

IC-003

Design of a Chatbot to Enhance Computational Thinking Skills of Junior High School Students: User Experience Research

Thanaphiphat Sangwonjirachot ^{1,*}

Natthapol Jaengaksorn ²

¹Master of Education Program in Educational Evaluation and Research,
Faculty of Education, Chiang Mai University, Chiang Mai, Thailand

²Department Educational Evaluation and Research, Faculty of Education,
Chiang Mai University, Chiang Mai, Thailand

*Corresponding author's email: thanaphiphat.sw@gmail.com

ABSTRACT

This research aimed to study the user experience and design a chatbot to develop computational thinking skills of lower secondary school students. The research used a qualitative research methodology by conducting in-depth interviews with 5 science and technology teachers and 7 students at Maeonwittayalai School to analyze their experiences and needs in using educational chatbots. The operation was divided into 2 phases: Phase 1, analyzing the user experience in 4 dimensions: roles, emotions, attitudes, and behaviors; and Phase 2, designing a chatbot based on the analysis results. The research results showed that users viewed the chatbot as a teaching assistant, an information source, and an alternative learning channel. The chatbot design integrated activities that enhance computational thinking skills covering 4 components: decomposition, pattern recognition, abstraction, and algorithm design, by applying the concept of problem-based learning. The chatbot components consisted of a natural conversational interface, an efficient navigation menu system, a scoring system, and a feedback mechanism that was tailored to different learning potential levels. This chatbot created a stimulating learning environment and addressed the challenges of teaching computational thinking in a Thai educational context. This research contributed to the development of educational technology innovations that effectively promoted 21st century skills while supporting the diversity of learners' needs and learning styles.

Keywords: Computational thinking, Chatbot, User Experience Research, Educational Technology Innovation

Introduction

The curriculum adjustment in Thailand according to the Basic Education Core Curriculum B.E. 2551 (Revised Edition B.E. 2560) has included computational science subjects in the science and technology learning group to develop students' computational thinking skills, which include algorithm design, pattern recognition, abstract thinking, and component separation (Office of the Basic Education Commission, Ministry of Education, 2017). This change aligns with the 21st century skills development approach that focuses on enabling students to solve problems systematically and logically, especially in lower secondary school, which is a critical age for developing higher-level thinking skills. However, organizing teaching and learning to develop these skills remains a challenge in the Thai education system, as students have diverse knowledge bases, learning styles, and access to technology.

Maeonwittayalai School is a medium-sized secondary school that operates a computational science course under the Basic Education Core Curriculum. In the academic year 2024, the school has 2 teachers in the subject, which results in an imbalance in the ratio between teachers and students, leading to a significant increase in teaching load. The school also has 2 computer labs, each with approximately 35-40 computers, causing some groups of students to share computers at a ratio of 2:1, which affects the efficiency of practical learning, i.e., students are unable to carry out learning activities through hands-on practice in full accordance with the specified process, resulting in the incomplete development of students' computational thinking skills. This phenomenon is consistent with the academic achievement of lower secondary school students, which shows that most students have moderate academic achievement. Based on these structural limitations, the researcher aims to apply chatbots, an artificial intelligence technology with the potential to act as teaching assistants, with the ability to continuously promote student learning 24 hours a day, which responds to students' needs for non-classroom learning.

Chatbots have significant potential to support education by creating personalized learning experiences, providing immediate feedback, and fostering highly interactive learning environments (Ouhaichi et al., 2023). The advantage of chatbots lies in their ability to adapt content to each learner's level of understanding, allowing

them to learn at their own convenience and readiness. Research by Imcham (2019) found that chatbots can effectively promote students' computational thinking skills. Integrating chatbots into the educational environment enhances learners' problem-solving abilities and understanding of complex systems (Lee et al., 2019). Additionally, chatbots help reduce learning pressure and create a friendly atmosphere, which are important factors in stimulating learner engagement.

User experience research is an essential process in developing educational technologies that meet user needs. This process consists of discovery, definition, development, and delivery (Design Council, as cited in Rotkomil, 2021), which helps developers deeply understand user needs and behaviors. User experience research examines not only user characteristics but also encompasses needs, motivations, behaviors, and expected outcomes (Yu, as cited in Sirilak, 2018). These data are crucial factors in designing a chatbot appropriate for the Thai educational context that can effectively enhance computational thinking skills (Skjuve & Følstad, 2021). Designing with user experience in mind makes the chatbot interesting, easy to understand, and responsive to learners' needs, resulting in more effective use.

Building on previous research, this study has developed a chatbot specifically designed to enhance computational thinking skills for lower secondary school students. By integrating concepts from Khamnaen and Koraneekij (2022) research on flipped learning with problem-based learning, the researchers have created a chatbot that not only provides knowledge but also motivates learners to practice analytical thinking, problem-solving, and algorithm design through activities, using user experience research as a framework for design and development. This chatbot aims to address existing gaps in computational science education.

Purposes

- 1) To study user experience that Enhance Computational Thinking Skills of Junior High School Students.
- 2) To design a chatbot that Enhances Computational Thinking skills of Junior High School Students by applying user experience research.

