



Assessing Design Thinking in Computing: Towards an Automated Evaluation of Skills

This system is applied in K-12 computing education to assess design-based learning outcomes

Snieguolė Bagočienė

PhD Student in Informatics Engineering, Vilnius University, sniegule.bagociene@mif.stud.vu.lt

INTRODUCTION

In education, assessing Design Thinking (DT) often depends on manual and subjective evaluation of student portfolios and reflections. This method is time-consuming, unreliable, and not scalable for digital or formative assessment (Rauth et al., 2010).

This research introduces a new, scalable model for evaluating DT competences. It draws on informatics engineering by integrating AI and learning analytics into computing education assessment.

PROBLEM STATEMENT

Current K-12 DT assessment is:

- **Labour-intensive & subjective** (e.g., teacher-marked portfolios, open responses)
- **Process-blind** – neglects personal growth
- **Slow feedback** – not real-time

Required: **objective, scalable, dynamic** approach aligned with competency-based education (Rauth et al., 2010; Zhai & Kong, 2022)

STUDY OBJECTIVES & SCOPE

This study proposes a **theoretical model** for an AI-driven assessment platform targeting DT competences:

- Automatically evaluate student artefacts (reflections, images, logs)
- Score **fluency, flexibility, originality, empathy, elaboration**
- Track individual progress over time
- Deliver real-time feedback via **REST/LTI API**

COMPARISON TABLE

	Periodic Assessment	Proposed System
Time	Hours	Instant
Consistency	Teacher-dependent	Algorithmic
Feedback	On-the-spot	Structured, real-time, individualised
Progress tracking	Manual	Continuous
Integration	Offline	LMS-ready API

CONTRIBUTION

This is the **first AI-based assessment system** for Design Thinking competences in the **Lithuanian K-12 context**, leveraging creativity constructs and semantic AI models. This system is currently in development as part of a PhD in computing education and engineering. (Thornhill-Miller et al., 2023)

The figure shows the system workflow from artefact upload to real-time feedback, using NLP, computer vision, and machine learning. The contribution is conceptual at this stage, outlining a proposed model yet to be implemented.



LEARNING ANALYTICS & FEEDBACK

Interactive dashboards support learners and educators by:

- Visualising learner profiles (radar plots)
 - Tracking longitudinal progress
 - Comparing across cohorts/norms
- (Ifenthaler & Yau, 2019; Siemens & Long, 2011)

METHODOLOGY OVERVIEW: AUTOMATED SCORING ENGINE

A modular AI system evaluates design thinking competences from student-generated content in learning platforms. Feature extraction is based on validated creativity models:

- **Fluency, Flexibility, Originality, Elaboration** (Torrance, 1990)
- **Divergence metrics via semantic distance** (Thornhill-Miller et al., 2023)
- **Computational creativity measures** (Olson et al., 2021; Zbainos & Tziona, 2019)

NLP & Vision-based features mapped to psychological creativity constructs (Olson et al. (2021))

ML-BASED SCORING

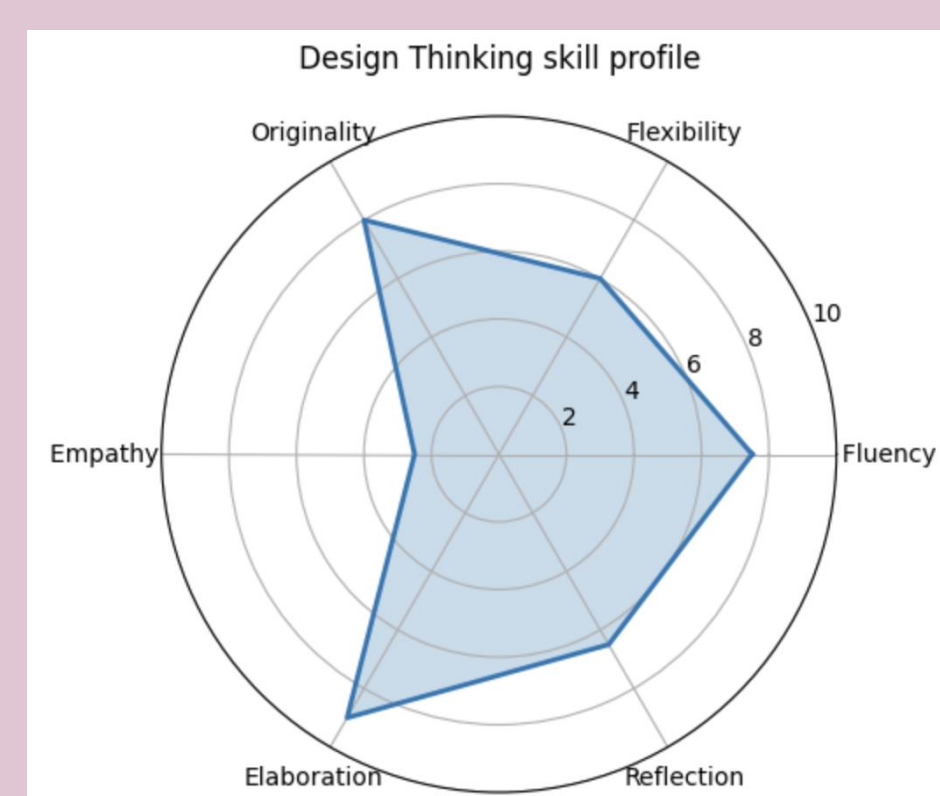
Transformer-based models (e.g., BERT, GPT-4) have demonstrated strong performance in evaluating higher-order thinking skills, such as argumentation, reflection, and reasoning, in student essays and design artefacts (Ludwig et al., 2021; Ormerod et al., 2021; Zhang et al., 2023).

