Artificial Intelligence in the Education Sector

YYGS IST III Computer Science Capstone

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Research Question:

To what extent can a proposed AI-powered system, designed to help students learn based on their individual needs using the four primary learning styles, improve their exam scores?

Hypothesis:

If high school students use the proposed AI-powered system, then students' average exam scores will increase because the system would integrate the four primary learning styles and identify knowledge gaps.

Flaws in Current Education System

Focuses on One-Size-Fits-All Approach

- Assumes that all students learn in the same way
- Not all students learn effectively with traditional lecture-style classes
- Not interactive
- Not based on educational psychology (4 different learning styles)

Limited Resources

- Inadequate Feedback
  - Grades and test scores do not provide constructive feedback to students
- Teachers lack time and resources to meet individual student needs
  - Outside tutors are expensive

Types of Learning

Types of Learning

Visual

Auditory

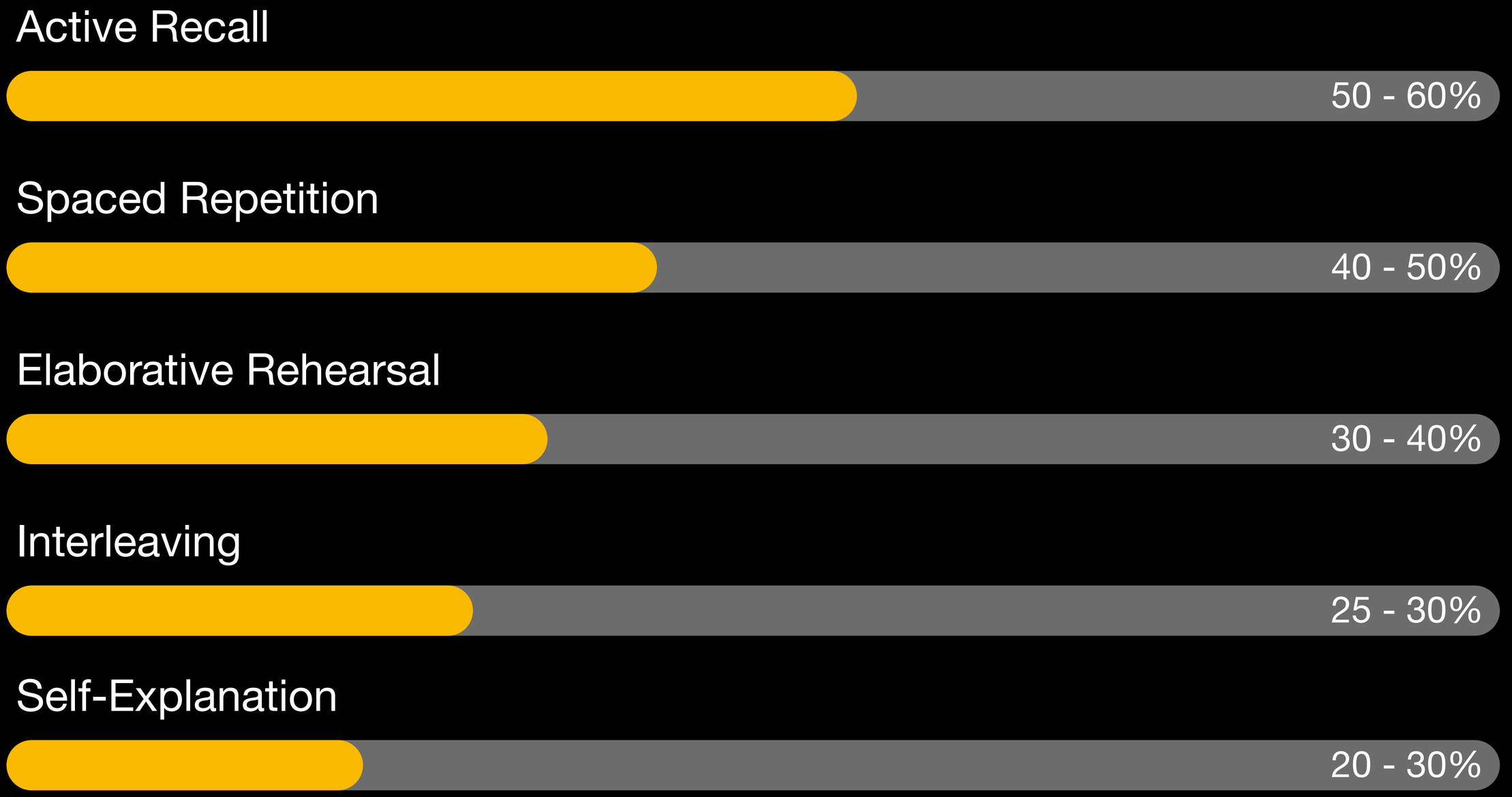
Tactile

Writing

What are?