Research Methodology

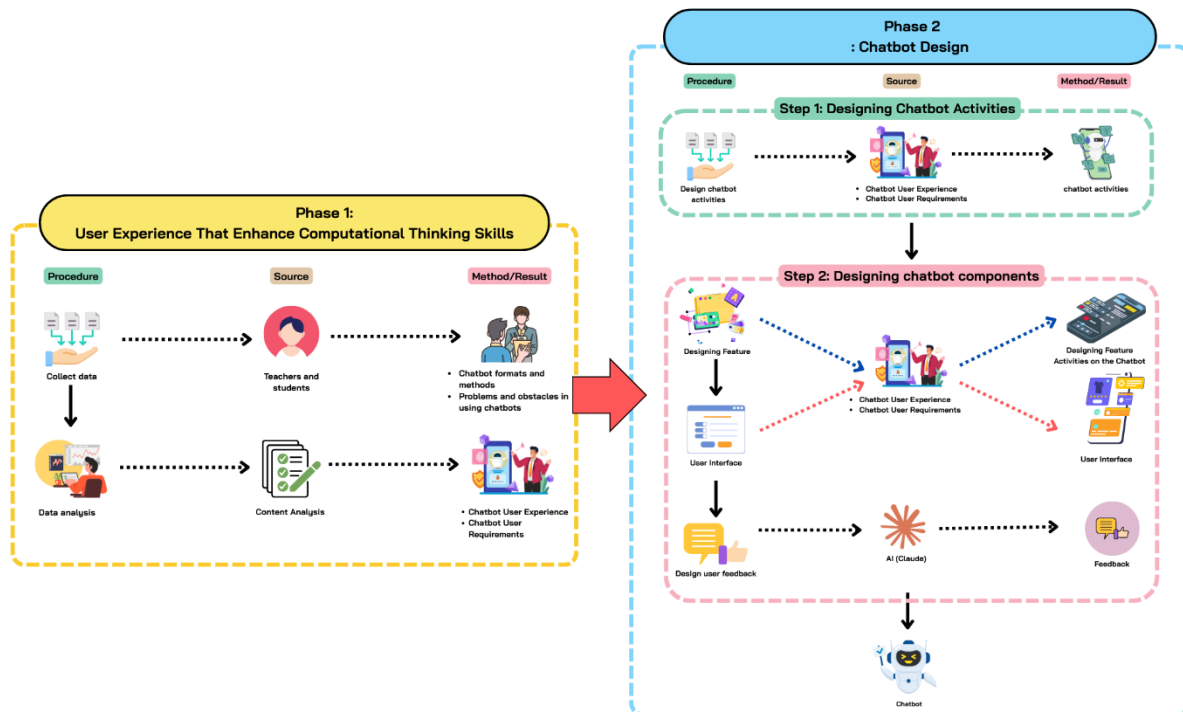


Figure 1 : Research Procedures

Phase 1: User Experience That Enhance Computational Thinking Skills

The research in Phase 1 follows an implementation model addressing objective 1: To study user experience that Enhance Computational Thinking Skills of Junior High School students. This phase employs qualitative data collection methods to analyze user experiences that foster computational thinking skills in Junior High School Students. Junior High School students and teachers were selected to provide interview data, which will inform the design of a chatbot aimed at promoting computational thinking skills for lower secondary school students.

Step 1.1 Informants

For interviews concerning user experiences that enhance computational thinking skills among junior high school students, the researcher employed purposive sampling with specific selection criteria. The interview informants were categorized into two groups:

1. Five teachers of Science and Technology subjects with the following qualifications.
 - 1.1 Teaching at the lower secondary level, grades 1-3, in the academic year 2022-2024
 - 1.2 Having experience in organizing learning that promotes students' computational thinking skills
 - 1.3 Having at least 1 year of teaching experience in school
2. Seven students from Maeonwittayalai School with the following qualifications.
 - 2.1 Currently enrolled at the Junior High School level at Maeonwittayalai School during the 2024 academic year
 - 2.2 Having completed at least one academic year in Computing Science courses
 - 2.3 Having experience in using chatbots related to learning

Step 1.2 Methodology

Table 1 : Example of User Experience Interview Guide

User Experience	Interview Questions
Role	1. What is your basic understanding of chatbots in learning management? 2. How do you think chatbots are significant to learning in the present day? 3. In which areas can chatbots help develop students' learning skills?
Emotions	1. How do students interact with chatbots, and to what extent are they interested? 2. What concerns or uncertainties do you have about implementing chatbots with students? 3. How ready and confident are you in learning new technologies?
Attitudes	1. What is your perspective on incorporating modern technology in the classroom? 2. What needs or suggestions do you have for developing educational chatbots? 3. What methods do you use to screen and evaluate the suitability of chatbots?
Behavior	1. What experience do you have in implementing chatbots in teaching, and how did you begin? 2. How do you experiment with or test chatbots before implementing them in the classroom? 3. What challenges have you encountered when using chatbots alongside teaching?

Step 1.3 Data analysis

Qualitative data analysis using content analysis to group and summarize similar user experiences and needs. The researcher divided them into 2 groups: (1) chatbot user experiences and (2) chatbot user needs, to be used as data for designing a chatbot prototype that promotes computational thinking skills in early secondary school students.

Phase 2: Chatbot Design

The research in Phase 2 follows an implementation model addressing objective 2: To design a chatbot that enhances computational thinking skills of Junior High School Students by applying user experience research. In Phase 2, the researcher designed the chatbot and chatbot activities as follows

Step 2.1 Designing Chatbot Activities

Data obtained from Phase 1 research was used to create the chatbot structure for activities enhances computational thinking skills among Junior High School students. The design process included the following steps

1. Study the data points obtained from the first phase of research and the curriculum related to the development of computational thinking skills of Junior High School Students to use in designing activities.
2. Sequencing the conversation activities between the bot and learners by dividing the designed activities into three sub-components according to computational thinking skill elements.
3. Creating a conversation structure with planned questions or activities and possible student responses for each activity.

