



Agent for Agency: Developing an AI Agent System to Support Student Agency in Generative AI-Integrated Data Analysis



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Introduction

Background

- **Student agency:** students capacity to actively shape their learning, make responsible decisions, and direct their educational trajectories
- Generative AI can both enhance and diminish student agency; **self-regulation** as a key mediating factor (Darvishi et al., 2024)
- SRL: focuses on internal cognitive & motivational strategies vs. **Agency:** broader construct including social & contextual conditions for enabling autonomy (Martin, 2004)
- **Gap:** need for an approach addressing both personal and environmental dimensions of agency in GenAI-integrated learning contexts

Purpose of study

- Grounded in **Bandura's (2001) social cognitive theory:** human functioning as reciprocal interaction of **personal × environmental × behavioral factors**
- Fostering agency through curriculum for **risk-taking, experimentation, and self-directed exploration** with guidance (Martin, 2004)
=> **Learning context:** student-driven data analysis project (select datasets → analyze them → derive insights)
- **Dual-agent system** designed to operationalize these dimensions:
=> **SRL Support Agent:** personal factors (task-dependent scaffolding)
Data Analysis Agent: environmental factors (structured task environ.)
- **Aim:** draw design implications for GenAI-integrated learning environments that foster student agency

Research Questions

- 1) How can an AI agent system be designed to support student agency in GenAI-integrated learning contexts?
- 2) How do learners perceive the system's support for their agency in terms of usability and educational effectiveness?