Evidence Based Learning Strategies

Evidence Based Learning Strategies



Current AI Tools

Evidence Based Learning Strategies

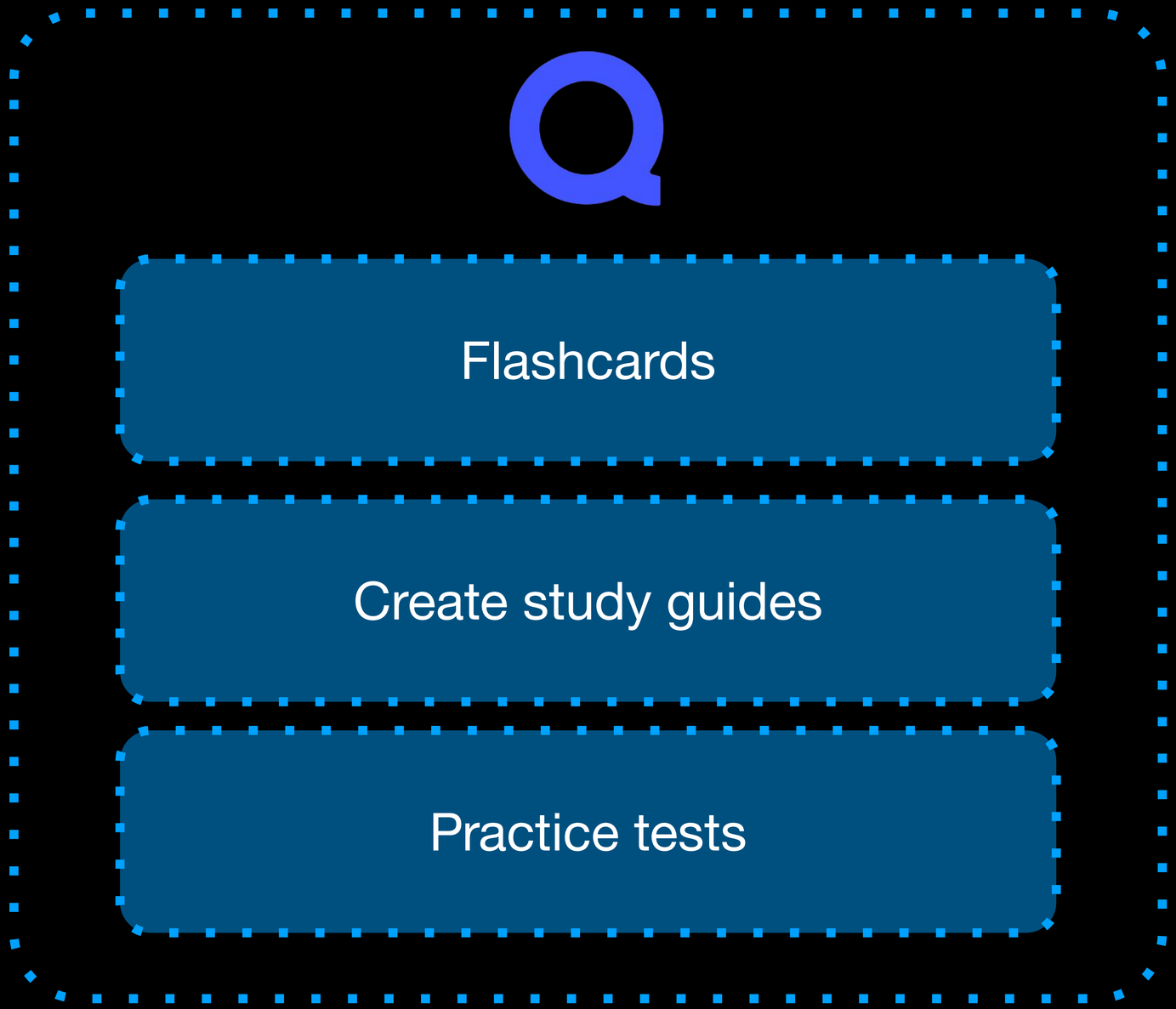
Active Recall

Spaced Repetition

Elaborative Rehearsal

Interleaving

Self-Explanation



Evidence Based Learning Strategies

Active Recall

Spaced Repetition

Elaborative Rehearsal

Interleaving

Self-Explanation

Real-time language translation

Adaptive language learning exercises

Assist with language barriers

Evidence Based Learning Strategies

Active Recall

Spaced Repetition

Elaborative Rehearsal

Interleaving

Self-Explanation

Customizable content

Active engagement

Rich media integration

Evidence Based Learning Strategies

Active Recall

Spaced Repetition

Elaborative Rehearsal

Interleaving

Self-Explanation

Resource diversity

Problem-solving for all subjects

Self-placed learning

Evidence Based Learning Strategies

Active Recall

Spaced Repetition

Elaborative Rehearsal

Interleaving

Self-Explanation

Conversation with AI

Personalized feedback and clarification

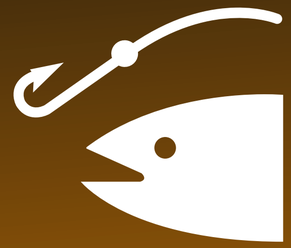
Guide student through the process

Student Psychology and Memory

Student Psychology and Memory

Encoding

Storage



Retrieval

Types of Memory

Sensory memory

Short-Term Memory

Long-Term Memory

Types of Memory

Sensory memory

Dual Coding

15-25% increase

Short-Term Memory

Long-Term Memory

Types of Memory

Sensory memory

Dual Coding

15-25% increase

Short-Term Memory

Elaborative Rehearsal

30-40% increase

Interleaving

25-35% increase

Long-Term Memory

Types of Memory

Sensory memory

- **Dual Coding**
  15-25% increase

Short-Term Memory

- **Elaborative Rehearsal**
  30-40% increase
- **Interleaving**
  25-35% increase

Long-Term Memory

- **Active Recall**
  50-60% increase
- **Spaced Repetition**
  40-50% increase
- **Self-Explanation**
  20-30% increase

How do we know this this model is feasible?

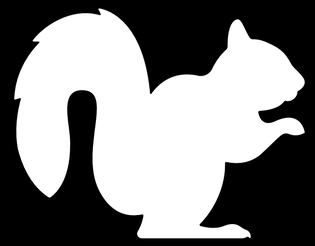
Current Implementation and Experimentation: **Squirrel AI** in China

- Founders: Derek Haoyang Li and Dr. Joleen Liang
- Chief Scientist: Dr. Qinsong Wen
- Rather than use teachers to tailor tutoring to students learning types, China is utilizing AI.
- Squirrel AI is meant to find students' specific gaps in knowledge and target those efficiently.
- Currently reaching more than 24 million students.

Squirrel Ai Learning

What Next?