Step 2.2: Chatbot Design

(1) Designing Features on the Chatbot

In this research step, the researcher analyzed and synthesized user experiences, user needs, and designed feature activities on the chatbot. Line Official Account (Line OA) was chosen as the main development platform because it is a channel that lower secondary school students are familiar with and widely used. The selected features were designed to meet the user's experience and needs, as follows:

1. Chat The chatbot was designed to be an alternative learning resource for users to promote computational thinking skills through conversations between learners and the chatbot. This feature meets the user's need for an alternative learning channel that can be used at any time. The chat format is designed to ask questions that encourage users to analyze and answer questions, which stimulates the thinking process during use. The conversation is in the form of real-time interactions, allowing learners to receive immediate feedback after answering questions or performing activities.

2. Rich Menu The menu system is designed to allow users to select text or activities based on their interests without having to type to search, which is convenient and encourages users to use the chatbot. This feature meets the user's needs in terms of friendliness and ease of use. It also includes a quiz menu system that allows users to test their understanding both before and after using the chatbot, which supports the assessment of learners' learning outcomes. The rich menu is arranged to cover all 4 types of computational thinking skills and uses icons that clearly communicate meaning. Enable users to access activities quickly and conveniently.

3. Greeting Message The initial message when users add friends to the Line Official Account is designed to have friendly content, provide a welcome, and provide basic instructions. This feature meets users' needs for friendliness and ease of use. The greeting message introduces the purpose of the chatbot, how to use it, and the benefits users will receive, making users feel that the system is friendly and easy to understand from the start.

4. Reward Card The point collection system is designed to allow users to redeem points accumulated from activities and received from teachers for points or prizes during teaching. This feature meets users' needs for pride in their achievements, encouraging users to continuously use the chatbot through rewards, which is an external motivation that helps strengthen learners' intrinsic motivation.

5. 1 On 1 Chat The chatbot is built on the basis of the Line Official Account, where conversations between users and the bot are in the form of one-on-one chats. This feature meets users' needs for confidence, safety, and safety awareness. Private conversations help learners feel safe answering questions and expressing their opinions without worrying that their classmates will see their answers, creating a safe space for learning.

6. Card-based Message The card-based message is designed to allow users to easily select questions or interests. This feature meets users' needs for reducing frequently asked questions. These cards are presented in an interesting way, with illustrations and concise text. This enables users to understand the content quickly and reduces the burden on users' typing, which is suitable for students' usage behavior in the digital age. The design of all these features takes into account the usage characteristics of the target group of lower secondary school students who want convenience, speed, interest, and simplicity. All features are consistent and linked to create a smooth user experience and effectively promote the development of computational thinking skills.

(2) User Interface Design

In this research step, the researcher is responsible for analyzing and synthesizing the user experience, user needs, and designing the user interface (User Interface) on the chatbot. The researcher chose to use Line Official Account (Line OA) as the main platform for developing the chatbot because it is a popular platform and

is familiar to lower secondary school students. The user interface components are designed according to the user experience and needs as follows:

1. Profile Page The profile page is designed to convey the enhance of computational thinking skills. The name is clearly meaningful and easy to remember, with a modern profile picture designed to attract the attention of the target group and convey computational thinking. In addition, necessary basic information about the chatbot is included. This section is designed according to the needs of users who want to interact with a chatbot with a clear and trustworthy personality.

2. Chat Interface The chat page is designed to be simple, uncomplicated, and easy to use. The elements are arranged according to the standard Line Application so that users are familiar and can use it immediately. A welcome message is displayed upon starting the application, along with clear instructions for use, and the colors are comfortable and suitable for reading messages for a long time. The conversation format is designed to be friendly, use easy-to-understand language, and have fast interactions so that users feel like they are chatting with a teacher or friend who is giving advice. This section is designed according to the needs of users who want a simple and accessible interface.

3. Rich Menu The rich menu is designed to be the main menu that covers all 4 types of computational thinking activities: (1) Problem decomposition, (2) Pattern recognition, (3) Abstract thinking, and (4) Algorithm design, with a user guide button. The use of clear icons for each activity and different colors to easily distinguish the types of activities allows users to access activities quickly without typing commands. This section is designed according to the needs of users who want to access content and activities quickly and conveniently.

4. Text Messages The text messages are designed to be concise, clear, and easy to understand, using language appropriate for lower secondary school students. Not too formal but still academically correct, with appropriate spacing and paragraphing to make it easy to read and understand, and using symbols or emoji to increase interest and convey the emotion of the message.

5. Quick Reply The text messages are designed to have clear answer options that are consistent with the questions and activities, especially for multiple-choice questions. To reduce user typing and increase efficiency in interaction, the options are worded concisely, easily understood, and have an appropriate number of options, not too many to confuse users. The display of options uses colors and icons to help users distinguish and select easily. This section is designed based on the experience and needs of users who want to be able to answer questions quickly and do not want to type long messages.

6. Message Templates Message templates are designed to present content with a fixed format, such as explaining the meaning of various skills, giving examples, and displaying questions. These templates have a clear structure, consisting of topics, content, and in some cases, illustrations or icons to increase interest. Using templates helps create consistency in the presentation of content, allowing users to become familiar with the format and predict the nature of the content. This section is designed based on the needs of users who want a systematic and predictable presentation format.

7. Rich Media Multimedia is designed to use illustrations, diagrams, and multimedia that are appropriate for the content and activities to increase interest and help explain complex concepts. Illustrations are designed to be clear, colorful, and to the point. Diagrams have an organized and easy-to-understand composition. The size and resolution of the media are taken into account for display on mobile devices. This section is designed based on the experience and needs of users who want a variety of interesting learning media. All user interface designs take into account the principles of User Experience design to create an interface that is effective, easy to use, and fully supports user learning. All elements are consistent in both design and usability to create a seamless user experience.

