Pedagogical Delivery and Feedback for an Artificial Intelligence Literacy Programme for University Students with Diverse Academic Backgrounds: Flipped Classroom Learning Approach with Project-based Learning

Siu-Cheung Kong, Guo Zhang, and Man-Yin Cheung

Abstract—There have been few systematic discussions of curriculum design and pedagogical delivery to promote artificial intelligence (AI) literacy to university students of diverse academic backgrounds. This study introduces the curriculum and pedagogy of an AI literacy programme for university students, and collects and presents feedback from the participants on its effectiveness. The course focused on machine learning, deep learning and developing AI applications. It was delivered using a flipped classroom learning approach with project-based learning. Feedback from the participants, collected through a flipped classroom survey, focus group interviews and reflective writing, showed that they enjoyed the flipped classroom learning approach, while the project-based learning helped them to develop concepts and ethical awareness concerning AI. It is recommended that the programme be extended to include more participants, such as senior secondary school students and the public. This study initiates a pathway for the delivery of AI literacy programmes. It may guide and inspire future empirical and design research on fostering AI literacy among citizens from diverse academic backgrounds.

Index Terms—artificial intelligence literacy, flipped classroom learning approach, pedagogy, project-based learning, university students

I. INTRODUCTION

The digital transformation of our societies is affecting our lives in unprecedented ways. Artificial intelligence (AI) plays a vital role in this transformation. The challenge of creating decent human-centred work is on the verge of becoming much more difficult as AI remakes employment landscapes around the globe [1]. At the same time, more people and communities are recognising security, privacy and other ethical issues involved in the use of AI that need to be addressed. Given that AI is relevant to all of us [2], it is necessary to cultivate AI literacy among all citizens [3, 4].

To date, most studies of AI literacy have been solely aimed at computer science-related majors and have emphasised programming knowledge [5, 6, 7], seldom covering ethical considerations [8, 9]. There has been little consideration of effective means to foster AI literacy among participants of diverse academic backgrounds. Specifically, the areas of what to teach (curriculum) and how to teach it (pedagogy) need to be addressed.

To fill this research gap, this study developed and implemented an AI literacy programme for university students of diverse academic backgrounds. This paper reports on the curriculum design and delivery of the AI literacy programme, incorporating feedback from the participants. It aims at addressing the following research question: is the flipped classroom learning approach with project-based learning adopted in this programme effective for fostering AI literacy among university students of diverse academic backgrounds?

II. CURRICULUM DESIGN

The curriculum of this literacy programme was designed based on the multi-dimensional conceptual framework of AI Literacy proposed by Kong and Zhang [4]. The cognitive dimension of this framework focuses on educating people on basic AI concepts and developing their competencies in using AI concepts to evaluate and understand the real world. The affective dimension emphasises the empowerment of participants, enabling them to react to the widespread use of AI in their daily lives and workplaces. The sociocultural dimension is aimed at encouraging the ethical use of AI.

Three content domains were the focus of this literacy programme: Machine Learning, Deep Learning and Developing AI Applications.

A. Course 1: Machine Learning

In Course 1, an introduction to the development and application of AI was provided, followed by content related to machine learning and the concepts of strong and weak AI. Participants were guided in a discussion of the potential and impact of AI in our society.

The participants then learned the ‘five steps of machine learning’: defining a problem, collecting data, pre-processing data, training the model and inference and prediction. After that, they were provided with hands-on experience using the five steps to conduct image recognition with Google Teachable Machine (https://teachablemachine.withgoogle.com/). Following this, the participants learned about two instances of supervised learning: ‘regression’ and ‘classification’. Related examples and hands-on experience were provided. Finally, the participants were taught the concept and working principles of unsupervised learning by applying k-means clustering in a series of case studies [3]. Overall, the course delivered major concepts concerning machine learning via analogies and real-life examples, aiming to foster participants’ understanding of the major concepts of machine learning and the principles underlying these concepts [3].
B. Course 2: Deep Learning

