Master Thesis Plan

Identifying Relevant Dimensions of Learning Interactions with AI for 10-13 Year-Olds: A Mixed-Methods Study with Teachers and Students

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1 Context and Rationale

The rapid adoption of generative AI among children and adolescents has created an urgent need to understand how AI-student interactions should be designed for educational settings. While 84% of Swiss 14-19 year-olds report regular AI use (WIP-CH, 2025), and 58% of children aged 9-12 use chatbots (Internet Matters, 2025), these tools were not developed with developmental and pedagogical needs in mind. The risks include cognitive delegation, emotional overreliance, and superficial learning.

This thesis is embedded within a broader collaborative project involving HEP Vaud, AI Swiss, everyone.ai, and the Social Brain Sciences Lab at ETH Zurich. The overarching project aims to develop the **SCAFFOLD framework** (Steered Contextual AI Framework for Orchestrating Learning Dialogue) – a methodology to

steer LLM behavior for safe and pedagogically appropriate AI-student interactions in education. Previous work has focused on adolescents aged 13-15; this thesis extends the investigation to **10-13 year-olds** (Cycle 2 and early Cycle 3 in Switzerland).

The thesis specifically addresses the foundational question: **What are the relevant dimensions of a learning interaction with AI that impact learning outcomes in educational settings?** Before designing effective AI interaction frameworks, we must first understand what interaction elements matter most from both pedagogical and cognitive perspectives.

2 Research Questions

Main Research Question:
What are the relevant dimensions of AI-student learning interactions that impact learning outcomes for 10-13 year-olds in the context of homework support (*devoirs de pratique et d'application*)?

Sub-questions:

1. What dimensions of learning interactions do teachers/educators identify as essential for effective learning with AI support?
2. What learning strategies and interaction elements do 10-13 year-old students perceive as helpful for their learning?
3. How do age differences (10-11 vs. 12-13 years) influence the relative importance of these dimensions?
4. What are the optimal levels of each dimension, and which elements should be avoided according to expert educators?

3 Theoretical Framework

The study draws on multiple theoretical perspectives:

- **Learning Sciences & Pedagogy:** Scaffolding theory (Wood et al., 1976), Zone of Proximal Development (Vygotsky, 1978), self-regulated learning (Zimmerman, 2002)
- **Intrinsic Motivation & Curiosity:** Learning Progress Hypothesis (Oudeyer et al., 2016), which posits that intrinsic motivation is driven by the maximization of learning progress – learners are naturally drawn to activities where they experience optimal improvement, neither too easy nor too difficult
- **Social Learning & Trust:** Affective Social Learning framework (Clément & Dukes, 2019), which emphasizes the role of emotions and social relationships in knowledge acquisition – children learn not just through cognitive processes but through affective engagement with trusted social partners, making the emotional quality of learning interactions critical
- **Cognitive Development:** Developmental stages relevant to 10-13 year-olds, metacognitive development, critical thinking emergence
- **Human-AI Interaction:** Co-thinking framework (Bardyn, 2025), parasocial relationships with AI, cognitive delegation risks (Neugnot-Cerioli & Muss Laurenty, 2024)
- **Educational Technology:** Acceptability-Usability-Utility model (Tricot et al., 2003)

3.1 Proposed Taxonomy of Learning Interaction Dimensions

Category	Dimensions
Cognitive Support	Monitoring understanding, Feedback (types and quality), Descaffolding, Memorization support, Practice/retrieval, Repetition, Variation/multiple perspectives
Affective Support	Engagement, Confidence/emotional aspects, Encouragement
Social & Metacognitive	Social aspects and relevance, Exploration, Consolidation, Metacognition, Learning methods

Category	Dimensions
Evaluation	Verification methods, Judgement/evaluation/comparison
Potential Barriers	Information overload, Time constraints, Unhelpful critique

4 Methodology

4.1 Phase 1: Focus Groups with Teachers/Educators

Participants: 10-20 teachers/educators from Suisse romande working with 10-13 year-olds
Format: 2-3 focus groups (120 minutes each), with 8-10 participants per group
Data collection opportunities:

- Pilot workshop: February 5, 2026 (AI Swiss Conference, Fribourg)
- Two workshops: February 11, 2026 (Journée cantonale éducation numérique vaudoise)
- HEP Vaud course: Spring 2026 (Morgane Chevalier's class, ~10 teachers in training)

Workshop structure with questionnaires:

1. **Pre-workshop questionnaire:** AI knowledge and current use, mood and engagement baseline
2. **Activity 1 - Defining optimal homework support:** Individual reflection followed by structured group discussion
3. **Activity 2 - How AI can help:** Guided reflection and structured questions on AI's role in learning support
4. **Post-workshop questionnaire:** Feedback on workshop, learnings, intention to use AI, confidence in project outcomes

Objectives:

- Validate and refine the proposed taxonomy of learning interaction dimensions
- Identify which dimensions are most critical for homework support (devoirs de pratique et d'application)
- Explore what AI behaviors should be avoided
- Discuss developmental differences between 10-11 and 12-13 year-olds

Recording: Audio recording of workshops with AI-assisted transcription and analysis

4.2 Phase 2: Focus Groups with Students

Participants: 24-36 students aged 10-13, divided into two age groups (10-11 and 12-13)
Format: Short focus groups (~15 minutes) in groups of 3-4 students
Objectives: - Explore students' learning strategies and what helps them learn - Understand their perceptions of helpful/unhelpful support during homework - Identify age-related differences in learning preferences

4.3 Phase 3: Survey with Teachers

Participants: Broader sample of teachers and educators (target: 50-100)
Format: Online questionnaire
Content:

- For each validated dimension: rate optimal levels for homework support context
- Identify what should be avoided at each dimension
- Context-specific framing: "devoirs de pratique et d'application"

4.4 Data Analysis

- **Qualitative analysis:** Thematic analysis of focus group transcriptions

- **Quantitative analysis:** Descriptive statistics and comparative analysis (age groups) of survey responses
- **Integration:** Mixed-methods synthesis to produce a validated taxonomy with recommended levels

5 Expected Contributions

1. **Validated Taxonomy:** A refined taxonomy of learning interaction dimensions relevant to AI-student interactions for 10-13 year-olds
2. **Developmental Insights:** Understanding of how age influences the importance of different interaction dimensions
3. **Design Guidelines:** Practical recommendations for optimal levels of each dimension in homework support contexts
4. **Foundation for SCAFFOLD:** Empirical grounding for the parametrization of AI interaction frameworks developed by the collaborative project

6 Timeline

Phase	Activities	Timeline
0	Cantonal access request (Vaud, Neuchâtel)	February 1, 2026
1	Literature review, taxonomy refinement, ethics approval	January-February 2026
2a	Pilot workshop (AI Swiss Conference, Fribourg)	February 5, 2026
2b	Teacher workshops (Journée cantonale vaudoise)	February 11, 2026
2c	HEP Vaud course workshops	Spring 2026
3	Focus groups with students (Phase 2)	March-April 2026
4	Survey development and distribution (Phase 3)	April-May 2026
5	Data analysis and synthesis	May-June 2026
6	Writing and revision	June-August 2026

7 Ethical Considerations

- **Cantonal access requests (*demande d'accès au terrain*):** Canton de Vaud (to be submitted by February 1, 2026), Canton de Neuchâtel (pending)
- Ethics approval from the University of Neuchâtel and relevant cantonal authorities
- Informed consent from teachers, students, and parents/guardians
- Data anonymization and secure storage in compliance with Swiss data protection regulations
- Special attention to working with minors: age-appropriate consent processes, right to withdraw

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