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Designing AI-Based Learning Assistant to Elevate Computational Thinking: A UX-Focused Redesign Approach

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Abstract: This study aims to evaluate and enhance the User Experience (UX) of SEKAPAI, a web-based AI learning assistant developed to support Computational Thinking (CT) development. The initial version was assessed using Cognitive Walkthrough, System Usability Scale (SUS), and User Experience Questionnaire (UEQ), involving ten participants. Data collected from these instruments were analyzed using descriptive statistics to quantify usability scores, and qualitative feedback from the walkthroughs was subjected to thematic analysis to identify pain points. The preliminary results showed a success rate of 90%, but also revealed issues in clarity and feature navigation. Based on user feedback, the platform underwent a redesign process guided by User-Centered Design (UCD) stages, resulting in improvements in structure, interaction flow, and interface clarity. The updated prototype showed clear improvements, supported by Maze testing with a UX score of 80 ('Good') and a SUS increase to 86 ('Excellent'), and the task success rate improved to 97.14%, indicating a significant enhancement in user satisfaction and efficiency. This study not only validates the effectiveness of UCD in refining AI-based learning tools but also highlights the potential for future system development. These findings contribute to the design methodology of intelligent educational systems by aligning pedagogical goals with interactive design strategies.

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Introduction

Computational Thinking (CT), was widely recognized as a core 21st-century skill (Wing, 2006) (Wong & Cheung, 2020) (Nouri et al., 2020). CT has been recognized globally through frameworks such as ISTE and CSTA. Meanwhile, since 2022, generative AI technologies such as ChatGPT have significantly transformed the landscape of education. Researchers confirm that ChatGPT could function as a digital teaching assistant that supports both students and educators in academic writing, language editing, and assessment feedback (No et al., 2025). Programming courses, in particular, ChatGPT helps students grasp knowledge by offering real-time responses and contextual support.

However, based on our observation, students who interact with ChatGPT often bypass key CT processes, such as abstraction and problem decomposition, in favor of relying on AI-generated answers. This phenomenon has been echoed in recent literature: (Qin et al., 2024) report cognitive depletion linked to heavy GPT_use; (Fan et al., 2024) identified a pattern of metacognitive laziness; (Zhai et al., 2024) highlighted weakened analytical depth; and (Liao et al., 2024) found that AI dependence leads to reduced creative autonomy. The results indicate that using AI Assistants without proper guidance could impede students' development of CT. These could become a delicate problem, since

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Generation Z excels at quickly adapting to technology, restricting their access would hinder their development. Therefore, the use of AI assistants in education should be implemented through a structured learning approach.

Previous research has proposed various methods to address this issue. (Hsu & Hsu, 2025) employed generative AI in game-based learning to foster logic and pattern recognition. (Lyu et al., 2024). developed CodeTutor, an LLM-based assistant that enhances abstraction and debugging via contextual feedback. Meanwhile, (Sonkar et al., 2023) Introduced the CLASS framework to deliver stepwise CT scaffolding through dialog-based tutoring. However, those studies do not include a framework to guide the design and development of a program. Meanwhile, (Liao et al., 2024) build an AI-assistance program based on a structured framework of scaffolding CT with ChatGPT (Figure 1). The program was developed for a Data Structures and Algorithms course at university level.

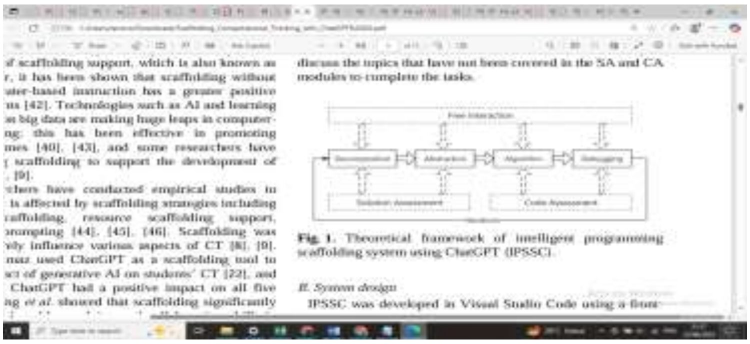

Figure 1. Theoritical Framework CT Scaffholding

These scaffolding framework to support the five most relevant dimensions in the CT framework, as identified by (Shute et al., 2017) which consist of decomposition, abstraction, algorithms, debugging, and iterations. The Solution Assessment (SA) module created to support Decomposition and Abstraction dimention, Code Assessment (CA) module to support Debugging and Algorithm Dimension, while Free Interaction Modules (FI) for Iterations Dimension. Therefore, instead of engaging directly with ChatGPT, three modules—SA, CA, and FI—were developed using a modified CT framework to scaffold students as they completed the course's coding tasks. This study integrates pedagogical concepts into the development of a software application designed to support student CT capacity. It effectivenes measured by CT Scales developed by (Karaahmetoğlu & Korkmaz, 2019). Thus, we identified this framework could be a promising approach to design an AI-based Learning Assistance for enhancing students CT skills.

