considering learning as occurring through practice, through collective activity, and mediated by culturally specific instruments. Because CHAT is increasingly drawn upon in medical education academia, it is necessary for medical educationalists to be familiar with this theory. This methodology article explains how CHAT theorizes learning in dynamic workplaces within an activity system comprising multiple practitioners engaged in activity, which is collaborative, multi-voiced, and bounded by a shared intended object. It provides an accessible overview of the central concepts within CHAT and a description of a methodological strategy (activity system analysis) to incorporate CHAT into one's own work. CHAT also theorizes where tensions lie within and between activity systems, causing difficulties in achieving the intended object, defining such tensions as contradictions. It is through the overcoming of past contradictions that activity has come to exist in its current form, abiding by social norms of the present time, and CHAT allows consideration of how practice within a system may be changed through resolution of contradictions. For example, the Change Laboratory is a contrived intervention where practitioners consciously contribute to developing and embedding new, improved ways of practicing using CHAT principles. This allows practitioners to have agency in improving their own areas of learning and practice. Throughout this article, examples are provided of how CHAT has been usefully applied to various aspects of medical education research, including undergraduate education, postgraduate education, and continuous professional development. By building on the introduction to CHAT provided in this article, the reader can start to use CHAT methodologically to describe complexity, identify practice-based contradictions, and develop improved forms of practice-based learning, in his/her own context.

Keywords: cultural historical activity theory, activity systems analysis, medical education, methodology, Change Laboratory

Introduction

Medical training and practice occur within healthcare organizations which are undergoing constant change.^{1,2} Cultural historical activity theory (CHAT) is a social theory for studying social practice, and is attracting increasing interest in medical education for studying dynamic systems in change.³⁻⁵ CHAT was originally devised for studying children at play, but it has been subsequently developed by philosophers interested in learning through practice, especially in complex

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systems, as this article will explain. CHAT considers the fundamental unit of life to be activity, which is collective and requires communication and interaction between practitioners.^{6,7} It is through activity and through working collaboratively that people learn. Within CHAT, the subject (individuals, groups or organizations) of the activity does not act directly on their environment, but always indirectly in some way, through action which is mediated by the use of instruments, which may be tangible or intangible, and have culturally specific meanings.^{8,9}

At first, CHAT may appear to be a complex and impenetrable theory. However, once familiarity with the fundamental aspects is gained, CHAT is a useful theoretical framework for increasing understandings of practice in complex learning environments. Complex learning environments can be understood to be those where multiple people are involved in shared activities within a single organisation or multi-organizational context.⁹ As this article will explain, CHAT considers learning and practice to be inseparable, making it an eminently suitable theory for studying the practice-based learning which occurs within medical education. Furthermore, CHAT is not only useful for examining or describing current practice, but also for identifying tensions or areas for development in a complex learning environment. CHAT is therefore useful for studying how practice and learning may be changed in the future in dynamic systems.^{4,9,10}

This article aims to provide a practical and accessible introduction to understanding CHAT and utilizing the theory as a framework in medical education research methodology. It will explain how CHAT aligns with medical education learning theories, describe how practice and learning can be understood as activity systems, and explain how systems-based tensions can be brought to light using CHAT. It will then explore how CHAT allows consideration of ways to improve future learning and practice.

Throughout the article, salient examples are provided to demonstrate how CHAT has been incorporated into existing medical education studies. Many terms are introduced in this article which may be overwhelming for those unfamiliar with CHAT. To mitigate this, definitions of terms are also provided in [Table 1](#) so the reader may refer to these as needed. This article is not intended to be exhaustive but aims to provide an overview so that the reader has the resources and fundamental understanding of CHAT on which to build and incorporate this into his/her own work.

Socio-Cultural and Socio-Material Educational Theory

Within medical education research, different methodological traditions and theoretical orientations exist. The theoretical stance of the researcher will influence all aspects of the conduct of research, and, more fundamentally, what the researcher believes is possible to achieve through research. The importance of making theory explicit in medical education research is therefore recognised.^{11–13} To understand the usefulness of CHAT to medical education, it is necessary to explain its place among varying medical educational theories. CHAT is a socio-cultural and socio-material theory. As such, it embraces the concept of distributed learning ie knowledge construction through interactions between living beings.^{14,15}

Socio-cultural theories are distributed learning theories which consider learning in interactions between living beings. They contrast with much medical learning and teaching which takes an individualist perspective eg, by focusing on preparation for practice: aiming to improve knowledge and skills in advance of commencement of work as a doctor. Those are acquisitive perspectives on learning, where the learner must acquire proficiencies they need for the workplace, and they suggest that improving education should involve doctors being more prepared for work.^{5,16} Socio-cultural perspectives differ by viewing workplaces not only as environments where people can learn but indeed where there is no separation between participation in work and learning.¹⁷ practice is learned by practicing.^{18,19} This educational perspective is implicit within much postgraduate medical education in the western world. In the example of the British system, the doctor graduates from medical school and becomes a postgraduate trainee, working and learning simultaneously.²⁰ It is through entering the workplace, through interactions with others, and by taking on the role of the doctor, that one learns to be a doctor.