Course 2 focused on deep learning, building on the participants’ foundation in machine learning. It comprised data cleaning and augmentation, (convolution) neural networks, computer vision and deep learning. Real-life data samples were used to review the applications of the five steps of machine learning while introducing the ideas of data cleaning and augmentation. After that, neural networks were introduced through an explanation of core ideas like perception, layers and weights. Lab sessions on training convolution neural networks and follow-up discussions were arranged to deepen participants’ understanding. Computer vision was also discussed as a typical application of neural networks. Finally, the participants sampled additional machine learning tools, including Microsoft Azure Machine Learning Studio (Classic).

C. Course 3: Developing AI Applications

Course 3 was a capstone project in AI application development that aimed to foster participants’ ethical awareness based on their foundation in machine learning and deep learning. Prior to the course, the participants studied self-directed reading materials about ethical principles and dilemmas related to AI. Lectures were mainly structured as guided discussions on the usage and design of AI in relation to ethical principles. These real-life scenarios helped participants relate to and reflect on ethical principles when designing AI. Three additional examples of AI applications were used as case studies in the lectures to focus on AI-related ethical issues.

Following the introductory lectures, the participants formed groups and prepared their projects with preliminary feedback from the course tutors. Individual consultations were later organised to provide detailed project development instructions. Various AI project development platforms, such as Google Teachable Machine and Microsoft Azure Machine Learning Studio, were introduced in subsequent sessions. Each group presented their work for peer evaluation and discussion in the final session, which provided additional opportunities for the participants to reflect on and deepen their ethical awareness. Ethical awareness was a significant component of the assessment rubric.

III. PEDAGOGY AND DELIVERY

The programme was delivered using a flipped classroom approach, with self-directed learning materials provided before each course. Course 3 adopted a project-based learning (PBL) approach on top of the flipped classroom approach. Fig. 1 demonstrates the course structure.

![Flow chart showing course structure](image)

In the overall structure of the course, we adopted the flipped classroom learning approach. In this approach, the knowledge transmission and knowledge internalisation processes are shifted [10]. During the knowledge transmission process, students gain material knowledge and concepts, while during the knowledge internalisation process, they internalise this knowledge through active learning. In flipped classroom learning, the knowledge transmission portion of a typical face-to-face lecture is shifted out of class time and is replaced by active learning tasks during the lecture [11, 12]. The flipped classroom learning approach has benefits in terms of increasing student engagement and promoting active learning [13, 14].

We used a flipped classroom learning approach to foster students’ AI literacy. In addition to the commonly accepted benefits of this approach, there were two fundamental factors in our decision to use flipped classroom learning in the delivery of this course. First, it effectively addressed the issue of university students’ limited class time. Compared with K-12 students, class time is significantly shorter in the university context. When university students are introduced to content knowledge before the lesson, class time can be optimised to investigate topics in greater depth, create meaningful learning opportunities and conduct class activities such as using AI tools, hands-on practice, in-depth laboratory sessions, presentations, peer-review, project-based learning and skill development. The flipped classroom learning approach may also facilitate self-regulated learning, which is of great benefit to university students and may, in turn, make a significant contribution to better learning outcomes. When learning via the flipped classroom learning approach, students are required to take control of their own learning progress and take responsibility for their own learning needs, which establishes an environment that brings self-regulated learning to the forefront [15]. Self-regulated learning is important for university students and appropriate to the university context. It also accelerates learning while maintaining long-term retention rates [16], which contributes to better learning outcomes. Studies have shown that integrating self-regulated strategy into the flipped classroom approach enables university students to learn more effectively [17]. The importance for instructors who adopt the flipped classroom approach to prepare university students with self-regulated learning skills has also been discussed [18].

As has been argued by several scholars [19], learning via solving small pieces of concept-rich tasks, or flipped learning, is a better fit for our digital era society. For this reason, we introduced a flipped classroom approach to develop university students’ AI literacy.

