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1. *Pedagogy, child development and Cultural Historical Activity Theory research (CHAT)*

I locate myself in the broad theoretical field of Cultural-Historical Activity research and have used this framework to study pedagogy and development for 22 years. My journey with CHAT began in my master's work in psychology where I used Vygotsky's Cultural Historical Theory to understand the epistemology of questioning in undergraduate psychology tutorials. My focus on semiotic tools in my master's degree led me to think about how technology, used as a tool, could impact mathematics pedagogy and, relatedly, learning. The appalling performance of mathematics students on international benchmarking tests of mathematics led me to focus specifically on mathematics classrooms as my context for research. In my PhD I investigated the impact that computer hardware and software had on teaching mathematics in disadvantaged schools in the Western Cape province of South Africa, using CHAT.

Central findings of this project indicate that it is not technology itself that leads to student attainment in mathematics, but, rather, how this technology is used pedagogically. A crucial finding for me at this time, was that what I have called a 'collaborative' mode of pedagogy seemed to be the kind of practice that opened discussion and dialogue, which in turn, led teachers' to explicate abstract

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[1] All images are used with parental consent and student assent.

concepts in a manner that linked them to the children's everyday, concrete concepts (Hardman, 2008; 2010; 2016; 2019; Hardman & Lilley, 2023). Further findings in research regarding technology and pedagogy, using CHAT, are that this theory can be developed into a language of description with which to analyse pedagogy in context (Hardman, 2007; 2016; 2019). To this end I have developed a checklist for researchers using CHAT principles as well as an interview schedule that aims to elicit core CHAT principles from respondents (Hardman, 2008; Hardman & Raudzingana, 2021; Hardman & Lilley, 2020; 2023; Hardman & Tshink, 2019; Hardman & Teschmacher, 2019)

Teach-Assess-Teach model of pedagogy.

Over the past 22 years I have drawn on the work of Vygotsky (1978; 1986), Hedegaard (1998; 2020), Craig (1996), Ratele (2018), and Luria (1980) to develop my own novel pedagogical model, the Teach-Assess-Teach model (TAT) (Hardman, 2023). As a cultural historical theorist, my pedagogical model is informed by my understanding that pedagogy involves a co-construction of meaning between teacher and taught, where student voices are necessarily incorporated into the process of meaning making through incorporating students' everyday concepts with the abstract concepts they are learning in the academy.

Figure 1: T-A-T model of pedagogy
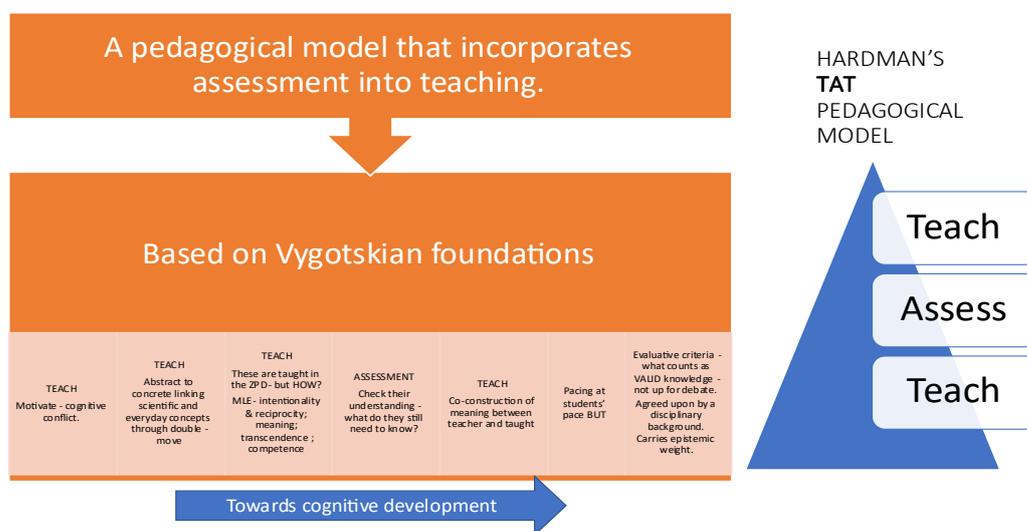
2. *Science teaching/learning and gamification research*

Years of working with pedagogy and technology have now led to my latest funded project: *Science Application for Learning and Teaching (SALT),* which is ongoing and is NRF funded (2022-2025). The SALT project focuses on science teaching at primary school to improve the poor results that children attain in benchmarking international tests for science in my country. Motivation is central to learning and gaming has been shown to motivate children to learn through play. My novel science application for tablets aims to motivate children to engage with science through gaming and is

underpinned by core psychological and pedagogical principles drawn from CHAT that have emerged out of my 22 years working in pedagogy and child development (Hardman, 2020; 2023).