Additionally, CHAT takes a socio-material perspective of learning. It does not assume the dualist (mind v. body) view assumed in acquisitive perspectives of learning, and instead views professional learning as participational, without a disparity between “knowing” and “doing”. Knowledge is practical, embodied, and social: it does not only exist in the mind as a thing to be transmitted from one person to the next. Socio-materiality differs from and complements socio-cultural theory: understanding the relationship between individuals and the social world is

Table 1 Definitions of Terms Related to Cultural Historical Activity Theory

Term	Definition
Socio-cultural theory	A group of theories which consider knowledge to be constructed through interactions between living beings. ^{14,15}
Socio-material theory	A group of theories which consider knowledge as existing in the relationship between individuals and the social world which, in particular, includes matter and materials. ^{10,16,21}
Cultural Historical Activity Theory (CHAT)	A social theory originally devised for studying children at play which has been subsequently developed by philosophers interested in learning through practice, especially in complex systems. The fundamental unit of the life is activity which is collective and requires communication and interaction between practitioners. The worker interacts with the environment through action which is mediated by instruments, which have culturally specific relevance. ^{6,7}
Activity System	The basic unit of analysis in CHAT (graphically represented by a series of triangle diagrams - see Figure 1). The activity system consists of a subject aiming to bring about a change, which is termed the object. The subject may be an individual, community, or organization. CHAT allows consideration of activity systems interacting with one another (see Figure 3). ^{7,56}
Object	The object is the reason why people are participating in an activity and holds all elements together in a bounded activity. Objects differ from the immediate goals of the component actions within an activity. ⁹
Zone of Proximal Development (ZPD)	An educational concept, originally used to represent the space between the actual developmental level of a child as determined by independent problem solving, and the level of potential development through problem solving under adult guidance or in collaboration with more capable peers. Through the lens of CHAT, the ZPD can represent the distance between learners simply learning things by rote without understanding the purpose, and later coming to internalize what the action really means. ^{5,26,29}
Internalization	The changes from knowing in principle what actions should be carried out to understanding the importance and significance of different aspects of activity, through familiarization with the system. ⁷
Externalization	Subjects begin to question why things are done the ways they are and start to identify where the contradictions exist in their activity. ⁷
Multi-voicedness	The concept that many social voices are in dialogue with one another in an activity. The bidirectional arrows in the activity system diagram (Figures 1 and 3) represent the dialogic nature of interaction. ¹⁰
Historicity	This represents why activity occurs in its current form: current activity has emerged through how past contradictions have been overcome. Important components of the activity system heavily shaped by cultural expectations, which are different at different times in history. ⁷
Contradiction	Conflicts and tensions within and between activity systems. Contradictions are the basis for improved forms of activity, by overcoming these contradictions and developing new ways of doing things. Contradictions are conventionally classified as primary, secondary, tertiary, and quaternary as defined in the main text. ^{7,34}
Expansive learning	The overcoming of contradictions to develop new forms of an activity is described as expansive learning. Developing new forms of activity is likely to require several iterations and expansive cycles as defined in the main text. ⁷
Formative interventions	Events during which contradictions are analyzed using CHAT by members of the community and innovations are devised. ⁷
Change Laboratory	A structured activity over multiple sessions during which a researcher facilitates practitioners in developing new forms of activity. Participants then devise the future model which resolves the contradictions identified in the process, including a plan for examining and implementing the new model. ^{4,37}
Activity Systems Analysis	The analytical process by which researchers can conceptualize and describe the activity of interest in terms of the CHAT framework (see Table 2). ⁹

important for understanding learning, but this also includes the vital role of matter and the material in how entities relate to each other and learn. In this context, the material

can be understood to relate to physical aspects of the world, which include, for example, objects, spaces, technology, and physical practices.^{10,16,21,22} This is apparent in

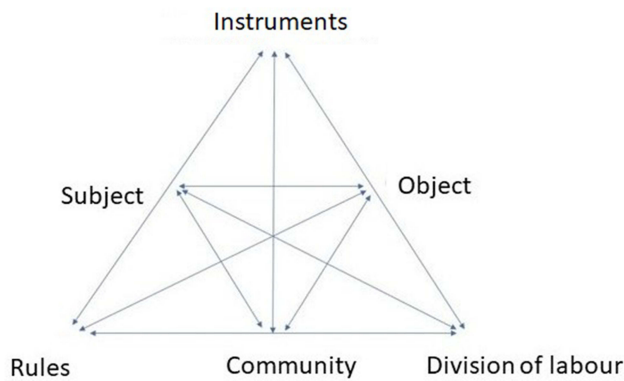


Figure 1 Diagram of the minimum unit of analysis from 2nd generation CHAT. **Notes:** Adapted with permission of the Licensor through PLSclear. From: Engeström Y. *Learning by Expanding: An Activity-Theoretical Approach to Developmental Research*. Cambridge: Cambridge University Press; 1987.⁷ Copyright 1987 Cambridge University Press.

a medical context, where we can understand that a doctor’s practice requires more than just his/her medical knowledge and person-to-person communication, but materials also. The doctor utilises a space in which to practice, the use of objects (eg, a stethoscope, sphygmomanometer), medical documentation, and access to other resources such as external policy, local, national, and international guidelines, and law.

Table 2 Eight-Step-Model.

