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The IEEE Technical Committee on Learning Technology (TCLT) has been founded on the premise that emerging technology has the potential to dramatically improve learning. The purpose of this technical committee is to contribute to the field of Learning Technology and to serve the needs of professionals working in this field.

The Bulletin of the Technical Committee on Learning Technology aims to report (1) the up-to-date outcome of the emerging learning technologies, (2) the review of learning technology related books, instruments or reports, (3) the collaboration opportunities of work-in-progress research ideas and projects, (4) the current development status of learning technology in the developing countries, and (5) the announcements of the upcoming activities that the learning technology community may interest. It would also serve as a channel to keep everyone aware of Technical Committee’s activities.

The bulletin is calling for articles in the following sections:

- **Emerging Learning Technologies**: an article with up to 8 pages the research outcome of learning technologies, including systems, tools, apps, etc., no theoretical or concept only research would be accepted.
- **Equity, Diversity & Inclusion (EDI)**: an article with up to 4 pages to discuss the issues for minorities in STEM education and how the community deal with the matter.
- **Book & Report Reviews**: an article with up to 4 pages.
- **Collaboration Opportunities**: an article with up to 4 pages to talk about the research progress and stage outcome as well as the aspects and needs of looking for collaborations.
- **Report from Developing Countries**: an article with up to 6 pages to describe the current research progress/difficulties/needs/limitations of the learning technology in the developing countries.
- **Event Info & Call for Event Host**: 1 page.

The bulletin articles have to give readers clear idea and vision of the advanced learning technologies with rich and proper figures, screenshots, and diagrams.

For preparing your manuscript, please follow the IEEE guidelines and use the template at [https://ieeauthor.wpengine.com/wp-content/uploads/Transactions-brief-short-or-communications-article-template.doc](https://ieeauthor.wpengine.com/wp-content/uploads/Transactions-brief-short-or-communications-article-template.doc). Please submit your manuscript to tclt-bulletin@ieee.org in Word format with the subject title “Bulletin Submission for [section]” (section indicates which section you would like to submit). All figures should be in high resolution and embedded in the main text.

The bulletin is included in Emerging Sources Citation Index (ESCI). The first decision for the submission is in 24 days.
Editorial

Maiga Chang, Rita Kuo, Jerry Chih-Yuan Sun, Jun Chen Hsieh

The official YouTube Channel of IEEE Technical Community on Learning Technology finally has a human readable URL: https://www.youtube.com/c/IEEETCLT. The channel provides the community with access to past ICALTs’ keynote speeches and expert interviews. Please keep subscribing to IEEE TCLT YouTube Channel so you can receive the incoming expert interviews and tutorials.

There are four articles published in this issue after the rigorous review process. The articles include one in Emerging Learning Technologies section, one in Equity, Diversity & Inclusion section, and two in Event Info & Call for Event Host section. The first article, entitled “Design of a Chatbot Learning System: Case Study of a Reading Chatbot,” in the Emerging Learning Technology was written by Wu and Liao. This article presents an innovative way to integrate Google, LINE, and web services by using algorithmic mechanisms that allows teachers to construct chatbot-based teaching materials for a reading class. The design is based on the theory of Kintsch’s single-text and Britts multiset reading comprehension models to develop teaching content and instructional flow. The authors introduced a step-by-step design of this teacher-friendly chatbot learning system that aids teachers with low technological knowledge and the ability to easily integrate technology into students’ learning.

The second article in the Equity, Diversity, & Inclusion section is “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,” written by Kong, Zhang, and Cheung. The article presents a curriculum design and pedagogical delivery to promote artificial intelligence literacy for university students of diverse academic backgrounds. The authors explained two introductory courses in machine learning and deep learning, and a capstone project course in AI applications that aimed to foster students’ ethical awareness. They evaluated the students’ flipped classroom learning experience and their understanding of AI and ethics. They concluded that the courses affect students positively in their ethical awareness of AI.

Both articles provide innovative applications for learning through chatbot design and curriculum design of AI literacy with a focus on ethical awareness of AI. Their detailed illustration of design processes can be useful for relevant researchers.