In this study, we adopt an User UCD approach, which prioritizes learners' needs throughout the development process. UCD has demonstrated superior outcomes in producing usable systems and enhancing learner satisfaction. As the primary users are students, their feedback is crucial in shaping a hopefully powerful and user-friendly platform (Teasley et al., 2021, Bergdahl et al., 2024). The Platform referred to in this as *SEKAPAI*. *SEKAPAI* is designed to provide effective scaffolding interactions aimed at improving students' CT competencies. The novelty of this research lies in its rigorous application of the UCD methodology to iteratively validate and refine an AI scaffolding framework specifically engineered to prevent "metacognitive laziness" in CT development. While existing studies focus on the pedagogical efficacy of AI tools, this study uniquely addresses the critical gap in user experience design, demonstrating that the systematic improvement of UI/UX is key to

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ensuring students actually adhere to the structured scaffolding process. Therefore, the primary purpose of this research is to evaluate the initial usability and iteratively redesign the *SEKAPAI* prototype to achieve optimal functional efficiency and user satisfaction**.** This leads to the following research questions: (1) How is the *SEKAPAI* prototype designed and structured to support the scaffolding CT theoretical framework? (2) How are the results of user evaluations regarding *SEKAPAI's* user interface design after the UCD-driven redesign?

Research Method

This study was conducted using the UCD approach. The primary purpose of adopting UCD was to ensure that the redesign process was rigorously driven by user feedback, a necessary step to overcome the common failure of AI educational tools that overlook UX and unintentionally compromise cognitive engagement. The novelty of this methodological choice is its direct application to iteratively validate and refine an AI scaffolding framework (SEKAPAI) designed to combat "metacognitive laziness," ensuring the final system compels students to follow structured CT processes. The tested application was SEKAPAI, an AI-based educational platform developed to support users in learning and enhancing computational thinking through AI-assisted interactive features. The research procedure consists of five main stages: (1) preliminary study, (2) initial usability evaluation, (3) UX redesign, (4) follow-up usability evaluation, and (5) comparison of results. In the second and fourth stages, the CW technique was employed to assess the interface design and user interaction. During these evaluations, participants were asked to complete a series of tasks—6 tasks during the first usability evaluation UE1 and 7 tasks in the second usability evaluation UE2—to examine the success rate and effectiveness of the platform's UI/UX elements. Participants were selected based on their relevance to the characteristics of the intended users. The criteria were as follows: (1) university student, (2) Good computer literacy/ tech savy, (3) frequently used ChatGPT.

