

STUDENT-TEACHER AUGMENTED RESPONSE (STAR):
A MULTI-AGENT COLLABORATIVE SYSTEM FOR SELF-DIRECTED
LEARNING IN NONTRADITIONAL EDUCATION SETTINGS

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INTRODUCTION

- Advancement in technology -> Integrating technology into classrooms
- However, there is limited research on supporting outside-classroom learning settings, such as online learning or self-directed learning
- Importance: help alleviate educational inequality
- Therefore, I
 - Run interviews to explore the limitations of current technology in supporting outside-classroom learning (Study 1)
 - Designed a Chatbot STAR that addresses those limitations (Study 2)
- Results show that STAR alleviates some of the limitations by
 - Reducing the time needed for learners to obtain a satisfactory response from ChatGPT
 - Helping students express their thoughts

BACKGROUND

TRADITIONAL V.S. NONTRADITIONAL EDUCATION SETTINGS

- Learning in Traditional Education Settings:
 - Happens in the classroom
 - Have human teachers
 - Follows a formal syllabus (issued by the Department of Education, etc.)
- Learning in Nontraditional Education Settings:
 - Any instance of **learning outside the classroom**, such as
 - Using YouTube to watch open courses, reading books, company training, museum tours, etc.
 - Has flexible learning content (i.e., learners can explore their area of interest, not following a formal syllabus)

IMPORTANCE OF NONTRADITIONAL EDUCATION SETTING

- Enhance **accessibility** of educational resources for nontraditional learners (e.g., adult learners, part-time students, underprivileged students, etc.)
- Self-directed, control their own pace -> helps adult learners **balance work & study**
- Flexible content -> increase **learning motivation**

CURRENT APPLICATION OF CHATGPT IN...

– TRADITIONAL EDUCATION SETTINGS

- For teachers:
 - Autograde assessments
 - Generate course material
- For students:
 - Language learning:
 - Acts as a conversation partner
 - Provide evaluative comments on students' writing
 - Non-language learning:
 - Acts as a virtual tutor
 - Generate sample responses to exam questions

CURRENT APPLICATION OF CHATGPT IN...

- NONTRADITIONAL EDUCATION SETTINGS

- Subject-specific AI Tutors leveraging techniques like
 - Chain of thought and buffer of thought
 - Post-generation self-check
 - External code databases

STUDY 1: INTERVIEW

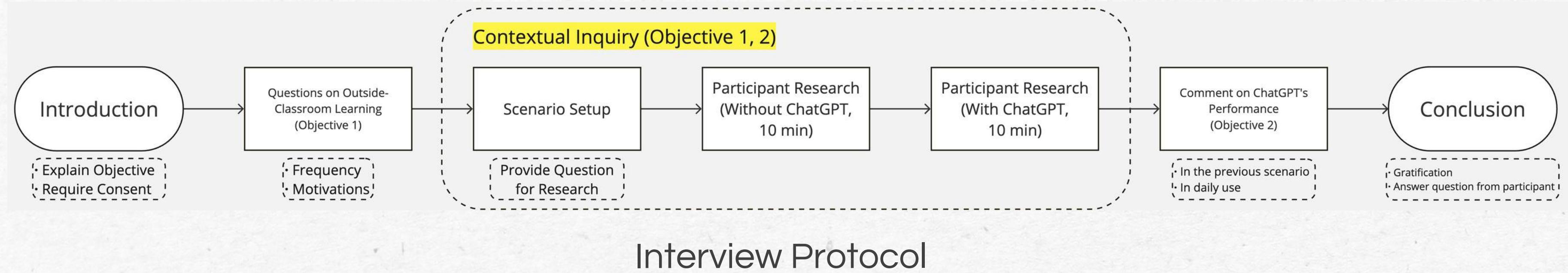
RESEARCH QUESTION:

**WHAT ARE THE LIMITATIONS OF CURRENT TECHNOLOGIES IN
SUPPORTING STUDENT LEARNING IN NONTRADITIONAL
EDUCATION SETTINGS?**