Activity System component	Question to ask
Activity	What sort of activity am I interested in?
Objective	Why is this activity taking place?
Subjects	Who is involved in carrying out this activity?
Tools	By what means are the subjects carrying out this activity?
Rules and regulations	Are there any cultural norms, rules and regulations governing the performance of this activity?
Division of labour	Who is responsible for what, when carrying out this activity and how are the roles organised?
Community	What is the environment in which activity is carried out?
Outcome	What is the desired outcome from this activity?

Notes: Reproduced with permission from Mwanza D. Conceptualising work activity for CAL systems design. *J Comput Assist Learn*. 2002;18(1):84–92.⁴⁷ © John Wiley & Sons Ltd.

Socio-material research foregrounds the material, unlike other perspectives or methodologies which emphasise human processes.²¹ The human should therefore not be perceived as divorced from materials in the workplace. This is relevant to medical practice where a variety of tools inform medical practice and design²³ and neglecting materials may put patient safety at risk.²⁴ There is no single theory of socio-materiality and there are many socio-material apparatuses which may be employed in research.^{22,23}

Socio-cultural and socio-material theories align with Gheradi’s²⁵ description of “knowing-in-practice”: knowledge is not a body of knowledge but an activity that is both individual and collective. Knowledge emerges from its own production, grounded in materials in specific contexts. Work is not the application of acquired knowledge, but through work knowledge is used as a resource in the production of further knowledge.²⁵

Such a theoretical position is useful for medical educationalists. For example, for the learners in medical education contexts (medical students and doctors) the hospital workplace is recognised as an important site of learning.¹⁰ This includes, for example, medical students who are undertaking rotations in different departments as part of their medical degree, and qualified doctors who are contributing to patient care while undertaking postgraduate training. Medical education researchers should therefore be interested in knowledge that is generated through workplace practice, and through interactions of learners with other humans and with materials. CHAT provides a corresponding framework, as described below.

Learning Through Activity

CHAT is a social theory originally devised for studying children at play but has been subsequently developed by philosophers interested in learning through practice, especially in complex systems.⁷ CHAT built on Marxist notions of work as a social, collective, practical, and material human activity.^{8,10} CHAT considers the individual and environment together, and postulates that human consciousness is co-created through participation in activity.^{9,26} Within CHAT, learning and development occur through practice, and the fundamental unit of the life of an organism is not individual behaviour, but activity which is collective and requires communication and interaction between people.⁶

This system forms the basic unit of analysis in CHAT – the activity system – and is graphically represented by

a series of triangle diagrams (see Figure 1). The activity system consists of a subject aiming to bring about a change, which is termed the object. The object of an activity may be material or intangible. Objects are “generators and foci of attention, volition, effort and meaning”.^{7(pXVI)} The object is the reason why people are participating in an activity and holds all elements together in a bounded activity. Objects differ from the immediate goals of the component actions within an activity.⁹

Learners do not react directly to their environment to carry out object-directed activity, but always in some way mediated by artifacts⁸ which are instruments including material tools and social relationships with other humans.¹⁰ Division of labour occurs through interactions among people within the community, and governed by rules, producing the workplace.²⁵ These important components are conceptualized in the activity system. Medical educators are likely to be interested in individual human learners in the workplace environment, and, in CHAT terms, there is no distinction between learning and doing. For the purposes of this article, I consider the “learner” to therefore be interchangeable with “practitioner”, and as the “subject” within the activity system which interacts with their environment through action mediated by instruments (as indicated in Figure 1).

One key figure in CHAT development, Leontiev, conceptualized distinctions between operation, action, and activity to explain the subject’s behaviour. Operations are the most basic level of human action. These are individual component parts of an action which are part of larger activities, and they take on meaning in the context of that activity. Actions are goal-directed and composed of simple operations. Actions occur over a relatively short period of time with a defined beginning and end. Actions tend to be individually focused and provide means for individuals to participate in activity. Activities are object-oriented, consist of multiple actions, and are collectively focused. Activities encompass collective and collaborative actions which are the steps taken by learners in participating in the activity.^{9,27}

Operations, actions, and activities require cultural and historical understanding to acquire meaning.²⁷ Figure 2 applies this to an example from a medical education context. As illustrated, in a busy acute medical hospital unit one might see a doctor pick up a needle and syringe (an operation). This is one step in the process of taking blood from a patient (the action). This one doctor is a member of the team working collaboratively to do the work of admitting unwell patients to the hospital, diagnosing them, and providing them with appropriate care (the activity).