In Course 3 of the AI application development, we adopted a PBL approach. Project-based learning is a student-centred pedagogical method that involves a dynamic classroom approach. It is believed that students who experience PBL acquire deeper knowledge through their active exploration of real-world challenges and problems. In this approach, students learn about a subject by working for an extended period of time to investigate and respond to a complex question, challenge, or problem. It is a style of active and inquiry-based learning. PBL contrasts with paper-based learning, rote memorisation, and teacher-led instruction that presents established facts or portrays a smooth path to knowledge because it instead presents students with questions, problems or scenarios [20]. The adoption of PBL in AI literacy is common [e.g. 21, 22], as the PBL learning methodology helps students search for real-world problems, develop complex solutions, and generate synergy among team members. In our study, the PBL was predicted to strengthen participants’ ethical awareness by having them go through the application development process and reflect on the ethical issues involved at each stage. It was also projected to deepen participants’ conceptual understanding through an application of the concepts in real-life scenarios.

IV. METHODOLOGY

The entire programme was delivered uniformly over a period of around 6 months, with around one month between each course to fit with the schedules of our participants due to their other learning commitments. The three courses took 7, 9 and 14 hours respectively, thus amounting to a total of 30 hours. Each of these courses was run over a period of 3 - 4 weeks to provide students with ample time to prepare for the self-directed learning and the project of Course 3 under our flipped classroom learning approach.
One hundred and twenty university students participated in Course 1. We publicised Course 2 among the 120 participants who had completed Course 1, and 82 participants volunteered to attend and completed Course 2. Course 3 was publicised among the participants who had finished Course 2, and 36 participants completed Course 3. For all three of the courses, approximately 75% of the participants were enrolled in bachelor’s degree programmes, including students in their first, second, third, and fourth years of study. The remaining participants were from postgraduate or higher diploma programmes. The participants came from a wide range of academic backgrounds: Mathematics, Information and Communication Technology, Health Education, Chinese Language Studies, Psychology, the Sciences (Natural Science and STEM Education), English Language Studies, General Studies, Music, History, Global and Environmental Studies and Global and Hong Kong Studies.

Three instruments were used to evaluate the participants’ feedback: 1) the Flipped Classroom Learning on AI Literacy survey; 2) students’ responses to focus group interview questions about flipped classroom learning in the AI literacy course and 3) students’ reflective statements on their understanding of AI and ethics.

Under this survey design we carried out two kinds of statistical analyses: 1) comparison of results from Part 1 (learning preferences) of the survey before Course 1, after Course 1, after Course 2 and after Course 3; and 2) comparison of results from the entire survey after Course 1, after Course 2 and after Course 3. When more than one set of survey results was compared, repeated measures ANOVA test was used with the survey results collected after different courses as the within-subjects factor. Findings of these two types of analyses were reported in the section “Results and Discussion”.

In the focus groups, the participants were interviewed about their views on the use of the flipped classroom learning approach after attending each course. They were asked about their preference for flipped classroom learning, the effectiveness of the approach, and suggestions for improvement.

The third instrument was the reflective statement that students wrote on their understanding of AI and ethics. The participants were asked to write 100 to 200 words in either English or Chinese about their understanding of AI and related ethical issues. They were asked to write this reflective essay before and after each course using the Moodle discussion forum.

V. RESULTS AND DISCUSSION

This section reports on the results of the flipped classroom surveys, focus group interviews, and reflective statements. Overall speaking the three courses received positive evaluation results, as summarized in Table II, from all participants completing each of the three courses.

