Artificial Intelligence Unplugged: Designing Unplugged Activities for a Conversational AI Summer Camp

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ABSTRACT

As conversational AI apps such as Siri and Alexa become ubiquitous among children, the CS education community has begun leveraging this popularity as a potential opportunity to attract young learners to AI, CS, and STEM learning. However, teaching conversational AI to K-12 learners remains challenging and unexplored due in part to the abstract and complex nature of some conversational AI concepts, such as *intents* and *training phrases*. One promising approach to teaching complex topics in engaging ways is through *unplugged activities*, which have been shown to be highly effective in fostering CS conceptual understanding without using computers. Research efforts are underway toward developing unplugged activities for teaching AI, but few thus far have focused on conversational AI. This experience report describes the design and iterative refinement of a series of novel unplugged activities for a conversational AI summer camp for middle school learners. We discuss learner responses and lessons learned through our implementation of these unplugged activities. Our hope is that these insights support CS education researchers in making conversational AI learning more engaging and accessible to all learners.

CCS CONCEPTS

• **Social and professional topics → Computer science education**; **Informal education**; **K-12 education**.

KEYWORDS

unplugged activities, conversational AI, CS and AI learning, middle school, summer camp

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1 INTRODUCTION

Artificial Intelligence (AI)-based conversational apps, such as Siri and Alexa, are becoming increasingly popular among young users [38]. The surging appeal of these conversational applications holds promise for attracting young learners to AI, computer science (CS), and STEM disciplines [35]. To leverage this popularity, researchers in the K-12 AI education community have started to explore teaching conversational AI to young students [17, 20]. Learning about conversational AI brings numerous benefits to young students, such as improved self-efficacy and persistence in learning AI [20, 31], higher motivation to share their ideas on AI [31], and a better understanding of general AI [34].

Despite the benefits and potential, challenges still exist in teaching conversational AI to young learners. The main concepts in conversational AI, such as *intents*, *training phrases*, and *responses*[1], are highly abstract and complex for young learners to understand [33]. Moreover, while most educational programs utilize digital tools to support learning conversational AI [21, 34], many learners face limited access to the internet and digital devices [8], and many schools are unable to afford to deploy these devices en masse [36]. Therefore, it is important to find ways to make learning about conversational AI more accessible and engaging for all learners.

One solution to this challenge is unplugged activities. Unplugged activities present a low-cost solution to teach complex CS concepts without using computers [7]. Numerous unplugged activities have demonstrated effectiveness in helping learners grasp CS concepts and enhance computational thinking in a fun and engaging way [5, 18]. In addition, they provide breaks from screen time and allow learners to move around and engage their whole bodies [37]. Despite the benefits, there are few unplugged activities tailored for teaching conversational AI. Moreover, there is scarce research to guide the iterative design of unplugged activities in the context of conversational AI education.

[1] In conversational AI systems, *intent* refers to the purpose a user has in mind when asking a question or making a statement (e.g., "request song recommendation"). *Training phrases* are example user expressions used to train the chatbot to recognize an intent (e.g., "Can you recommend a song?"). *Responses* are the messages that the chatbot provides to the user when an intent is triggered (e.g., "Sure! I recommend 'Blinding Lights' by The Weeknd.")

This experience report describes the design and deployment of a series of unplugged activities with 50 middle school learners in conversational AI summer camps over two years. The unplugged activities include two CS-focused activities, namely *Yoga from Scratch* and *Lego Algorithm*, and three conversational AI-specific activities, namely *User, Developer, Agent Card Game*; *Mission Agent Training*; and *Chatbot Personality*. The activities are designed to foster the conceptual understanding of conversational AI and to prepare learners to develop personally relevant chatbots during the camp. The results of our summer camp experiences suggest that these unplugged activities enable learners of all backgrounds and skill levels to explore CS and AI in an interactive, non-digital manner.

