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# A CULTURAL-HISTORICAL ACTIVITY THEORY APPROACH TO STUDYING THE DEVELOPMENT OF STUDENTS' DIGITAL AGENCY IN HIGHER EDUCATION

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## ABSTRACT

Researching classroom practice requires theoretical resources that can explain the variety inherent in such an activity as well as the dynamic nature of classroom practice. Cultural-Historical Activity Theory (CHAT) offers the possibility of accounts of social, cultural, and historical aspects of the context and of how students adapt and transform in these contexts. This conceptual paper engages with the relevance and utility of CHAT for researching student practices in a course as an activity system. It draws on

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part of a Ph.D. research study that explores first-year engineering students' access and engagement with technological resources for learning. A key concept in the study is the development of the ability to control and adapt to technology, known as digital agency. The research question addressed in this paper is *"How does CHAT reliably build theory of the complexity inherent in the development of digital agency among first-year engineering students learning at a university?"* Some of the challenges in the application of CHAT for researching in this context are identified, such as describing practice as an activity system and identifying the object of the activity system. In addition, the value of CHAT for such studies is explained including the contribution it makes in the identification of contradictions and tensions that cause change and development in the activity system. These findings offer insight as to the usefulness of CHAT for engineering educators and scholars understanding their practice or researching learning and teaching in the classroom.

## 1 INTRODUCTION

### 1.1 Context

Higher education institutions have migrated from traditional approaches to teaching and learning without digital technologies to the ubiquitous use of information and communication technologies for teaching and learning. A review of the literature on the 20-year journey of technology-enhanced learning in South African universities reveals that these institutions have transitioned from relatively subpar ICT infrastructure and education provision to cloud-based ICT infrastructure with unlimited educational resources that are freely, openly, and simply accessible both within and outside the institution (Ng'ambi et al. 2016). As universities develop ICT infrastructure for learning, some students still face challenges in adopting and adapting to technology due to the high levels of inequality that have their roots in the apartheid era. Oyedemi and Mogano (2018) established in their study that 73 percent of students did not have access to computers at their high schools and 82 percent of students from rural high schools did not have computer access or internet at their schools. As such, many students enter university with varying levels of digital literacy, and digital skills. Others lack hardware devices, internet services, and access to digital technologies for learning. Another study into the use of technology in teaching and learning in South Africa found that students' social practices and learning through digital media lacked opportunities and experience with digital technologies (Czerniewicz & Brown 2013). It was reported in this study that students had hardly used a computer prior to university and did not have easy access to technology off campus. The persistence of the digital divide in the country therefore presents challenges to both students and educators.

Ragnedda and Muschert (2017) described three levels of the digital divide, including physical access to the internet, different uses of the internet, and social and tangible benefits accrued from differentiated uses of the internet. First, there is a divide

between those who can and cannot access the Internet; second, there is a divide regarding motivation, aptitude, and purpose of use; and, thirdly, there is a divide with respect to the social, cultural, economic, personal, and political benefits that can be gained online. The latter demonstrates that there are socio-technological disparities between persons from different backgrounds that impact on their opportunities and capacities to translate digital involvement into benefits while avoiding the harm that may result from using ICTs (Ragnedda & Muschert 2017). This contributes to limitations in the development of digital skills, competence, and literacies among some students.

First-year engineering students require engagement with ICT for learning in a range of courses. Differential access and preparedness for technology therefore presents challenges for both students and course lecturers. How students develop their digital capabilities, resolve contradictions that may exist, and transform their social conditions in the process, is of interest in this study and informed the choice of Cultural-Historical Activity Theory (CHAT) as appropriate for conceptual framing. Contradictions are tensions or conflicts between and within activity systems that are potential sources of change and development and are used for empirical research (Engeström 2001).

### 1.2 Digital agency

The term digital agency was first used at the Fifth International Summit on Information and Communication Technology in Education in 2017 where it was defined as the individual's ability to control and adapt to a digital world (Passey et al. 2018). Since then, other definitions have emerged. For example, Goriss-Hunter et al. (2022) defined digital agency as the level of autonomy that a student experiences when digital technology is used in the classroom. Digital agency is regarded as a subset of student agency and some scholars still describe it as student agency in a digital learning environment. It has been argued that academic achievement and how students feel about their learning experiences in a digitally mediated environment are significantly impacted by student agency (Luo et al. 2019).