The first article in the Event Info & Call for Event Host section is the information of the 1st International Workshop on Metaverse and Artificial Companions in Education and Society (MetaACES 2022). MetaACES 2022 will take place on June 24th, 2022 in a fully online mode. Organized by The Education University of Hong Kong, MetaACES 2022 aims to provide academics, researchers, practitioners, and related professionals in the education field a channel for interactive exchanges related to emerging technologies, the metaverse, and artificial intelligence.

CS Buzz 2022 is the second article in the Event Info & Call for Event Host section. The article introduces a professional development program for K-12 teachers learning how to teach various topics in Computer Science in New Mexico. The K-12 teachers will also understand how to integrate different Computer Science topics into a single hands-on project in order to mentor middle and high school students conducting Computer Science related projects in the future.

The current submission statistics in the Bulletin of TCLT show that authors receive the first decision notification in average 20.91 days, and for the accepted articles the authors get the acceptance notification in average 44.53 days as Fig. 1 shows. Fig. 2 shows that the accepted articles are published online on average 88.51 days after they were submitted.

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Design of a Chatbot Learning System: Case Study of a Reading Chatbot

Wen-Hsiu Wu and Guan-Ze Liao

Abstract— Technology is more than a tool; the use of technology is also a skill that needs to be developed. Teachers are expected to have the ability to integrate technology into their teaching methods, but whether they have the required technological expertise is often neglected. Therefore, technologies that can be easily used by teachers must be developed. In this study, an algorithm was developed that integrates Google Sheets with Line to offer teachers who are unfamiliar with programming a quick method for constructing a chatbot based on their teaching plan, question design, and the material prepared for a reading class. To meet the needs for reading classes, reading theories and effective reading instruction are incorporated into the learning and teaching mechanism of the chatbot system. To create a guidance structure that is suitable for students of various levels of ability, Nelson’s multipath digital reading model was employed because it can maintain a reading context while simultaneously responding to the diverse reading experiences of different readers.

Index Terms— Educational technology, Learning management systems, Mobile learning

I. INTRODUCTION

According to [1], the use of technological tools to supplement teaching and learning activities can help students access information efficiently, develop self-directed learning in students, and improve the quality of instruction. However, many teachers continue to adhere to traditional teaching methods rather than integrating technology into teaching because of their negative attitude toward and low confidence in technology use; insufficient professional knowledge and technological competence; and a lack of technological resources, training, and support [2], [3]. Therefore, this study focused on the development of a system to cater to teachers’ technological abilities and teaching needs.

In this study, a reading class was considered the target context. In accordance with the theory of reading comprehension, Kintsch’s single-text [4] and Britt’s multitext [5] reading comprehension models were integrated into the learning mechanism design. To provide assistance to students on the basis of the level of comprehension with which they have difficulty, Nelson’s multipath reading model was employed to design the question and answer mechanism [6].

To make the system easily operable and accessible for teachers who lack a programming background, Line, which is the most used communication platform in Taiwan, was used as the front-end interface, and Google Sheets, a commonly used cloud-based spreadsheet, was employed as the database containing teaching content and learning records. Moreover, programs and algorithms were developed using Google App Script to connect the Line and Google Sheets services.

A. Models of Reading Comprehension

According to Kintsch’s reading comprehension model, which is called the construction–integration model, reading comprehension is a process of continuous construction and integration [4], [7]. In this model, each sentence in a text is transformed into a semantic unit, which is called a proposition. The reader then constructs a coherent understanding by continually recombinig these propositions in an orderly fashion. Reference [8] reviewed studies on single-text processing and assumed that the reading process involves at least three levels of memory representation. The surface level represents decoding of word meaning in the early reading stage. The textbase level represents the process of transforming a text into a set of propositions on the basis of lexical knowledge, syntactic analysis, and information retrieved from memory. The situation level represents the process of constructing a coherent understanding of the situation described in the text through experience accumulated in life.