2 BACKGROUND AND RELATED WORK

"CS Unplugged" is a long-standing initiative to introduce CS concepts to novice learners without using computers [7]. Such unplugged activities offer many advantages, including reducing the barrier of learning programming [4], presenting a feasible solution for contexts with limited access to computing devices [9], immersing students in a relatable manner [18], and dispelling the misbelief that CS revolves solely around programming [16]. "CS Unplugged" provides free CS lessons, unplugged activities, and teaching materials through its website [6]. It has not only been widely implemented in educational outreach endeavors like afterschool initiatives and summer camps [1, 2] but also integrated into conventional CS classrooms [29, 32]. Nishida et al. [27] analyzed the "CS Unplugged" activities and identified seven design patterns that made the activities successful; 1) No computers, 2) Games or challenges, 3) Kinaesthetic, 4) Student directed, 5) Easy implementation, 6) Growing body of ideas, and 7) Sense of stories.

While AI as a field has existed since the 1950s [23], most research regarding unplugged activities in AI education has been published recently [22, 23, 25, 26]. General AI unplugged activities such as "the Turing Test" [3] and the "Intelligent Piece of Paper" [28] have been shown to demystify AI by transforming the ambiguous notion of "intelligence" to computer tasks that simulate human-like behavior [14]. Long et al. [25] presented three AI unplugged activities, "Introducing AI," "Sensors and Cyborgs," and "Semantic Network," with instructions and materials on their website for learners aged 5 to 14 [24]. Ma et al. [26] created two unplugged activities, "Pasta Land-Decision Tree" and "Penguins-k-Nearest Neighbor" for a middle school after-school program. A survey and interviews suggested that the activities effectively helped learners to understand Machine Learning and AI better. Similarly, Lindner et al. [22] created unplugged activities related to machine learning and implemented them with high school students. These unplugged activities addressed AI4K12's Big ideas [33] and aimed to provide an inclusive curriculum to serve all students regardless of background knowledge or experience level, and they demonstrated promising learner outcomes in both CS and AI domains [13].

3 CONTEXT

3.1 Conversational AI Summer Camps

The unplugged activities were implemented in the context of two-week-long in-person AI summer camps for middle school students (rising 7th and 8th graders) in the Southeast United States. The summer camps aimed to engage students in learning about CS and AI through conversational AI, centering around general CS and AI concepts, conversational AI concepts, unplugged activities, and chatbot development projects. Four sessions were conducted over three years: one in 2021 (a pilot), two in 2022[2], and one in 2023. In the pilot year, we adopted a few popular CS Unplugged activities such as "Human Crane" [10] and "Sorting Networks" [11]. We recognized that using these existing CS unplugged activities with limited connection to our AI learning content seemed to limit engagement, which motivated us to develop a set of new unplugged activities tailored to our content and context in the next two years.

3.2 Learners and Facilitators

This experience report focuses on the 50 learners who participated in our summer camp during 2022 and 2023, including one camper who attended in both years. In 2022, 32 learners participated in two sessions (17 girls and 15 boys, 25 Black/African-American, 5 Hispanic/Latinx, 4 White, 1 Asian, 1 Native American/Alaskan Native)[3]. The average age was 12.7 years (SD=0.7). In 2023, 19 learners participated in one session (7 girls and 12 boys, 6 Black/African-American, 2 Hispanic/Latinx, 8 White, and 4 Asian). The average age was 12.05 years (SD = 0.4). There were two English learners whose primary languages were Portuguese and Turkish, respectively.

This experience report also includes some of the experiences of our undergraduate camp facilitators. The 13 unique facilitators (one attended both years' camps) consist of eight women and five men across several majors (e.g., Computer Science, Psychology, and Health Education). There were eight facilitators in 2022 and six in 2023. Their roles were to brainstorm the initial unplugged activity ideas; lead or assist with the unplugged activities during the camp; and provide feedback during testing and after the deployment with learners. We collected data from both learners and facilitators, within a study approved by the institutional review board (IRB) of the University of Florida, and we obtained parental consent and participant assent from all campers before the study as well as informed consent for data collection from all facilitators.

4 ITERATIVE DESIGN PROCESS

We utilized an iterative design approach [19], working with the camp facilitators and learners in ideating, prototyping, testing, and improving the unplugged activities. We designed five novel CS and AI unplugged activities over two years. In 2022, we created the *Yoga from Scratch* and *User, Developer, Agent Card Game*; in 2023, we created the *Lego Algorithm, Mission Agent Training*, and *Chatbot Personality*. Two graduate researchers and three voluntary undergraduate facilitators collectively brainstormed the initial ideas based on existing CS and AI Unplugged activities, the design patterns for successful CS Unplugged activities [27], and a set of well-defined learning objectives for the camp.

