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# Introductory Visual Programming for Indonesian Diaspora Children at Sanggar Belajar PERMAI, Penang, Malaysia

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**Abstract**

Digital literacy and basic programming skills are important competencies for children who are increasingly exposed to digital technology and online learning environments. This community service activity aimed to introduce two learning domains to Indonesian diaspora children at Sanggar Belajar PERMAI, Penang, Malaysia: digital literacy and introductory visual programming. The program was conducted online via Zoom on December 23, 2025, by a team from the Faculty of Mathematics and Natural Sciences, Universitas Negeri Surabaya, in collaboration with Sanggar Belajar PERMAI. The activity used a participatory mentoring approach through interactive explanation, guided practice, discussion, and participant responses, supported by a learning module prepared by the team. The materials covered digital footprints, privacy, safe online behavior, computational thinking, basic programming logic, sequence, loops, and debugging using visual block-based activities on studio.code.org. Evaluation was conducted qualitatively using observable indicators aligned with the two learning domains. Digital literacy observations focused on participants' responses to discussions on digital footprints, privacy, and safe information sharing, while visual programming observations focused on their ability to follow sequencing tasks, arrange and revise command blocks, use repeated commands, and participate in programming challenges. The observations showed that participants responded to digital safety discussions, followed visual programming activities, and demonstrated gradually increasing engagement during game-based challenges. Although the online format limited individual monitoring and direct interaction, the session remained interactive with support from facilitators and parents. These results describe observed participant responses during the activity and do not represent measured improvements in digital literacy, computational thinking, confidence, or problem-solving skills.

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## INTRODUCTION

Digital literacy has become an essential competence in contemporary education, particularly as children are increasingly exposed to digital devices, online platforms, and technology-based learning environments. In the context of education, digital literacy is not limited to the ability to operate digital tools, but also includes the capacity to access information, communicate responsibly, understand digital footprints, protect privacy, and use technology in an ethical and productive manner. Thelma et al., (2024) emphasized that digital literacy plays an important role in preparing students for the future workforce, while (Lee, 2014) highlighted that digital literacy education is needed to develop students' ability to participate effectively in digital environments. Therefore, introducing digital literacy from an early age is important to help children become responsible and adaptive users of technology.The development of digital literacy is closely related to the concept of digital citizenship. Children need to understand that their activities in online spaces may leave digital trails and have social consequences. For this reason, digital literacy education should include internet safety, privacy awareness, respectful online communication, and the ability to make wise decisions when interacting with digital media. This is especially relevant for children who learn in community-based educational settings, where access to technology and structured digital learning may vary. Community-based education can become an important space for strengthening children's awareness, confidence, and participation in social and educational development. (Yates & Youniss, 1999) explained that community service and youth engagement contribute to the formation of civic identity, while (Crabtree, 2008) argued that international service-learning provides meaningful opportunities for educational collaboration across communities and cultures.

In addition to digital literacy, basic programming is increasingly introduced to children as a way to develop logical thinking, creativity, and problem-solving skills. Programming education enables learners to understand how instructions are structured, how problems can be broken down into smaller steps, and how solutions can be developed systematically. Previous community service activities have shown that basic programming training can increase students' interest and understanding in the field of informatics, such as Python programming training conducted by (Wati et al., 2023) and (Tribethran et al., 2023). However, for younger learners, programming concepts need to be delivered through a simpler, more visual, and interactive approach so that they can understand abstract computational concepts more easily. Despite the increasing importance of digital literacy, children in community-based learning settings may have limited access to structured and child-friendly programming activities. Therefore, there is a need for mentoring activities that introduce digital citizenship and basic computational thinking through accessible, visual, and practice-based learning.

Visual programming offers a child-friendly approach to introducing computational thinking because it allows students to arrange commands, observe immediate results, and learn programming logic without being heavily burdened by syntax. (Busbice, 2010; Mather, 2021; Vorderman, 2019) emphasized that programming for children should be introduced through gradual, engaging, and practice-based activities. In line with this, visual programming activities can introduce sequencing, loops, events, and simple project development in a more accessible way. Recent community service activities also support the importance of introducing programming logic through visual and structured learning, such as training using Code.org by (Minsih et al., 2024; Soelton et al., 2025) and the introduction of flowchart and pseudocode to improve students' programming logic by (Cahyaningtyas et al., 2025). Furthermore, Imwati et al. (2025) showed that introducing coding and artificial intelligence concepts to teachers can support digital transformation in cross-disciplinary learning.

