



RESEARCH PAPER

CHAT framework to study affordances in CALL environments

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Abstract

This paper proposes to explore the theory of affordances in the light of cultural historical activity theory (CHAT) to study affordances in complex Computer-Assisted Language Learning (CALL) environments. **The term 'affordance' designates an action possibility that is offered by an environment or an object to an actor in the environment either "for good or ill" (Gibson, 1979).** It depends not only on the inherent characteristics of the environment but also on the users' perception and action capabilities. CALL affordances are said to be a unique combination of social, educational, linguistic, and technological affordances (Blin, 2016a). However, there is limited research to date that looks at affordances from an ecological perspective linking the micro moment-to-moment interaction levels with the macro level within which they are embedded in educational contexts (Blin, 2016a). This paper explores the analytical tools of CHAT (Leontyev, 1978; Engeström, 1987) as particularly suitable to investigate affordances at the macro, meso and micro levels of technology-mediated sociocultural educational contexts in CALL.

Keywords

Affordances; cultural historical activity theory; CALL

1. Introduction: Affordances, CALL and CHAT

CALL studies have explored technological affordances for Web 2.0 technologies or virtual worlds (Dalgarno & Lee, 2010; Nocchi, 2017), linguistic affordances in telecollaborative chat (Darhower, 2008), constraints due to incompatibility between technological affordances and linguistic activities (Laurillard, Stratfold, Luckin, Plowman, & Taylor, 2000), and the interplay of social, pedagogical and technological affordances in computer supported collaborative learning environments (Kirschner, Strijbos, Kreijns, & Beers, 2004). However, the interpretations and implications of affordances in CALL design and research are still largely under-explored by the CALL community (Blin, 2016a). According to Blin (2016a) and Bonderup Dohn (2009) the problem with the current research scenario in CALL affordances is, **first, a lack of clarity of the concept of 'affordance' as reflected in certain studies that do not necessarily state the ontological and epistemological basis of their understanding of affordances in an explicit manner. Second, the mixing and matching of mutually incongruent understandings of the concept that has led to deformed representations and interpretations both at theoretical and practical levels.**

This paper explores the suitability of two theoretical approaches in investigating affordances in CALL environments: CHAT (Leontyev, 1978; Engeström, 1987) and the **post-cognitivist interpretations of Gibson's theory of affordances** (Kaptelinin & Nardi, 2012). These two theoretical standpoints have been borrowed from different psychological traditions. However, they are both complementary in their perception of contextual influence on learning and transformative change. Both are rooted in the belief that the individual psychological, collective social, and environmental contextual levels are all interconnected, from a learning viewpoint.

2. Cultural Historical Activity Theory (CHAT)

CHAT proposes to observe activity as an aggregate of multiple artefact-mediated neighbouring actions. Moreover, according to CHAT, actions make sense only in the context of a whole series of actions the individual carries out and the interrelated actions of others (Blunden, 2015). Furthermore, CHAT proposes epistemological tools necessary to concretely capture complex forms of systemic interaction that bring about transformative change. That is, the possibility to perceive the learning activity as a dynamic instrument changing from the old to a new state.

The concept of 'activity' aims to understand the individual within his/her broader cultural context. Society in turn is perceived as an extension of the agency of individuals who use and produce artefacts. According to Engeström (2001), "objects became cultural entities and the object-orientedness of activity and action became the key to understanding the human psyche (p. 134). All scholars enjoin that Vygotsky's (1978, 1962) ideas form without doubt the basis of all contemporary variants of activity theory (Lektorsky, 2004). However, the first variant of psychological activity theory was elaborated by Vygotsky's student, the famous Soviet psychologist, A.N. Leontyev (1904-1979).

2.1 Leontyev's object-oriented activity theory and its component parts

The conceptual framework of activity theory was developed by Leontyev mostly in two books: *The Problems of the Development of Mind* (1981) and *Activity, Consciousness and Personality* (1978). In these, he set out to trace the evolution of the human mind from its most basic form to advanced forms of consciousness. The concept of activity was introduced by Leontyev as the most central concept of his approach (Leontyev, 1981). He further elaborated the bridge between the individual and the social, the mind and the material as being represented by the activity of specific individuals. Leontyev proposes a symbiotic relationship between the individual who is governed by the norms and rules of the society but the society in turn depends on the activity of the individual.

