Research Outline: **Optimising STEM Learning Pathways through Explainable AI** (XAI)

Candidate: Nolwazi Trinity Tshawane

Background: M.Sc. Educational Technology (In Progress) | B.Tech. Industrial Engineering (Complete)

1. Research Problem

While Educational Data Mining (EDM) has successfully predicted student failure risks, most models function as "black boxes," offering little actionable insight for educators or students. In STEM education, where logic and process are critical, there is a significant gap in providing explainable feedback that helps students understand why a specific learning path is recommended.

2. Research Objectives

Systemic Optimisation: To apply Industrial Engineering optimisation frameworks to map and refine the "Learning Flow" in digital STEM environments.

Explainable Scaffolding: To implement SHAP (Shapley Additive exPlanations) or similar XAI techniques to decode predictive models of student performance, turning data into pedagogical "scaffolds."

Intervention Framework: To design an automated feedback system that provides personalised, transparent recommendations to novice programmers to reduce cognitive load and attrition.

3. Proposed Methodology

Drawing on my engineering background in Process Modelling, I propose a three-phase approach:

Data Acquisition: Utilising interaction logs from online programming environments (e.g., University of Coimbra’s DEI platforms).

Model Development: Training ensemble machine learning models to identify key behavioural predictors of success.

XAI Implementation: Applying XAI to generate "Global Importance" maps and "Local Explanations" to assist teachers in real-time intervention.