METHODOLOGY

Data Collection: Interview and Contextual Inquiry

Data Analysis: Interpretation Session and Affinity Diagramming



SHINING POINT: \CONTEXTUAL INQUIRY

AFFINITY DIAGRAMMING

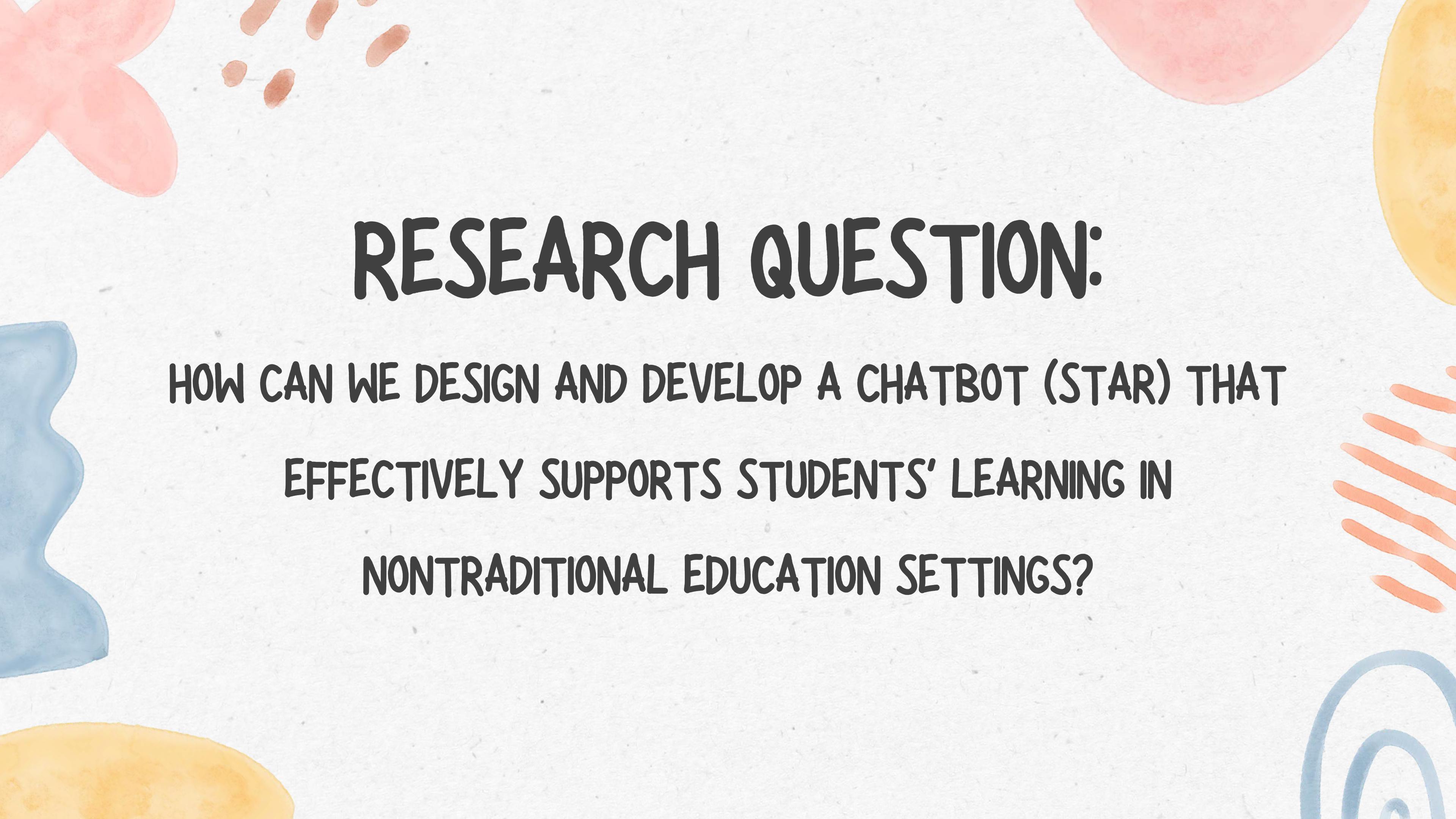
- 165 First Level Insights
- 38 Second Level Insights
- 6 Third Level Insights