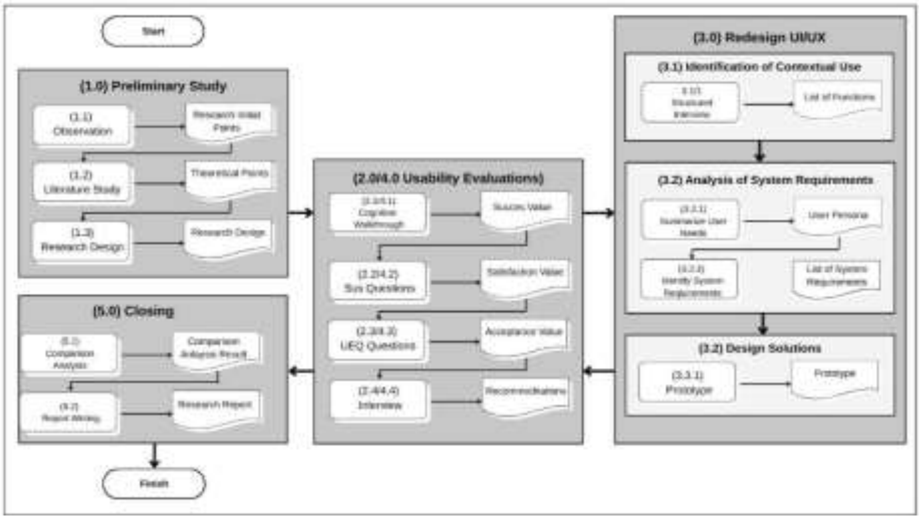

Figure 2. Research Procedure

At Usability Evaluation (UE) 2.0 stages, all phases were rigorously implemented using an initial user interface and scenario of interaction developed by (Liao et al., 2024). The initial Cognitive Walkthrough (CW) tasks (Table 1) were adapted from scenarios of interaction and functional flow. It focused primarily on cognitive steps of SA, CA, and FI

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modules—specifically on reading prompts, submitting logical answers, evaluating feedback, and reflecting through open-ended interaction.

Table 1. Initial Cognitive Walkthrough

No	Task	Module
1	Read and understand the given problem scenario	SA
2	Type and submit the proposed logical solution to the problem	SA
3	Review assistant's feedback on the submitted logic and revise if necessary	SA
4	Write and submit the corresponding code implementation	CA
5	Analyze assistant feedback regarding code correctness and edge cases	CA
6	Ask follow-up questions and receive clarification or suggestions via free interaction	FI

Each session—comprising the SA, CA, and FI features—was given a 3-minute time allocation to encourage focused exploration. Additionally, the system implemented a sequential feature activation mechanism: CA became accessible only after SA was completed, and FI was unlocked after both SA and CA were used. Whereas, the initial user interface design of *SEKAPAI* (Figure 3) strictly followed the SA–CA–FI scaffolding structure presented in the referenced GPT-based framework. This ensured that the platform's layout, feature flow, and evaluation sequence were aligned with proven interaction models.

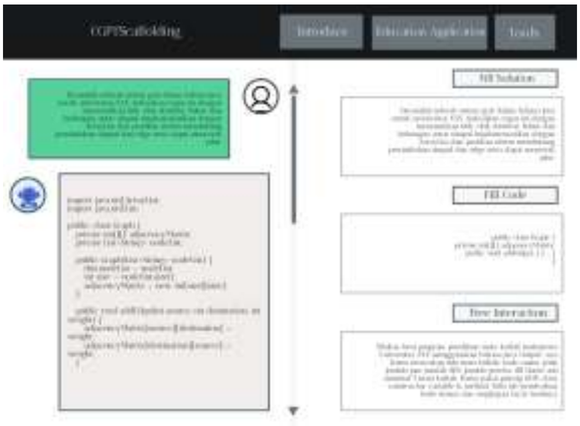

Figure 3. Initial User Interface Design

Furthermore, the usability evaluations were carried out within four distinct stages. These began with 1) Cognitive Walkthrough (CW), which was conducted to evaluate users' step-by-step interaction with the system during task completion, a process critical for determining the task success rate and identifying specific friction points within the UI/UX elements. Following this, 2) System Usability Scale (SUS) questionnaires were administered to assess users' subjective satisfaction and perceived usability rate (Brooke, 2020). At this phase, we also use Maze as a tool to conduct task analysis, providing objective metrics such as direct success rate, misclick rates, time-on-task, and heatmaps to pinpoint critical navigational issues. For deeper acceptance insights, 3) Standard User Experience Questionnaire (UEQ) to measure acceptance rates across various experience dimensions. Data analysis was performed using descriptive statistics, and the resulting UEQ scores were interpreted through benchmarking against the standard UEQ database to provide contextual

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meaning for the results. Finally, 4) Unstructured interviews were employed in the final stage of evaluation. Its purpose was to gain deeper insights from their experience--capture nuanced emotional responses, contextual interpretations, and latent needs that might not emerge through structured instruments. The data obtained from these interviews were then analyzed qualitatively and presented descriptively to highlight key insights.