- While Squirrel AI is making progress in the right direction, it has not accomplished the full potential of personalized learning through AI technology.
- “We need students to understand their own learning. We need them to determine what they want to learn, and we need them to learn. Squirrel AI doesn’t address those things at all. It only makes it more efficient to bring all of the students to the same standardized place.” -Professor Jutta Treviranus
- Squirrel AI implements techniques such as:
    - Establishing personal profiles and milestones for learners
    - Adapting to learners’ strengths and weaknesses
- We plan to personalized tutoring step further with new, proposed AI technology.



Our Proposed AI-Powered Learning System

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- Active Recall
- Spaced Repetition
- Elaborative Rehearsal
- Interleaving
- Self-Explanation

Our Proposed AI-Powered Learning System

Active Recall — Practice Quizzes, Memory Games

Spaced Repetition

Elaborative Rehearsal

Interleaving

Self-Explanation

Our Proposed AI-Powered Learning System

Active Recall	Practice Quizzes, Memory Games
Spaced Repetition	Review Scheduler, Adaptive Flashcards
Elaborative Rehearsal	
Interleaving	
Self-Explanation	

Our Proposed AI-Powered Learning System

Active Recall	Practice Quizzes, Memory Games
Spaced Repetition	Review Scheduler, Adaptive Flashcards
Elaborative Rehearsal	Concept Mapping, Discussion Forums
Interleaving	
Self-Explanation	

Our Proposed AI-Powered Learning System

Active Recall	Practice Quizzes, Memory Games
Spaced Repetition	Review Scheduler, Adaptive Flashcards
Elaborative Rehearsal	Concept Mapping, Discussion Forums
Interleaving	Mixed Practice Sets, Adaptive Problem Sets
Self-Explanation	

Our Proposed AI-Powered Learning System

Active Recall	Practice Quizzes, Memory Games
Spaced Repetition	Review Scheduler, Adaptive Flashcards
Elaborative Rehearsal	Concept Mapping, Discussion Forums
Interleaving	Mixed Practice Sets, Adaptive Problem Sets
Self-Explanation	Reflection Journals

Develop a Course that is Tailored for YOU

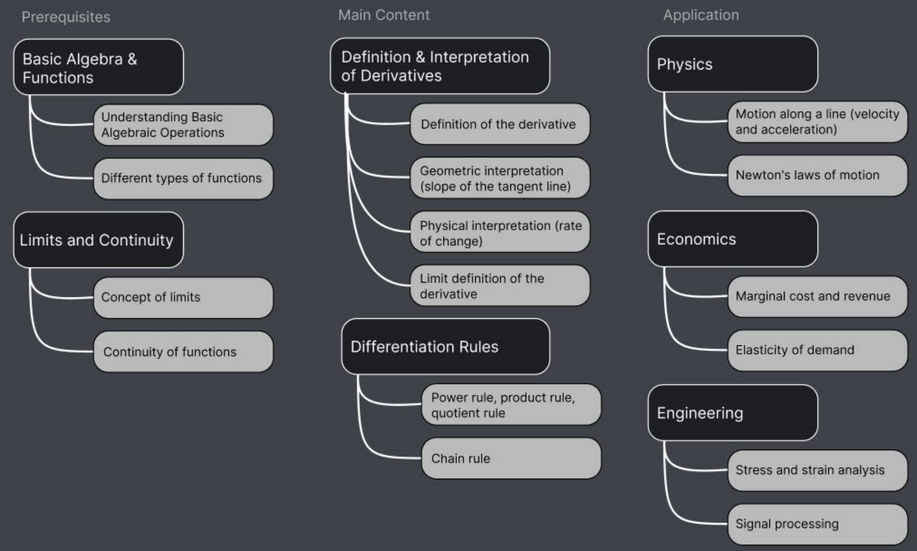
Choose a topic to learn about

Let's gauge your depth of understanding

How well do you understand the properties and operations of polynomial functions?