As research on digital agency emerges, it has the potential to inform interventions and influence engineering students' digital learning environments and learning skills (Klemenčič 2017). Digital technologies have the potential to transform underprepared students in the use of technology to become competent others who can teach their fellow students how technology is used for learning. It is argued that in education, digital technologies affect human people relationally, culturally, and technologically suggesting that the framework of agency should consist of critical domains to student agency in digital contexts (Stenalt 2021).

## 1.3 Cultural Historical Activity Theory (CHAT)

CHAT has developed and evolved as an interdisciplinary theory over more than 100 years (Fenwick et al 2011). The principles of CHAT were first drawn from the works of Vygotsky, Luria, and Leontiev (Engeström 2001), and is a theory that has widely been applied in educational research in a variety of contexts. From CHAT's earliest days, it elucidated relations, mediation, human learning and development proceeds using direct experimental and non-experimental empirical research (Fenwick et al. 2011). For explaining learning and development, CHAT not only focuses on the role of people's social relations but also the use of tools/artefacts over time. This represents a departure from the theories of learning and development as a purely cognitive process.

Fenwick et al. 2011 contend that CHAT is frequently used in naturalistic and qualitative educational research. CHAT provides a knowledge of the historical approach to activity, considering the history of mediating objects, learning environments, technology, and many more. A variety of case studies and comparative studies employing CHAT in settings such as classrooms have also been published.

In recent years, CHAT has frequently been used in interventionist research approaches on educational environments, including change laboratories (Sannino et al. 2016). Mukute (2009), for example, used CHAT to identify and analyse inconsistencies; model and implement solutions in permaculture learning and practice at one school and its community in Zimbabwe. CHAT is also useful in educational research where curriculum, programmes, and organizational transformation are of particular interest (Fenwick et al. 2011).

CHAT has been found to be useful in expounding the complex systems involved in computer human interaction studies in the education arena (Kaptelinin & Nardi 2018). For example, CHAT was used to demonstrate how instructors use technology to mediate the teaching and learning of a subject in primary school (Hardman 2005a). Similarly, the study was broadened to show how CHAT provided a framework for South African technology research (Hardman 2005b). CHAT was also used to investigate pedagogical variations in teaching computers in mathematics classes (Hardman 2015). The study drew from CHAT to understand pedagogical modes emerging out of teaching with technology. Batiibwe (2019) conducted a literature review on the application of CHAT to understand how emerging technologies can mediate learning and instruction in a mathematics classroom. She supported the idea of the classroom as an activity system and found the mediation tool in CHAT to be effective.

The concept of social change is intertwined with CHAT and aims to comprehend the world not as it is, but as it evolves. This makes CHAT relevant for studying agency in the educational space. Hopwood (2022) examined three approaches to agency when using CHAT, namely, transformative activist stance, transformative agency by double stimulation, and relational agency. Despite overlapping underpinnings and apparent commonalities in dialectics, mediation, motives, and practice, they identified significant variances. Bringing these distinctions to light revealed what each approach in CHAT has to offer as well as the subtleties that set them apart. CHAT also conceptualises agency as mediation development where change happens due to unavoidable contradictions and tensions inherent in the activity system. Development is therefore understood as a process of becoming a subject capable of agency, that is, able to contribute, influence and change the environment and the social as well as material circumstances (Rainio 2010).

This paper draws on part of a Ph.D. research study that explores how first-year engineering students access technological resources for learning. A key concept in this study is the development of their digital agency. The objective of the study is to show how CHAT reliably builds theory describing the complexity inherent in the development of digital agency among first-year engineering students learning at a university.