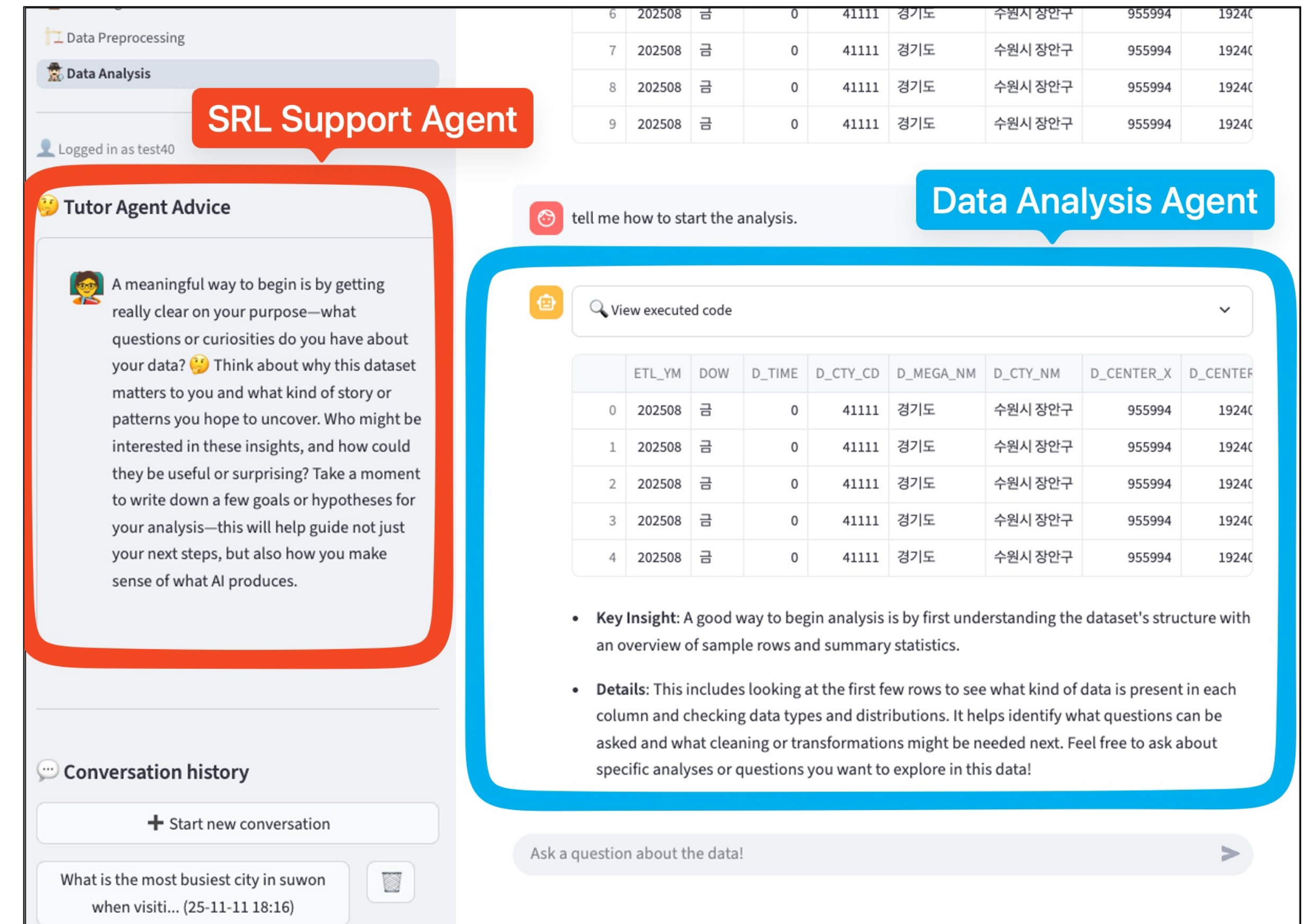
Methods

- **Research Design:**
 - **Design-based research (DBR);** this poster reports on the first of two iterative cycles
 - Cycle 1: Session 1 (2h) → Session 2 (2h) → Data Collection
- **Participants:** 15 high school students (ages 16–17); limited data analysis experience & no prior use of GenAI for analytical tasks
- **Data Collection:**
 - Usability evaluation & Perceived effectiveness: selected items from SLA-GAI (Xia et al., 2025) — competence, agentic action, psychological dimensions
 - Semi-structured focus group interviews & System interaction logs
- **Data Analysis:**
 - Quantitative: descriptive statistics, interaction patterns
 - Qualitative: thematic analysis of interview transcripts

Results

RQ1 — Dual LLM-based AI agents System

- **1. SRL Support Agent** (side-bar) ← Bandura's **personal** factors
 - MAPS model (Frazier et al., 2021): **Agency and Metacognition** as reciprocal components in goal-directed behavior
 - **Metacognitive:** Plan, Execute(Prompt Literacy, Responsibility), Reflect
 - **Affective:** Self-Efficacy, Intrinsic Motivation
 - Emphasis on **Prompt Literacy** and **Learning Responsibility** as key competencies for GenAI-integrated learning (Lee et al., 2024)
 - **Dialogue Management System (DMS)** architecture: Intent Assessor → TutorAct Selector → Prompt Generator → Tutor Utterance



[Fig. 1] User Interface of the Dual LLM-based agent system

- **2. Data Analysis Agent** (main-page) ← Bandura's **environmental** factors
 - **Planning:** **execute only user-requested analyses** (strong constraint via system prompt) → maximizes **student autonomy**
 - **Tool-use:** PythonAstREPLTool — writes and executes Python code for data manipulation, visualization, and analysis
 - **Memory:** contextualized responses maintained throughout the analysis
 - **Output:** executable **Python code** with **summaries of key insights** (Fig. 1)

RQ2 — Learner Perceptions of Agency Support

- **1. Survey Results** (N=15)
 - **Usability evaluation** (overall $M=4.25$, $SD=.82$)
 - High: **Favorability** ($M=4.62$) | Low: **Ease of use** ($M=4.00$)
 - **Perceived effectiveness** (SLA-GAI selected items; Xia et al., 2025)
 - High: **Self-Motivation** ($M=4.40$, $SD=.97$), **Self-Efficacy** ($M=4.20$, $SD=.69$), **Learning Responsibility** ($M=4.17$, $SD=.83$)
 - Low: **Metacognitive Planning** ($M=3.67$), **Prompt Literacy** ($M=3.73$)
- **2. Interview Insights** (semi-structured FGI; n=6)
 - (+) request-only design of **Data Analysis Agent** -> supported sense of autonomy and ownership
 - (+) non-directive guidance of **SRL Support Agent** -> encouraged metacognitive engagement
 - (-) structured learning phases to guide the overall analysis process

Discussion

- **Cycle 1 Insights**
 - Dual-agent system → positive overall response, but gap between **affective engagement (high)** and **metacognitive development (low)**
 - **"Intentionally doing less" design:** Data Analysis Agent's request-only design → effectively supported learner autonomy
 - **"Structured guidance" design:** SRL Support Agent's non-directive scaffolding alone → insufficient for systematic analytical thinking
- **Cycle 2 Refinements**
 - Data Analysis Agent → **AI-suggested, user-confirmed prompts via prompt generator API tool-calling:** enhancing learner controllability
 - SRL Support Agent → **Three-phase workflow (Planning → Execution → Reflection):** explicit structure for analytical process

References

- Bandura, A. (2001). Social cognitive theory: An agentic perspective. *Annual review of psychology*, 52(1), 1-26.
- Darvishi, A., Khosravi, H., Sadiq, S., Gašević, D., & Siemens, G. (2024). Impact of AI assistance on student agency. *Computers & Education*, 210, 104967.
- Frazier, L. D., Schwartz, B. L., & Metcalfe, J. (2021). The MAPS model of self-regulation: Integrating metacognition, agency, and possible selves. *Metacognition and Learning*, 16(2), 297-318.
- Lee, M., Yi, T., Der-Thang, C., Song, H., & David, H. (2024). Exploring interactions between learners and ChatGPT from a learner agency perspective: A multiple case study on historical inquiry. *Education and Information Technologies*, 30(6), 7167-7189.
- Martin, J. (2004). Self-regulated learning, social cognitive theory, and agency. *Educational psychologist*, 39(2), 135-145.
- Xia, L., Shen, K., Sun, H., An, X., & Dong, Y. (2025). Developing and validating the student learning agency scale in generative artificial intelligence (AI)-supported contexts (SLA-GAI). *Education and Information Technologies*, 30(10), 13999-14021.

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