Sanggar Belajar PERMAI Penang, Malaysia, is one of the community-based learning spaces that supports educational access and social development for Indonesian communities abroad. Several previous community service programs have been implemented in relation to PERMAI Penang, indicating that this community has become an important partner in educational, social, and capacity-building activities. Minsih et al., (2024) reported the strengthening of multicultural education at SB PERMAI Penang as an effort to improve understanding and appreciation of Indonesian cultural diversity. In another context, (Soelton et al., 2025) focused on mental strengthening to enrich self-readiness among Indonesian community members and SMEs associated with PERMAI in Penang, Malaysia. Marlapa et al., (2024) also implemented capacity building related to job sustainability for PERMAI members in Pulau Pinang. These studies show that PERMAI Penang has an important role as a community partner in supporting empowerment programs for Indonesians in Malaysia. However, community service activities specifically focusing on digital literacy and basic visual programming for Indonesian diaspora children at Sanggar Belajar PERMAI remain relevant to be further developed.

Based on these considerations, children of the Indonesian diaspora in Malaysia need access to learning activities that support digital literacy and early computational thinking. As part of efforts to expand child-friendly technology learning, the International Community Service Program of the Faculty of Mathematics and Natural Sciences, Universitas Negeri Surabaya, implemented a mentoring activity on digital literacy and basic visual programming for children at Sanggar Belajar PERMAI, Penang, Malaysia.

This activity was conducted online through Zoom Meeting and designed to introduce digital citizenship, internet safety, sequencing, loops, events, and a simple final project through interactive learning.

This community service activity aimed to provide digital literacy mentoring and introduce basic visual programming to Indonesian diaspora children at Sanggar Belajar PERMAI, Penang, Malaysia. The activity was expected to help participants understand the importance of safe and responsible technology use while also developing basic logical thinking, creativity, and problem-solving skills through visual programming. In addition, this program was intended to strengthen international collaboration between FMIPA Universitas Negeri Surabaya and Sanggar Belajar PERMAI in supporting access to relevant and meaningful technology education for Indonesian children living abroad.

## METHOD

### Participant Characteristics

This community service activity was implemented using a participatory mentoring approach to introduce digital literacy and introductory visual programming to Indonesian diaspora children at Sanggar Belajar PERMAI, Penang, Malaysia. A total of 25 children participated in the activity. The participants were elementary school students enrolled in Grades 1 through 6 at Sanggar Belajar PERMAI. This range of grade levels was considered in designing the learning activities so that the materials could be delivered using simple language, visual demonstrations, familiar daily-life analogies, and progressively structured tasks. Participants were included if they were registered learners at Sanggar Belajar PERMAI and attended the scheduled mentoring session. Information on participants' exact ages, gender distribution, and prior programming experience was not systematically collected and therefore was not used as an analytical variable in this activity.

The program was conducted online through Zoom on December 23, 2025, from 14.00 to 16.00 Malaysia Time. The activity involved lecturers from the Faculty of Mathematics and Natural Sciences, Universitas Negeri Surabaya, representing the Undergraduate Programs in Data Science, Actuarial Science, and Artificial Intelligence, in collaboration with teachers and facilitators from Sanggar Belajar PERMAI. In this program, the participatory mentoring approach involved interactive explanations, guided demonstrations, questioning, discussion, and participant responses throughout the learning activities rather than one-way delivery of instructional material.

### Preparation and Needs Assessment

The implementation consisted of three main stages: preparation, implementation, and evaluation. During the preparation stage, the community service team coordinated with representatives and teachers from Sanggar Belajar PERMAI to identify the participants' learning conditions, determine the technical format of the online activity, and prepare learning materials appropriate for elementary school students.

The preparation process considered two main characteristics of the learning context: the participants represented a broad elementary-school range from Grades 1 to 6, and the programming activities would be conducted collectively rather than through individual device access. These considerations informed the selection of simple explanations, familiar examples, visual learning materials, and activities that could be demonstrated and discussed collectively through screen sharing. The learning activities were therefore arranged progressively, beginning with familiar daily-life sequences before introducing block-based programming, repeated commands, and simple debugging tasks.