(3) Designing User Feedback Mechanisms

Development of the feedback system The researcher applied Claude AI technology to simulate the user's text input data in each activity. Claude AI was set to simulate the user's text input, 150 messages per activity, divided into 3 groups, 50 messages per group, to cover a variety of answer formats. The development of the feedback system that adapts to the user's ability level.

The feedback was designed for users with different ability levels. From the analysis in phase 1, the researcher classified them into 3 groups: the proficient group, the middle group, and the weak group. Users will receive feedback when they complete the last activity of each unit in the form of a subjective test in which users must express their thinking and opinions. The feedback was designed to be appropriate for the ability level of each user group.

Results

Phase 1: Analysis of User Experience that Enhance Computational Thinking Skills

The synthesis of data from research on user experiences that enhance computational thinking skills development among Junior High School students revealed that teachers and students who served as research informants provided details regarding: 1) Role, 2) Emotions, 3) Attitudes, and 4) Behaviors related to using chatbots that enhance computational thinking skills for Junior High School students. The findings are as follows:

1. Role

Teachers and students perceive the role of chatbots in the learning process differently, which can be classified into the following main roles: Teachers see the role of chatbots in 4 main aspects: (1) as a teaching assistant who can explain content and answer students' questions at all times, especially outside of class time; (2) as a source of information that is accessible at all times, allowing students to search for answers immediately via the Internet; (3) as a tool to complete the understanding of content that students do not clearly understand in the classroom; and (4) as an alternative learning channel for students who do not dare to ask teachers directly. Students see the role of chatbots in 2 main aspects: (1) as a flexible information search tool, such as being able to ask for help summarizing for easier understanding; and (2) as an assistant to review lessons and understand complex content by themselves.

2. Emotions

Teachers and students have various emotional responses to interacting with chatbots, with both positive and negative feelings as follows: Positive feelings: Both teachers and students expressed satisfaction with the natural and friendly interaction experience of the chatbots, with students stating that "conversations in a conversational manner make us feel friendly and easy to understand." Feeling relaxed when using chatbots with informal communication helps create an atmosphere conducive to learning, which is consistent with the teacher informant who said that "From trying it that day, the content that it answered us was clearer than on Google. It was like combining many websites into a summary for us." Negative feelings found that teachers and students were concerned about relying too much on technology. Students expressed their concerns that "Using technology is an advantage, but there are also disadvantages, such as we may rely too much on technology to the point where we cannot solve problems by ourselves." and lack of confidence in the accuracy of the information. The feelings of teachers and students reflected the need to design a chatbot that promotes students' computational thinking skills and has a reliable data verification system.

3. Attitude

Teachers and students demonstrated their mental attitudes and thinking tendencies towards using chatbots in learning, with both positive and negative attitudes as follows: Positive attitudes towards using chatbots as a tool to support teaching and learning, seeing the value in reducing teachers' workloads and increasing students' learning opportunities. Teachers viewed chatbots as "learning that is not limited by time and place. Students can learn whenever they want." and the most important negative attitudes included concerns about the impact on the development of analytical thinking skills. One teacher expressed concern that "children may think analytically less by themselves." Students themselves were aware of this risk, saying, "I think that if I use a chatbot, I won't think. I didn't try to think the way he did." There are also concerns about the security and privacy of the information that students ask, to be private, and to control its use within appropriate limits."

4. Behavior

Teachers and students provide behavioral data on the observed action patterns and patterns of user interaction with the chatbot, with positive and negative behaviors as follows: Positive behaviors Including using the chatbot to find additional information outside of the classroom, including repeated use and testing to assess understanding. Negative behaviors were also found, including over-reliance on the chatbot, which may affect the development of analytical thinking skills, and lack of verification of the accuracy of the information received.

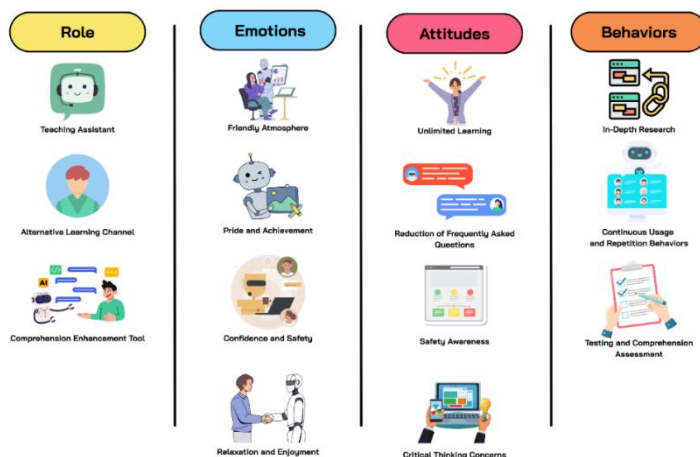


Figure 2: Results of Qualitative Data Analysis from User Experience Research

Phase 2: Chatbot Design

Based on the analysis from Phase 1, the researcher designed a chatbot to enhance computational thinking skills of Junior High School Students by applying user experience research. In Phase 2, the researcher divided the chatbot design process into three steps: (1) Designing chatbot activities, (2) Designing chatbot components, and (3) Creating a chatbot prototype. The details are as follows:

Step 1: Designing Chatbot Activities

The researcher utilized data from Phase 1 research and relevant curricula for developing computational thinking skills of Junior High School students to design chatbot activities. These activities enhance computational thinking skills for Junior High School students across four categories: (1) Decomposition, (2) Pattern Recognition, (3) Abstraction, and (4) Algorithm Design. The details are as follows:

1. Decomposition

Based on the analysis of user experience interviews and essential requirements for enhance computational thinking skills related to Decomposition, it was found that teachers and students prioritize teaching methods that emphasize systematic problem-solving as follows: (1) Teachers prefer using Problem-based Learning that connects real situations to content. (2) Students enjoy learning that focuses on planning and breaking problems into smaller steps. (3) Open-ended questions are used to stimulate analytical thinking. These findings led to the design of activities that allow learners to practice analyzing situations, dissecting problems, and sequencing steps to solve complex everyday problems. This aligns with learners' needs to develop systematic problem-solving skills. Example activities are shown in Table 2.