What is forceful in Leontyev’s proposition is that he gives a concrete unit of analysis, the human activity both in its subjective and objective forms. This provides an observable unit that extends Vygotsky’s sociocultural mediational processes for psychological development. To explain what ‘activity’ is, one needs to understand the ‘object of activity’ as elaborated by Leontyev. The ‘object’ of an activity can be an external or internal one, for example, “the object of eating,” “the object of labour,” “the object of contemplation,” etc. (Leontyev, 1981, p. 49).

The object has both an objective (independent) and subjective (perception-based) existence. It is summoned by a need or desire of the subject. When a need (of the subject) finds its object, the latter acquires an existence both on the material and psychic realms as ‘motive’ for the subject’s ‘activity’. In its ‘independent’ existence in the material realm it undergoes transformation at the same time as it transforms the activity of the subject. In its ‘idealised’ existence in the psychic realm, it appears as a product of the perception and reflection of the subject engaging in the practical activity. Both objective and subjective are united in this concept of the object of activity.

Leontyev (1978) further stresses the social development of activity as humans develop complex multiphase activities, working in groups, to engender greater ergonomic advantage. Consequently, a socially needed ‘object’ is decomposed into a series of ‘goal-oriented actions’. ‘Actions’ form the skeletal structure of ‘human activities’. ‘Action’ is regarded as the process of an individual that obeys a conscious ‘goal’ in order to achieve a result. The goals of the individual’s actions are part and parcel of the activity as they intend to realise the group’s object but they differ from the object motivating the activity as a whole. Social cooperation implies setting of specific ‘goals’ for individual ‘actions’ thereby entailing ‘division of labour’.

Additionally, Leontyev distinguishes between the cognitive treatment of known objects (operations) and unknown objects (actions) for humans. ‘Operations’ are a type of sub-action. The operations or operational activity have an acquired quality to them. The relation between an activity, actions and operations are flexible, that is, an action can become an activity, it can also become an operation, just as a goal can transform into a motive, and so on.

A hierarchical representation of activity, actions, and operations in Leontyev’s activity theory is summarized in Table 1.

Table 1

A summary of activity, actions, and operations (Leontyev, 1978)

	Unit	Description	Object
activity	triggered by a need or desire of the subject that has found its object; undertaken as a consequence of awareness of motive	derived from social motive; dependent on individual actions	motive of the activity remains constant; realized through various sub-motives or goals
action	structural constituents of activity; cognitive treatment of unknown object	result-oriented process of individual aiming goal; collective actions realise activity	goal of action is a subset of motive but distinct from the motive of activity it realizes

operation	controlled repeated features of action; conscious or subconscious treatment of known object	ways and means of thinking but not thinking itself	autonomous from motive or goals but determined by cultural-historical usage
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The significance of Leontyev’s suggestion lies in the decomposition of any activity into actions, and the latter into operations. Leontyev’s students began to study collective activity in different forms (Lektorsky, 2004). They have shown that it is not enough to understand collective activity in terms of actions, operations, motives, goals, and tasks. It is also necessary to take into account the values and norms of activity. Furthermore, the notion of contradictions as the driving force of change and development in activity systems became the guiding principle of empirical research of activity systems in the works of Engeström and his colleagues (Engeström, Miettinen, & Punamäki, 1999).

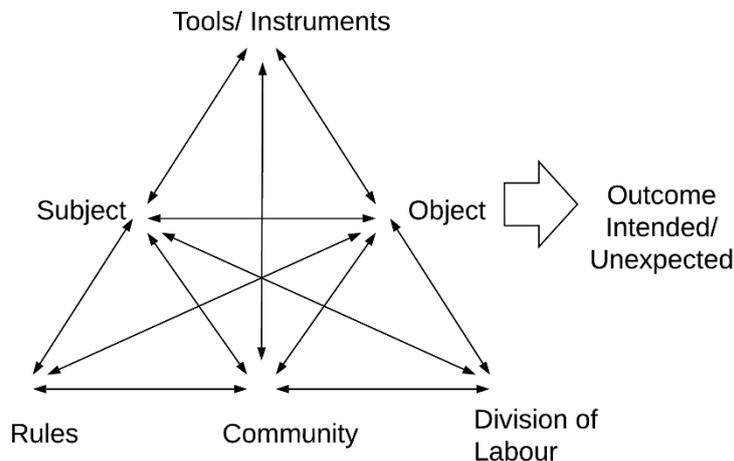
2.2 Engeström’s model of Activity Theory