## 2 METHODOLOGY

### 2.1 Data collection

An ethnographic approach to data collection was employed in the Mechatronics Engineering class. After obtaining ethics approval, observations and interviews were conducted. Observations of the students during engineering drawing classroom learning was undertaken for three hours per week over eight weeks. The researcher observed events and patterns which appeared to account for the agentic behaviour among students as they used digital technologies. Following the observations, nine students were identified for one-on-one interviews through purposeful sampling. The interview questions were revised repeatedly for internal consistency. The interviewee explained the questions to the students for reproducibility. Each interview lasted approximately one hour. Indicators of the development of digital agency were identified in literature. They included students' autonomous use of technology, breaking away from a frame of action, visualizing new possibilities, transforming disturbances encountered collectively and ability to collaborate with others as they learnt the subject. The data were in the form of field notes, interview transcripts, videos, and audio of recorded lectures.

## 2.2 Data analysis

In the data analysis phase, both inductive and deductive coding were employed to analyse the observations and interview data through thematic analysis. All nine audio recordings from the one-on-one interviews were transcribed, and the transcripts were carefully edited and verified for accuracy. To protect the privacy of the interviewees, pseudonyms were used to anonymize their identities.

Interview transcripts and field notes were imported for analysis into NVivo Release 1.7, a qualitative data analysis software, for first level coding. In vivo statements were extracted and analysed for concepts that are related to the research question. The concepts were then categorised into themes based on CHAT tenets categories, namely, subject, object, division of labour, community, rules, outcome and mediating artifacts. After categorising the concepts into themes, the activity systems within the data were examined, and contradictions present were identified. These contradictions were further scrutinized to determine their contribution to the development of digital agency among engineering students. This analysis aimed to explore how the identified contradictions influenced the students' ability to exercise control and adapt to digital technologies in their academic activities.

# 3 RESULTS AND DISCUSSION

To understand digital agency development and its possible consequences, the activity system and its tenets were identified and analysed from the data. The CHAT activity system was used to delineate the engineering classroom activities into the tenets of subject, mediating artifacts, object, rules, community, and division of labour. Although the classroom learning practice had a number of subsystems, only the main activity system is presented in this paper. A second-generation CHAT activity system that describes the interactions among the tenets is shown in Fig. 1. The activity system was used as the unit of analysis.

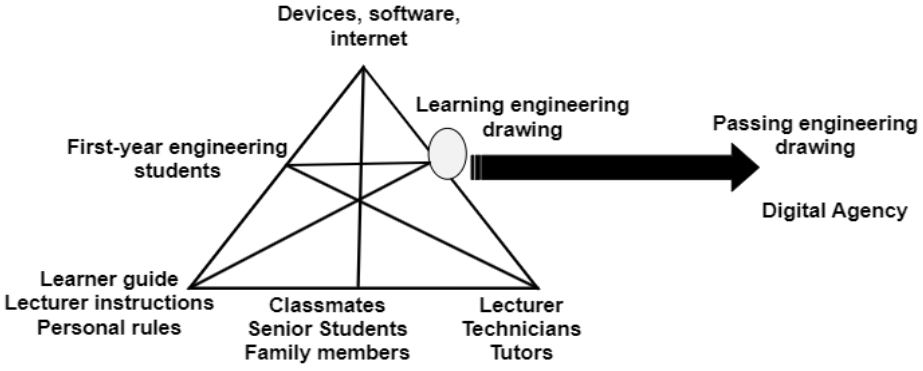


*Fig. 1. CHAT activity system*

In this study, the engineering students are the subjects involved in the achievement of the object. The object is important because it is the moving target in an activity system (Engeström 2001). The object in this case is learning engineering drawing including theory and practicals, mediated by cultural mediating artifacts (devices, software and the internet) embedded within a social context. The community is the broader social

context in which this system operates. In this case there are senior students, family members and classmates. For example, classmates assist one another in learning the software and carrying out homework tasks. Learning software, devices and the internet as well as learning the subject, constantly drove the activity systems guided by the rules. The division of labour consisted of people who assisted the students as they learnt the subject. The lecturer was a resource as he taught and assessed the students online, face-to-face and via pre-recorded videos. By studying the activity system, the researcher could identify the interactions that first-year engineering students had to negotiate, as well as the tensions and contradictions in these interactions.