Table 2: Activities in Decomposition

Sub-activities	Questions/Content	Focus
Meaning	Decomposition is the skill of analyzing and breaking down complex problems into smaller components to make them easier to manage and solve. Problem solvers must be able to study the full complexity of a problem and select appropriate tools for solving each component. Event planning, with steps including: 1) Setting date and time 2) Choosing venue 3) Creating guest list	
Mystery Explorer	1. From the following scenarios, which one requires the most complex problem decomposition?	Problem-based Learning

Sub-activities	Questions/Content	Focus
	2. When decomposing a problem effectively, what step should you begin with?	Problem-based Learning
	3. If planning a friend's birthday party, what should be considered for effective problem decomposition?	Planning
	4. (Open-ended question) Explain how to decompose the process of preparing for university entrance exams into simple steps.	Open-ended questions to stimulate analytical thinking

2. Pattern Recognition

Based on the analysis of user experience interviews and essential requirements for enhance computational thinking skills related to Pattern Recognition, the findings indicate that teaching methods that encourage pattern observation are crucial. Specifically: (1) Teachers use thought-provoking questions (2) Puzzle games and open-ended questions are employed to assess thinking (3) Learners need to connect learning with real-life situations These concepts have been integrated into chatbot activities that allow learners to analyze patterns of varying complexity, practice observing relationships between elements, and connect these to real-life phenomena and nature. This approach aligns with the computational thinking skills that teachers emphasize. Example activities are shown in Table 3.

Table 3: Activities in Pattern Recognition

Sub-activities	Questions/Content	Focus
Meaning	Pattern Recognition is the skill of finding similarities or recurring patterns in problems, helping to predict and develop effective problem-solving methods. Example: Learning Mathematics 1. Equation solving: Observing similar operational patterns across different equations 2. Problem-solving: Finding identical structures and thinking methods in different problems	
Pattern Analyst	1. Which pattern do you think is the most complex? 2. If you need to analyze a complex pattern, which method would be most effective? 3. In a "Number Pattern Guessing" game, players receive the following sequence: 2, 6, 12, 20, 30, ?. Which analytical thinking approach would be best to find the answer? 4. (Open-ended question) Provide examples of patterns in daily life that can be predicted or anticipated.	Thought-provoking questions Connection to real-life situations Connection to real-life situations Open-ended questions

3. Abstraction

Based on the analysis of user experience interviews and essential requirements for enhance computational thinking skills related to Abstraction, findings indicate that promoting abstract thinking is a crucial component in developing computational thinking skills. Specifically: (1) An atmosphere conducive to thinking and questioning. (2) Opportunities for learners to express opinions and engage in self-directed learning. (3) Use of inquiry-based teaching methods The chatbot activities have been designed to develop understanding of abstract concepts, encourage learners to analyze and explain abstract ideas, and apply these concepts in system and application design. This approach aligns with promoting the thinking aspects of computational thinking skills. Example activities are shown in Table 4.

Table 4: Activities in Abstraction

Sub-activities	Questions/Content	Focus
Meaning	Abstract thinking is the skill of filtering out unnecessary information to focus on the essence of a problem by selecting only the most relevant and important data. Example: Travel Planning 1. Route selection: Focusing on distance, time, and cost while disregarding minor details 2. Report preparation: Selecting only important information relevant to the topic	
Abstract Thinker	1. In the context of Computational Thinking, what does Abstraction mean? 2. Which option exemplifies the use of abstract thinking in computational thinking? 3. What is the importance of abstract thinking in computational thinking? 4. (Open-ended question) Provide examples of using abstract thinking to solve problems in daily life.	Atmosphere conducive to thinking Atmosphere conducive to thinking Inquiry-based learning Opportunities for expressing opinions

4. Algorithm Design

Based on the analysis of user experience interviews and essential requirements for enhance computational thinking skills related to Algorithm Design, findings indicate that developing problem-solving procedural design skills is crucial. Specifically: (1) Students prefer programming that emphasizes planning and step-by-step problem-solving (2) Teachers prioritize creating an atmosphere conducive to systematic thinking (3) Real-life situations are used to practice problem-solving skills These concepts have been integrated into chatbot activities that allow learners to consider characteristics of efficient algorithms, analyze key factors in procedural design, and apply these concepts to real-life problem-solving. This approach aligns with the emphasis on developing systematic planning and problem-solving skills. Example activities are shown in Table 5.