### Module Development and Expected Observable Outcomes

The learning module was developed by lecturers who were members of the community service team from the Faculty of Mathematics and Natural Sciences, Universitas Negeri Surabaya. The module served as the main instructional guide and was designed for elementary school participants from Grades 1 to 6. It emphasized simple explanations, visual materials, familiar examples, interactive discussion, and progressively structured activities. This approach is consistent with recommendations that introductory programming for children should use structured, engaging, and child-friendly learning experiences (Busbice, 2010; Vorderman, 2019; Mather, 2021).

The module covered two main learning domains. The digital literacy component addressed digital footprints, privacy, safe information sharing, and responsible behavior in online spaces. The introductory visual programming component covered computational thinking, basic programming logic, sequence, loops, and debugging. The expected observable outcomes for digital literacy included participants' ability to respond appropriately to questions concerning digital footprints, privacy, and information that should or should not be shared online. For visual programming, the expected observable outcomes included participants' ability to suggest logically ordered instructions, identify appropriate movement commands, recognize repeated actions that could be represented using loops, and identify or propose corrections when an incorrect command sequence produced an unexpected result.

The module was developed internally by members of the community service team and adapted to the learning context at Sanggar Belajar PERMAI. Its use in this activity focused on providing structured guidance for the mentoring session and observable task-based responses rather than measuring standardized learning gains.

**Implementation of the Mentoring Activity**

The implementation stage was conducted through interactive explanation, demonstration, guided practice, questioning, and discussion. At the beginning of the session, participants were introduced to basic programming logic using a familiar daily-life analogy involving the steps of brushing their teeth. Participants were guided to identify the sequence of actions required to complete the activity and to recognize that certain actions may need to be repeated until the desired condition is achieved. This analogy was used to introduce the concepts of sequence, loops, and simple conditional thinking before participants encountered visual programming tasks.

The activity then continued with digital literacy material using the "Follow the Digital Trail" video. Participants were introduced to the concept of digital footprints and the importance of protecting personal information in online environments. Facilitators discussed examples of private information that should not be shared openly, including full names, home addresses, telephone numbers, dates of birth, and school identity, as well as information that may be relatively safer to share, such as hobbies. Participants were invited to respond to questions and relate the discussion to their experiences using digital platforms.

The introductory visual programming session was conducted using studio.code.org. The activities were delivered sequentially through "Move It Maps," "Sequencing with Angry Birds," "Programming with Angry Birds," and "Programming with Harvester." The sequence was designed to introduce concepts progressively, beginning with ordered instructions and movement commands, followed by sequencing, repeated commands or loops, and basic debugging through the identification and revision of incorrect command blocks. The Code.org platform was accessed using the Indonesian-language interface.

Participants did not use individual devices to manipulate the Code.org activities independently. Instead, the platform was operated by the facilitators using a shared device and displayed to participants through Zoom screen sharing. Participants were involved by responding to interactive questions, suggesting movement directions, proposing appropriate command blocks and their arrangement, determining the required repetitions, and suggesting corrections when the displayed program did not produce the expected result. The facilitators implemented the participants' proposed responses on the shared screen so that the effects of each command could be observed collectively. Teachers present at Sanggar Belajar PERMAI also assisted participants during the activities and supported individual observation of their responses.

**Evaluation and Observation Procedures**

Evaluation was conducted through qualitative observation using predefined behavioral indicators aligned with the expected observable outcomes. Online facilitators monitored the overall learning process and group interaction, while teachers present at Sanggar Belajar PERMAI assisted in observing the 25 participants individually. A simple three-level observation rubric was used to distinguish whether a target behavior was not demonstrated, demonstrated with guidance, or demonstrated independently.

A score of 0 indicated that the target behavior was not demonstrated even after prompting. A score of 1 indicated that the participant demonstrated the target behavior after prompting or guidance from a teacher or facilitator. A score of 2 indicated that the participant demonstrated the target behavior independently before receiving facilitator guidance. Because the activities used a facilitator-operated shared device, independent performance referred to an independently proposed response or solution rather than independent manipulation of the Code.org interface.

Instruction-following was considered demonstrated when a participant responded appropriately to a facilitator prompt, identified a logical next step, or suggested a command consistent with the displayed task. Sequencing performance was observed when participants proposed instructions or command blocks in an appropriate logical order. Debugging was identified when participants recognized that the displayed program did not produce the expected result and proposed a change to the command sequence, movement direction, or repetition. Engagement was operationalized through observable participation, including answering or asking questions, responding to facilitator prompts, suggesting commands or movement directions, and contributing to discussions.