### 3.1 Contradictions

The CHAT analysis showed that there are two significant sets of contradictions to the development of digital agency as shown in the activity system (Fig. 2.); the primary and the secondary contradictions. The primary contradictions were identified within the mediating artifacts: device, software and the internet that are used for learning in the engineering course. The secondary contradictions were identified between the subject and the object, subject and mediating artifacts as well as between the subject and the division of labour.

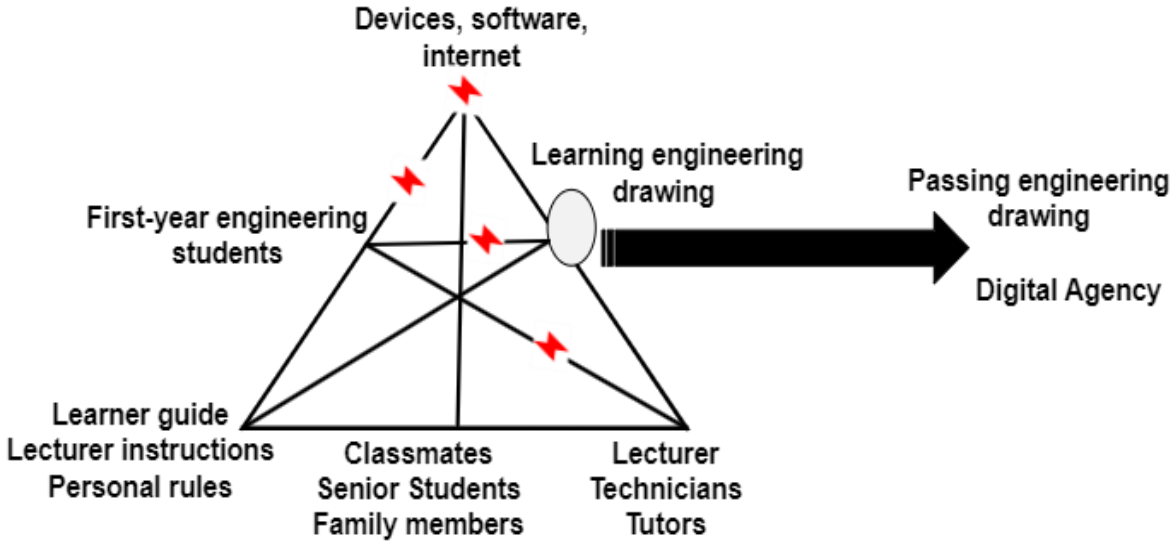


*Fig. 2. Tensions in activity system*

The type of contradictions and their locations are described in Table 1. In resolving these challenges, students showed attributes of digital agency. For instance, in the context of this study, engineering students were required to secure funding and purchase additional Random-Access Memory (RAM) to enhance compatibility with software applications such as SolidWorks and AutoCAD. In order to enhance the two-step verification sign-in process for Blackboard, students needed to ensure their phones were charged to authorize the login. Alternatively, some students opted to

work remotely from their residences to overcome challenges posed by non-portable desktop computers and software versions that differed from those available on campus.

*Table 1. Primary and secondary contradictions*

| **Contradictions/ Location** | **Examples** |
|---|---|
| **Primary**<br>Within mediating artifacts | RAM inadequacy in laptops.<br>LMS reported to be redundant, difficult to use, had sign-in issues, needed two-step verification, and had an incompatible application for cell phones.<br>Desktop computers were not portable, updates were incompatible.<br>Tablets and cell phones were not compatible with the software. |
| **Secondary**<br>Between subject and mediating artifacts<br><br>Between students and division of labour<br><br><br>Between students and object | First year engineering students had no access to devices like laptops and had no knowledge of software and applications.<br><br>Slow/no wi-fi connection.<br>Different software versions.<br>Transmission-oriented teaching.<br><br>Power failure issues, and long online lectures. |

The prevailing power failure issues are culturally and historically explained as they date back to the apartheid era and lack of investment and corruption in the democratic era. Despite the power outages, first-year engineering students exercised agency by discovering ways to complete engineering drawing tasks using software, devices, and the internet. Even during power outages, some students used their recharged laptop batteries to do engineering drawing tasks for a few hours. Others who did not have access to laptop computers worked on non-digital assignments before returning to drawing tasks once power was restored.