Table 5: Activities in Algorithm Design

Sub-activities	Questions/Content	Focus
Meaning	Algorithm Design is the skill of creating a systematic sequence for problem-solving, focusing on finding the shortest, most efficient method that can correctly solve the problem Example: Homework Management 1. Task sequencing: Arranging homework assignments by priority and difficulty level for each subject 2. Exam preparation reading: Systematically planning reading schedules with appropriate time and content allocation	
Procedure Engineer	1. What characteristics should an efficient algorithm have? 2. When designing algorithms for solving everyday problems, which of the following factors should be considered most? 3. From the following scenarios, which demonstrates the most efficient use of an algorithm? 4. (Open-ended question) Design a step-by-step procedure for cleaning your bedroom following the Algorithm Design concept.	Planning and step-by-step problem-solving Atmosphere conducive to systematic thinking Real-life situations for practicing problem-solving skills Real-life situations for practicing problem-solving skills

Step 2: Designing chatbot components

The researcher developed a chatbot to enhance computational thinking skills for Junior High School students. The design details and prototype of this chatbot aim to enhance computational thinking skills for Junior High School students and will be tested with the research sample. The chatbot design is divided into three sub-sections: (1) Designing chatbot feature activities, (2) Designing the user interface, and (3) Designing user feedback mechanisms.

(1) Designing Feature Activities on the Chatbot

In this research phase, the researcher analyzed and synthesized user experiences, user requirements, and designed feature activities on the chatbot. The researcher followed specific steps in selecting features as detailed below.

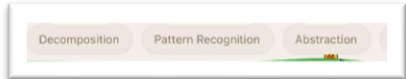
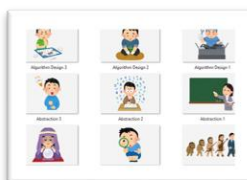
Table 6: Details of Features on Line Official Account (Line OA) Responding to User Experiences and Requirements

User Experiences and Requirements	Feature	Details
1. Alternative learning channel with continuous availability	Chat	The chatbot serves as an alternative learning resource for users, promoting computational thinking skills through conversations between learners and the chatbot
2. Friendly atmosphere and ease of use	Rich Menu	A menu system that allows users to select messages based on their interests without having to type search queries, encouraging chatbot engagement
	Greeting Message	Initial message displayed when users add the Line Official Account as a friend
3. Pride and achievement	Reward Card	A point accumulation system that allows users to exchange points earned from teachers for scores or prizes during instruction, motivating users to engage with the chatbot
4. Confidence and safety	1-on-1 Chat	The chatbot is built on the Line Official Account platform, where conversations between users and the bot are conducted in a one-on-one format, ensuring high-level security
5. Unlimited learning	Chat	The chat format poses questions for users to answer, stimulating thinking during usage
6. Reduction of frequently asked questions	Card-based Message	Messages in card format that allow users to select questions or topics of interest
7. Testing and comprehension assessment	Rich Menu	A menu system of tests that allows users to assess their understanding before and after using the chatbot

(2) Designing the user interface

In this research stage, the researcher's role involves analyzing and synthesizing user experiences, user requirements, and designing the user interface (UI) for the chatbot. The researcher followed specific steps in selecting the user interface design as detailed below.

Table 7: Details of User Interface Components on Line Official Account (Line OA) Responding to User Experiences and Requirements

Topics	User Interface Components	Source
1. Profile Page		User Requirements
2. Chat Interface		User Requirements
3. Rich Menu		User Requirements
4. Text Messages		User Requirements
5. Quick Reply		User Experiences and Requirements
6. Message Templates		User Requirements
7. Rich Media		User Experiences and Requirements

(3) Designing user feedback mechanisms

The design of feedback mechanisms for learners aims to provide appropriate feedback that enhances computational thinking skills. This feedback will be delivered to learners when they interact with the chatbot during each sub-activity. The design incorporates Open AI technology to provide customized feedback to learners, categorizing them into three groups: high-performing, average, and low-performing students. Each group will receive differentiated feedback tailored to their specific learning needs and proficiency levels.

Table 8: Examples of User Input and Feedback

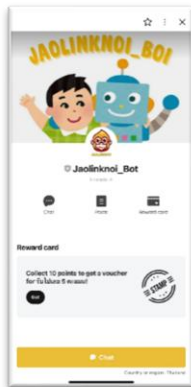
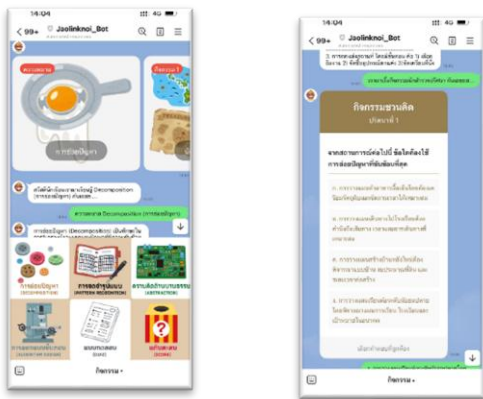
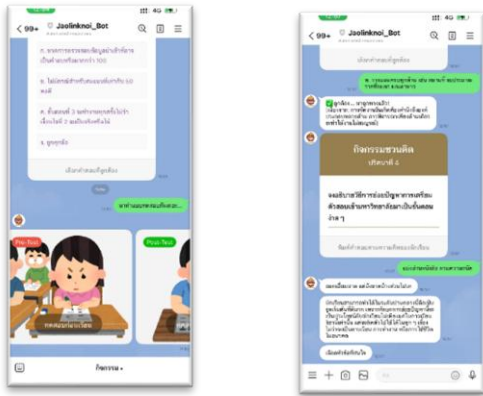
Activities	Response Group	User Input	Feedback to User
Decomposition			
Explain how to decompose the process of preparing for university entrance exams into simple steps.	High Performance	1. Categorize by exercise type: end-of-chapter exercises, past exams, supplementary problems 2. Break down into subtopics and create a mind map for clear overview	The student demonstrates excellent understanding of decomposition principles, can analyze complexity, comprehend fundamental concepts, and appropriately apply them to various situations.
	Average Performance	1. Categorize by exam type 2. Separate understood topics from those not yet understood	The student demonstrates moderate decomposition skills, which represents a good starting point. This skill will prove beneficial in academic pursuits, professional environments, and future life situations.
	Low Performance	1. Study before class 2. Read favorite subjects first	The student demonstrates basic decomposition skills. While not yet at full potential, this represents an important first step. This ability will develop into a critical skill for addressing challenges across all dimensions of life.
Pattern Recognition			
Provide examples of patterns in daily life that can be predicted or anticipated.	High Performance	1. Relationship between velocity and distance of freely falling objects 2. Sound wave reflection patterns in rooms of different shapes	The student demonstrates strong pattern recognition understanding, can analyze and identify recurring characteristics in various elements clearly, and comprehends the principle of finding recurring components.
	Average Performance	1. Traffic light signal changes based on time cycles 2. Movement patterns of clock hands each hour	The student demonstrates moderate pattern recognition ability, which provides a good foundation. The skill of identifying recurring characteristics or elements will be beneficial in multiple areas.
	Low Performance	1. Daily sunrise and sunset times 2. Seasonal changes	The student demonstrates limited pattern recognition ability. While not yet at full potential, this represents a commendable first step. The ability to identify recurring components will become an important skill in the future.