The main limitation of a single text is that it only reflects the viewpoint of a specific author rather than offering the comprehensive viewpoints. Even when arguments are objectively summarized in a literature review, the author still selects from among original sources. According to [5] and [9], if students are to address an issue critically and know how to construct a complete understanding of an issue, they should be allowed to learn by reading actual texts, practice selecting and organizing information, and interpret thoughts in their own manner. In multitext reading, texts have the role of providing raw information; reader must thus be clear on the purpose to their reading if they are to select and integrate relevant information and manage diverse or even contradictory viewpoints; otherwise, they may become lost in the ocean of information. Britt et al. extended the Kintsch model to propose the documents model and suggested that a higher level of proposition is event related and includes several clauses and paragraphs; this level involves understanding construction in multitext reading [5], [10]. Reference [8] reviewed studies on multitext reading and concluded that the reading process involves at least three memory representations: the integrated model represents the reader’s global understanding of the situation described in several texts, the intertext model represents their understanding of the source material, and the task model represents their understanding of their goals and appropriate strategies for achieving these goals. Compared with Kintsch’s theory, multitext reading theory is more reader-directed and emphasizes the reader’s approach to constructing a coherent and reasonable understanding from texts representing various viewpoints.

As suggested in [8], the challenge faced in the teaching of multiple-document reading is how to design a guidance structure that considers the reading paths of different students. Nelson proposed a digital reading model that can maintain a context and simultaneously respond to the diverse reading experiences of different readers. Nelson suggested breaking a text into smaller units and inserting hyperlinks in these units, allowing readers to jump from the current document to the content pointed to by the hyperlinks without affecting the structure of the text [6]. Moreover, reference [11] used Nelson’s model in a clear
manner by treating reading units as nodes, interunit relationships as links, and reading experience as a network composed of nodes and links. Therefore, the collection of content with which the reader interacts can be treated as a representation of the reader’s reading process. Nelson’s multipath digital reading model inspired us to shift the complex teacher–student interaction during reading instruction to a chatbot system. Learning content can be considered a node, and question–answer pairs can be considered links to related learning content. If question–answer pairs fully represent students’ understanding, the students can be guided to the content they require on the basis of the answer they select. The following section explains the factors that must be accounted for within a well-designed question–answer framework.

B. Design of Questions and Instructions

Two particular reading interventions are employed to promote comprehension: an instructional framework based on self-regulated learning targets, which is used for basic-level comprehension, and a framework based on teacher-facilitated discussion targets, which is employed for high-level comprehension and critical–analytic thinking [12]. Among interventions for teacher-facilitated discussion, questioning differs from direct explanation and strategic interventions, which help students develop reading comprehension through direct transfer of skills. Instead, questioning, involving asking students questions in a step-by-step manner, helps them actively construct and develop their understanding of a text.

A good question does not always come to mind easily; thus, teachers must prepare well before class. According to [13], before designing questions, teachers must have a general understanding of the text, consider probable student reactions, possess specific thinking skills, and decide which competencies should be evaluated. According to [14] and [15], when designing questions, the level of the question should be based on the complexity of the cognitive processing required to answer the question. For example, factual questions, requiring the lowest level of processing, require students to recall relevant information from the text; paraphrased questions require students to recall specific concepts and express them in their own way; interpretive questions require students to search for and deduce a relationship among concepts that are not explicitly stated in the text; and evaluative questions, requiring the highest level of processing, require students to analyze and evaluate a concept in the text by using the context and their prior knowledge.

Questions can not only reflect the level of comprehension but also promote thinking. If higher-level questions are posed, students are more likely to think beyond the surface of the topic [16]. For example, even if a student can answer factual questions correctly, they do not necessarily gain insight from the facts. If the teacher then asks the student to paraphrase or interpret a concept, which would indicate whether the student can link facts together, the student is likely to demonstrate higher-level competency [16].

