

UCS 503 Software Engineering Project Report

End-Semester Evaluation



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FocusSphere — Project Report

Intelligent Matchmaking Model for Learning

Introduction

FocusSphere is an AI-driven virtual study platform engineered to address some of the most common challenges faced by modern learners—distraction, low motivation, and social isolation. In today's digital learning environment, students often struggle to maintain consistent focus or find compatible study partners who share similar goals, study pace, and learning styles. Traditional study groups, while popular, frequently become sources of distraction rather than productivity. FocusSphere bridges this gap through intelligent, technology-enhanced collaboration.

At its core, FocusSphere combines AI-powered matchmaking, synchronized Pomodoro-based study rooms, and real-time collaboration tools to recreate the structure and accountability of a physical study environment. Instead of relying on random pairings, the platform uses a hybrid approach consisting of vector similarity search, semantic embeddings, and LLM-based intent analysis to understand the deeper meaning behind users' study goals. This ensures that learners are matched with partners who complement their academic interests, focus levels, and work styles.

The platform transforms solitary studying into a supportive, interactive experience. Through synced timers, shared progress tracking, and transparent match justification, FocusSphere encourages users to remain accountable, avoid distractions, and sustain concentration for longer periods. This shift—from unstructured solo study sessions to guided, AI-matched peer collaboration—aims to significantly improve study discipline, cognitive retention, and overall academic outcomes.

Need Analysis

According to the OECD, nearly 65% of students experience isolation and distraction while studying, particularly in remote or high-pressure academic environments.

From the survey and user research presented:

Key Student Problems

- Low focus levels when studying alone — average 4–7/10.
- Friends act as distractions — 40%+ students spend study sessions chatting.
- Major causes of inefficiency:
 - Phone notifications (54%)
 - Motivation issues (24%)
 - Getting stuck & giving up (33%)
 - Distracting friends (27%)
- Students lose 20–30 minutes per hour due to inefficiency.
- Students reported being 72% more disciplined when studying with strangers.
- Accountability tools (like partner timers) rated 3.59/5 for positive impact.
- 50% want a Panic Button for support when stuck.
- 64% would study 3–5 hours more per week with a better system.

These insights show a strong need for a structured, intelligent platform that:

- Reduces distractions
- Supports accountability
- Provides compatible study partners
- Encourages consistent study habits

Problem Statement

Students face distractions, isolation, and an inability to find compatible study partners.

Existing study platforms rely on random pairing and lack smart matching based on learning objectives.

FocusSphere solves this through:

- A virtual study system with synchronized Pomodoro timers
- AI-driven matchmaking based on users' deep study intent
- Real-time study room collaboration

Proposed Solution

FocusSphere uses:

- User profiles + study goals
- Embedding-based vector similarity
- LLM-powered re-ranking
- Shared-Pomodoro study rooms
- Optional chat + screen share
- Feedback loops for continuous learning

This provides:

- High-precision match recommendations
- Better discipline and engagement
- Reduced distractions
- Higher cognitive retention

Feasibility Study

1. Technical Feasibility

- The AI model analyses study goals using NLP techniques implemented in matching.py.
- The system supports:
 - Vector search (ChromaDB) for similarity
 - LLM reranking for improved match quality
 - Fallback mechanisms if LLM is unavailable (graceful degradation)
- Architecture includes:
 - **React Frontend**
 - **Flask Backend**
 - **PostgreSQL Database**
 - **WebSockets** for chat & sync timer
 - **ChromaDB** for embeddings

All chosen technologies are open-source and widely supported, making development smooth.

2. Operational Feasibility

- Aligns naturally with student study habits.
- Interface is intuitive and easy to adapt.
- Trust Bonus features (shared university, location, mutual friends) improve comfort & collaboration.
- Continuous feedback makes the platform adaptive to user needs.

3. Economic Feasibility

- Free-tier LLM APIs keep operational cost close to zero.
- Scalable infrastructure ensures low marginal cost per user.
- Future monetization options include:
 - Freemium model
 - B2B licensing for schools/universities
 - Tutor marketplace commissions

Overall, FocusSphere is highly affordable and sustainable.

System Architecture

The FocusSphere system is built using a lightweight, modular architecture that supports fast development, real-time collaboration, and efficient AI-based matchmaking.

Frontend

- **React.js + Vite**
- Handles user interface, profile setup, study goals, and virtual study room.

Backend

- **Flask + Flask-SocketIO**
- Provides REST APIs for authentication, matchmaking, and user management.
- SocketIO enables real-time timer sync and chat.

Database

- **PostgreSQL (Neon)** for production
- **SQLite** for local development
 - Stores user profiles, study goals, session history, and embeddings.

Real-Time Layer

- **Socket.IO with gevent**
- Manages bi-directional communication and live updates inside study rooms.

AI Layer

- **Google Gemini API**
- Generates semantic embeddings for study goals and user intent.

Machine Learning Layer

- **scikit-learn**
- Performs similarity matching, ranking, and score calculation for pairing users.

Matching Algorithm Overview

The matching system uses a **multi-stage process** as illustrated throughout

Stages

1. Filtering:

Removes irrelevant or unavailable users.

2. Vector Similarity Search:

Uses embeddings to measure deep semantic similarity of study goals.

3. LLM Reranking:

Adds contextual nuance, generating:

- **Compatibility score**
- **Human-readable justification**

4. Trust Bonus:

Extra score if users share:

- Same university
- Similar location

5. Graceful Degradation:

If LLM fails → fallback to vector results to avoid system downtime.

Proof of Concept (POC)

Implemented Features:

- User authentication (register/login)
- Token-based secure access
- Profile management
- Status update: study goals + availability
- Real matchmaking results with:
 - Compatibility Score
 - LLM Explanation

Screenshots include real API responses proving working implementation.

User Evaluation

- Match Acceptance Rate
- Session Duration (implicit feedback)
- User Ratings (explicit feedback, 1–5 stars)
- Repeat Pairing Rate
- Engagement Rate (how often users start sessions)

User Feedback Insights

- Positive response toward stranger-study for productivity
- Students appreciated transparency of “why this match” justifications
- Longer average sessions indicated reduced distractions
- Users liked Panic Button and accountability features

Strategic & Social Impact

- Cognitive retention increases by **up to 80%** through matched study partners.
- Platform democratizes access to virtual study partners globally.
- Helps under-resourced students find structured learning environments.
- Creates mental wellbeing benefits through companionship and reduced isolation.

Conclusion

FocusSphere is a technically feasible, economically sustainable, and socially impactful solution to modern-day study challenges. It intelligently pairs students for optimal collaboration while enhancing focus, reducing distractions, and supporting mental wellbeing.

With real working APIs, clear architecture, and strong user demand signals, FocusSphere is ready for extended development and scalable deployment.