

**RESEARCH TITLE**

# Utilising linkography to understand the cognitive mechanisms of technology learners during the design process

**Name:** *Dr Nicolaas (N.) Blom*  
**Supervisors:** *Professor Ronél (R.) Ferreira*  
*Dr Alfred Edward Jules (A.E.J.) Bogaers*  
*Dr Maria Margaretha Catharina (M.M.C.) (Grietjie) Haupt*  
**Institution:** *University of Pretoria, South Africa*  
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**ABSTRACT**

*The 21st century is marked by an increase in information sources available to designers when solving design problems. Current design thinking procedures and theoretical frameworks do not, however, elucidate how designers rely on a variety of social, conceptual and physical information sources when designing. As such, ongoing research is required to not only understand how designers interact with information sources, but also to find suitable methodologies for investigating such interactions. The purpose of this study was threefold. Theoretically, I aimed to explore and describe how Grade 8 learners' thoughts can develop during the design process as a result of their interactions with social, conceptual and physical structures during a STEM task. Methodologically, I attempted to demonstrate the implementation of linkography as an emerging methodological strategy when studying learners' thought processes. Finally, I developed a model of learners' extended design cognition during the early phases of the design process that may hold practical application value for pre-service and in-service teachers. My study is embedded in Extended Design Cognition and Activity Systems Theory. I implemented a mixed methods design, following a critical realist approach. I conveniently sampled three medium-resourced schools and purposefully selected nine Grade 8 participants. Verbal (spoken and written) and visual (sketches, 3D models and gestures) data were generated and documented by means of Think Aloud Protocol methodology, and analysed quantitatively and qualitatively, utilising linkography. This study makes an ontological contribution in terms of the basic structures, mechanisms and events underpinning learners' design processes. Findings indicate that learners will synthesise their understanding of a design problem and possible solutions by way of incremental forward and backward design moves, while building on their own and one another's thoughts during collaborative designing. Although the participants engaged actively with technological knowledge, they rarely used scientific knowledge. The physical environment however played a vital role in scaffolding and supporting their design processes by means of perception-action cycles.*

**Keywords:** Activity Systems Theory, critical realism, design cognition, Ecological Psychology, extended cognition, linkography, novice designers, STEM education, Technology Education, Think aloud protocol study (TAPS)

The full thesis can be found at <http://hdl.handle.net/2263/71703>