Confidence and problem-solving skills were not treated as standardized outcomes because no validated instruments were administered to measure these constructs. Similarly, the activity did not include a pre–post assessment of digital literacy. Therefore, the evaluation focused on directly observable participant responses and task performance during the mentoring session.

Teachers at the learning site recorded individual observations using the same behavioral indicators and performance categories across participants, while the online facilitators documented the overall interaction and implementation process. The individual observation records were subsequently reviewed and summarized descriptively across the 25 participants. The resulting data were used to report the number and proportion of participants who demonstrated selected visual programming behaviors independently or with facilitator guidance, rather than to infer standardized changes in broader competencies(Winarsih et al., 2025).

## RESULTS AND DISCUSSION

The community service activity was implemented as an online mentoring program on digital literacy and basic visual programming for Indonesian diaspora children at Sanggar Belajar PERMAI, Penang, Malaysia. The learning process was designed to introduce participants to computational thinking, basic programming logic, and responsible technology use through child-friendly and interactive activities. The activity used a learning module prepared by the team and studio.code.org as a supporting platform for visual block-based learning. The results are discussed based on four main aspects: preparation of learning materials, participants' understanding of computational thinking and programming logic, digital literacy awareness, and engagement in visual programming activities.

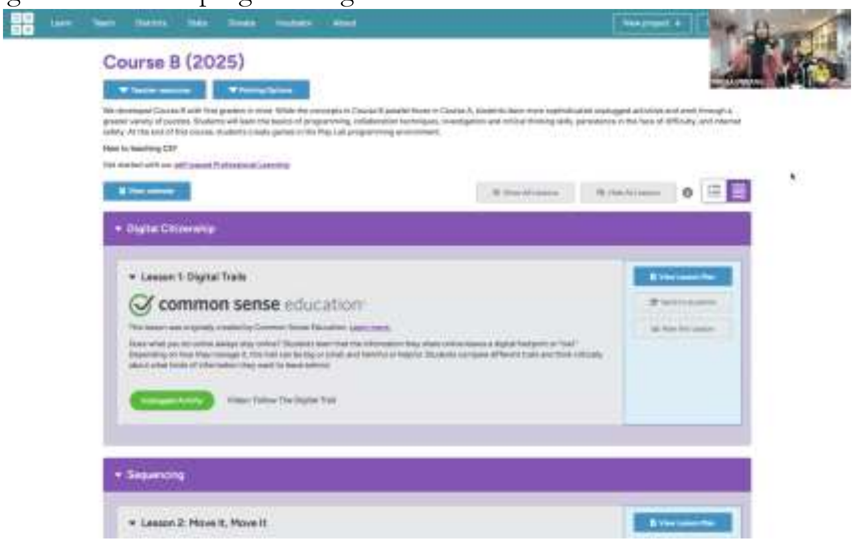


**Figure 1.** Learning materials and visual programming platform used in the mentoring activity.

### Computational Thinking and Basic Programming Logic

The first learning activity introduced basic programming logic through examples from everyday life. The facilitators used the analogy of brushing teeth to explain that a task must be completed through a set of ordered instructions. Participants were guided to identify the steps involved in brushing teeth, starting from taking a toothbrush, applying toothpaste, brushing the teeth, rinsing, and repeating several steps until the teeth were clean. This activity helped participants understand the concept of sequence, namely that instructions must be arranged in a logical and systematic order to achieve a specific goal.

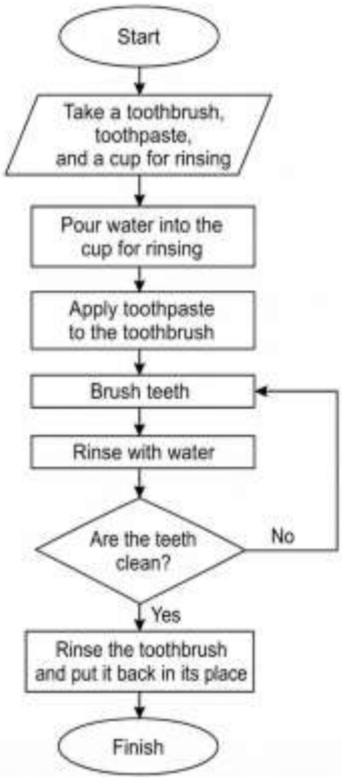


**Figure 2.** The brushing-teeth sequence used as an analogy for basic programming logic.

The brushing-teeth analogy also introduced the concept of loops through repeated brushing and rinsing actions. In addition, the condition of whether the teeth were already clean or not provided an initial illustration of conditional thinking. The use of this familiar activity made the abstract idea of programming easier to understand because participants could connect it with their daily routines. The observation suggests that contextual analogies may help children understand basic computational thinking concepts in a more accessible way. This is also in line with the view that programming for children should be introduced gradually through structured, engaging, and practice-based learning experiences (Busbice, 2010; Sihombing et al., 2019; Vorderman, 2019).