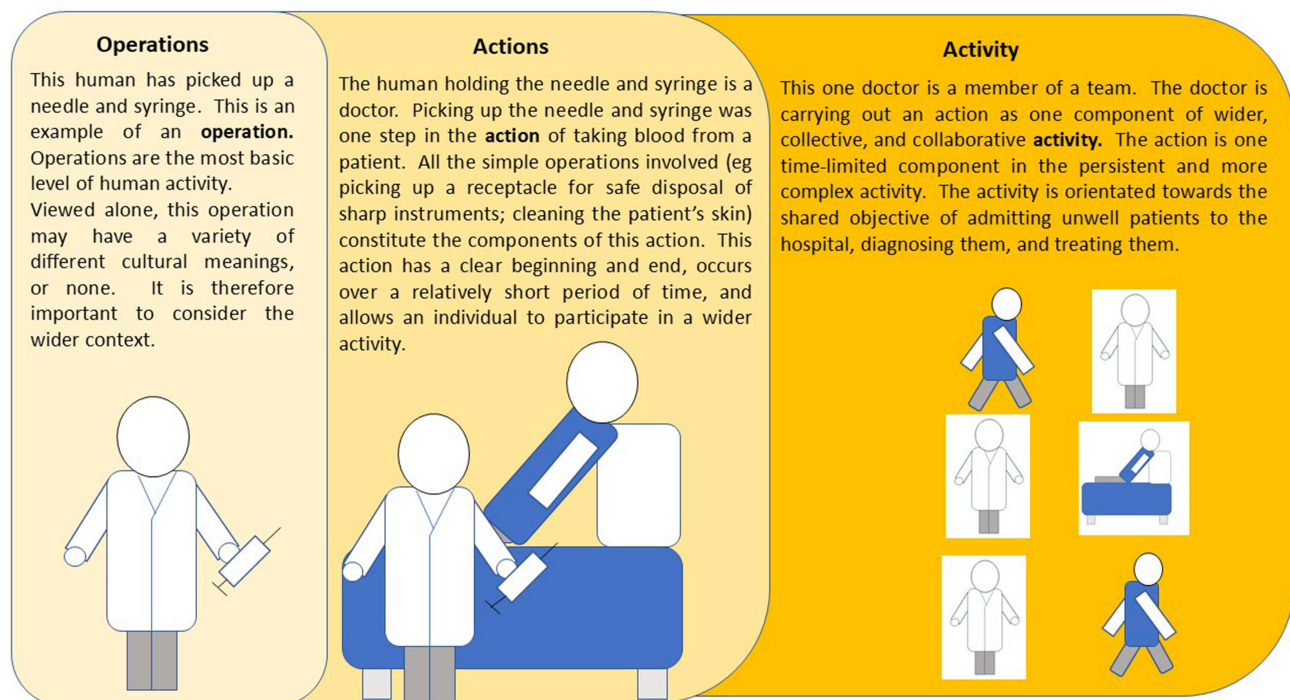


Figure 2 Diagram demonstrating the distinctions between operation, action, and activity as described by Leontiev.²⁷

Note: Data from Leontiev.²⁷

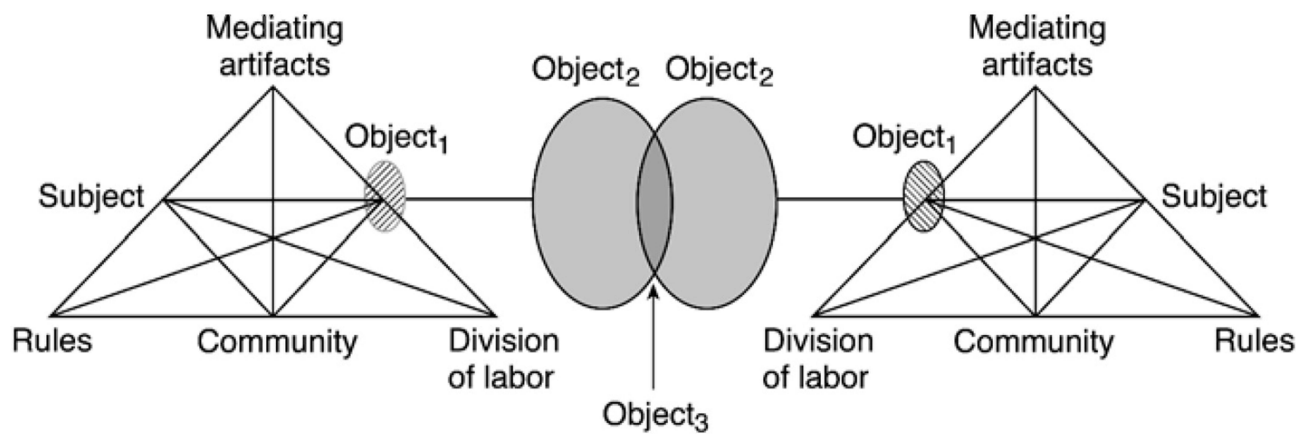


Figure 3 Diagram of 3rd generation CHAT, adapted from Engeström. The diagram demonstrates that neighbouring activity systems may have outcomes which may or may not be aligned.

Notes: Reproduced from Engeström Y. *Expansive Learning at Work: Toward an activity theoretical reconceptualization*. *J Educ Work*. 2001;14(1):133–156.⁵⁶ Reprinted by permission of Taylor & Francis Ltd, <http://www.tandfonline.com>. © 2001 Taylor & Francis Ltd.