- Not at all
- Basic understanding
- Good understanding
- Excellent understanding

Build a Concept Graph



Add Resources to the Mix

Add Resource

Calculus 1 - Derivatives
Organic Chemistry Tutor

Create Course

Experiment Methodology

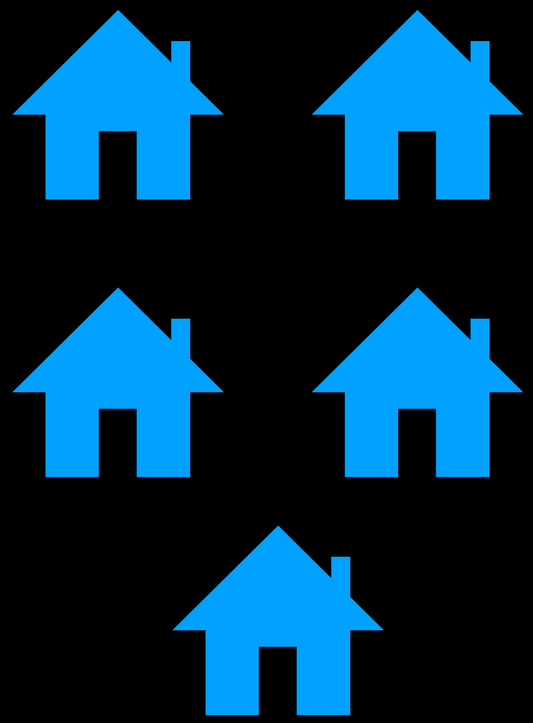
Materials

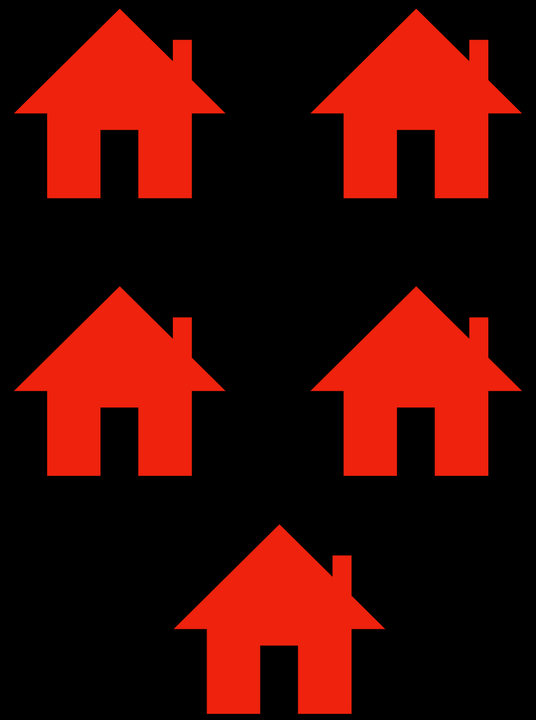
- **New Jersey Graduation Proficiency Assessment (NJGPA)**
  - Required for graduation in high schools in NJ
  - Tests students on grade 10 ELA, algebra 1, and geometry
  - Consists of both multiple choice and open-ended questions
- **Proposed AI-model**
  - Used by research subjects to prepare for NJGPA