Probably one of the most influential activity theorists of present times, Yrjö Engeström focuses on developmental work research in the domains of health, education, training and work organisations. His interpretation of CHAT draws upon Vygotsky’s socioculturally-mediated cognitive process and Leontyev’s conceptualisation of activity theory. Engeström’s review of CHAT and examination of the various units of analysis in his classic work *Learning by Expanding* (1987) led to the conception of the “expanding triangle” that has been the hallmark of his work and that of his followers (Blunden, 2010, p. 229).

In Engeström’s basic model of the expanding triangle, the activity of social subjects is illustrated in concrete terms that obviate the individual-social blur. In Engeström’s triangle (see Figure 1), the Vygotskian tool-mediated (material and semiotic tools) individual to object or individual to environment relation is further expanded to feature the individuals’ relationship to their environment as being mediated by their community. The community’s relationship with the fulfilment of common needs is mediated by a division of labour. The individual’s relationship with the community gives way to the formation of more complex communities and social relations that are mediated by norms, rules, values and traditions. This ‘whole’ represents human activity (individual or collective subject) set against its cultural-historical backdrop as determined by its component parts and multiple bidirectional mediations.

Figure 1

Engeström’s model of activity system (1978)



In Engeström’s developmental work scope, the object of this activity system is seen as a “problem space” with contradictions that arise either internally in the mediating links or externally to the activity system. Each iteration of the activity schema attempts to resolve these contradictions resulting in a changed relation between the component parts of the system. This produces an ‘outcome’ that may be either intended or unexpected (Engeström, 2005, 2001, 1987).

2.3 Third generation CHAT and its analytic tools

When activity theory started being adopted and applied internationally (Cole, 1988), conceptual tools were developed to include dialogue (Wertsch, 1991), multiple perspectives (R. Engeström, 1995), and networks of interacting activity systems (Engeström, 2001). **These developments expanded Leontyev’s activity theory into the third generation of activity theory where the basic unit of analysis includes at least 2 interacting activity systems.** Third generation activity theory suggests the need to encompass a more complex macro level collective activity-based and socio-culturally-mediated understanding of human behaviour rather than a micro level understanding of interacting activity systems only. In third generation activity theory, two interacting activity systems are taken as the minimal unit of analysis focusing on the constraints and possibilities of inter- and intra-organisational learning. It seeks to answer four fundamental questions: who the learners are (i.e. subject); why they learn (i.e. needs/motives); what they learn (i.e. object); how they learn (i.e. activity, actions, operations).

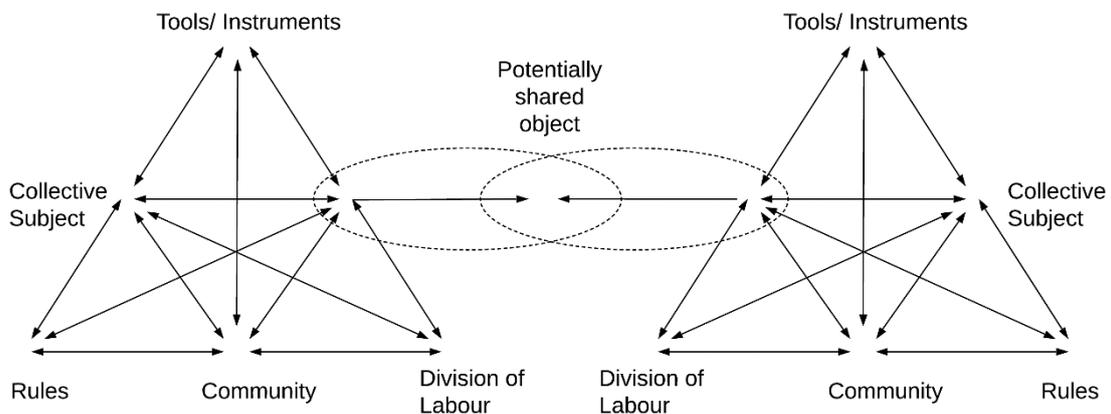
The five most important concepts of third generation activity theory are: interacting activity systems as the unit of analysis, historicity, transformative change, multivoicedness and contradictions (Engeström, 1999, p. 177), as discussed below.

