What previous research has already backed up:

1. Seeing other people's annotations helps **(Wang et al., 2023; Liu et al., 2021).**
2. Group feedback improves teamwork **(Wang et al., 2023).**
3. Students liked systems that let them interact with others **(Wang et al., 2023; CSR strategies).**
4. Seeing what peoples are doing helps **(Reading Together; Curiosity Map concept).**
5. AI-Generated Feedback or Explanation **(Wang et al., 2023).**
6. Section-Wise Summarization **(Liu et al., 2021).**
7. Voting or Highlighting Useful Peer Comments **(Wang et al., 2023).**
8. Role-Based Collaboration Encourages Active Engagement (**Collaborative Strategic Reading (CSR)**)
9. Click-and-Clunk Strategy Helps Identify Confusing Parts
10. Confusion and Revisit Behavior Can Indicate Cognitive Struggle (***Reading Together* and the NLP-backed RoBERTa study**)
11. Shared Annotation History Enhances Asynchronous Collaboration (**Wang & Janssen, 2021**)
12. Meta-Cognitive Prompts Improve Understanding(pop-ups, **Bot-for-Papers**)
13. Collaborative Debate Sharpens Critical Thinking (**Zhu et al., 2022**).
14. Reading Together with Real-Time Cues Boosts Peer Learning

How we can make it collaborative:

1. **Annotate together** → Seeing what other peoples are doing, commenting and responding or reacting to them if needed. Ai can be there in the loop to verify whether the individuals response is right or wrong.
2. **Quick Notes sharing for Specific Section** → Users can leave brief notes or insights on specific sections of a paper. When others reach that same section during their own reading, they'll see those shared thoughts in context. If their understanding aligns, they can react or endorse the note. If not, they can engage in a lightweight discussion or provide alternate viewpoints. Throughout this exchange, the AI quietly observes and steps in only when needed, offering clarifications, identifying misconceptions, or guiding users toward the most accurate interpretation, along with a brief explanation of why.
3. **I am stuck here** → While reading, if a user finds a part confusing, they can drop a quick marker, like "I'm stuck here." This can be shared publicly or anonymously. Other readers who see the marker can offer their interpretations or explanations to help clarify that section. AI acts as a silent validator in this loop, analyzing all responses and stepping in when needed to highlight the most accurate explanation or gently guide users toward a clearer understanding.
4. **Discussing in the Chat** → Users can engage in a shared chat space to discuss anything related to the paper, whether it's new ideas, confusions, or general thoughts. This open forum encourages spontaneous collaboration and knowledge sharing. Meanwhile, the AI quietly monitors the conversation in the background and steps in

when helpful, clarifying misconceptions, suggesting related content, or summarizing key points to keep the discussion productive and on track.

5. **Expertise Based Help** → When users join the platform, they can optionally tag their areas of expertise, such as methods, math, theory, or ML theory. If someone gets stuck on a section (e.g., a complex equation), the system can quietly notify relevant peers with matching expertise, inviting them to assist. This allows help to come from the right person at the right time, without disrupting the reading flow.
6. **Shared Summary** → As users read, highlight, comment, and discuss, the AI continuously synthesizes all these interactions into a dynamic, shared summary. It organizes key takeaways, clarifies debated sections, and filters out noise, creating a coherent overview of the paper and the collaborative dialogue around it. This evolving summary helps everyone stay aligned and is especially useful for those who join the reading session later, offering them a structured entry point into the discussion.

Implicit AI help:

1. **Graph/Table/Equation/Image/etc Auto Narration** → When users encounter complex visuals, like graphs, tables, equations, or diagrams, the AI will detect focus behavior (e.g., prolonged hovering, zooming, or pauses) and trigger a contextual pop-up. This will provide an on-the-spot explanation that narrates the purpose, trends, or results shown in that element. Whether it's interpreting a chart's findings or breaking down an equation step by step, the goal is to make these technical components more accessible and immediately understandable.
2. **AI Invite Group Discussion** → When multiple users mark confusion or struggle with the same section of a paper, the system detects this as a shared challenge zone. AI then flags the section as needing attention and proactively invites the relevant users into a focused group discussion. It may also surface clarifying resources, ask guiding questions, or propose summaries, creating a space for collaborative sensemaking around difficult content.
3. **Contribution Balance Monitor** → A lightweight dashboard visualizes individual contributions, such as annotations, explanations, comments, and reactions, across the paper. This fosters awareness of group dynamics and gently encourages quieter participants to engage more actively. By promoting balanced collaboration, it helps ensure that insights are shared equitably and that all voices are included in the learning process.
4. **Confusion Detect** → When a user pauses, hovers, or scrolls repeatedly over a specific section, patterns often associated with confusion, the system gently intervenes. A subtle pop-up appears offering AI assistance, such as an explanation, simplified summary, or related resource. This passive support helps users overcome difficult moments without disrupting their flow.

Existing features:

1. User Authentication System
2. PDF Upload and Viewer Integration
3. Persistent Annotations
4. Chat Feature with GPT Integration
5. AI-Powered structured Summarization
6. Real-Time Feedback System
7. Quiz and flashcards
8. Notes taking
9. Engagement tracking
10. Collective highlight and summary