In recent years, the OECD’s Programme for International Student Assessment reading comprehension standards [17] have increasingly emphasized the role of the reader’s personal reflection in reading comprehension. However, irrespective of whether the questions require the students to organize information from texts, use their prior knowledge, or reflect on their life experiences, students must respond in accordance with the context of the text. In other words, they should not express their opinions and feelings freely as they wish. If making deductions from a text is the main competency to be assessed, the level of students’ comprehension can be determined by evaluating their selection of original sources while expressing their thoughts. Moreover, if students are asked to cite original sources, they are more likely to avoid straying from the topic and to demonstrate critical thinking [9].

To create a good questioning practice, teachers must consider the different levels of the various students and provide assistance accordingly. The different types of questions represent different levels of reading comprehension. Higher-order questions involve more complex cognitive strategies than strategic lower-order questions. Reference [18] stated that for students who have trouble in constructing meaning from a text, teachers should provide a supporting task, such as word recognition. References [14] and [19] have highlighted that for students who need help answering challenging questions, teachers should encourage more advanced use of thinking skills, such as metacognition and awareness of thinking.

The instant feedback that a teacher can provide on the basis of a student’s reply cannot be easily replaced by a predetermined instructional framework. Instead of replacing face-to-face instruction in a class, the system aims to solve the problems encountered during oral question-and-answer sessions and to provide teachers with students’ learning information to enable further counseling. Because identifying how students make inferences from texts is difficult for a teacher during oral communication, a recording mechanism is needed to help the teacher note the source of a student’s inference. According to [20], even if a teacher is well prepared, poor oral presentation skills can affect students’ understanding of questions. Therefore, a digital tool that fully implements a teacher’s questioning framework can be used to prevent misunderstanding. According to [21], some students fail to take the opportunity to practice because they feel reluctant to express themselves in public; thus, an individual-oriented learning system can ensure that every student practices an equal amount.

By summarizing the aspects that needed to be considered in the design of questions and instructions, the main guidelines of this system were defined as follows. The question design should support true/false questions, multiple-choice questions, and essay questions for different levels of students. The mechanism of replying to a question should support self-expression and connection with corresponding resources. The system must provide a basic mechanism for determining students’ level of reading comprehension from their qualitative reply and guide them to reread the text for self-modification and self-monitoring.

C. Application of a Chatbot

The earliest chatbot—ELISA, developed by Weizenbaum in 1966—used algorithmic processing and predefined response content to interact with humans [22]. Chatbots are commonly used to assist individuals in completing specific tasks, and the dialogues are designed to be purposeful and guided [23].

Recently, chatbots have been widely applied in educational settings and have been demonstrated to have beneficial effects on learning. For example, in [24] and [25], chatbots were applied to language learning and determined to induce interest and motivation in learning and increase students’ willingness to express themselves. The results of one study [26], in which chatbots were applied to computer education revealed that students who learned in the chatbot-based learning environment performed comparably to those who learned through traditional methods. Moreover, [27] recently developed a chatbot framework by using natural language processing (NLP) to generate appropriate responses to inputs. They used NLP to distinguish and label students’ learning difficulties, connect students with the corresponding grade-level learning subjects, and quickly search for learning content that met the students’ needs. Other scholars [28] applied a chatbot to the learning management system of a university and employed artificial intelligence to analyze the factors that motivate students to learn actively, monitor academic performance, and provide academic advice. The results indicated that the method improved student participation in their course.

Many commonly used communication platforms and free digital resources now support the development of chatbots. Designing and maintaining a system of teaching aids would be time-consuming. Chatbots already have high usability and are accepted by the public, meaning that using an existing platform to develop a chatbot would reduce users’ cognitive load during the learning process. Therefore,
this study developed algorithms to link the services of two open source platforms, Google and Line, and create a cloud spreadsheet that can act as a database for storing teaching content and learning records. Because the algorithms connect with a spreadsheet, creating a new chatbot learning system by using the proposed approach is easy; the spreadsheet would be duplicated, and the setting would be updated with information on the new chatbot.