We held unplugged activity workshops during the professional development[4] to test each activity multiple times before the camp. During these workshops, facilitators participated in the activities

[2]The two sessions in 2022 followed a nearly identical curriculum; we held two sessions to reach more learners.
[3]Learners could identify as more than one race/ethnicity.
[4]We held 60 hours of PD to prepare the facilitators to provide lessons and technical support to the learners.

acting as learners. At the end of each activity, we discussed potential challenges, areas of confusion, and how to make improvements. After two or three times of testing, we refined the instruction and created the final version of activity materials (e.g., worksheets). We conducted the final workshop to test the usability of the instructions and materials and prepare the facilitators to lead or assist with each activity during the camp.

We implemented these unplugged activities in the summer camp over two years with 50 middle school learners. In 2022, we implemented the *Yoga from Scratch* and *User, Developer, Agent Card Game*; in 2023, we implemented the *Yoga from Scratch* (again), *Lego Algorithm, Mission Agent Training*, and *Chatbot personality*. To identify the reactions and feedback on each activity, we used the following channels. First, facilitators shared their opinions through daily reflections and the post-camp individual interviews in both years. Graduate researchers also wrote observation notes after each activity, which captured points for clarification, confusion moments, or discussion questions to be added. Lastly, learners wrote free-response reflection notes after each activity in 2023 anonymously to the following prompts: 1) What did you learn from this activity? 2) What did you like/not like about the activity? What can be improved?; the responses were coded for alignment with the learning objectives by a researcher. In addition, five randomly selected learners participated in a 30-minute-long focus group interview after experiencing unplugged activities in the 2023 camp.

5 CS & AI UNPLUGGED ACTIVITIES

This section introduces the five novel unplugged activities that have been produced from the previously described iterative refinement process. Two of these unplugged activities are CS-focused and three are more specific to conversational AI concepts.

5.1 CS Unplugged Activities

While our context focuses on conversational AI, we contextualize AI in the broader CS field. Thus, we included two CS Unplugged activities: *Lego Algorithm* and *Yoga from Scratch*.

5.1.1 ***Lego Algorithm***. This activity aims to demonstrate the importance of providing specific instructions in programming.[5]

- **Learning objective** I can demonstrate the process of computer task execution and describe the differences between a human, a computer, and AI.
- **Related camp lesson** *Intro to CS/AI*
- **Preparation** Lego blocks, printouts of Lego figures[6], blank paper, and pencils.
- **Instructions**
  (1) Split students into groups of 3 or 4. Distribute one blank sheet of paper, a pencil, and one Lego figure to each group.
  (2) Each group writes down detailed instructions on how to build the given Lego figure. (15 minutes)
  (3) Collect the instructions and figures and disassemble the figures into individual pieces.
  (4) Distribute each disassembled figure and its instructions to a new group, ensuring each group receives a different set of instructions than the figure they wrote about.
  (5) Instruct students to build the Lego figure using only the instructions they received without making any assumptions.
  (6) Distribute photos of the original Lego figures. Compare their final figure with the original images.
- **Discussion and debriefing** After the activity, engage the students in a discussion using the following questions: (1) "How detailed did you need to be when making the instructions?" (2) "Did you face any challenges building the Lego?" (3) "Did you make any assumptions during the exercise?" Summarize the key takeaway by emphasizing the importance of precise instructions in computer programming and introduce the background of AI's emergence by explaining that AI is based on data and can make assumptions like humans.

This activity was implemented in the 2023 camp following the *Intro to CS and AI lesson.* One student group wrote in their instructions for a car figure: *"put the rim on the wheel ∗4."* The group receiving their instructions literally put four rims on one wheel (see Fig. 1), making the group who wrote the instruction realize their instruction was ambiguous.