Table 2. User Experience Questionnaires
(source: https://www.ueq-online.org/)

No	Left	Right	Scale
1	annoying	enjoyable	Attractiveness
2	not understandable	understandable	Perspicuity
3	creative	dull	Novelty
4	easy to learn	difficult to learn	Perspicuity
5	valuable	inferior	Stimulation
6	boring	exciting	Stimulation
7	not interesting	interesting	Stimulation
8	unpredictable	predictable	Dependability
9	fast	slow	Efficiency
10	inventive	conventional	Novelty
11	obstructive	supportive	Dependability
12	good	bad	Attractiveness
13	complicated	easy	Perspicuity
14	unlikable	pleasing	Attractiveness
15	usual	leading edge	Novelty
16	unpleasant	pleasant	Attractiveness
17	secure	not secure	Dependability
18	motivating	demotivating	Stimulation
19	meets expectations	does not meet expectations	Dependability
20	inefficient	efficient	Efficiency
21	clear	confusing	Perspicuity
22	impractical	practical	Efficiency
23	organized	cluttered	Efficiency
24	attractive	unattractive	Attractiveness
25	friendly	unfriendly	Attractiveness
26	conservative	innovative	Novelty

Results and Discussion

First User Evaluation

In the first phase, we involved 10 participants. All participants were students currently enrolled in a Basic Programming course. They followed each of the stages described in the previous section.

Table 3. Results of User Evaluation 1 (UE1)

Task of CW	Success Rate (%)	Drop Off (%)	Misclick Rate (%)	Duration (seconds)	Person	Sus Score	UEQ Score					
							AT	PE	EF	DE	ST	NO
1	90	10.0	46.3	25.1	1	70	3.83	3.75	4.75	3.75	2.75	5.25

2	76	10.0	22.8	35.9	2	84	4.50	4.25	4.00	4.00	4.25	4.75
3	80	-	43	45.2	3	70	4.17	4.00	4.00	3.75	3.25	3.50
4	90	-	9.1	14.9	4	88	4.00	4.00	4.00	3.50	4.00	5.25
5	100	10.0	2.5	11.2	5	87	3.67	4.25	3.75	3.75	3.25	4.75
6	100	-	38.7	3.3	6	84	3.00	3.88	3.15	3.13	3.00	3.29
					7	83	4.25	3.34	2.13	3.25	4.12	3.22
					8	71	3.55	3.75	3.12	4.00	4.32	3.12
Average	90	10.0	46.3	25.1	9	82	3.24	2.75	3.00	5.02	3.23	4.33
					10	81	4.33	3.25	5.12	3.44	5.12	3.21
					Total	80	36.08	32.25	33.25	33.44	34.02	34.59

The results in Table 3 reveal that the initial design of the platform UE1 was far from optimal. Although the average satisfaction score appeared moderate, closer inspection of user interaction metrics—such as a high mis-click rate (46.3%), inconsistent task completion times, and low SUS scores on several tasks—indicated notable usability issues. Problems related to unclear interface elements, poor navigation flow, and inefficient task guidance hindered the user experience, particularly during early-stage interactions.

Table 4. Suggestion of the participants

No.	Suggestions
1	Add logo image on the login page
2	Change interface colors to beige and blue
3	Add introduction and explanation on landing page
4	Improve landing page navigation from start
5	Simplify feature bubble buttons (SA, CA, FI)
6	Differentiate button colors for (SA, CA, FI)
7	Add a send icon to the chat button
8	Display a session duration timer
9	Add access to activity history
10	Add the Log out button in

Table 4 presents a summary of user suggestions and the corresponding design revisions made during the iterative development process. Other suggestions such as adding session timer, activity history access, and a visible log-out button were also highlighted. These recommendations were prioritized and accommodated in the redesign, especially those that support clearer navigation and align with the platform's computational thinking framework.

Redesign UI/UX

Based on previous phase results, there were additional features integrated into the foundation for *SEKAPAI* redesign. To support the redesign process, qualitative feedback was gathered from participants regarding specific pain points in the system interface. This input was grouped and categorized by task stage. Table 5 presents the findings categorized by

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usability aspects—learnability, efficiency, accuracy, memorability, and satisfaction—along with targeted recommendations for design improvements. These insights were gathered through observation and open-ended feedback during user testing sessions.