Activities	Response Group	User Input	Feedback to User
Abstraction			
Provide examples of using abstract thinking to solve problems in daily life.	High Performance	1. Organizing class schedules using colors to represent different subjects 2. Grouping clothes by color for easier selection	The student demonstrates excellent understanding of abstract thinking, can filter unnecessary details, distinguish important information, and create efficient models.
	Average Performance	1. Categorizing clothes 2. Grouping books	The student demonstrates moderate understanding of abstract thinking, which provides an important foundation applicable to many aspects of life. Continued practice will help develop this skill further.
	Low Performance	1. Organizing bags 2. Making labels	The student demonstrates basic understanding of abstract thinking, still faces challenges in separating important elements from unnecessary details, and requires practice in creating appropriate models.
Algorithm Design			
Design steps for cleaning your bedroom following the Algorithm Design concept.	High Performance	1. Start by collecting items from the desk, then from the bed, followed by sweeping, mopping, and finally cleaning windows 2. Organize study desk, fold blankets on bed, sweep floor, mop floor, open windows for ventilation	The student demonstrates excellent understanding of algorithm design, can create clear, concise, and efficient step sequences that lead to desired outcomes.
	Average Performance	1. Collect garbage, dust surfaces, sweep floor, mop floor 2. Make bed, put away clothes, sweep floor	The student demonstrates moderate algorithm design capability, showing a good foundation in sequential thinking, a skill applicable to all aspects of life.
	Low Performance	1. Sweep floor, mop floor 2. Collect garbage, sweep floor	The student demonstrates basic understanding of algorithm design, still faces challenges in systematically sequencing problem-solving steps, and requires additional practice in creating efficient solution methods.

Step 3 : Creating a chatbot prototype

After completing the design of the chatbot, its components, and structure, the researcher will proceed to create a prototype of the chatbot designed to enhance computational thinking skills for Junior High School students. This prototype will demonstrate the capabilities available to users and will be tested to determine whether the developed chatbot effectively enhance computational thinking skills among Junior High School students.

Table 9: Details of the Chatbot Prototype

Details	Chatbot Prototype
1. Profile Page Clear explanation about the chatbot's objective in developing problem-solving skills through engaging activities	
2. Conversation System Developed to be natural and user-friendly with easily accessible main command menus for various functions and presentation of learning activities covering all 4 components of computational thinking skills: decomposition, pattern recognition, abstraction, and algorithm design	
3. Comprehension Review System Analysis of answers and immediate feedback, along with ability assessment divided into 3 levels, providing recommendations to help users learn effectively, including pre-test and post-test when using the chatbot	

Details	Chatbot Prototype
4. Point Accumulation System Diverse scoring structure and clear achievement levels to create learning motivation, users receive benefits according to achievement levels and can exchange accumulated points for various rewards, promoting continuous skill development	

Discussion

This research developed a chatbot to enhance computational thinking skills of lower secondary school students. The study of user experience was the basis for design and development. The results of the research showed that the study of user experience in designing a chatbot that promoted four aspects of computational thinking skills: decomposition, pattern recognition, abstract thinking, and algorithm design.

The design of the chatbot activities using the problem-based learning concept stimulated learners' interest and engagement, which is consistent with the research of Duangnate & Klaimongkol (2022) and Khamnaen & Koraneekij (2022) who found that this learning model enhanced computational thinking skills and achievement motivation of students. In addition, grading the difficulty of the activities and providing appropriate feedback for each group of learners (high, medium, and low) helped learners develop their skills to their potential.

The user experience research before developing the chatbot provided insights into the needs and expectations of users, enabling the design of a chatbot that truly meets the needs of users, which is consistent with the concept of Skjuve and Følstad (2021) who emphasized the importance of analyzing user needs in developing effective chatbots.

Conclusions

User experience research to develop chatbots that promote computational thinking skills of early secondary school students is important and necessary in the digital age. This research has shown that studying user experience is an important factor in designing and developing effective educational chatbots. The developed chatbots can promote four aspects of computational thinking skills: decomposition, pattern recognition, abstract thinking, and algorithm design.

Designing diverse and appropriate chatbot activities for students' ability levels, using problem-based learning concepts, and providing appropriate feedback for each group of students are important factors that promote the development of students' computational thinking skills. In addition, designing a user interface that is friendly and attractive can stimulate learners' engagement and interest.