2.3.1 Interacting activity systems as the unit of analysis

Third generation activity theory proposed by Engeström (2008) suggests a new unit of analysis in which a collective (subject), artefact-mediated and object-oriented activity system is seen in its relation to other activity systems. **The “social mediators”** (Engeström, 2008) such as rules and division of labour as well as tool-mediators (Leontyev 1978; **Vygotsky, 1978**) together influence the subject’s enactment of activity (collective) and actions (collective or individual) to attain an object that is potentially shared by the systems by virtue of their inter-activity/ inter-action. The interacting activity systems in ‘third generation activity theory’ (henceforth, referred to as CHAT) are illustrated in Figure 2.

Figure 2

Unit of analysis of third generation activity theory (interacting activity system)



2.3.2 Historicity

Activity systems have a historical identity that are shaped by their practical use and theoretical ideas that change over time. For example, educational work needs to be analysed against the history of its contextual organization as well as the more global history of theoretical pedagogical and didactic concepts, procedures and tools employed and accumulated in the contextual activity (Engeström, 2001).

2.3.3 Multivoicedness

CHAT introduces interacting activity systems and the plurality of subjects and voices forming different perspectives and interests. The division of labour in an activity gives way to hierarchical positions for the participants that lead to multivoicedness in networks of interacting activity systems. Moreover, the artefacts, rules and conventions that govern the activity systems also contribute to different perspectives. The multivoicedness of discourse (Engeström, 1995; Wertsch, 1991) **draws on Bakhtin's (1981) "heteroglossia" or "orchestrated polyphony"**.

2.3.4 Contradictions

The most salient feature of the interacting activity systems are its inherent contradictions and tensions. Contradictions are basically actions that do not follow the expected course of action but are, nevertheless, seen as potential building blocks of change and development (Engeström, 2008). They may either emerge within a node of an activity system, or between the nodes (secondary contradictions), or between different activities (tertiary contradictions), or between different developmental phases of a single activity (quaternary contradictions) (Kuutti, 1996). CHAT emphasises not only identifying inherent contradictions and tensions but also suggests ways to overcome these through direct interventions (Engeström & Sannino, 2010, p. 5).

Primary contradictions reflect the fundamental tensions in the general realm/society. In Marxist terms, the primary contradiction of capitalism resides in every commodity, between its use value and exchange value (Engeström, 1987). In the context of education, the primary contradiction may be the tension between learning/teaching for **one's long-term** holistic development versus learning/teaching to secure marks in a module for institutional recognition and certification (Lin, 2007).

2.3.5 Expansive transformation

An expansive transformation is accomplished when the object and motive of the activity are reconceptualized to adopt a significantly wider array of possibilities than those present in the previous mode of the activity (Engeström, 2001). Generally, such a reconceptualisation is the product of an attempt to overcome a contradiction. It emerges **as participant(s) begin to question and deviate from the activity's established norms**. In some cases, this develops into collaborative envisioning and a deliberate collective change effort as the activity moves through cycles of qualitative transformations (Engeström, 1987).

The notions of **human agency or the power to act is at the centre of CHAT's understanding** of activity. This level of analysis zooms out to the activity level instead of solely observing **isolated psychic functions inside an individual's head in order to understand human development**. CHAT imposes a further zooming out to explore the individual activity in its collective interactions with other activity systems.

3. Activity theoretical approaches to affordances

In the light of CHAT's ecological stance that views human activity as mediated by cultural and social artefacts and tools, it is necessary to review Gibson's original interpretation of 'simple affordances' in the light of more encompassing complex influences and constraints exerted by neighbouring activities and the sociocultural context within which the

interacting activity systems operate. An understanding of the evolution of the concept of affordances is proposed first.