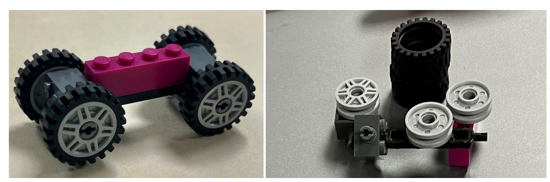

Figure 1: The intended Lego figure (left), the output from the other group following the instruction (right)

All sixteen participants' reflections aligned with the learning objective. One student wrote they learned *"that you have to be very specific with a computer because they can't make assumptions like us,"* and another student stated *"I learned how important specifics are in computer coding, also how AI makes it easier."* In the interview, some students stated they *"really love playing with Legos"* and *"especially enjoyed the Lego activity."* Facilitators also remarked that *"Both students for who [sic] English is not their first language still participated extensively and found workarounds to roadblocks."*

5.1.2 ***Yoga from Scratch***. This activity aims to teach the basic programming concepts (i.e., loops and conditionals) through block-based programming and physical movements.

- **Learning objective** I can explain the purpose and usage of loops and conditionals in a block coding language and use my body to follow the coded program.
- **Related camp lesson** (in a broad sense) *Intro to CS/AI*
- **Preparation** A set of yoga poses [7], paper blocks representing each pose, Scratch block printouts, marker pens, and an open space for students to be able to move their bodies comfortably.

[5] This activity was adapted from online educational resources using legos [30], inspired by algorithm-related activities using drawings [12] and the well-known peanut butter and jelly sandwich activity [15].

[6] The instructor should build different Lego figures for each group in advance (e.g., a car, dinosaur, heart) and print out the pictures of each figure. The figures cannot be too complex; ideally comprised of less than eight blocks for each figure.

[7] Prepares simple yoga poses prior to the activity (e.g., Warrior, Triangle, Tree pose).

- **Instructions**

(1) Instruct a set of predetermined yoga poses.
(2) Introduce the Scratch blocks and their usages. Establish a limit to the time for the 'wait' block (e.g., maximum 5 seconds) and the number of repetitions for the 'repeat' block (e.g., maximum three times).
(3) Split students into groups of 3 or 4 and distribute the yoga pose blocks, Scratch functions, and a marker pen.
(4) Instruct each group that they will have 10 minutes to write the program of yoga sequences using all the given blocks. Encourage them to be creative in writing the conditions (e.g., **If** "you are wearing glasses," **then** "do Warrior pose.").
(5) After the time is up, collect the written programs from each group and put them on the whiteboard.
(6) Instruct all students to follow the block code written by each group, doing the yoga poses accordingly.

- **Discussion and debriefing** After the activity, engage the students in a discussion using questions such as: (1) "Were you able to create the yoga sequences as you wanted using the Scratch blocks?" (2) "What does 'if, then' block do?" Wrap up the activity by summarizing each block's meaning and usage and how they can help make the code concise and accommodate conditions.

Figure 2: Yoga poses sequence programmed by a group of learners (left), learners following the coded blocks (right)

Although facilitators stated they observed enthusiasm among the learners in the daily reflection, students' reactions were mixed, with positive reactions including *"I learned a lot more about blocks and what they do," "I liked when we did the poses from the other teams, following their instructions"* and negative ones including *"I didn't learn anything," "I learned that I already know how to use Scratch."* One facilitator explained this mixed response in the interview:

> *I think the kids that said 'that didn't teach me anything' are the ones that have block-coded before and done things more complex. So they didn't really learn anything different. And we also never really talked about things like these, 'if then else' statements in our camp, that's a statement you use in regular programming. So I think making that connection maybe would foster their interest a little bit more in the yoga activity.*

5.2 Conversational AI Unplugged Activities

Three conversational AI unplugged activities were created to help understand conversational AI concepts, closely connected to AI4K12 Big Ideas [33]. We describe these activities: *User, Developer, Agent Card Game; Mission Agent Training*; and *Chatbot Personality.*

5.2.1 *User, Developer, Agent Card Game.*

- **Learning objective** I can identify and explain the "user", "agent," and "developer" roles in the design and development of chatbots.
- **AI Big Ideas** #2. Representation and Reasoning.
- **Related camp lesson** *Intro to Chatbots*, *Chatbot Development*
- **Preparation** Three stacks of *developer's goal, user's utterance*, and *agent's response* cards.
- **Instruction**

(1) Shuffle each deck of cards and randomly distribute them on separate tables.
(2) Split the students into three teams and assign a table with a deck of shuffled cards.
(3) Each team will work together to group the cards based on individual chatbot ideas. Each chatbot idea will have three cards: a *developer's goal* card, which describes what the developer wants to create (e.g., "a chatbot that recommends music"); a *user's utterance* card, which has an example of what a user might say (e.g., "Can you please recommend a fun song?"); and an *agent's response* card, which has an example of the chatbot's response (e.g., "Sure, Wobble by V.I.C is a fun song.").