Through this activity, participants began to recognize that programming is not only related to using a computer, but also to arranging logical steps to solve a problem. Each instruction has a specific role and must be executed in the correct order. This understanding became the foundation for the next activities, in which participants worked with visual blocks to control characters, solve challenges, and revise instructions when the output did not match the expected result.

**Responses to Digital Literacy Awareness**

The second aspect of the activity focused on digital literacy. Participants were introduced to the concept of digital trails through the "Follow the Digital Trail" video available on the learning platform. The material emphasized that online activities may leave traces and that children need to be careful when sharing information in digital spaces. Facilitators explained examples of private information that should not be shared online, such as full name, home address, telephone number, date of birth, and school identity. Participants were also introduced to examples of information that is relatively safer to share, such as hobbies, as long as it does not reveal sensitive personal details.


**Figure 3.** Facilitator explaining digital trails through a video-based learning activity.

During the digital literacy session, participants responded to questions concerning digital footprints, privacy, and safe information sharing. They were guided to distinguish private information, such as home addresses, telephone numbers, dates of birth, and school identities, from information that was relatively safer to share. Their responses during the discussion were recorded as observable participation in the digital literacy activity; however, no pre–post assessment was conducted to determine changes in digital awareness. This supports (Lee, 2014) argument that digital literacy education is needed to help learners participate effectively in digital environments.

**Visual Programming Activities**

The third aspect of the activity was the introduction of visual programming using studio.code.org. The activity began with "Move It Maps", where participants were asked to direct a character from the starting box to the target box. This activity trained participants to identify the initial position, movement direction, distance between boxes, and the correct order of instructions. Based on the observation, participants were able to follow the task and determine appropriate movement steps. This activity became an initial exercise for understanding sequencing in a visual and concrete way.

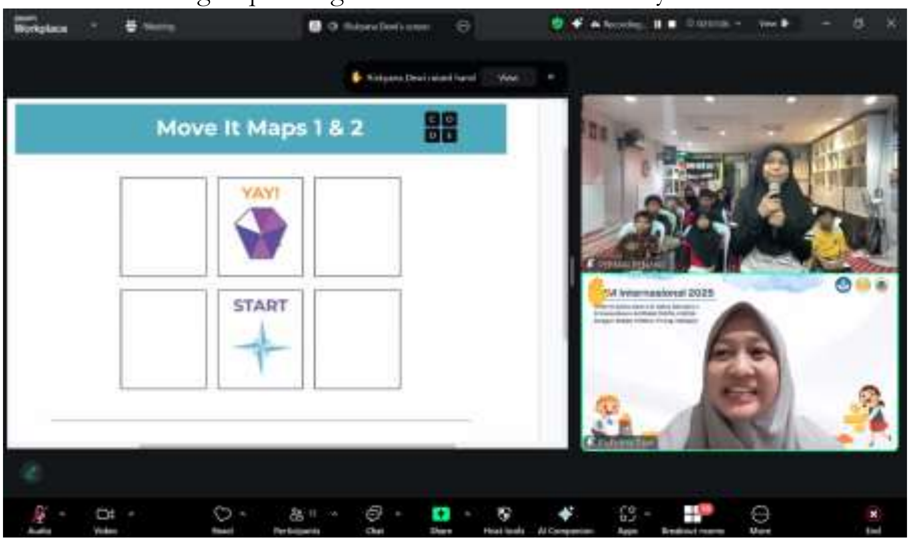


**Figure 4.** Participants learning to direct a character from the starting box to the target box.

The activity continued with "Sequencing with Angry Birds". In this stage, participants were introduced to the workspace, command blocks, and play area. The goal was to move the Angry Birds character toward the pig by arranging command blocks in the correct order. Observation showed that participants began to recognize the function of each component and tried to arrange logical instructions to achieve the target. When the character did not move as expected, participants discussed the error and attempted to revise the command blocks. This process introduced participants to debugging, namely the effort to identify and correct mistakes in the instruction sequence.