3.1 Affordances

Technological artefacts offer opportunities to users for action that can be described at the level of operational functionalities (like pushing a button or typing on the keyboard). These simple functionalities in turn facilitate more sophisticated social and/or pedagogical actions (like sharing a written message or image on-screen). This transformation of simple operational functionalities into action possibilities loaded with rich meaning that serve to fulfil certain user needs drives design principles in human computer interaction (HCI) and engineering design. These are called affordances, a term coined by the perceptual psychologist James Gibson (1979).

Affordance is a relational property as it depends both on the inherent objective characteristics of the environment and also on the action capabilities of the organism. Thus, a ladder affords climbing for an adult human but not for an infant as the latter lacks the capacity to climb up the ladder despite its rungs. Various interpretations of affordances have emerged. In line with Blin (2016a) and Kaptelinin (2014), this paper **argues that affordances need to be reviewed through CHAT's epistemological perspective.**

3.2 From cognitivist to post-cognitivist or CHAT understanding of affordances

Albrechtsen, Andersen, Bødker, & Pejtersen (2001) assert that activity theory and Gibsonian thinking share the common notion that perception is not afferent, that it is connected with action. Furthermore, people perceive their environment only through acting. However, activity theory is argued to present a much larger theoretical scope for the study of perception and action as compared to the theory of affordances. This is **because, unlike Gibson's direct perception of real information, CHAT considers the cultural-historical aspect of an actor's interaction with the environment. Moreover, CHAT takes into account mediation and learning unlike Gibson's naturally occurring directly perceived affordances. A view contrary to Gibson's initial idea has been presented by Eleanor Gibson and Anne Pick (2000) who assert that affordances do not automatically present themselves to the actor. They must be discovered through perceptual learning and actors must learn to use them. Additionally, activity theory understands the use of tools as a cultural organ/extension, and this is not accounted for in Gibson's theory of affordances. CHAT offers an account of all the levels of human activity while Gibson's affordances focus mainly on the lowest level of operations.**

Baerentsen and Trettvik (2002) **extend Gibson's affordances to need-related, instrumental and operational affordances. Need-related affordances are related to motives and needs (at the activity level). Instrumental affordances are related to the action possibilities (at the action and operation levels) shaped by sociocultural artefacts. The instrumental affordances are equated to Gibson's affordances that are further subdivided into adaptive operational affordances related to the human adaptation to the environment and consciousness affordances that are learned through active participation in the cultural-historical context. Learning environments are very diverse in terms of the opportunities they provide. In the context of computer-supported collaborative learning, Kirschner, Strijbos, Kreijns, & Beers (2004) affirm that "education is always a unique combination of technological, social, and educational contexts and affordances" (p. 50).**

4. Affordances in language learning and CALL

In CALL ecosystems, educational, technological, linguistic and social affordances are inextricably interlinked. The technological affordances are inscribed within broader **"educational affordances" which afford "construction and transformation of a shared object", "linguaging" and "linguistic and cultural learning" (Blin, 2016a). Blin, Nocchi, and Fowley (2013) suggest that some of these affordances are consciously engineered by CALL designers, while others emerge in the course of the users' interactions with the technological tool, digital objects, peers, teachers, or other users of the target language.**

4.1 Linguistic, pedagogical, social affordances in technology-rich learning environments

A CHAT perspective incorporates the dimension of activity and change into the notion of **affordance, thus broadening the erstwhile concept of 'operational affordances'** (Baerentsen & Trettvik, 2002), **or 'simple affordances'** (Turner, 2005), such as clicking on <send message> etc., **into 'complex affordances' or 'organisational affordances'** (Vyas, Chisalita, & Dix, 2008) composed of networks of interacting actions and activities that undergo change. An example would be sharing peer feedback asynchronously by clicking on <send message> with learners following a collaborative synchronous interaction session between learners. This includes pedagogical, linguistic and social action possibilities or affordances that are facilitated by technological affordances and that could **potentially accommodate changes in users' task ownership, autonomy and group dynamics**, as well as their emotional, semiotic and functional values related to the technology (Vyas, Chisalita and Dix, 2008).