Within an activity system, the subject of interest may be an individual, group or organization.⁹ The learning of the subjects within the activity system is facilitated through cultural means. Rules, community, and division of labour are heavily shaped by cultural expectations, which are different at different times in history.⁷ This denotes the Cultural Historical aspect of CHAT. Understanding historical context is essential to understanding why activity occurs in its current form.¹⁰

Within the activity system, knowledge is co-constructed between the learner and their social world. Learners need to skilfully work within a system, and with the tools used within the activity system (which includes theories and concepts) as part of their practice.²⁸ Within CHAT, the activity cannot be understood only by looking at its individual constituent parts.²⁹ CHAT emphasises that many social voices are in dialogue with one another (multi-voicedness), and each part of the activity system influences the others. The bidirectional arrows in the diagram represent the dialogic nature of interaction.¹⁰ Engeström has advanced the study of CHAT by incorporating not only one bounded activity system, but the interactions between neighbouring systems.⁷ This emphasises the concept of multi-voicedness.⁸ This conceptualization of multiple systems under study with CHAT has generally been termed third-generation CHAT (see Figure 3).

Studying medical learning as an activity system is exemplified by a rapid ethnography by Cleland et al³⁰ which interpreted the learning in a surgical training boot camp in Scotland by incorporating CHAT. This allowed theorization of the learning of surgical trainees as

a dynamic, unpredictable system; consideration of cultural and historical context in which surgical training takes place; and the influence of social others in obtaining social and symbolic gains. Surgical training was therefore conceptualized as learning through interactions with others in a complex system, beyond simply didactic teaching and the formal curriculum.

Other existing literature demonstrates how the activity system model has been applied and how researchers have related components of the system to medical education and practice. For example, Lingard et al¹ adopted CHAT to describe interprofessional collaboration and interprofessional education within a Canadian transplant department. The authors present a case where various professionals with conflicting opinions are involved in the care of a patient's pre-operative assessment to demonstrate division of labour and structural divisions in this context. They highlight that the differing work schedules and physical locations of interdisciplinary team members lead to inefficient and confusing conditions. Artifacts (or instruments) emerge to facilitate carrying out activity in this system eg, making requests in person rather than by telephone, targeting requests to a limited group of specialists from other services. In order to function, practitioners must negotiate with one another and draw different expert opinions together to make a collaborative decision. However, they also highlight that apparent solutions also generate new challenges. CHAT allowed these researchers to describe a system in flux, with multiple voices, in which the locus of control shifts.

Gormley et al³¹ espouse the use of CHAT in in situ simulation which aims to provide contextuality and authenticity to learners, and believe that CHAT can improve organizational learning. They provide the theoretical example of simulating emergency basic life support (BLS) whilst maintaining adequate infection control in the context of the Covid-19 pandemic. In this context, the object of the activity is providing efficient emergency care while maintaining high standards of staff safety, and the subjects are healthcare workers. The activity is mediated by instruments (eg, Personal Protective Equipment), and the subject interacts with rules (eg, BLS guidelines), community (healthcare workers), and division of labour (different tasks taken on during resuscitation process). The activity which the patient is undergoing in this scenario can also be conceptualized as a separate but interacting activity system.

In the case of a larger-scale research project, Archer et al³² adopted CHAT during their three-year investigation into medical revalidation which was commissioned by the United Kingdom (UK) General Medical Council (GMC). In the UK, revalidation is the process by which doctors demonstrate that they are continuing to develop as professionals and maintain their clinical abilities, and therefore allowed to remain registered with the GMC and continue to practice medicine.³³ Archer et al³² considered medical revalidation as an activity system, with the components of the framework mapping to interacting factors involved in medical revalidation: the subject being doctors aiming to achieve an object (revalidation), mediated by instruments (eg, supporting information, IT systems), in interaction with rules (eg, GMC guidance), community (eg, medical colleagues, GMC, patients), and division of labour (eg, doctors reflecting on their own practice, responsible officers making recommendations, patients providing feedback). Using this framework, they explicated that the proposed object of medical revalidation is not always achieved and there may be a mismatch with the outcome, (eg, doctors perceiving revalidation as perfunctory and a “tick-box” exercise), and to highlight specific components where improvements may be made.

These studies exemplify how CHAT is a suitable theory for studying complex learning and workplace environments, as it views work as constantly changing mix of actors over long periods of time, and widely distributed in space.⁷ Furthermore, CHAT allows consideration of how and why an activity system occurs in its current form, and

how it may be changed in the future to overcome tensions within the system, as described below.

Tensions in the System

The purpose of CHAT is not simply to display practice in an activity system, but to understand where conflicts and tensions lie as a basis for improved forms of activity.⁷ When tensions occur, the community is not integrated and working harmoniously, and there are multiple conflicts.⁸ In the context of CHAT, these conflicts are termed contradictions.³⁴ Contradictions in activity systems provide barriers to practice and learning. If contradictions are severe, the activity may collapse, and the subject may not be able to attain the object which is meant to be directing the activity.⁹ In other words, contradictions result in an activity not leading to its desired outcome. Contradictions therefore must lead to change and so are the main cause for development in activity systems. Contradictions are typically categorised as follows:⁷

- Primary contradictions: the tension between the use value and exchange value of an element of an activity system, eg, differing interpretations of and rules emerging from multi-voicedness within the system;
- Secondary contradictions: when two elements or more of the same activity system are in tension with each other;
- Tertiary contradictions: when there is tension between the dominant version of an activity and a new version, typically when the new version has been aimed at finding relief from one or more secondary contradictions;
- Quaternary contradictions: tensions between at least two different interacting activity systems.