<table>
<thead>
<tr>
<th>TABLE II</th>
<th>EVALUATION RESULTS BY PARTICIPANTS AFTER EACH OF COURSE 1, 2 AND 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Course 1</td>
</tr>
<tr>
<td>N=120</td>
<td>N=82</td>
</tr>
<tr>
<td></td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>I understand more about Artificial Intelligence (AI) after attending the course.</td>
<td>4.33 (0.59)</td>
</tr>
<tr>
<td>I like the blended learning mode of this course (self-learn and workshop).</td>
<td>4.21 (0.64)</td>
</tr>
<tr>
<td>Overall, the course is worth attending</td>
<td>4.32 (0.63)</td>
</tr>
</tbody>
</table>

Note: A 5-point Likert scale with 5=Strongly Agree and 1=Strongly Disagree was adopted.

A. Feedback on Course 1

Most of the 120 participants in Course 1 enjoyed the flipped classroom learning approach. According to the results for all four parts of the survey after Course 1, the mean was 4.0 marks out of a maximum score of 5 (SD = 0.45).

Table III compares participants’ responses to the first part of the survey before and after Course 1. Statistically significant increase was observed, indicating participants’ higher preference over the flipped classroom learning approach after Course 1.

In line with the results of the surveys, the participants also demonstrated a preference for this learning approach through focus group discussions and reflective statements (see Table IV for quotes from some of the participants). Several participants mentioned that they enjoyed the flexibility in learning pace and the deeper learning they experienced in the flipped classroom. Some of them also reported that the flipped classroom learning approach facilitated self-directed learning.
learning, which is an important skill in the digital era. They also mentioned that, after the pre-lesson reading, the hands-on workshops have helped to deepen their understanding. Some participants even expressed their preference to have more workshops. All these demonstrated the importance of the workshops as an integral part of the learning process of the participants. Some participants, on the other hand, shared that they would prefer more time between lessons to study the self-learning materials better. This highlights the importance of both the pre-class learning and the synchronous classes for an effective implementation of the flipped classroom learning approach. More time has accordingly been allowed between classes in the further offering of our courses.

B. Feedback on Course 2

Table V summarises the change in responses to Part 1 of the survey by participants completing both Courses 1 and 2. Consistent with the above findings after Course 1, participants in this course showed a statistically significant increase in their responses to learning preference after Course 1 with the survey result staying at a similar level (around 4 marks out of 5) after Course 2.

Beyond the positive perception demonstrated in the survey results, the participants’ responses in the focus group interviews and reflective statements conducted after Course 2 confirmed the usefulness of the flipped classroom learning approach for their understanding of AI concepts. The participants pointed out that the novelty of topics concerning AI suited enquiry-based learning and that the flipped classroom learning approach was suitable for fostering AI literacy. Some of the participants also appreciated the learning materials provided. Participants also expressed that the hands-on experience during the workshops had supplemented their learning. Some participants, on the other hand, commented on the more difficult contents of Course 2. This indicated the importance of setting the right level of difficulty for the course contents in fostering AI literacy.

TABLE IV

SELECTED QUOTES FROM PARTICIPANT INTERVIEWS AND REFLECTIVE STATEMENTS AFTER COURSE 1 ON THE USEFULNESS OF THE FLIPPED CLASSROOM LEARNING APPROACH

I prefer the flipped classroom to traditional lectures. I major in computer science. When studying the materials, I could skip the parts I already knew. When I can adjust the learning pace myself, my learning efficiency increases (S18).

The development of AI is so fast. We cannot totally depend on learning from instructors in the classroom. Self-directed learning is important. The flipped classroom facilitates and encourages self-directed learning. So, I think the flipped classroom learning approach is suitable for learning AI (S97).