- **Discussion and debriefing** Engage the students in a discussion using the following questions: (1) "Can you think of any examples of chatbots?", (2) "What else can a chatbot be used for?", (3) "How do you think a chatbot can understand what a user says?", (4) "If you could create your own AI chatbot, what tasks would you want it to do?" Wrap up by encouraging them to view themselves as developers and empowering them to think about what type of meaningful chatbot they can develop.

This activity was included fully in 2022 and as a shortened version in 2023 due to time constraints as a part of the *Intro to Chatbots* lesson (Fig. 3). Facilitators appreciated the high engagement in collaboration and competition, saying that *"I think the kids were very engaged. They really seemed to respond well with the competitiveness."*

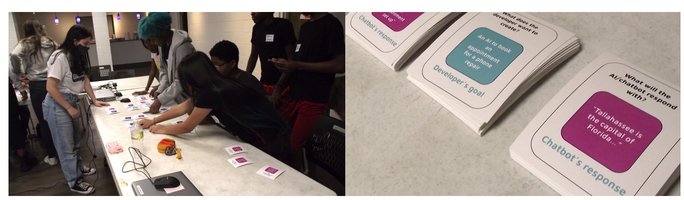

Figure 3: Learners classifying user, developer, and agent cards (left), shuffled sets of cards (right)

5.2.2 *Mission Agent Training.*

This activity demonstrates the process of agent training by letting students act out agents, users, and developers in different agent training phases.

- **Learning objective** I can describe how the conversation between an agent and user develops depending on training phases.
- **AI Big Ideas** #3. Learning
- **Related camp lesson** *Intro to Chatbots, Intro to Data and Machine Learning, Intro to Intents, Intro to Special Intents*

- **Preparation** One agent mask[8], one default fallback card[9], pre-written user question cards[10], blank index cards, masking tape, and a whiteboard.
- **Instruction** This activity comprises three rounds reflecting the phases of agent training and between-round activities to train the agent.
  (1) **Round 1**: Agent knows NOTHING.
  Choose two student volunteers to act as a chatbot and a user in front of the class. The agent student receives one default fallback response flashcard and the agent mask; the user student receives a set of flashcards with pre-written questions. The user and agent attempt to have a conversation using only the given flashcards.
  (2) **Between rounds**: Agent needs HELP.
  (3) **Round 2**: Agent learned the responses RANDOMLY.
  Choose two new students to play the roles of agent and user. Collect and shuffle the response index cards and provide them to the agent and let them have a conversation only using the given flashcards.
  (4) **Between rounds**: Agent needs HELP.
  The whole class identifies *intents* and classifies user questions into these intents. Draw a table on the whiteboard with the intents acting as the title for each column. Use tape to stick each question card under the correct intent. Ask students to take turns sticking their response cards in the correct intent sections.
  (5) **Round 3**: Agent can now have a GOOD conversation.
  Replace the current agent and user with two new students. Provide the agent with the sorted and ordered responses.
- **Discussion and debriefing** Engage the students in a discussion using the following questions: (1) "What challenges did the agent or user encounter in each round?", (2) "What sorts of keywords did you use to recognize the intents?", (3) "What did we do to make the agent smarter?" During the discussion, bring up any notable incidents in each round and explain how those incidents could impact a chatbot (e.g., mention that there was a response with a typo and ask how the flawed data would impact the chatbot training). Debrief this activity by connecting each step with the conversational AI concepts (e.g., user questions categorized as intents are called *training phrases*).