Consideration of contradictions in a complex system is highly relevant when considering the practice-based learning of doctors and medical students. In their study of doctors transitioning from undergraduate to postgraduate training, de Feijter et al³⁴ carried out thematic analysis of data generated through focus groups with newly graduated doctors concerning patient safety, then incorporated CHAT for further analysis. They determined that learning to practice as a doctor often contradicts the priority of maintaining patient safety, especially during the transitional phase. The authors advocate that by focusing on resolving such contradictions, learning and patient safety may be improved. Similarly, Klitgaard et al³⁵ conducted an

ethnographic study of doctors undertaking the first months of their initial postgraduate training. Using thematic analysis, these researchers identified four key ‘struggles’ which newly graduated doctors experience when entering the hospital workplace, and used CHAT to explore contextual influences on these and expressed these struggles as contradictions. One conceptualized contradiction was the finding that newly graduated doctors are not ultimately responsible for final decision-making (rules) which contradicts their (subject) feeling of responsibility. Another contradiction lay between different interacting theorized activity systems: newly graduated doctors’ object to take on the role of the doctor contradicts the perceived object of other hospital staff who wished for patient discharges and more free hospital beds.

CHAT is useful for considering where tensions lie in a system of practice. The next section will describe how these tensions can be overcome by resolving contradictions, leading to new iterations of activity.

Overcoming Contradictions and Making Change

Contradictions may occur at different levels. It is through reflection on contradictions and considering new forms of an activity that systems develop.³⁶ Activity systems occur in their present form because of historicity: past events which have influenced them to do so, and how past contradictions have been overcome. This change to form a new type of activity is termed expansive learning. In the future, there will be further evolutions to systems through discovering new ways of doing things, coming from currently un-thought space.²⁹

Vygotsky, the progenitor of CHAT, developed the educational idea of the Zone of Proximal Development (ZPD). ZPD represents the space between the actual developmental level of a learner as determined by independent problem solving, and the level of potential development through problem solving under adult guidance or in collaboration with more capable peers.²⁶ Through the lens of CHAT, the ZPD has been incorporated to represent the distance between learners simply learning things by rote without understanding the purpose, and later coming to internalize what the action really means.⁵ In other words, within the activity system, the subject may know in principle what actions should be carried out, but it is only as the subject becomes familiar with the functioning within the system and the mediated actions they are learning, they start to

understand the importance and significance of different aspects of activity (internalization). This is moving from abstract learning to concrete learning and occurs with influence from teachers and/or the wider community.⁷

Furthermore, through this learning process, learners will also begin to question why things are done the ways they are (externalization). Over time, learners identify where the contradictions exist in their activity. By reflecting on these contradictions, expansive learning may occur ie developmental changes in activity systems. This occurs through moving across ZPDs and creating new ways of carrying out an activity. Expansive learning therefore involves changing entire activity systems or fields of activity.⁷

Expansive learning leads learners and activity systems to become qualitatively different³⁶ as contradictions emerge and are resolved.⁸ Ultimately, the purpose of studying workplace practice using CHAT is to identify where the contradictions lie and how they may be overcome to lead to expansive learning. Generating change is challenging, and may require multiple small cycles of innovation, during which changes are evaluated and refined. Engeström describes these as expansive cycles, with seven typical steps.⁷

- Questioning (criticisms or rejection of accepted practice);
- Analyzing (finding out causes or explanatory mechanisms in a given situation);
- Modelling (presenting a new model for activity in a publicly observable way);
- Examining the model (running or experimenting on the new model to ascertain its full dynamics);
- Implementing the model;
- Reflecting on and evaluating the process;
- Consolidating the outcomes into a new form of practice.

Effective change requires learners in practice to have agency to take initiative and recommend and plan for changes away from established ways of doing things.³ Engeström identified that dynamic research is required to progress, mediate, record and analyze cycles of expansive change.⁷

Expansive learning can involve formative interventions, during which contradictions are analyzed by members of the community, and innovations are devised.⁷ Formative interventions, for example, include the Change Laboratory. This is a structured, contrived

activity which consists of multiple sessions occurring over several months, during which practitioners are presented with a work activity by a researcher. A “mirror” is provided which represents daily work (eg, a videotaped episode of work). The researcher facilitates the workers in mapping workplace activity to the CHAT framework, and then helps participants identify contradictions in the system. Participants then devise the future model which resolves the contradictions, including a plan for examining and implementing the new model. In this way, practitioners are provided with agency to transform their own area of practice for the better.^{4,37}

The Change Laboratory has been shown to be of use in medical education contexts. In Denmark, researchers utilized the Change Laboratory to develop innovative change in a pediatric department and develop new ways of learning and practice. The conflict between learning and patient care were conceptualized as two activity systems contradicting each other. The researchers presented the findings of previous ethnographic data as the mirror, and participants contributed to development of an improved structure of working over a series of six reflective meetings with doctors in the department.³⁸

Morris et al⁵ also highlighted two cases of effective Change Laboratory use within medical education in the UK. In the first case, Reid et al² had described co-creation of effective placements during UK student assistantships. Student assistantships are mandated by the UK GMC to increase preparation for practice by taking on the responsibilities of a newly qualified doctors.^{39–41} This research sought to explore readiness of healthcare organizations to make the necessary adaptations to comply with GMC guidance about student assistantships. Utilizing change laboratories with three hospital teams, Reid et al² facilitated professionals in identifying cultural and historical influences on current practice, and developing a new structure of practice so that final year medical students could take on more active clinical roles.