Based on the individual observation rubric, 19 of 25 participants (76%) were able to suggest an appropriate sequence independently, while the remaining 6 participants (24%) completed the task with facilitator guidance. In the debugging activity, 21 of 25 participants (84%) independently identified an incorrect command or proposed an appropriate correction, whereas the remaining 4 participants (16%) required prompting from the teacher or facilitator.


**Figure 5.** Participants learning sequencing by arranging visual command blocks.

At the beginning of the visual programming activity, participant involvement was still limited. Based on facilitator observation, approximately two to three students actively tried to arrange the command blocks. This observation suggests that participants were still adapting to the programming environment and the concept of block-based instructions. However, the activity still provided an important first experience because participants could see the immediate relationship between the blocks they arranged and the movement of the character on the screen.

The next activity, "Programming with Angry Birds", introduced participants to the combination of movement instructions and loop commands. Participants learned to use the repeat block to create a more efficient solution instead of arranging the same movement commands one by one. This activity trained logical thinking and problem-solving skills because participants had to determine the correct path, direction of movement, and number of repetitions required for the character to reach the target.

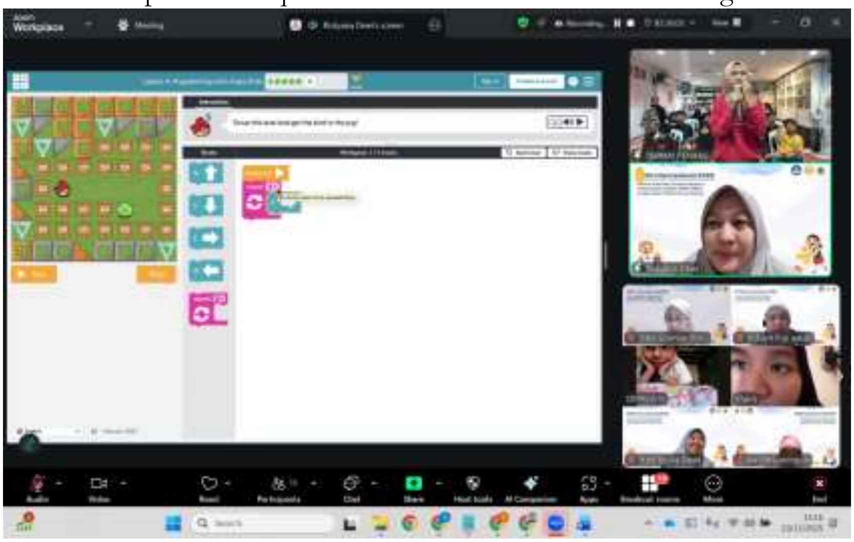

**Figure 6.** Participants learning the loop concept using repeat blocks.

Participant engagement increased during the loop activity. Around three to five students were actively involved until the seventh exercise, and the number increased to around five to seven students toward the tenth exercise. This gradual increase suggests that repeated exposure to visual programming tasks helped participants become more familiar with the learning environment and more confident in trying solutions. The game-based context, clear visual feedback, and gradual level of challenge appeared to encourage participants to participate more actively.

The final programming activity discussed in the session was "Programming with Harvester". This activity strengthened the concepts of sequence and loops through a different problem context, where participants needed to guide a farmer character to collect corn. Compared with the previous activities, this stage showed higher participant involvement. Participants were more willing to answer questions, suggest command blocks, and revise the instructions when the solution did not work. This indicates that participants had begun to understand the basic mechanism of block-based programming and were able to transfer their understanding to a new problem context.

**Figure 7.** Participants applying sequence, loops, and problem-solving in the Harvester activity.

**Participant Engagement and Learning Dynamics**

Overall, the visual programming activities showed that participants were able to follow the learning process and gradually improve their engagement. The use of concrete examples, visual blocks, game-based challenges, and facilitator guidance supported participants' understanding of sequence, loops, and debugging. These concepts are fundamental in developing computational thinking because they train learners to arrange instructions, recognize repeated patterns, evaluate errors, and develop solutions systematically. The activity also provided an opportunity for participants to collaborate, communicate their ideas, and build confidence during the learning process.