II. DESIGN OF SYSTEM

A. Instructional Flow Design

1) Structure

A piece of text contains several propositions, and the propositions may be parallel or subordinate to a large proposition. Therefore, the structure of textual analysis and the teaching structure are hierarchical. The proposed system has three levels: the text, chapter, and content levels (Fig. 1). Each card in a carousel template represents one text, and having multiple texts is acceptable (Fig. 2). Chatbot designers can update the chatbot interface and carousel template on the basis of their teaching structure once they have added a new text in Google Sheets (Fig. 2). Students can select any text they want to learn from at any time because of a menu button, called “Classes for Guided Reading of Texts,” which prompts the carousel template to pop up (Fig. 3). Each chapter has its own ID number, and the system connects the chapter’s learning content by the ID. For example, the ID of “Characteristic” is “01”; thus, if students press the button showing “Characteristic”, the system searches for the teaching content labeled “010000” for publishing on the chatbot and then moves to the next content in accordance with the next ID assigned by the designer (Fig. 4).

Fig. 1. Teaching structure (for a sample text).

Fig. 2. Carousel template.

2) Instructional Content Design

According to Kintsch’s theory, instructions should assist students on the basis of the level at which they fail to arrive at a correct understanding of the text. In the surface level, instructions should provide word explanations. In the textbase level, instructions should help connect propositions that the students have ignored. In the situation level, the system should guide students in expressing a concept in their own way and in accordance with their experience. In some cases, the coherence between instruction contents that are not distinct is strong. Therefore, the teacher’s instructional flow can be designed as a linear structure or created with branches and flexibility to help guide students to the content at an appropriate level depending on whether the student knows specific concepts.

Teaching content that comprises an instructional flow is coded. The content in question form can be used to create a branch for the instructional flow. Each question can accept up to 13 branches. To arrange the next content to be published, the system requires the teacher to assign IDs to the branches of each question. According to multitext reading theory, at the integrated level, instructions should guide students to construct a global understanding of the texts. Therefore, each content ID is generated uniquely so that the next ID to be assigned is not limited to the range of texts currently being learned. For paraphrased questions that require students to respond in their own way and when no answer accurately represents a student’s thoughts,
the system allows the student to reply by typing out a response if the next ID is set to “000000” (Fig. 4). The system stores the student’s learning progress by recording the order in which the student encountered the content, the buttons they pressed, and their replies (Fig. 5).

For both multiple-choice and paraphrased questions, the system asks the student to provide their qualitative reasoning and original sources; their responses enabled us to understand how students interpret texts (details in section II-B-5). In the case of a student’s thought not being represented by any answer, the student’s qualitative reply is treated as an exceptional case not considered by the teacher during the design stage, and all such replies are collected and given to the teacher.

### B. Design of Question and Answer Mechanism

#### 1) Questioning Mechanism

Whether the students answer a question correctly does not reflect whether they fully understand a text. Examining the process of students’ interpretation can be a way to accurately follow their real thinking. According to Kintsch’s construction–integration model, a text is a combination of multiple propositions. Similarly, a reading comprehension question must be answered by combining different propositions. Therefore, by comparing the combinations of propositions used by the teacher and the students, it can be determined whether students have overlooked specific aspects, and appropriate guiding questions can then be provided to help the students review the text.

#### 2) Text Processing

To help the teacher more effectively identify the connection between student responses and the text, the system cuts and codes the text provided by teachers by using the punctuation mark as a breakpoint. The system then creates a webpage on the basis of these sentence units and gives students the link to the webpage in a chatbot dialog (Fig. 6). The webpage has a guide that helps students reply, explain their reasoning, and pick sentences as resources to support their viewpoint (Fig. 7). The webpage is connected to the Line Login service; thus, the user’s identity is recognized and students’ replies are recorded and sent back to the same Google Sheet for the chatbot system and another subsheet for storage (Fig. 8).

#### 3) Sentence Marker

When a teacher designs questions, they usually have a reference answer in mind and need to refer to specific information and propositions from the text for support, interpretation, and inference. Similarly, students must select corresponding textual sentences as the basis for their interpretations. According to multitext reading theory, at the intertext level, sourcing across texts is one of the main competencies that must be developed and evaluated if each sentence is to be coded uniquely. Students can pick sentences across texts.

