



# Proactive AI Chatbot Intervention Strategies for Enhancing Learning Experience

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## Problem

A **Proactive System** is one that first identifies the user's state and environment, and then actively finds, suggests, and informs the user of what is needed. **The proactivity of AI systems can change the overall user experience** by encouraging positive behaviors, helping users remember important information, and providing timely recommendations. While various domains have successfully harnessed this proactivity for positive effects, **there is a lack of research on the impact of proactive AI tutor interventions in the educational domain.**

Therefore, as AI chatbots become increasingly prevalent in E-learning frameworks, the impact of AI tutor proactivity on enhancing students' learning experiences should be explored.

## Related Work / Motivation

### ❖ Three Branches of Proactive AI System Research

First, what type of intervention should be made? Second, what timing is appropriate for the intervention? Third, what level of intervention is optimal?

### ❖ Commonly Used Intervention Types

Intervention levels are typically divided into four stages. Studies in other domain show users benefit most from proactive interventions when they can reject or ignore them, maintaining control.

### ❖ Appropriate Intervention Strategies in the Educational Domain

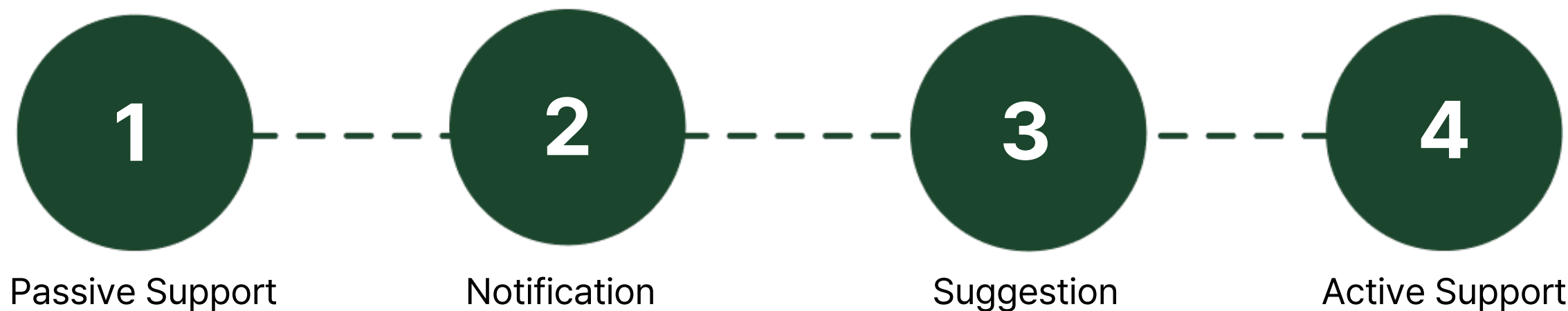
Everyday interventions like recommendations differ from educational contexts. In daily life, preferences and utility matter, while education requires considering immersion, understanding, satisfaction, and performance.

### ❖ Research Purpose

This study evaluates four levels of intervention in an E-learning environment to analyze which strategies have the most positive impact on the overall learning experience.

## Our Approach

### Intervention Strategies



Group	GPT Prompt Example
Passive Support (PS)	"You must not intervene until the student asks a question first."
Notification (N)	"Inform the student that the keyword \${keyword1} is important for the objective \${objective1} in the current video lecture."
Suggestion (S)	"Inform the student that the keyword \${keyword1} is important for the objective \${objective1} in the current video lecture, and ask if they would like to try solving additional educational materials you can provide. If they agree, create a related quiz for them."
Active Support (A)	"Inform the student that the keyword \${keyword1} is important for the objective \${objective1} in the current video lecture, and have them try additional educational materials. The y cannot refuse and must complete the quiz before continuing with the video."

The GPT-based AI tutor(chatbot) uses the following prompts for each user group. This study divides groups for E-learning sessions with AI chatbot interaction and analyzes their learning experiences at different intervention levels through user study.

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## Acknowledgment

This work was supported by Institute of Information & communications Technology Planning & Evaluation (IITP) grant funded by the Korea government(MSIT) (No. RS-2022-00155966, Artificial Intelligence Convergence Innovation Human Resources Development (Ewha Womans University)).  
I would like to thank my industry advisor, Dr. Hyukgi Kim, from KHU Medical Center.

## Method

### ❖ User Interface and System Main Features

E-learning with Your AI Tutor!

AI chatbot에게 언제나 강의 내용에 대해 질문할 수 있습니다.

Passive Support

Notification

Suggestion

Active Support

State

Reinforcement Learning

Find the best sequence of actions that will generate the optimal outcome

Collect the most reward!

Agent

YOU

Action

Environment

Observation (state)

강의 제목: 강화학습의 기초

강의 출처: MATLAB Korea, 강의 학습이랑? | 강의 Part 1

강의 요약: 강화학습의 개념과 MDP의 개념, 정책 최적화에 대해 배웁니다.