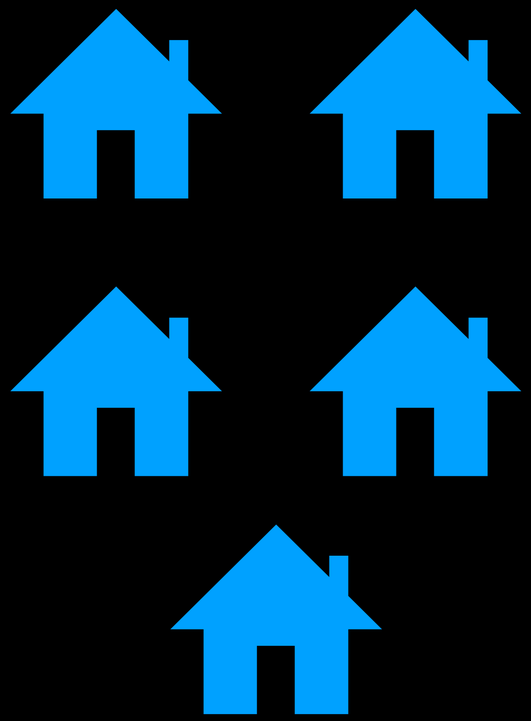
Experimental Procedure

- **Research Subjects**
  - High school students in 10 towns in NJ
  - Control Group
    - Students in five of the towns will not be given access to our study tool
  - Experimental group
    - Students in the other five towns will use our study tool to prepare for the NJGPA
- **Data Collection**
  - Collect results of NJGPA scores taken by each group