This activity was implemented in the 2023 camp after learners completed the related lessons. In Figure 4, learners acted out the agent and the user (top), *Intents, Training phrases* (User Questions), and *Responses* are classified on the whiteboard (bottom). Most learners' (88%) responses aligned with the learning objectives (i.e., the importance of data and how intents work). One learner stated, *"I learned that you need intents to categorize the responses for the agent to respond with a good answer."* Another learner reflected on an incident where one student's agent response, "There are two movie theaters in town," was written to belong to the "Activities in Town" intent, but some learners tried to categorize it into the "Movies" intent. The student stated, *"I learned that if you put 2 words that can go for 2 categories, the agent might put it in the wrong category."*

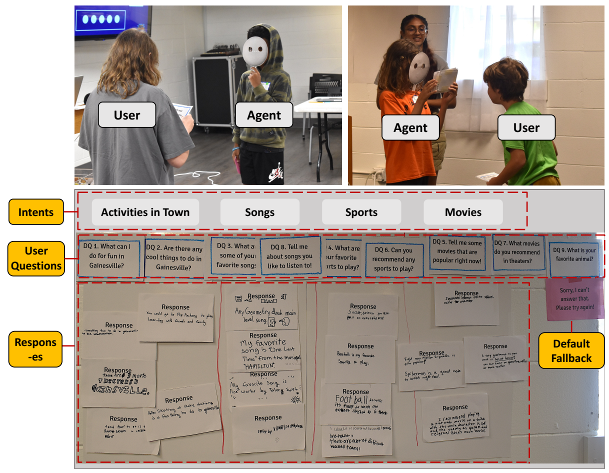

Figure 4: Learners acting out the agent and the user

5.2.3 *Chatbot Personality.*

This activity allows students to design a chatbot personality through voice traits and language use, act out this personality, then receive peer feedback.

- **Learning objective** I can explain how different voice traits can influence the personality of a voice-based chatbot and infuse proper personalities into my chatbot.
- **AI Big Ideas** #4. Natural Interaction
- **Related camp lessons** *Chatbot Personality Design*, *Chatbot Development*
- **Preparation** Worksheets (see example in Fig. 5) and pencils.
- **Instruction**
  (1) Split the students into pairs and distribute one worksheet per pair. Instruct each pair to develop a unique personality for their chatbot by brainstorming key characteristics (i.e., name, pitch, speed, tone) and completing the worksheet.
  (2) Instruct each pair to create a dialogue script for their chatbot's *Greet*[11], *Default Fallback*, and *Bye* intents[12] in the dialogue section of their worksheet.
  (3) *Option 1.* Have two pairs of students come out to the front and act out their dialogue scripts. Let the rest guess the personality and give feedback on how to improve them.
  Option2. Have each pair group with the adjacent pair to form a small group. Have one pair act out their dialogues, and the other guess the personality and give feedback. Take turns and do the same.
- **Discussion and debriefing**
  Engage the students in a discussion using the following discussion questions: (1) "Did the chatbot personalities and dialogue scripts feel natural?" (2) "What feedback helped you improve?" Summarize the activity emphasizing that developers can create chatbots to deliver emotions and have more natural interactions with humans by customizing their voice features and languages.

[8] Make a mask to represent a conversational agent, such as a Google Home speaker
[9] A default fallback response is triggered when the user's expression cannot be matched to any existing intents (e.g., "Sorry, I can't answer that. Please try again.)
[10] Questions that users might ask (e.g., "Can you recommend sports to play?"). Include topics that middle school students might be interested in.
[11] A Greet intent is usually triggered at the initiation of the conversation, such as "Hi, I am [BotName]."
[12] Bye intent is triggered when the user intends to end the conversation. An example response for the Bye intent is "Bye! Talk to you later."