AUTOMATED DT SKILL VISUALISATION

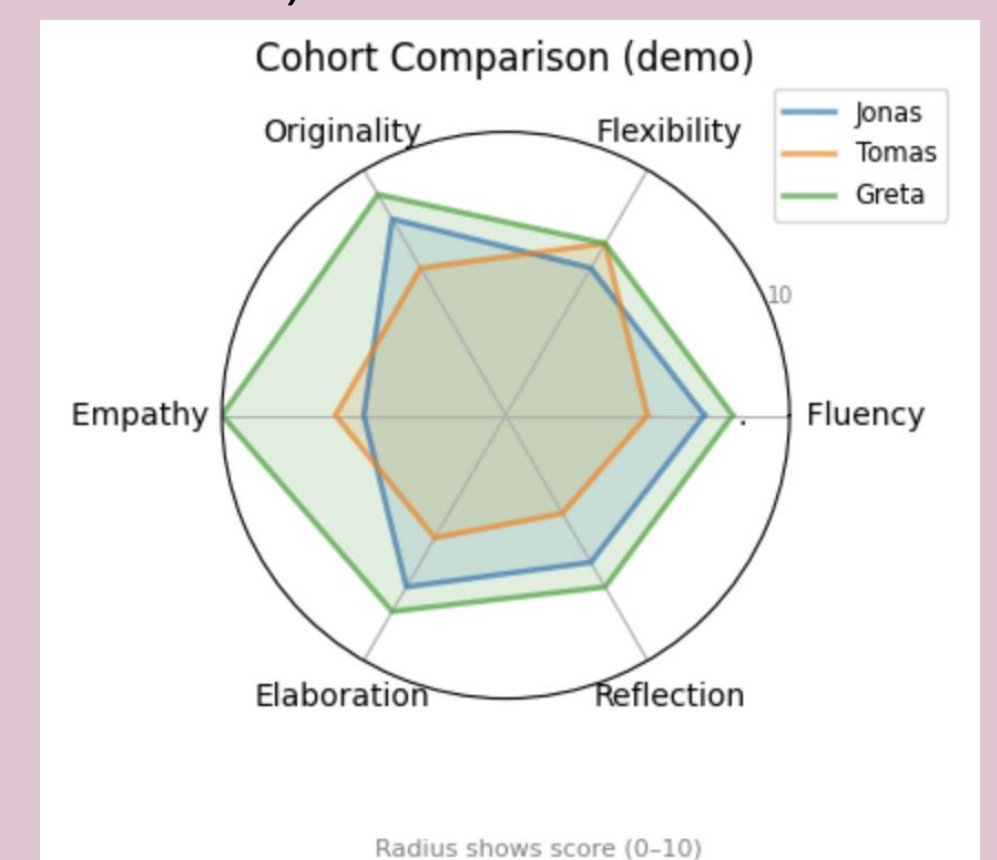
The system also targets the automated evaluation of critical thinking, recognised as a key 21st-century competence. The approach builds on established frameworks and AI-driven assessment methods:

- Standardised measures such as the Watson–Glaser and California Critical Thinking Skills Test (CCTST).
 - Reflection-based scoring from student artefacts (e.g., journals, project logs).
 - Integration of transformer-based scoring models, shown effective in evaluating higher-order reasoning (Ludwig et al., 2021).
 - AI-supported assessment frameworks such as the Critical Thinking Assessment Test (CAT) and AI Assessment Scale (AIAS), enabling flexible, scalable feedback generation.
- This enables a holistic profiling of learners' reasoning and decision-making across creative and analytical tasks.

Individual skill profile (radar)



Cohort comparison (demo: 3 students)



First AI-based engine to auto-score Design Thinking competences in | Lithuanian K-12 context

MULTILINGUAL EXPANSION

The system will support **cross-linguistic scalability** via language-agnostic features (semantic vectors, visual input).

“S-DAT demonstrates valid, scalable assessment across 11 languages” (Haase, Hanel, & Pokutta, 2025)

REFERENCES