Data Analysis



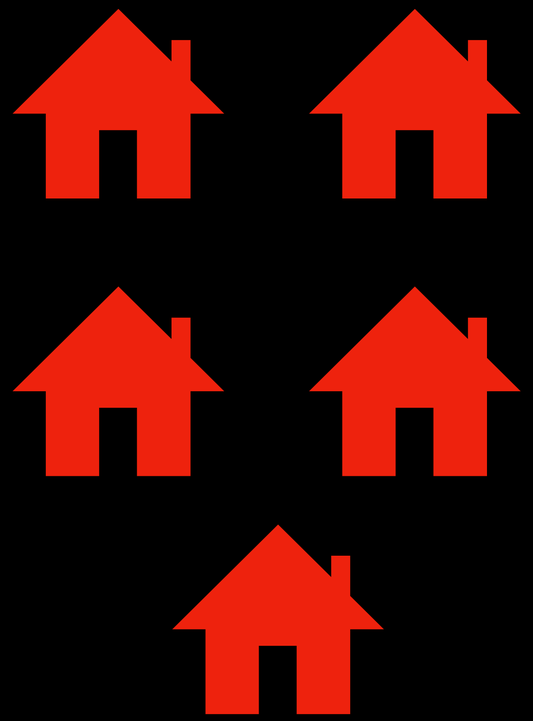


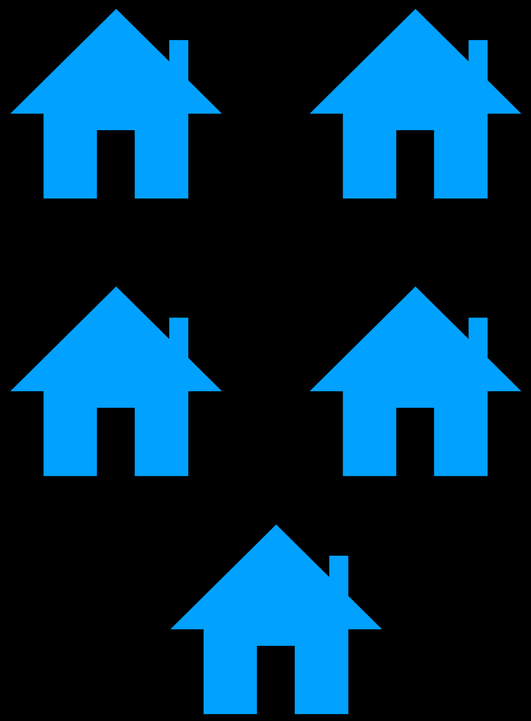


Error in the Control

- Should have remained stable with no access to the AI model

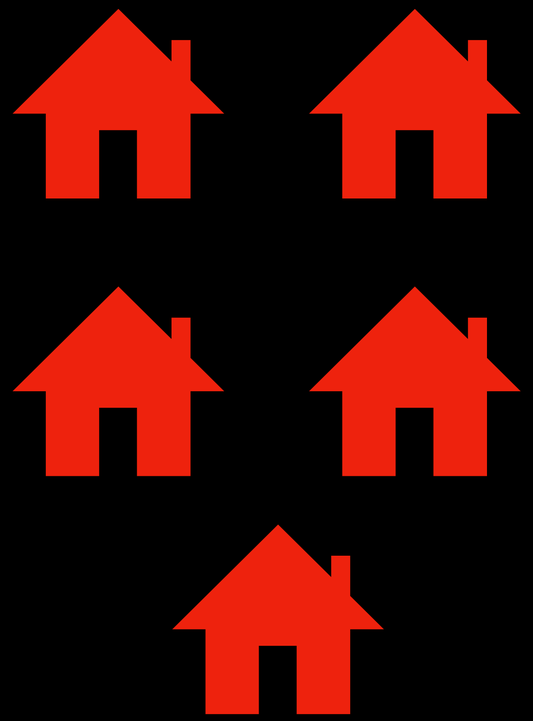
- Cannot accurately support hypothesis because there must be experimental or design error

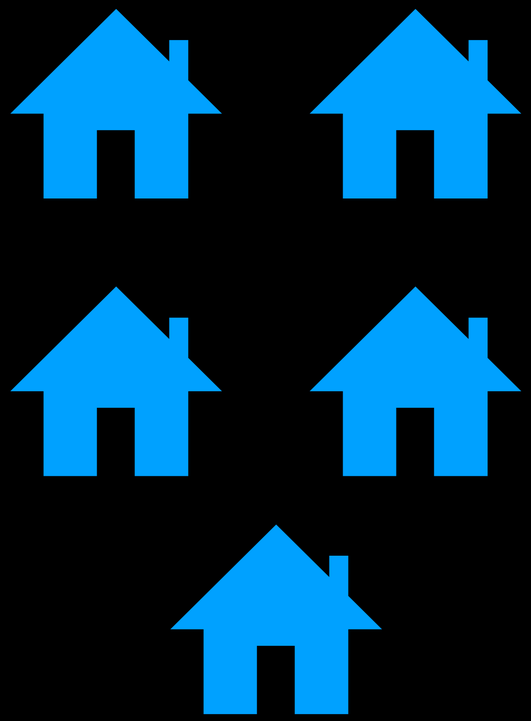




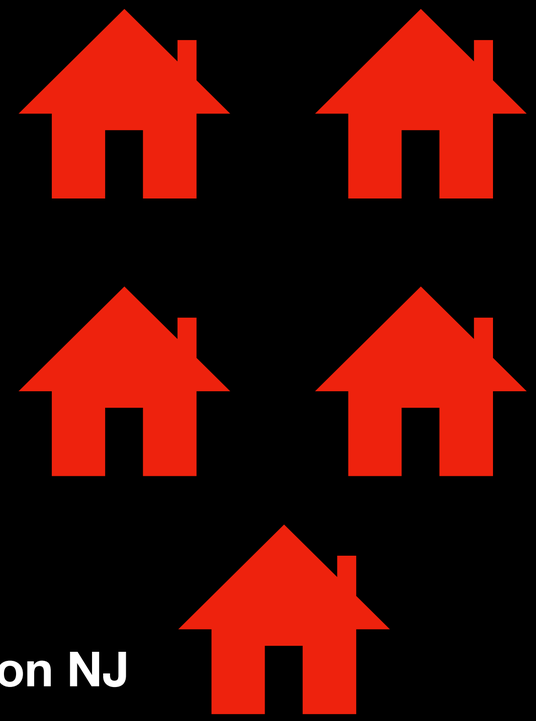
Average Decrease

- Does not support hypothesis, as it demonstrates the AI model NOT improving test scores
- Model would need redesign or improvement





Average Increase



- Supports hypothesis!
- Demonstrates the AI model having positive benefit on NJ students and helping them pass exam
- Shows one successful model that could still have improvements

Conclusion

High school students who used the proposed AI-powered system demonstrated an increase in their average exam scores. This improvement is attributed to the system's ability to effectively integrate the four primary learning styles and identify knowledge gaps.

Sources