#### 4) Sentence Match

To calculate the similarity between a student’s answer and the reference answer provided by the teacher, the system compares the references of both. On the basis of the difference between the references, the system can distinguish and label the completeness of the student’s comprehension and provide a guiding question with which the student can review the text.

#### 5) Qualitative Replies Classification and Analysis

Because the learning patterns of a group of students are unknown at the beginning of a course, the teacher should track students’ learning process in the long term and observe how students’ explanations and sentence selection evolve under the influence of the guiding questions provided by the system. Before analysis, if a user’s replies include multiple-choice selections and qualitative explanations with supporting sentences, the replies are classified into correct and incorrect. If a user’s replies are paraphrased replies rather than multiple-choice selections, their correctness is determined manually because the system is not yet capable of automatically determining correctness. Another area of analysis in which we are interested is comparing how different students interpret a given question; thus, we plan to classify qualitative explanations on the basis of sentence IDs.
III. SUMMARY AND FUTURE RESEARCH

The integration of technology into teaching requires consideration of many aspects, such as the teacher’s attitude, teacher’s technological knowledge and ability, and teaching needs, which are often overlooked. Because we believe that tools should be useful, not just usable, this study aimed to develop a teacher-friendly teaching-aid system based on theories of the teaching and learning of reading and empirical studies of technology applications.

Thanks to the advancement of technology and the willingness of each platform to release development permission, we were able to link Google, Line, and web services by using algorithmic mechanisms. The advantage of this integration is that we do not need to spend considerable time and money to develop a system but use the existing advantages and convenience of these platforms to achieve a similar experience. Moreover, as system developers, we are able to focus on the development and implementation of pedagogical theories rather than the basic operation and maintenance of the system.

To investigate the usability of the system and to help us improve the system, we will invite students and teachers as participants. This system is a prototype. Some message types follow a Line template, and thus, there are limitations, such as the number of buttons, length of the content, and appearance of the message. In addition, the Google Sheet employed in this study, restrictions and drop-down lists cannot be implemented to prevent designers from constructing learning content with an incorrect format. Therefore, many functions need to be implemented and improved to make the system more accessible for designers. Moreover, because students’ data stored in Google Sheets cannot currently be read easily, the data must be organized; we expect to take the same Google Sheet format as the basis for developing another chatbot with which teachers can produce statistical analyses of students’ learning records.

The system is expected to be a tool that can help teachers understand how students make interpretations and inferences when reading a text. Especially for students who cannot obtain the correct understanding, the relationship between their explanations and text sentences can help teachers to counsel such students or help researchers analyze the factors causing misunderstanding. In the future, we expect to apply machine learning models to further distinguish and label students’ reading difficulties.

References

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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.

The Flipped Classroom Learning on AI Literacy survey assessed the effectiveness of the flipped classroom learning approach in developing AI literacy among the participants. The survey contained four parts assessing the participants’ feedback on flipped classroom learning: learning preferences, the flipped classroom learning environment, self-regulated learning, and the overall flipped learning experience. Table I summarises the structure of this survey with a sample question from each of these 4 parts. The pre-/post-course survey was conducted both before and after the course. As parts 2 – 4 focus on the experience of the participants through the courses, it is more appropriate to collect participants’ feedback on these parts after Course 1, 2 and 3 instead of before Course 1. The survey for participants to complete before Course 1 thus focuses solely on the first part, i.e. the part on their learning preferences. This part contains 7 multiple-choice questions (with five choices per question). In the survey administered after Course 1, 2 and 3, the participants were asked to answer questions for all four parts, a total of 24 multiple-choice questions (with five choices per question).

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></td>
<td>N=120</td>
</tr>
<tr>
<td>Mean (SD)</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, 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.

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 practice on operating AI. (Reflection translated from Chinese; S82)

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.

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 convolution 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).

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)

Table VII selected quotes from participant focus group interviews and reflective statements after course 2.