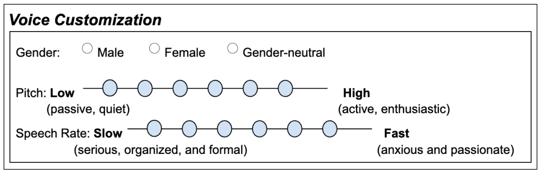

Figure 5: Voice customization section in the worksheet

This activity was implemented in 2023 after the *Chatbot Personality Design* lesson and the initial ideation of chatbot projects. Ten out of sixteen (63%) learners' reflections aligned with our learning objective. Learners stated that they learned that *"the personality of a bot can make the user feel they are talking to a real person."* and *"pitch, speaking rate, and the words that the chatbot uses all determine its personality."* Two students stated that they learned about *"the importance of peer feedback,"* which is also a valuable lesson but not directly related to our learning objectives. Four students' responses were far from our learning objectives (e.g., *"I learned that I am terrible at acting."*) While most learners said they liked acting out part of this activity, some said they did not like it, appreciating the given options to act out in front of the class or in a small group. A few facilitators stated that this activity was not as engaging, saying in the daily reflection, *"A lot of the kids have 'calm' and 'relaxed' personalities, which means their responses are automatically similar to the neutral ones, and it is hard to suggest changes."*

6 LESSONS LEARNED

- **The "CS Unplugged" design patterns apply to AI unplugged activities.** Our design experience taught us that AI unplugged activities may benefit from sharing foundational design patterns with CS Unplugged activities [27]. For instance, the activities like the *User, Developer, Agent Card Game* and *Chatbot Personality* followed the rule of involving "games or challenges" in that we included competition, earning points, and guessing games, and we observed high engagement among the learners. In addition, the rule of "kinaesthetic" was applied to such activities as the *Lego Algorithm* and *Yoga from Scratch* that allow learners to use tangible objects and move their bodies, and these received positive reactions from learners and facilitators.
- **Unplugged activities should be closely tied to lessons.** We connected the unplugged activities to specific lessons and placed them near/after the related lessons in the camp. We also carefully directed the discussion and debriefing session after each activity to emphasize the connections. For example, the *Mission Agent Training* activity was closely tied to a series of lessons related to chatbots and intents. This appears to have been effective, as most learners' reflections aligned with the learning objectives and showed positive reactions. The *Yoga from Scratch* emphasized this lesson in reverse: the feedback from learners and facilitators suggested that a lack of a strong connection with camp lessons made this activity less effective.
- **Provide multiple means of action and expression for diverse learners.** Providing students with multiple means and options to express and engage made the unplugged activities more inclusive. For example, the *Chatbot Personality* activity allowed learners to present their outcomes in front of the class or share them in a small group, which helped both outgoing and shy learners express themselves comfortably. Considering individual learners' personalities and giving them options for expressing themselves makes the activity more inclusive.
- **Offer diverse kinaesthetic opportunities.** In our camp, we included diverse kinaesthetic actions such as physical movement (e.g., yoga), writing and crafting (e.g., Lego), and acting (e.g., *Chatbot Personality*). We found that this increased the possibility for all learners to find at least one preferred kinaesthetic activity. In addition, diversified kinaesthetics also made the activities more accessible to students who were English-as-a-second-language learners. Our diversified channels of kinaesthetics helped engage more learners in more inclusive activities.
- **Be adaptive and flexible.** When instructing unplugged activities, the activities should be adapted to the learners' characteristics, knowledge levels, and learning context. For instance, the *Yoga from Scratch* would have been more effective if most learners were new to block-coding languages and interested in learning about Scratch. Also, instructors should adjust the level of structuredness to fit their learning situation. While our activities were designed for an informal learning context (i.e., summer camp), they can also be deployed in classroom settings with enough flexibility and adaptability.

7 CONCLUSION AND FUTURE WORK

This experience report has described the design and deployment of five CS and conversational AI unplugged activities, which were iteratively designed for 50 middle school learners over three two-week summer camp sessions across two years. We shared the iterative design process, detailed instructions for each activity, reactions and feedback from learners and facilitators, and lessons learned. This paper makes three contributions. First, it presents novel CS and AI unplugged activities in detail to be easily deployed in formal and informal learning settings. Second, it describes the iterative design process for designing and deploying the unplugged activities with the participation and feedback of middle school learners and undergraduate camp facilitators. Finally, we share the challenges and lessons learned from the experience across the two years of camp in the hope that they will be helpful for CS education researchers and practitioners to make AI learning more engaging and accessible to all learners through unplugged activities. In the future, we plan to further iterate and conduct scale-up implementations of the activities with more learners in more diverse settings. We also plan to introduce quantitative evaluations (e.g., surveys) for the activities to supplement the qualitative data (e.g., reflection notes) utilized in this paper.

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