### 3.2 CHAT's contribution

In this study, there was a classroom learning environment where the lecturer instructed the first-year engineering students using digital technology. CHAT was used to frame the system in context, including social, cultural, and economic influences over time. The rules that students observed whilst interacting with the lecturer were historically based and culturally negotiated. Numerous circumstances beyond both the lecturer and the engineering student's power to modify them individually enabled and constrained each party's agency, that is, the acts they performed in relation to each

other. A variety of other individuals, such as classmates and senior students, mediated the interactions for this particular subject.

Cultural-Historical Activity Theory was applied in this study with reference to the specific meaning of each word in its name. The term cultural in this instance referred to the idea that first-year engineering students were enculturated, and that everything they did was influenced by and drawn from their cultural resources and ideals (Foot 2014). The terms historical and cultural were used in combination to denote the idea that because cultures are rooted in histories and change through time, analyses of what the students did at any given time was understood in the context of those histories. To communicate its situatedness, the term activity, which referred to what students did collectively, had undergone cultural and historical modifications. In addition, CHAT encapsulated the conceptual framework for comprehending and explaining students' activity that led to development of digital agency.

Students created, employed, and adapted to digital technologies of various kinds to learn and communicate (Vygotsky 1978). The activity system where students learnt engineering drawing was constantly changing through learning actions in response to CHAT's systemic contradictions that allowed a multifaceted analysis of the complex practice in the hybrid classroom. The contradictions and tensions in the activity system which are historically explained, caused students to find alternatives to overcome them thereby developing their digital agency.

### 3.3 Complexities of CHAT

Using CHAT as a theoretical framework and tool to build theory presents complexities. One challenge is the difficulty in determining the *object* and the perspective from which it should be named. There is ongoing debate about who should define the *object* and how it guides the other components of the system. In the specific activity system depicted in Fig1, the object was defined by the researcher rather than through collaborative efforts by a group. The participants could have defined the object differently. Conceptualising the course as an activity rather than selecting a particular practical or task also increased the complexity of the application of CHAT.

The activity system depicted in Fig.1 served as the main focus of analysis, emphasizing a collective perspective rather than individual actors. This approach, as suggested by Engeström (2001), highlighted the limitations of CHAT in adequately addressing the individual experiences with digital technologies. By zooming in and examining each student's unique responses to contradictions related to technology, a deeper understanding of their development of digital agency could be gained. This finer-grained analysis would provide valuable insights into how students navigate and adapt to digital technologies within the context of the activity system.

## 4 SUMMARY

In summary, CHAT framework proved to be a valuable tool for investigating the development of digital agency in educational settings. CHAT offered a comprehensive understanding of this developmental process by taking into account both the social and material aspects and their interplay within the classroom. The outcomes of this study shed light on the applicability of CHAT for engineering educators and researchers who aim to enhance their understanding of their own teaching practices or explore the dynamics of learning and teaching in the classroom.

## REFERENCES


Batiibwe, M. S. K. (2019). Using Cultural Historical Activity Theory to understand how emerging technologies can mediate teaching and learning in a mathematics classroom: a review of literature. *Research and Practice in Technology Enhanced Learning*, *14*(1), 1–20. https://doi.org/10.1186/s41039-019-0110-7

Czerniewicz, L., & Brown, C. (2013). The habitus of digital “strangers” in higher education. *British Journal of Educational Technology*, *44*(1), 44–53. https://doi.org/10.1111/j.1467-8535.2012.01281.x

Engeström, Y. (2001). Expansive learning at work: Toward an activity theoretical reconceptualization. *Journal of Education and Work*, *14*(1), 133–156. https://doi.org/10.1080/13639080020028747

Fenwick, T., Edwards, R., & Sawchuk, P. (2011). *Emerging approaches to educational research* (pp. 1–232). London: Routledge.