In the other case, the UK Royal College of Obstetricians and Gynaecologists undertook a project focusing on improving learning cultures for doctors training in obstetrics and gynaecology. This had been due to widespread and systemic undermining within UK Obstetrics and Gynaecology training. Researchers facilitated practitioner-led change laboratories which developed new ways of working to improve the training experience and lead to safer patient care.^{5,42,43}

Applying CHAT to Research

Theory – propositions which are logically aligned and are used to explain the relation(s) between different constructs⁴⁴ – can be employed in research in a variety of ways and may be explicit or implicit.¹² Theory can help researchers increase understanding of phenomena under study.³¹ When a researcher uses one or more theories to structure the analysis of their study, this referred to as the study’s theoretical framework.⁴⁴

This article has provided examples of how CHAT has been usefully incorporated in the theoretical frameworks of medical education studies. This has included conceptualising learning and practice as activity systems,^{1,30–32} adding theory to data through using CHAT to deepen understandings after initial analysis,^{34,35} and through using CHAT to identify areas of contradiction and change in practice.^{2,5,38,42}

CHAT may be particularly helpful for practitioner-researchers⁵ ie, practitioners who are conducting research within their own field of practice.⁴⁵ Conducting research as a practitioner-researcher can provide unique value to medical education as I have discussed in detail elsewhere.⁴⁶ As a practitioner-researcher, insights can be gained into the inner workings of a system, eg, necessary components of an activity system like the mediating instruments, the rules, and the division of labour are likely to be more apparent to and well understood by someone working in that environment compared to an outsider.

It may be challenging for a researcher to begin working with CHAT. Yamagata-Lynch⁹ provides a practical and accessible description of the method for analysing data using CHAT to study complex learning environments: activity systems analysis (ASA). Yamagata-Lynch advocates for ASA to allow users to convey the essence of complex data in a model that can be communicated with others. The ASA process involves asking questions of the data. One systematic way is the Eight-Step-Model of ASA⁴⁷ as displayed in Table 2. Clearly, in the busy workplace of the hospital with several interacting workers carrying out multiple actions, the system is complex. In order to adopt ASA usefully, and so that the process does not become overwhelming, it is necessary to focus on and present only the most salient and essential aspects of activity systems.⁹

ASA allows the researcher to map data from their area of study to the components of the activity system, and express complex practice in CHAT terms. I have adopted ASA in my doctoral research which investigated workplace influences

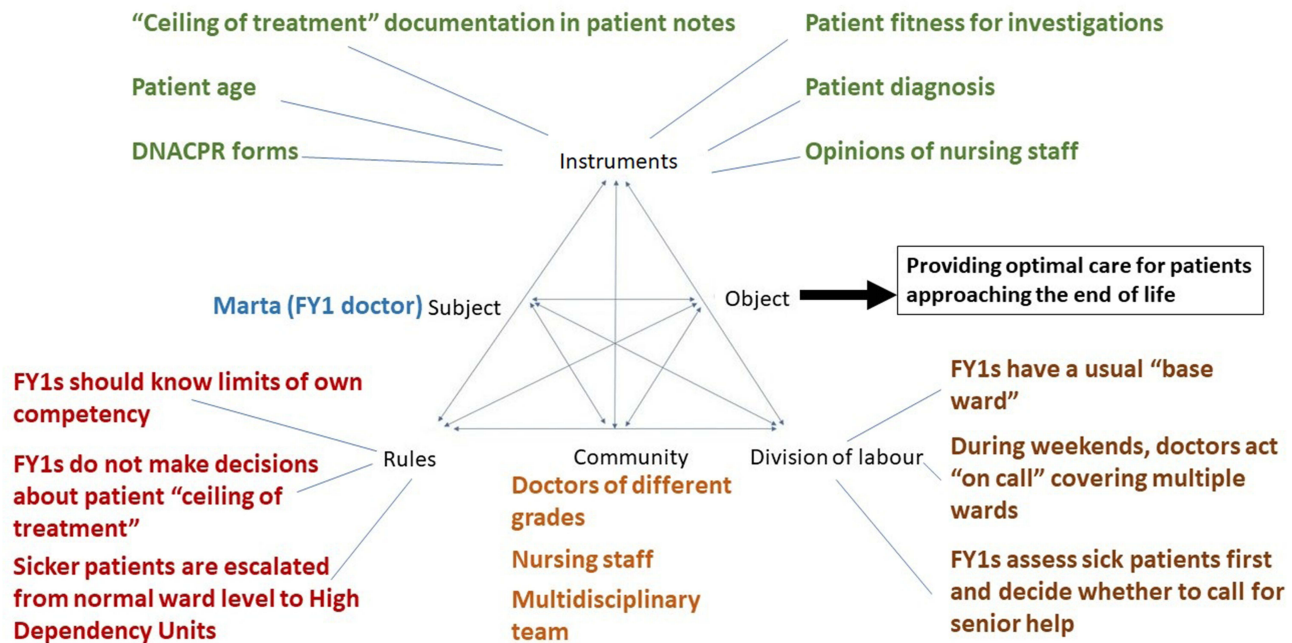


Figure 4 Example of the outcome of activity systems analysis. In this case ASA was applied to data generated from interview with newly graduated (FY1) UK doctor exploring experiences of caring for patients approaching the end of life in the hospital workplace.⁴⁸

on newly qualified doctors recognising patients approaching the end of their lives and providing corresponding appropriate care in the hospital workplace.⁴⁸