Table 5. Qualitative Assessment Result

Aspect	Feedback	Recommendation
Learnability	Some users are confused when starting the conversation and navigating between features.	Add introductory instructions on the landing page. Use clearer button labels and consistent guidance.
	Feature names SA, CA, FI are unclear for new users.	Add short tooltips or brief descriptions for each feature.
Efficiency	Users spent excessive time finding where to start and which feature comes first.	Streamline navigation by guiding the user flow in sequence SA → CA → FI.
	Feature transitions (from SA to CA to FI) felt disconnected without clear indicators.	Implement feature activation logic and visual progress indicators.
Accurancy	Users often misclick buttons or get confused between similar UI elements (e.g., chat button vs. send).	Redesign iconography and differentiate button colors.
	Text and chat bubbles appear too similar; hard to tell who is speaking.	Apply distinct styles or color codes for AI and user bubbles.
Memorability	Users forget where to find activity history and logout options.	Place these features in predictable and clearly labeled locations.
	The current interface lacks visual personality, making the platform feel generic.	Customize with color schemes (beige and blue) and add character via logo.
Satisfaction	Participants liked the AI interaction but wanted more personalization.	Add session timer, personalize AI name/icon, and allow users to track learning progress.
	Users expected to see their previous chats automatically but couldn't access without using all features first.	Provide subtle guidance or badge indicators for feature completion.

Several enhancements were then introduced to address issues related to navigation flow, clarity, and user control. The *Landing Page* was added to provide an overview of the platform's objectives, key modules SA, CA, FI, and development background, thereby establishing context before task engagement. The *Sign up & Login Page* was implemented to

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enable secure, personalized access and to support future data tracking. The *Recently Activity* feature allows users to revisit previous conversations, accessible only after all main modules have been completed, to preserve the intended learning sequence. Lastly, the *Logout* function was incorporated to give users control over exiting the platform or returning to the homepage. These additions were directly informed by user needs and aligned with the principles of UCD to enhance overall usability and user satisfaction.

Table 6. Added Features of the Application

Features	Functions
Landing Page	Provides an overview of the platform, including its purpose, available features SA, CA, FI, and development team.
Sign up & Login Page	Allows users to securely access the system.
Solution Assessment (SA)	Encourages students to critically evaluate a proposed solution by responding to prompts that stimulate reflection rather than passive acceptance.
Code Assessment (CA)	Trains students to analyze code structure, logic, and potential errors, enhancing their debugging and reasoning skills.
Free Interaction (FI)	Enables open-ended conversations with AI, allowing students to ask questions, explore ideas, and confirm their understanding in a more autonomous learning context.
Recently Activity	Displays previous conversations, accessible only when all features SA, CA, FI have been used.
Logout	Allows users to return to the homepage or exit the platform.

Figure 4 illustrates the proposed user persona, which served as a reference throughout the design and evaluation process. To ensure that the redesigned interface met the real needs and characteristics of its target users. This persona captured key attributes such as user goals, frustrations, digital literacy, and expectations when interacting with an AI-assisted decision support system.

Figure 4. User Persona

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Thereafter, we redesigned the user interface of the *SEKAPAI* platform, which was iteratively developed following findings from the first user evaluation. These interfaces then became a subject for further user evaluation tests to be taken in the subsequent phase.

Figure 5. Interface of SEKAPAI after Redesign

Second User Evaluation

The User Evaluation 2 UE2 stage involves 10 samples with identical criteria but from different individuals. Additionally, a number of CW were conducted, adapted to align with the results of the redesign. These additions consist of: Sign up and Login to the platform CW1, Read the landing page introduction and click “Start Conversation” CW2, Access the recently activity CW9, and Log out from the platform CW10. The result are shown at table 2.

Table 7. Result of UE2

Task of CW	**Success Rate (%)**	**Drop Off (%)**	**Misclick Rate (%)**	**Duration (seconds)**	**Person**	**Sus Score**	**UEQ Score**					
							AT	PE	EF	DE	ST	NO
1	90	10.0	45.3	25.1	1	78	3.83	3.75	4.75	3.75	2.75	5.25
2	100	-	30.3	35.9	2	90	4.50	4.25	4.00	4.00	4.25	4.75
3	100	-	5.6	46.7	3	78	4.17	4.00	4.00	3.75	3.25	3.50
4	100	-	5.7	14.9	4	95	4.00	4.00	4.00	3.50	4.00	5.25
5	100	-	-	4.8	5	95	3.67	4.25	3.75	3.75	3.25	4.75
6	100	-	67.7	14.0	6	80	4.33	4.00	4.00	3.50	3.25	4.75
7	90	10.0	30.8	11.8	7	83	4.17	5.00	4.00	3.75	4.00	4.25
8	90	-	20.5	10.2	8	88	4.67	4.25	4.00	4.50	3.25	5.75
9	100	10.0	12.3	3.5	9	78	3.83	4.00	4.50	3.75	3.25	4.00
10	100	10.0	5.0	23.1	10	95	4.17	3.50	5.50	3.00	4.00	4.00