RESULTS

CURRENT TECHNOLOGY (ESPECIALLY CHATGPT)'S LIMITATIONS IN SELF-DIRECTED LEARNING

- Technological Factors:
 - ChatGPT's response lacks depth
 - Time inefficient
 - ChatGPT has a short memory
- Human Factors:
 - Lack of patience for ChatGPT
 - Lack of self-understanding (i.e., can't identify gaps in their own knowledge and learn accordingly)
 - Cannot express one's thought clearly and accurately

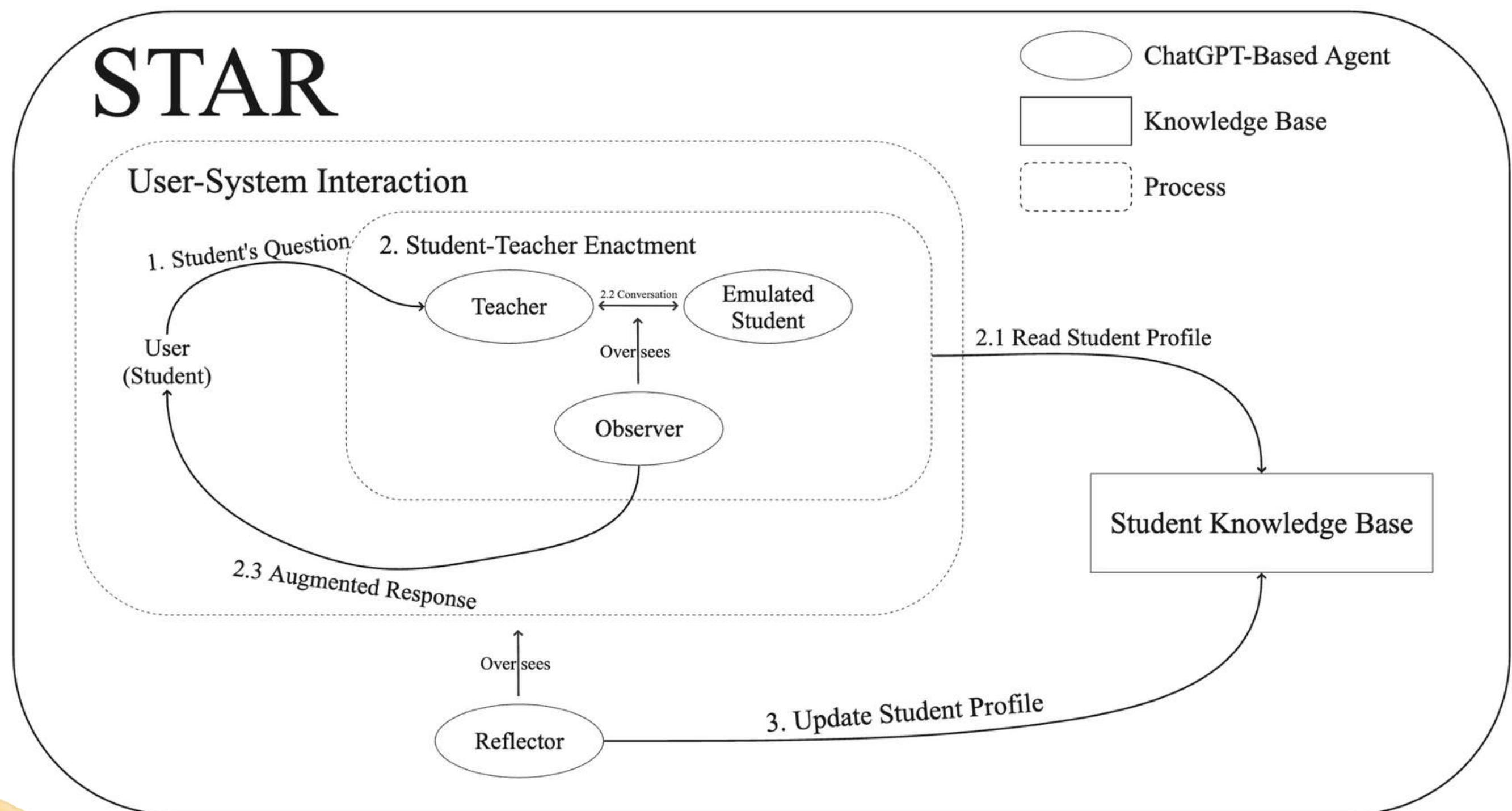
STUDY 2: DESIGNING A CHATBOT

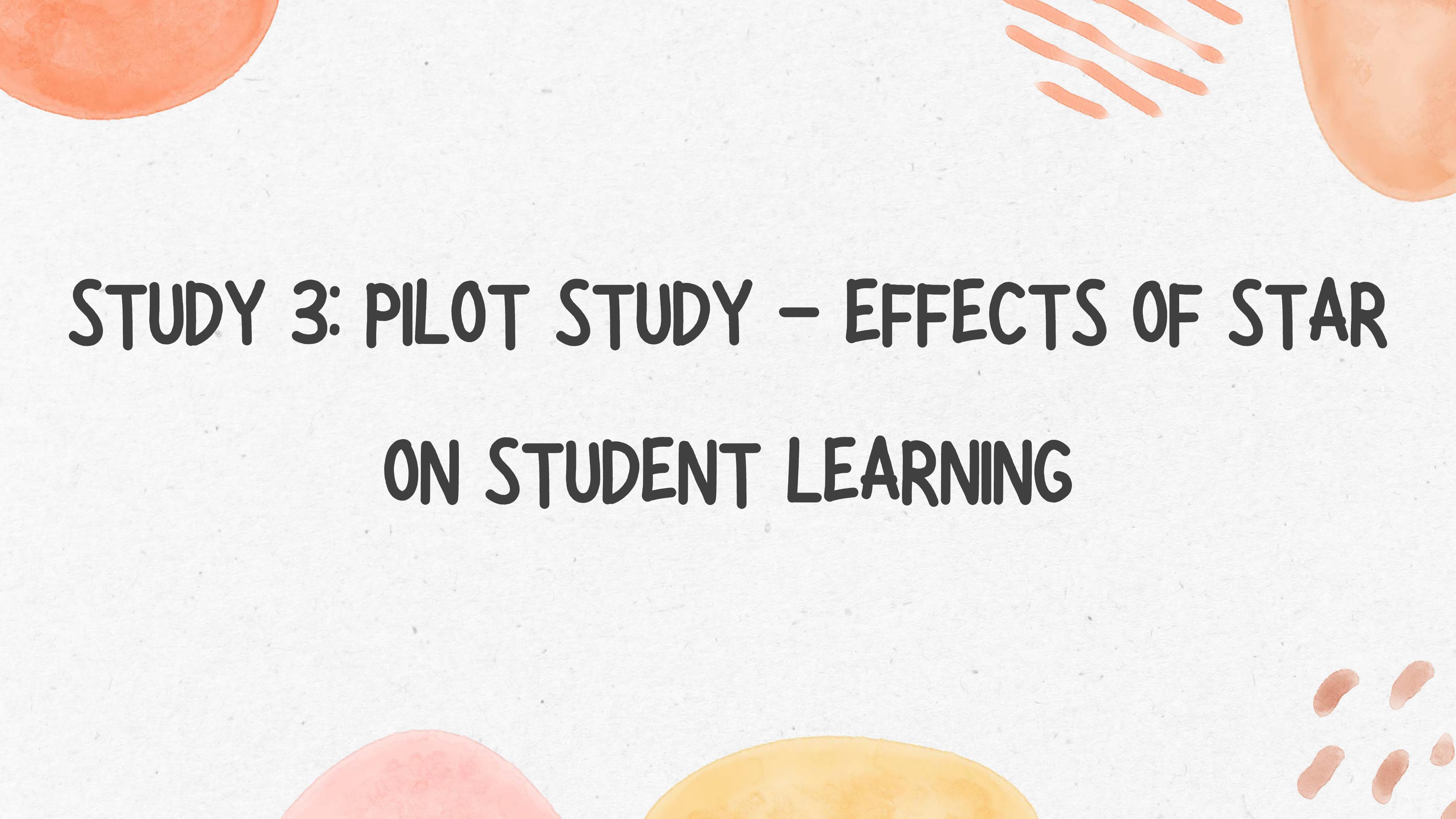


RESEARCH QUESTION:

**HOW CAN WE DESIGN AND DEVELOP A CHATBOT (STAR) THAT
EFFECTIVELY SUPPORTS STUDENTS' LEARNING IN
NONTRADITIONAL EDUCATION SETTINGS?**

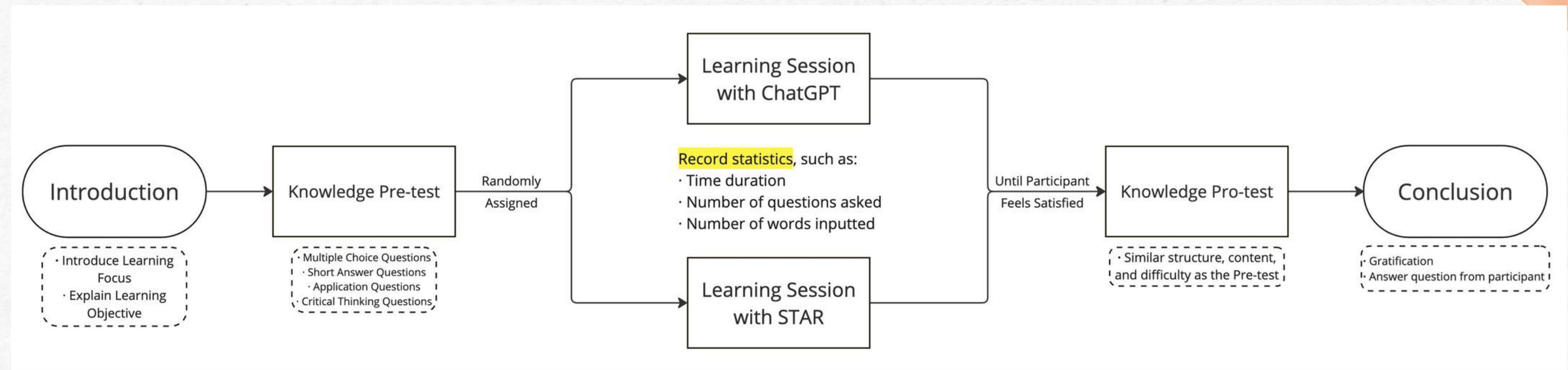
DESIGNING STAR





STUDY 3: PILOT STUDY – EFFECTS OF STAR ON STUDENT LEARNING

EXPERIMENT DESIGN



Learning focuses are purposely selected from **a wide range of subjects**.

- 6 Learning focuses with their relevant learning objectives and knowledge tests
- 4 participants, each assigned three learning focuses
- A total of 12 learning sessions, 6 with ChatGPT and 6 with STAR