After the two workshops, my understanding of AI has been deepened… During the workshops, I have also had hands-on experience in training AI or using various AI online platforms; these are all very interesting. I think learning AI is a very complicated topic, and so I hope to learn more AI knowledge and applications in the future. (Reflection translated from Chinese; S2)

Through the workshops on learning about AI, my understanding of AI has been enhanced compared to what I knew before the workshops. Unfortunately, the opportunities to practise with AI were limited by the number of workshops. I look forward to joining more AI workshops that follow, thus gaining more practices on operating AI. (Reflection translated from Chinese; S82)

The time between lessons was relatively short, and thus it was a bit rushed and there was relatively little time for self-learning and reflection of the course materials. (Reflection translated from Chinese; S95)

TABLE V

RESULTS OF PART 1 (LEARNING PREFERENCE) IN THE SURVEY AFTER COURSES 1 AND 2

<table>
<thead>
<tr>
<th></th>
<th>Before Course 1 Mean (SD)</th>
<th>After Course 1 Mean (SD)</th>
<th>Paired t-test</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(max. mark: 5)</td>
<td>3.70 (0.48)</td>
<td>3.93 (0.50)</td>
<td>0.23</td>
<td>5.41*** &lt; 0.001</td>
</tr>
</tbody>
</table>

N=82; *p < 0.05; **p < 0.01; ***p < 0.001

Table VI shows the results of the entire flipped classroom survey. The mean scores remained high throughout Course 2 (the mean scores were around 4 marks out of a maximum of 5). This shows that the participants appreciated learning about AI via the flipped classroom learning approach.

TABLE VI

RESULTS OF THE SURVEY ON THE FLIPPED CLASSROOM LEARNING APPROACH AFTER COURSES 1 AND 2

<table>
<thead>
<tr>
<th></th>
<th>After Course 1 Mean (SD)</th>
<th>After Course 2 Mean (SD)</th>
<th>Paired t-test</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall (max. mark: 5)</td>
<td>4.02 (0.46)</td>
<td>3.99 (0.46)</td>
<td>-0.03</td>
<td>-0.68</td>
</tr>
</tbody>
</table>

N=82; *p < 0.05; **p < 0.01; ***p < 0.001

TABLE VII

SELECTED QUOTES FROM PARTICIPANT FOCUS GROUP INTERVIEWS AND REFLECTIVE STATEMENTS AFTER COURSE 2

I prefer the flipped classroom because it allows more in-class interaction and enquiry-based learning. Enquiry-based learning is very important, especially for learning AI. For instance, there was an Excel spreadsheet demonstration of convolutional provided as autonomous learning materials. We were able to try the spreadsheet before the lesson, which improved the teaching efficiency; more time was allowed for enquiry (S31).

AI was a new topic for me. The self-directed learning gave me a general idea of the fundamental concepts before the lesson. The courses focused on the application of AI. With the flipped classroom, we had more time to explore the use of the software and the applications of AI (S55).

Through the platforms and hands-on experience introduced by the instructors during the workshops, my understanding of machine learning has been deepened. Overall speaking, this course has benefited me a lot. (Reflection translated from Chinese: S22)

From the demonstrations by the instructors and my own hands-on practice during the workshops, I now have a deeper understanding of how to handle datasets and to look for their inadequacy. (Reflection translated from Chinese; S17)

I am very interested in deep learning of AI. However, I think this topic is difficult for me to follow and imagine. Especially talking about how the convolution layer and pooling layer work to show the feature map. It is abstract to imagine in my mind. (Reflection; S57)
C. Feedback on Course 3

Table VIII tabulates the responses to Part 1 (Learning Preference) of the survey from participants who had completed all three courses. In line with the results after Courses 1 and 2, a statistically significant increase in the participants’ learning preference over the flipped classroom learning approach was observed after Course 1. Such level of preference was maintained to the end of Course 3.