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Average	97.14	10.0	26.49	21.89	Total	86	4.13	4.10	4.25	3.73	3.73	4.63

The results in Table 7 present a comprehensive overview of the redesigned *SEKAPAI* platform's usability evaluation, combining task performance and user perception metrics. The *Success Rate (SR)* averaged 97.14%, indicating that nearly all users completed tasks successfully without assistance. A low Drop-Off Rate of 10% reflects strong user engagement, while a Misclick Rate of 26.49% still indicates room for improvement in interface clarity. The task completion time averaged around 22 seconds, showing users could interact efficiently. The SUS score reached 86 ("Excellent"), and UEQ results across all dimensions ranged between 3.73–4.63, reinforcing overall satisfaction. Based on the positive feedback from interviews, no additional features were deemed necessary during this evaluation phase.

Table 8. UEQ Benchmark UE2

Scale	Mean	Comparison to benchmark	Interpretation
Attractiveness	1,8	Good	10% of results better, 75% of results worse
Perspicuity	2,25	Excellent	In the range of the 10% best results
Efficiency	1,85	Good	10% of results better, 75% of results worse
Dependability	1,575	Good	10% of results better, 75% of results worse
Stimulation	1,825	Excellent	In the range of the 10% best results
Novelty	1,175	Good	10% of results better, 75% of results worse

The UEQ benchmark results at Table 8 demonstrate that the redesigned *SEKAPAI* platform achieved strong user experience performance across all six evaluated dimensions. Perspicuity (M = 2.25) and Stimulation (M = 1.825) were categorized as Excellent, indicating these aspects fall within the top 10% of best-performing systems in the benchmark dataset. Meanwhile, *Attractiveness*, *Efficiency*, *Dependability*, and *Novelty* scored between 1.175 and 1.85, classified as Good, meaning 75% of systems in the benchmark performed worse in these areas figure 7. These results highlight that users perceived *SEKAPAI* as not only easy to understand and engaging, but also reliable, efficient, and appealing—reflecting the positive impact of the redesign phase on the platform's overall usability and user experience.

Discussion

Redesign Factor

The redesigned SEKAPAI platform demonstrated a marked improvement in usability and user satisfaction, as evidenced by the increased SUS score (from 80 to 86) and task success rate (from 90% to 97.14%). Significantly, the final score of 86 classifies the *SEKAPAI* prototype in the top 10% of all tested systems and is categorized as *'Excellent'*.. This contextual framing confirms that the redesign effort moved the platform from merely *'Good'* usability (score 80) to a superior, competitive level. These findings underscore the effectiveness of the UCD methodology in addressing user pain points identified during the first evaluation—particularly related to clarity, navigation, and the logic structure of interactions. This success is consistent with studies by (Subiyakto et al., 2022) (Alsadi & McPhee, 2021) and (Ramírez et al., 2025) which similarly reported increased usability following iterative design grounded in user feedback. This convergence of findings strengthens the argument that UCD provides a robust framework for developing adaptive and effective AI-supported educational tools. Furthermore, the implementation of additional

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features—such as Recent Activity and Landing Page—addressed prior gaps and contributed to a more holistic learning journey. Meanwhile, as the key component of feature are SA-CA-FI modules, The SA module benefited from clearer problem presentation, while the CA module saw improved user engagement due to better debugging support. Additionally, the FI module facilitated more meaningful and autonomous learning interactions. Overall, the study provides strong empirical support for UCD's applicability in CT-oriented digital learning environments. identified during the first evaluation—particularly related to clarity, navigation, and the logic structure of interactions. These findings are consistent with studies by (Subiyakto et al., 2022) (Alsadi & McPhee, 2021)and (Ramírez et al., 2025) which similarly reported increased usability following iterative design grounded in user feedback. This convergence of findings strengthens the argument that UCD provides a robust framework for developing adaptive and effective AI-supported educational tools. Furthermore, the implementation of additional features—such as Recent Activity and Landing Page—addressed prior gaps and contributed to a more holistic learning journey.

Meanwhile, as the key component of feature are SA-CA-FI modules, The SA module benefited from clearer problem presentation, while the CA module saw improved user engagement due to better debugging support. Additionally, the FI module facilitated more meaningful and autonomous learning interactions. Overall, the study provides strong empirical support for UCD's applicability in CT-oriented digital learning environments.