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)

### Table III

<table>
<thead>
<tr>
<th>TABLE III</th>
<th>RESULTS OF PART 1 (LEARNING PREFERENCE) IN THE SURVEY ON THE FLIPPED CLASSROOM LEARNING APPROACH AFTER COURSE 1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before Course 1 Mean (SD)</td>
</tr>
<tr>
<td>Part 1</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>Part 2</td>
<td>Mean (SD)</td>
</tr>
</tbody>
</table>

N=120; *p < 0.05; **p < 0.01; ***p < 0.001

### Table IV

<table>
<thead>
<tr>
<th>TABLE IV</th>
<th>SELECTED QUOTES FROM PARTICIPANT INTERVIEWS AND REFLECTIVE STATEMENTS AFTER COURSE 1 ON THE USEFULNESS OF THE FLIPPED CLASSROOM LEARNING APPROACH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>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).</td>
</tr>
</tbody>
</table>

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)

### Table V

<table>
<thead>
<tr>
<th>TABLE V</th>
<th>RESULTS OF PART 1 (LEARNING PREFERENCE) IN THE SURVEY AFTER COURSES 1 AND 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part 1</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>Part 2</td>
<td>Mean (SD)</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

<table>
<thead>
<tr>
<th>TABLE VI</th>
<th>RESULTS OF THE SURVEY ON THE FLIPPED CLASSROOM LEARNING APPROACH AFTER COURSES 1 AND 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>Mean (SD)</td>
</tr>
</tbody>
</table>

N=82; *p < 0.05; **p < 0.01; ***p < 0.001
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 |
|----------------------------------|-----------------|-----------------|-----------------|
|                                   | Before Course 1 | After Course 1  | After Course 2  | After Course 3  |
| Mean (SD)                         | Mean (SD)       | Mean (SD)       | Mean (SD)       | Mean (SD)       |
| Part 1 (max. mark: 5)             | 3.70 (0.49)     | 4.00 (0.52)     | 4.07 (0.53)     | 4.09 (0.53)     |
| Statistical Test Results          |                 |                 |                 |                 |
| F-value                           |                 |                 | 11.05***        | 0.24            |
| Partial \( \eta^2 \)              |                 |                 | Before Course 1 | After Course 1, 2, 3 |
| Pairwise comparison               |                 |                 |                  |                 |

\( N=36; *p < 0.05; **p < 0.01; ***p < 0.001 \)

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 as well as the collaborative work and discussions during the workshops assisted them in learning. Some participants suggested more assistance be given on carrying out the project.

| Table IX Results of the Survey After All Three Courses |
|----------------------------------|-----------------|-----------------|-----------------|
|                                   | After Course 1  | After Course 2  | After Course 3  |
| Mean (SD)                         | Mean (SD)       | Mean (SD)       | Mean (SD)       |
| Overall (max. mark: 5)            | 4.10 (0.47)     | 4.06 (0.51)     | 4.13 (0.48)     | 0.43 0.01 |

\( N=36; *p < 0.05; **p < 0.01; ***p < 0.001 \)

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 approach 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>
<thead>
<tr>
<th>Table X Selected Quotes from Focus Group Interviews and Reflections After Course 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>More project-based practice should be included. For instance, the trainer may guide us to utilise the platforms step by step based on a specific project. (S8)</td>
</tr>
<tr>
<td>The workload is perfect for me. The volume of the self-directed learning materials is proper (S14).</td>
</tr>
<tr>
<td>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)</td>
</tr>
<tr>
<td>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)</td>
</tr>
<tr>
<td>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)</td>
</tr>
</tbody>
</table>

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.
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).


Siu-Cheung Kong currently is Professor of the Department of Mathematics and Information Technology (MIT); and Director of Centre for Learning, Teaching and Technology (LTTC), the Education University of Hong Kong. Prof. Kong has produced over 230 academic publications in the areas of pedagogy in the digital classroom and online learning; policy on technology-transformed education and professional development of teachers for learner-centered learning; computational thinking and artificial intelligence education. Prof. Kong is at present serving as the Editor-in-Chief of the international journal Research and Practice in Technology Enhanced Learning (RPTEL) and Journal of Computers in Education (JCE). Prof. Kong is the Convener of Computational Thinking Education in Primary and Secondary Schools International Research Network (IRN) under World Educational Research Association (WERA) since May 2019.