학습 목표: 이 강의는 강화학습의 개념을 이해하고, 정책 최적화를 할 수 있도록 합니다.

Log In

Log Out

Web Development

HTML, CSS, JS, Flask API

Chatbot

GPT-3.5-turbo model

GPT Reference Material

Transcribe the lecture video into a text file using an Google Speech to Text (STT) model.

User Action

Watching a lecture, Asking questions, Taking quizzes

System Main Features

1. Objective Extraction: GPT extracts learning objectives from the lecture content.

2. Quiz Generation: GPT generates quizzes based on the learning objectives.

3. Message Generation and Delivery: When the lecture content covers the learning objectives, the AI tutor (GPT) sends pre-generated messages to the student, tailored to the characteristics of each group. (see the figure below)

Examples of AI Tutor Interactions for Each Intervention Strategy

Passive Support (PS)	Notification (N)	Suggestion (S)	Active Support (A)
<div><div>June 04, 2024, 11:41 AM</div><div>강의 제목: 강화학습의 기초</div><div>Tutor: 지금이 강의가 시작되는 순간입니다. 강화학습의 기초를 배우고자 하십니까?</div><div>강의 요약: 강화학습의 개념과 MDP의 개념, 정책 최적화에 대해 배웁니다.</div><div>학습 목표: 이 강의는 강화학습의 개념을 이해하고, 정책 최적화를 할 수 있도록 합니다.</div></div>	<div><div>June 04, 2024, 1:07 PM</div><div>Tutor: 지금이 강의가 시작되는 순간입니다. 강화학습의 기초를 배우고자 하십니까?</div><div>강의 요약: 강화학습의 개념과 MDP의 개념, 정책 최적화에 대해 배웁니다.</div><div>학습 목표: 이 강의는 강화학습의 개념을 이해하고, 정책 최적화를 할 수 있도록 합니다.</div></div>	<div><div>June 04, 2024, 1:07 PM</div><div>Tutor: 지금이 강의가 시작되는 순간입니다. 강화학습의 기초를 배우고자 하십니까?</div><div>강의 요약: 강화학습의 개념과 MDP의 개념, 정책 최적화에 대해 배웁니다.</div><div>학습 목표: 이 강의는 강화학습의 개념을 이해하고, 정책 최적화를 할 수 있도록 합니다.</div></div>	<div><div>June 04, 2024, 1:07 PM</div><div>Tutor: 지금이 강의가 시작되는 순간입니다. 강화학습의 기초를 배우고자 하십니까?</div><div>강의 요약: 강화학습의 개념과 MDP의 개념, 정책 최적화에 대해 배웁니다.</div><div>학습 목표: 이 강의는 강화학습의 개념을 이해하고, 정책 최적화를 할 수 있도록 합니다.</div></div>

### ❖ User Study

N = 8, User Tasks: Watch a lecture, chat with an AI tutor, take a post-test, fill out a questionnaire  
Group Assignment: randomly assigned, Experiment Duration: Up to 40m for each

## Results

### ❖ Measurement Metrics

\* 7-point Likert scale

Quantitative Evaluation	Immersion (self-rated), Ownership (self-rated), Satisfaction (self-rated), Learning Outcomes(Accuracy Rate for 20 Quizzes), Engagement(Question Frequency)
Qualitative Evaluation	Question Patterns, Interviews on Users' Overall Learning Experience

Metric	PS	N	S	AS
Immersion	7	5	6	6
Ownership	7	6	3	4.5
Satisfaction	7	4	6.5	6
Learning Outcomes	15.5	16.5	18.75	18.5
Engagement	5	4	1.5	1

#### Question Patterns

- Students find it difficult to identify key points (questions mainly about unfamiliar terms)
- After AI intervention, students tend to ask follow-up questions.

#### 'Suggestion' Acceptance Rate

The 'Suggestion' group tends to accept the AI's suggestions almost all the time.

#### Additional Discussion Factors from Interviews

- The intervention timing must be considered seriously.
- Despite losing some control, students were delighted with AI intervention because they believed that AI intervention would enhance their performance.

### ❖ Findings

We identified the following trends through the analysis of various evaluation metrics and interaction logs, and plan to research a dynamic intervention level automation mechanism based on these findings in the future.

#### 01. Proactive AI Can Boost Focus.

AI intervention in educational settings helps students stay engaged and immersed in the lecture content. However, the effectiveness depends on appropriate intervention timing.

#### 03. The More Proactive the AI, the Better the Results.

Increased AI intervention can enhance student academic performance.

#### 02. It's Okay to Lose Control – It's Helpful!

Students mostly accept AI suggestions and find them useful. Despite losing some control, overall satisfaction remains high, and they prefer more educational activities over simple notifications.

#### 04. Proactive AI Can Make Students Passive.

More proactive AI intervention can make students more passive. Therefore, adjusting intervention levels is necessary.