Further Improvement

The scope of this study is limited to the prototyping phase; hence, the findings do not assert that the product has a measurable impact toward enhance student CT enhancement. Nonetheless, the redesign outcomes effectively eliminate factors that potentially compromise user experience—an aspect that could adversely influence the development of CT competencies.

Further study needed to deploy the prototype into a fully operational program. Upon successful development and completion of functional testing, the effectiveness of the design in enhancing CT can be empirically evaluated. Grounded in the findings and the framework employed in this study, several established software design methodologies—such as Agile, Design Thinking, and Extreme Programming—have demonstrated effectiveness in the context of educational applications (Neumann & Baumann, 2021) (Wu et al., 2025) (Castillo López et al., 2023).

Meanwhile, to measure design's effectiveness in fostering CT, previous study has employed assessment tools the CTS or simply by using a set of tasks that exhibit feature of CT. We implore the CTS since it widely used to assess CT by certain degree of accuracy. However, it is deemed necessary to translate the notion of CTS into the native language in order to maintain linguistic equivalence and minimize the risk of conceptual misalignment or perceptual inaccuracies (Lee & Yoon, 2021) (Silva & Costa, 2022) (Brown, 2021). In addition, other assessment instruments could be utilized, particularly those aimed at gauging learner engagement, such as the Student Engagement Instrument or the Learning Experience Questionnaire. Both of which evaluate the quality of learners' experiences while interacting with the platform (Pérez, 2020) (Limin, 2023).

The success of the SEKAPAI redesign provides actionable guidelines for developers of future AI-assisted learning tools. First, the implementation of sequential feature activation (SA → CA → FI modules) demonstrates a critical design pattern: AI assistance should be provided through structured, mandatory steps that enforce key CT processes (Decomposition, Abstraction, Debugging) rather than offering a direct, single-step answer. This structure is

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essential to mitigate metacognitive laziness. Second, the significant improvement in the SUS score post-redesign emphasizes that high usability is non-negotiable for pedagogical effectiveness; developers must invest in robust UI/UX processes (like UCD and detailed task analysis) to ensure the system's design does not interfere with the student's cognitive effort toward the learning task itself. Third, the positive reception of supporting features (Recent Activity and clearer Landing Page) implies that maintaining learner orientation and context through high-clarity visual scaffolding is just as important as the functional AI feedback. These findings collectively advocate for shifting the design focus of AI education tools from mere function to pedagogically informed interaction design.

Conclusion

The initial version of the *SEKAPAI* prototype adopted the original interface design and task flow from the framework proposed by Liao et al (2024). A CW evaluation was conducted using this version, allowing users to interact with the prototype through guided tasks aligned with CT. Positively, all core modules received moderate usability ratings and fulfilled the intended interaction structure. However, several issues were identified, including unclear feature labels, lack of visual cues for task progression, and limited navigational feedback, which impacted the overall intuitiveness and learnability of the platform. The redesign process was conducted by incorporating user feedback through the UCD stages. This included structural adjustments, clearer visual hierarchy, simplified navigation, and improved button labeling. As a result, the SUS score increased from 80 to 86 (categorized as Excellent), the task success rate rose to 97.14%, and Maze testing yielded a UX score of 80, indicating a substantial improvement in user satisfaction and interface efficiency. Table 7 summarizes the Maze-based evaluation, which includes Success Rate (SR), Drop-Off Rate (DO), and Misclick Rate (MR) as key usability indicators. The average SR of 97.14% shows users could complete tasks effectively, while a low DO of 10% indicates minimal task abandonment. However, an average MR of 26.49% points to a few interface areas needing clarity improvements. Overall, these metrics confirm the redesigned version significantly enhanced the platform's usability. This study not only validates the effectiveness of the UCD approach in refining AI-based learning tools but also highlights the potential for future system development. These findings ultimately contribute to the design methodology of intelligent educational systems by aligning pedagogical goals with proven interactive design strategies.

Recommendation

This study is limited to the prototype development and usability testing phase. In future work, *SEKAPAI* will be developed into a fully deployable application, functionally tested, and empirically evaluated for its effectiveness in improving students' CT competencies. This will require integration with backend infrastructure database *PostgreSQL*, API *OpenAI*, front-end development via *Next.js*, and real-time deployment on *AWS*. Additionally, further studies may include controlled experiments using pre/post CTS to measure learning impact, as well as UI/UX adaptations for early childhood education contexts.

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