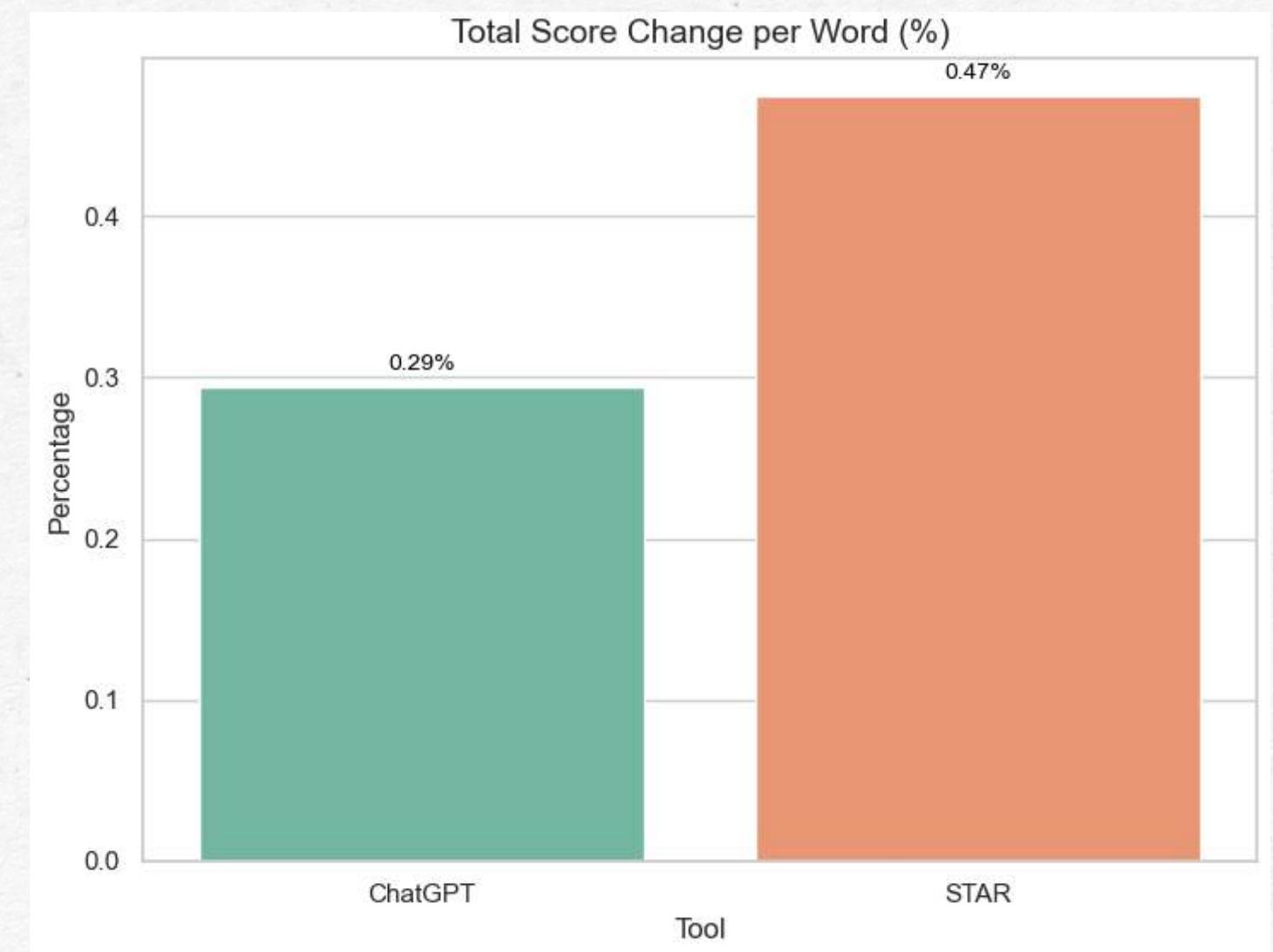
Sample Learning Focus & Objective:

- Learning Focus: Lacan's "Mirror Stage" (Psychology & Philosophy)
- Learning Objectives:
 - Understand the concept of Lacan's Mirror Stage in psychoanalytic theory.
 - Identify the significance of the Mirror Stage in the development of the self.
 - Explain the implications of the Mirror Stage for identity formation and psychological development.

RESULTS



Percentage change in pre- and post-test mark for the **critical thinking question**



Percentage change in pre- and post-test **total score per inputted word**

LIMITATIONS & FUTURE STEPS

LIMITATIONS – SYSTEM DESIGN

- Multiple rounds of Student-Teacher Enactment may distract the Observer Agent
- Cold-start problem: hard to construct student profiles for new users
- Limited impact on Math learning and queries on calculation questions
- Quality-Cost Tradeoff: computing a multi-agent workflow instead of consulting a single LLM is more expensive and computationally intensive

LIMITATIONS – METHODOLOGY DESIGN

- Participant: **not representative** of the whole learner population, which includes adult learners, part-time students, adolescents, etc.
- Interview & Affinity Diagramming:
 - User's behavior during contextual inquiry may **differ from its behavior** in real-life
 - Grouping insights is **subjective**
- Pilot Study:
 - **Metric used:** different participants may have different conversation styles, which may affect data interpretation
 - Learning focuses: **different levels of difficulty** may skew the data collected
 - **Application scope:** 6 learning focuses may not be representative of STAR's effect on learning process in nontraditional education settings

THANKS!!!