Foot, K. A. (2014). Cultural-historical activity theory: Exploring a theory to inform practice and research. *Journal of Human Behavior in the Social Environment*, *24*(3), 329–347. https://doi.org/10.1080/10911359.2013.831011

Goriss-Hunter, A., Sellings, P., & Echter, A. (2022). Information Communication Technology in schools: Students Exercise ‘Digital Agency’ to Engage with Learning. *Technology, Knowledge and Learning*, *27*, 785–800. https://doi.org/10.1007/s10758-021-09509-2

Hardman, J. (2005a). Activity Theory as a framework for understanding teachers’ perceptions of computer usage at a primary school level in South Africa. *South African Journal of Education*, *25*(4), 258–265. https://www.ajol.info/index.php/saje/article/view/25046/20717

Hardman, J. (2005b). Activity theory as a potential framework for technology research in an unequal terrain. *South African Journal of Higher Education*, *19*(2), 378–392. https://journals.co.za/doi/pdf/10.10520/EJC37127

Hardman, J. (2015). Pedagogical variation with computers in mathematics classrooms: A cultural historical activity theory analysis. *Psychology in Society*, *48*, 47–76. http://dx.doi.org/10.17159/2309-8708/2015/n48a3

Hopwood, N. (2022). Agency in cultural-historical activity theory: strengthening commitment to social transformation. *Mind, Culture, and Activity*, *29*(2), 108–122. https://doi.org/10.1080/10749039.2022.2092151

Kaptelinin, V., & Nardi, B. (2018). Activity theory as a framework for human-technology interaction research. In *Mind, Culture, and Activity* (Vol. 25, Issue 1, pp. 3–5). Taylor & Francis.

Klemenčič, M. (2017). From student engagement to student agency: Conceptual considerations of European policies on student-centered learning in higher education. *Higher Education Policy*, *30*(1), 69–85. doi:10.1057/s41307-016-0034-4

Luo, H., Yang, T., Xue, J., & Zuo, M. (2019). Impact of student agency on learning performance and learning experience in a flipped classroom. *British Journal of Educational Technology*, *50*(2), 819–831. https://doi.org/10.1111/bjet.12604

Mukute, M. (2009). Cultural historical activity theory, expansive learning and agency in permaculture workplaces. *Southern African Journal of Environmental Education*, *26*, 150–166. https://www.ajol.info/index.php/sajee/article/view/122818

Ng'ambi, D., Brown, C., Bozalek, V., Gachago, D., & Wood, D. (2016). Technology enhanced teaching and learning in South African higher education--A rearview of a 20 year journey. *British Journal of Educational Technology*, *47*(5), 843–858. https://doi.org/10.1111/bjet.12485

Oyedemi, T. D., & Mogano, S. (2018). The digitally disadvantaged: Access to digital communication technologies among first year students at a rural South African University. *Africa Education Review*, *15*(1), 175–191. https://doi.org/10.1080/18146627.2016.1264866

Passey, D., Shonfeld, M., Appleby, L., Judge, M., Saito, T., & Smits, A. (2018). Digital agency: Empowering equity in and through education. *Technology, Knowledge and Learning*, *23*(3), 425–439. https://doi.org/10.1007/s10758-018-9384-x

Ragnedda, M., & Muschert, G. W. (2017). *Theorizing digital divides*. Routledge.

Rainio, A. P. (2010). *Lionhearts of the playworld: An ethnographic case study of the development of agency in play pedagogy* [Helsingin yliopisto]. http://urn.fi/URN:ISBN:978-952-10-5959-9 http://hdl.handle.net/10138/19883

Sannino, A., Engeström, Y., & Lemos, M. (2016). Formative interventions for expansive learning and transformative agency. *Journal of the Learning Sciences*, *25*(4), 599–633. https://doi.org/10.1080/10508406.2016.1204547

Stenalt, M. H. (2021). Digital student agency: Approaching agency in digital contexts from a critical perspective. *Frontline Learning Research*, *9*(3), 52–68. https://eric.ed.gov/?id=EJ1309730

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.