**TABLE VIII**

RESULTS OF PART 1 (LEARNING PREFERENCE) IN THE SURVEY AFTER ALL COURSES

<table>
<thead>
<tr>
<th>Part 1 (max. mark: 5)</th>
<th>Before Course 1 Mean (SD)</th>
<th>After Course 1 Mean (SD)</th>
<th>After Course 2 Mean (SD)</th>
<th>After Course 3 Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3.70 (0.49)</td>
<td>4.00 (0.52)</td>
<td>4.07 (0.53)</td>
<td>4.09 (0.53)</td>
</tr>
</tbody>
</table>

**Statistical Test Results**

<table>
<thead>
<tr>
<th>F-value</th>
<th>Partial η²</th>
<th>Pairwise comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>11.05***</td>
<td>0.24</td>
<td>Before Course 1 &lt; After Course 1, 2, 3</td>
</tr>
</tbody>
</table>

N=36; *p < 0.05; **p < 0.01; ***p < 0.001

Considering responses for the whole survey, Table IX shows that the participants’ preference for the flipped classroom continued throughout the whole programme. The 36 participants who completed the programme showed an appreciation of the flipped classroom learning approach, with high marks throughout the entire programme. The mean scores remained above 4 out of a maximum of 5.

Table X shares some selected quotes from the focus group interviews and participants’ reflective statements after Course 3. Some participants commented on the appropriate workload on the pre-course reading. Some participants also pointed out the flipped classroom learning approach addresses the need of the course well: the theoretical part of the course could be covered in the pre-course learning, while the synchronous workshops with instructors and fellow classmates can be reserved for the practical part of the course. Other participants emphasised the importance on the workshops assisted by the instructors and fellow classmates, these issues were solved.

| TABLE IX |

RESULTS OF THE SURVEY AFTER ALL THREE COURSES

<table>
<thead>
<tr>
<th>After Course 1 Mean (SD)</th>
<th>After Course 2 Mean (SD)</th>
<th>After Course 3 Mean (SD)</th>
<th>F-value</th>
<th>Partial η²</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.10 (0.47)</td>
<td>4.06 (0.51)</td>
<td>4.13 (0.48)</td>
<td>0.43</td>
<td>0.01</td>
</tr>
</tbody>
</table>

N=36; *p < 0.05; **p < 0.01; ***p < 0.001

D. Project-based Learning

Course 3 involved application development through a group project, and this project-based learning as a pedagogy was well-received by the participants. They perceived that the project-based learning had been useful in developing their understanding of concepts and ethical awareness (see Table XI).

Several students pointed out that comparatively speaking, the flipped classroom learning approach was more appropriate in Courses 1 and 2 and less appropriate in Course 3, in which more rapid support was needed. Al-Samarraie et al. [23] also point out that when the flipped classroom learning approach is applied in technology disciplines, it brings challenges in the form of a lack of immediate feedback, which may increase the frustration of weaker students.

| TABLE X |

SELECTED QUOTES FROM FOCUS GROUP INTERVIEWS AND REFLECTIONS AFTER COURSE 3

More project-based practice should be included. For instance, the trainer may guide us to practise using the platforms step by step based on a specific project. (S8)

The workload is perfect for me. The volume of self-directed learning materials is proper (S14).

Both theories and application are involved in this course. For the theories, we can pre-learn by ourselves and in class, we can have more hands-on practice. (S31)

This course allowed me to apply the AI knowledge learnt previously. It was difficult at the beginning, because I could not come up with meaningful AI innovations. After spending some time to work out an idea for AI innovation, I was not sure how to implement it. Through discussions with the instructors and fellow group members, these issues were solved. (reflection translated from Chinese; S29)

This series of courses is very interesting and meaningful. I learned a lot of foundational knowledge related to AI. Now I know various websites about AI, and I have attempted with my group members to make an AI application. (reflection translated from Chinese; S36)

VI. CONCLUSION AND FUTURE WORK

This paper presents the curriculum design and delivery of an AI literacy programme for university students in Hong Kong. The programme was 30 hours in duration. One hundred and twenty students attended Course 1, 82 attended Course 2 and 36 attended Course 3. The participants came from diverse academic backgrounds. We collected feedback from the participants through a survey, focus group interviews and reflective writing. The feedback showed that the students appreciated the flipped classroom learning approach. They also reported that project-based learning helped them to develop their understanding of concepts and their ethical awareness concerning AI.