An example of how I applied this to the empirical data from my research is shown in Figure 4. This data was generated from an interview between me and a newly graduated doctor (FY1 in UK terms) about her experiences of caring for patients approaching the end of life. As Figure 4 illustrates, applying CHAT as a framework allowed me to identify factors involved in this doctor's workplace practice in enacting this role, for example, tangible instruments (eg, documentation), intangible instruments (eg, awareness of the patient's age), rules (eg, FY1s should know the limits of their competency), division of labour (eg, FY1 must first assess sick patients before calling for senior input).⁴⁸ This approach allowed me to analyze and present the complexity of this area of practice. Further details of this research and the results will be published elsewhere.

Conclusions

Healthcare organizations are dynamic workplaces comprised of multiple people with different perspectives, interacting with one another and with non-human tools to carry out their work and to learn. Such complex environments inevitably experience challenge, including tensions in providing

quality education and meeting the service demands for adequate patient care, and the need to adapt to emergent challenges. CHAT is a socio-cultural and socio-material theory which can be used to describe activity in a collaborative, dynamic environment with multiple voices, where the entire activity is bounded by a shared intended object.^{7,9,10} This article has explicated the central concepts within CHAT and has demonstrated that CHAT is a useful framework for analyzing and describing complexity in practice as related to medical education. CHAT has varied application as the examples presented here have included undergraduate education (eg, clinical assistantships for final year medical students),² postgraduate education (eg, surgical training),³⁰ and continuous professional development (eg, medical revalidation for trained doctors).³²

By incorporating CHAT, researchers can describe complexity and identify contradictions in the system which cause the activity to suffer and cause the desired object to not be achieved. CHAT also allows consideration of how practice within a system may be developed in the future in individual and collective experience, through resolution of contradictions.³⁶ This includes the Change Laboratory, where practitioners can contribute to developing and embedding improved ways of practicing.⁷

Like all frameworks, CHAT has limitations. CHAT is complex and the effort required to gain proficiency with the

theory may be off-putting (although texts such as this should provide a helpful foundation). Researching practice-based learning inevitably will require data generated through and in the workplace, and in the medical context there are likely to be ethical and practical challenges to achieving this. Like all research, there must be consideration of power imbalances between the participants and researcher, and this is especially important when researching medical students and doctors, who already may be operating within a hierarchical structure.^{46,49} Generating appropriate data will also likely involve immersion of the researcher in the medical workplace, which must be balanced against the need to maintain patient confidentiality and not be disruptive to patient care. Furthermore, considering all components of CHAT will require exploration of the cultural and historical reasons why practice occurs in its current form, for example, necessitating access to historical documents for analysis. This may be logistically difficult and have issues around organizational confidentiality. These factors will mean that the research is time consuming, and will require careful planning and dialogue with organizations to reach a satisfactory research agreement involving local governance and ethical approvals.^{50–53}

Additionally, workplace learning theories differ in how they incorporate the role of individual agency⁵⁴ and CHAT has faced the criticism of privileging the social over the individual. CHAT is a distributed learning theory and critics have stated that CHAT only considers learning as part of group practice.⁵⁵ To explore individual learning and reflexivity, it is likely to be more appropriate to incorporate another framework with a cognitive basis. Despite this criticism, working with CHAT can in fact empower individuals by allowing individuals to engage in the Change Laboratory and become agents of change in their own areas of practice.⁴

This article has provided an overview of CHAT and its usefulness to medical education research methodology. It is hoped that this article will provide those previously unfamiliar with CHAT with an awareness of this theory, and they will be able to refer to this accessible article when interpreting studies which have used CHAT or when pursuing applying CHAT in their own work. In particular, the reader may wish to do this by using activity systems analysis which provides a logical process by which researchers may begin to describe activity in terms of CHAT.⁹ I hope that this article encourages the reader to incorporate CHAT in studying practice-based in complex

learning environments, and to facilitate change for the better within his/her own context.

Research Ethics Statement

This is a methodological article and does not aim to report original research. In addressing the aim of this article, the author refers to his own primary research and presents a small sample of the findings from a qualitative research interview study. The study was granted management approval by NHS Research and Development offices in NHS Lothian and in NHS Fife, which was co-ordinated by the NHS Scotland Permissions Co-ordinating Centre, UK. The need for formal NHS Research Ethics Committee was waived as no patient data was collected. Nevertheless, all aspects of this planned research were scrutinised, including processes for informed consent, data management and confidentiality. Dr David Hope, University of Edinburgh, provided an independent research ethics opinion as he is a medical educationalist who was not involved in the study. During recruitment to this study, the interview participants underwent an informed written consent process, and pseudonyms are used to protect confidentiality of participants. Further detail and discussion of how ethics involving this research have been managed can be found in the author's doctoral thesis which is referenced appropriately.

Disclosure

The author reported no conflicts of interest for this work.

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