**Figure 8.** Participants of the basic visual programming mentoring activity at Sanggar Belajar PERMAI.

The increase in engagement can be interpreted as the result of several factors. First, the learning activities were connected with concrete and familiar contexts, such as daily routines and simple games. Second, the platform provided immediate visual feedback, allowing participants to see whether their instructions worked or needed revision. Third, the challenges were presented gradually, so participants could adapt to the learning environment before moving to more complex tasks. These findings are consistent with previous community service activities showing that programming training can strengthen students' interest and understanding of basic computational concepts (Wati et al., 2023; Tribethan et al., 2023). In addition, visual and structured learning activities can support the development of programming logic among beginner learners (Cahyaningtyas et al., 2025; Mulyandi et al., 2025).


**Figure 9.** Documentation of the online mentoring activity with facilitators and participants.

**Challenges and Reflection**

Although the mentoring activity showed positive participant engagement, several challenges were identified during the implementation. Although the online facilitators had limited opportunities to directly monitor each participant, teachers present at Sanggar Belajar PERMAI supported individual observation during the session. Nevertheless, the online format still limited the facilitators' direct access to participants' screens, gestures, and technical difficulties. In a face-to-face setting, facilitators can directly observe children's screens, gestures, hesitation, and technical difficulties. However, in the online format, observation depended mainly on verbal responses, camera visibility, and the willingness of participants to share their progress. This condition made it more difficult to identify whether all participants had understood the instructions at the same pace.

Another challenge was related to the limitation of interaction between facilitators and participants. The activity was conducted within a limited duration, while the participants had different levels of familiarity with digital learning platforms and block-based programming. As a result, the facilitators needed to balance the explanation of concepts, demonstration of programming activities, and time for participant practice. This finding reflects one of the common challenges in technology-based community service programs, in which learning effectiveness depends not only on the availability of digital platforms, but also on interaction, guidance, and participant readiness. In this context, the mentoring process needs to be designed with clear instructions, gradual tasks, and flexible facilitation so that children can remain engaged during online learning.

Despite these limitations, the activity also showed an important form of support from the surrounding learning environment. Some participants were unable to join the activity from the same physical room, but this challenge was addressed through parental support, particularly by providing personal devices and helping children access the online session. This support indicates that the success of digital literacy and visual programming mentoring is not determined solely by the facilitators, but also by the involvement of families and the community partner. This is consistent with the idea that community-based education requires collaboration among educational institutions, community organizations, and families to create meaningful learning experiences. In the context of Sanggar Belajar PERMAI, previous community service activities also show that PERMAI has served as an important partner for educational and capacity-building programs for Indonesian communities in Penang (Marlapa et al., 2024; Minsih et al., 2024; Soelton et al., 2025).

The reflection from this activity suggests that future programs should provide more structured technical preparation, smaller mentoring groups, and longer practice sessions. A pre-activity orientation may help participants become familiar with the platform before the main session begins, while smaller groups can allow facilitators to monitor participant progress more closely. In addition, the learning module prepared by the team can be further developed into a sustainable mentoring guide that can be used by Sanggar Belajar PERMAI after the program ends. Therefore, this activity should not be viewed only as a one-time training session, but also as an initial step toward continuous collaboration in strengthening digital literacy, computational thinking, and child-friendly technology learning for Indonesian diaspora children in Malaysia.

## CONCLUSION

This community service activity introduced digital literacy and basic visual programming to Indonesian diaspora children at Sanggar Belajar PERMAI, Penang, Malaysia. During the mentoring session, participants were introduced to computational thinking, basic programming logic, sequence, loops, debugging, digital footprints, privacy, and responsible behavior in digital spaces. Facilitator observations showed that participants were able to follow the visual programming activities, arrange command blocks, respond to errors by revising their instructions, and demonstrate gradually increasing engagement during successive programming challenges. Participants also responded to discussions concerning digital footprints, privacy, and safe online behavior. However, these observations represent participants' responses during a single mentoring session and should not be interpreted as evidence of measurable improvement in digital literacy, computational thinking, confidence, or problem-solving skills, as no pre–post assessment or standardized outcome measurement was conducted. The online format also limited individual monitoring and direct interaction with participants. Future activities may include longer practice sessions, smaller mentoring groups, more structured technical preparation, and pre–post or standardized assessment instruments to provide stronger evidence regarding participants' learning outcomes.

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