In language learning, Van Lier (2000) introduced the notion of linguistic affordances that he defined as the relation of interaction possibilities between people. He proposed an **interplay of 'immediate linguistic affordances' and socially 'mediated affordances' to link language to actions**. Furthermore, he argued in favour of the ecological notion of affordance as an alternative to input, wherein an active and engaged learner perceives linguistic affordances in an environment with rich semiotic budget and enacts them for linguistic action. This promotes, according to van Lier (2000), interactional processes between the learner and speech acts that trigger action potentially promoting further action leading to higher and more successful levels of interaction. By enacting these affordances new linguistic actions are possible which lead to the speakers producing more complex interactions. Different individuals with different motives construe the task in **different ways unlike the notion of 'input' that carries the idea of static coding and decoding of pre-meditated and expected responses**. He further posited that the unit of analysis should be the activity itself rather than any kind of linguistic input or object.

Social affordances refer to interpersonal (user-user) interactions between subjects (group formation and social dynamics within the group) as well as the user-tool interactions that take place. These are perceived, emergent, and acted upon by users based on their needs, motives, past experiences, etc. (Kirschner et al., 2004). Affordances, therefore, are not only designable and independent features of a system, but rather are dependent on the relationship between the system/artifact and the organism/user. This elicits the question not only of interface design, but also of interaction design, that is:

- Defining/designing the artefacts, environments and systems as they relate to historical and social usage;
- Anticipating how this usage will mediate human interaction and learning;
- Exploring the emergent interaction between the artefact, users and contextual environment with a view to changing and improving the previous design (Reimann, 2001).

There is a dearth of research that takes into account different viewpoints, such as of learners, teachers, and the whole community formed of individuals (e.g. learners, teachers and other stakeholders), as well as the groups collaborating in various modes (e.g. different groups of learners and teachers and their various interactional modes).

Specific interaction types and spaces are generated by CSCL tools, tasks and participant roles. These need to be identified and defined through further research on linguistic, pedagogical and social affordances in technology-mediated complex learning environments. A CHAT view on affordances advocates that researchers should not only look at the technological affordances but also at the educational/pedagogical and social action possibilities or affordances that are intertwined as complex affordances in such interacting learning systems.

5. Conclusion

The notions of original Gibsonian understanding of affordances are considered limited. A need is felt for more advanced understanding of affordances as designed and emerging at all levels of human activity for individual actions and operations and collective activities in technologically, socially and culturally rich contexts of learning. CHAT offers the epistemological tools that support the exploration of these affordances at different levels. Furthermore, Gibson talks about countless possibilities of affordance waiting out there to be discovered. However, he does not explicitly delve into the question of why the observer should choose an affordance; what motivates him/her to look for affordances in their environment; what motivates the observer to choose one affordance over another in a series of perceived affordances. These are questions that invariably implicate motivation; the motives that lie at the origin of any activity. It is noteworthy that the aforementioned **questions have the purpose of orienting one's perspective** towards a micro-macro understanding of the theory of affordances, rather than the original understanding of affordances by Gibson.

CHAT proposes to bridge the gap between the micro and macro levels of human activity. It offers epistemological tools necessary to capture the system level dynamics (need, change and contradiction) of various spaces and timescales (both remote and close) interacting within technology rich learning environments. The macro level dynamics determine the actions and tensions that emerge at the meso and micro levels of the activity system. Therefore, as suggested by Levy & Caws (2016), it is crucial to zoom out and in from micro to macro and again back to micro levels of the learning environment, to capture the holistic picture of the systemic activity, contradictions and change. CHAT **seeks to "explain the qualitative transition from a series of mental individual actions to a new collective, material activity system"** (Engeström, 1987, p. 22). The identification of the transformation of the mediated actions will help to identify the emerging affordances.

In line with the conceptualisation of affordances proposed by the post-cognitivist perspective, this paper argues that CALL learning action possibilities could be explored in two tiers: those that are directly perceived and have an operational automatic quality (designed affordances) and those that are constructed in learning activities and practices as a result of socially and culturally-mediated interpretations (emerging affordances). This calls for an implementation of the aforementioned CHAT analytical tools in a concrete context that would help define designed and emerging affordances in interacting activity systems at the level of participants, learning design, and institutional interactions in CALL.

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