These findings have several implications. First, the study examines and validates the use of flipped classroom learning approach with project-based learning in AI literacy education. It successfully fills the gap in pedagogy and delivery, which is a large step towards promoting AI literacy among citizens of diverse academic backgrounds.

| TABLE XI |

SELECTED QUOTES FROM REFLECTIONS AFTER COURSE 3

This course gave me a better understanding of what AI is. Before, I saw some technology-related products as AI artefacts, e.g. automatic doors. Now I understand that AI artefacts need to go through a series of analytical processes before becoming functional. Automatic doors only involve pedestrian sensors, not AI. In the project work, based on the guidance of the teacher, I conceived a solution that can help humans solve some problems in daily life and increase convenience. But at the same time, it made me understand the limitations and ethical considerations involved in AI (reflection translated from Chinese; S5)

Course 3 made me reflect on the applications of AI and pay attention to ethical considerations such as user privacy, fairness, beneficence, and nonmaleficence. At the end, I conceived and completed a simple waste sorting AI with my group members, which also strengthened my confidence in continuing to research in the future, solving problems in life with innovative thinking, and applying AI (reflection translated from Chinese; S18)
In this course, I gained the experience to apply AI and use Microsoft QnA Maker to address a daily life problem. I know more about how to use AI from workshops, for example making a chatbot. In terms of ethical considerations, I remembered that in the past, I was afraid of a betrayal by AI. However, that is a plot from sci-fi. Humans are the most horrible things. In the project, I tried to make a chatbot. I noticed that the data provided was very important, for example if I intentionally used input with discrimination, bias or other bad things. That can cause big problems in our society. Therefore, we must set regulations to avoid such problems (reflection; S32).

Second, the study suggests that setting an appropriate level of difficulty concerning course content is of great importance in literacy programmes. In this study, participants felt empowered after attending the programme. An important reason for this was that the programme was designed with an appropriate level of difficulty. To increase the accessibility of literacy courses for the public, we must consider the needs of the participants and their limited prior knowledge, adjusting the difficulty of the tasks to a moderate level. Only in this way will participants feel empowered to unleash their digital creativity.

The final implication is that cultivating students’ self-directed learning is important. Some of the participants in the focus group interview pointed out that applying the flipped classroom learning approach in Course 3 was not as effective as in Courses 1 and 2, as the participants failed to receive immediate assistance from the instructors. Several participants also reported that they were not self-motivated enough for this method, as learning through the traditional approach involves more guidance from instructors and makes their study easier. It is evident that too much reliance on instructors undermines the efficiency of the flipped classroom learning approach. The workplace is of growing importance as a model for learning, leading to an increasing need for self-directed learners. It is therefore vital to cultivate university students’ self-directed learning habits. In future offering of Course 3, we plan to adopt project-based learning as its major pedagogy since the project has served as a crucial part in driving participants’ learning in Course 3.

The significance of this study lies in its validation of a pathway for the development of AI literacy among citizens from diverse academic backgrounds. We encourage researchers and educators in the human-computer interface, AI and learning science communities to both engage in conversation around the curriculum and pedagogy in this study and use them as a guide for future empirical and design research on AI literacy. The programme should also be offered to members of the public, including senior secondary school students and citizens from all walks of life.

**References**


[2] V. Van Roy, F. Rossetti, K. Perset, and L. Galindo-Romero, “AI watch, national strategies on artificial intelligence: A European perspective,” JRC Publications Office of the European Union, Luxembourg, from workshops, for example making a chatbot. In terms of ethical considerations, I remembered that in the past, I was afraid of a betrayal by AI. However, that is a plot from sci-fi. Humans are the most horrible things. In the project, I tried to make a chatbot. I noticed that the data provided was very important, for example if I intentionally used input with discrimination, bias or other bad things. That can cause big problems in our society. Therefore, we must set regulations to avoid such problems (reflection; S32).


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