The research results concluded that the developed chatbot prototype as an educational innovation can be used to develop chatbots that promote learners' computational thinking skills under the concept of studying user experiences and needs and in line with the learning curriculum. However, there are still limitations of the research in its application. This research has significant limitations in terms of the sample size being limited to early secondary school students in a single educational institution, which may affect the broader reference of the results and the practical application of the research results. At the classroom level, teachers can use chatbots as teaching assistants to answer questions and provide feedback, allowing teachers to have more time to take care of students on more complex issues.

Recommendations

1. Recommendations for applying the research results

1.1 Teachers of computational science should use chatbots as a supplementary tool in teaching and learning to promote students' computational thinking skills. This can be used as an extracurricular activity or integrated into classroom teaching.

1.2 Teachers should be trained to have knowledge and skills in using chatbots to promote students' learning, including continuous monitoring and evaluation of chatbot usage.

2. Recommendations for future research

2.1 Research should be conducted to develop chatbots that promote computational thinking skills for students in other grades.

2.2 Comparative research should be conducted between the use of chatbots to promote computational thinking skills and other teaching methods to obtain clear information on the effectiveness of chatbots in promoting learning.

References

- Ali, M. R., Majelan, Z. S., Pourebadi, M., Mehrdad, R., & Tajeran, M. (2024). AedBot: A novel educational chatbot based on artificial intelligence. *Computers & Education*, 180, 104435.
<https://doi.org/10.1016/j.compedu.2023.104435>
- Atmatzidou, S., & Demetriadis, S. (2559). Advancing students' computational thinking skills through educational robotics: A study on age and gender relevant differences. *Robotics and Autonomous Systems*, 75, 661-670. <https://doi.org/10.1016/j.robot.2015.10.008>
- Design Council. (2005). *The design process: What is the double diamond?*
<https://www.designcouncil.org.uk/our-work/skills-learning/tools-frameworks/framework-for-innovation-design-councils-evolved-double-diamond/>
- Duangnate, N., & Klaimongkol, Y. (2022). Effects of using game-based learning in mathematics on computational thinking of elementary school students. *Journal of Information and Learning*, 33(1), 11-23. <https://so04.tci-thaijo.org/index.php/jil>
- Garrett, J. J. (2011). *The elements of user experience: User-centered design for the web and beyond*. Pearson Education.
- Imcham, S. (2019). Effects of online scaffolding chatbot on computational thinking of tenth grade students with different personalities. *Chulalongkorn University Theses and Dissertations (Chula ETD)*. 9818.
<https://digital.car.chula.ac.th/chulaetd/9818>
- Khamnaen, N., & Koraneekij, P. (2022). Effect of a flipped learning model with problem-based learning and gamifications to enhance computational thinking and achievement motivation of upper secondary school students. *Journal of Education Naresuan University*, 24(4), 156-164.
- Lee, M. J., Ko, A. J., & Kwan, I. (2013). In-game assessments increase novice programmers' engagement and level completion speed. In *Proceedings of the 9th Annual International ACM Conference on International Computing Education Research (ICER '13)* (pp. 153-160). Association for Computing Machinery. <https://doi.org/10.1145/2493394.2493410>
- Mishra, A., Shukla, A., & Sharma, R. (2024). Advanced NLP techniques for chatbot development: A comprehensive review. *International Journal of Intelligent Systems*, 39(3), 1-22.
<https://doi.org/10.1002/int.22983>
- Ministry of Education. (2017). *Indicators and core learning content for science subject group (Revised 2017) according to the Basic Education Core Curriculum B.E. 2551 (2008)*. Ministry of Education, Thailand.
- Office of the Basic Education Commission, Ministry of Education. (2017). *Learning management guide for basic science subjects: Technology (Computing Science)*. Ministry of Education, Thailand.
- Ouhaichi, H., Spikol, D., & Vogel, B. (2023). Research trends in multimodal learning analytics: A systematic mapping study. *Computers and Education: Artificial Intelligence*, 4, 100136.
<https://doi.org/10.1016/j.caeai.2023.100136>

- Rotkomil, P. (2021). *Development of learning management prototype aligned with behavioral patterns of Alpha Generation elementary school students: Application of user experience research*. [Master's thesis, Chiang Mai University]. Graduate School, Chiang Mai University, Chiang Mai.
<https://cmudc.library.cmu.ac.th/frontend/Info/item/dc:164121>
- Sirat, I. (2019). *Effects of using chatbot with online scaffolding on computational thinking of grade 10 students with different personalities* [Master's thesis, Chulalongkorn University]. Chulalongkorn University Intellectual Repository.
- Sirilak, W. (2018). Design research and user experience study to develop design principles and prototype for promoting positive research mindset of teachers. *Chulalongkorn University Theses and Dissertations (Chula ETD)*. 3302. <https://digital.car.chula.ac.th/chulaetd/3302>
- Skjuve, M., Følstad, A., Fostervold, K. I., & Brandtzaeg, P. B. (2021). My chatbot companion - a study of human-chatbot relationships. *International Journal of Human-Computer Studies*, 149, 102601.
<https://doi.org/10.1016/j.ijhcs.2021.102601>
- Yu, W., Yang, Y. (2020). Research on User Experience Design of Cross-Border E-commerce Platform Based on CUBI Model and NPS Index in the Context of Expanding Import: A Case Study of KaoLa. In: Ahram, T., Falcão, C. (eds) *Advances in Usability and User Experience*. AHFE 2019. *Advances in Intelligent Systems and Computing*, vol 972. Springer, Cham. https://doi.org/10.1007/978-3-030-19135-1_52