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The International Workshop on Metaverse and Artificial Companions in Education and Society (MetaACES 2022)  
(24 June 2022)

Siu-Cheung Kong, Yunsi Ma

I. INTRODUCTION

The First International Workshop on Metaverse and Artificial Companions in Education and Society (MetaACES 2022), organized by The Education University of Hong Kong, will be held on 24 June 2022 in a fully online mode. For more details of MetaACES 2022, please refer to https://www.eduhk.hk/metaaces2022.

MetaACES 2022 aims to provide an interactive platform for academics, researchers, practitioners, and professionals in the education sector to share and exchange research agenda, innovative ideas as well as practices of promoting and exploring metaverse, artificial companions, and related technologies. MetaACES 2022 comprises seminars and panels delivered by internationally renowned scholars, researchers, and practitioners. Catalysed and facilitated by emerging technologies, the metaverse and related artificial companions will affect us in every aspect of our lives.

The workshop program includes keynotes, abstract presentations, and panels. All the accepted abstracts of the workshop will be published in ISBN-coded proceedings. Accepted abstracts will be selected and invited to submit their full papers to one of the three Open Access ESCI publications: Elsevier's Computer & Education: Artificial Intelligence, Springer's Research and Practice in Technology and Learning Companions in Education and Society. MetaACES 2022 will also hold a workshop with the Centre for Learning, Teaching and Technology (LTTC), The Education University of Hong Kong (email: Csckong@eduhk.hk).

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Y. Ma is with the Centre for Learning, Teaching and Technology (LTTC), the Education University of Hong Kong (email: yma@eduhk.hk).

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II. THEMES

MetaACE 2022 focuses on the themes related to education and society. The main themes of MetaACES 2022 include but not limit to the followings (in alphabetical order):

- Automated Feedback
- Avatars or Player Characters for Learning
- Behaviour and/or Interaction Modeling, Detection and Visualization
- Big Data Analyzed and Processed by Computers
- Bridging Informal and Formal Learning Outcome
- Chatbot
- Computational Models of Knowledge and Expertise
- Computer Supported Discussion Analysis and Assessment
- Educational Applications of Metaverses
- Educational Robots and Toys
- Emotion (Affective State) Modeling, Recognition and Detection
- Emotive Agents
- Enhancing Grading, Scoring and Feedback
- Game Analytics
- Human Computer Interaction (HCI)
- Human Robot Interaction (HRI)
- Intelligent Agents, Tutors and Mentors
- Internet of Things (IoT), Internet of Everything (IoE), and/or Sensors
- Learning Companion Robots (Robotic Learning Companions)
- Languages, Thinking Skills, Meta-cognitive Skills, Cognitive Skills, and STE(A)M
- Learning Analytics in Educational Games
- Learning Companions
- Metaverse in Education and Society
- Motivational and Affective Factors on Learning with Technology
- Natural Language Processing supported Tools, Systems, Applications, Mobile Apps, and Chatbots
- Non-Player Characters for Learning
- Personal Learning Environments (PLE)
- Roles of Artificial Companions in Metaverse
- Role Playing Games for Learning
- Security and Privacy Issues
- Sentiment Analysis
- Simulation and Training (Skill, Competence, Vocational Learning)
- Social Network Analysis (SNA)
- Speech Recognition and Synthesis
- Stealth Assessment
- Unstructured and Semi-structured Data for Computer to Read and Learn
- User Experience (UX) Evaluation
- Virtual and Augmented Learning Environments
- Virtual Animal Learning Companions
- Virtual Characters and Companions in Learning and Life
- VR, AR and Simulation Technology

III. IMPORTANT DATES

- Abstract submission due: 25 April 2022
- Abstract review due: 10 May 2022
- Camera-ready abstract submission: 23 May 2022
- Author registration deadline: 4 June 2022
CS Buzz 2022

Rita Kuo, Amy Knowles

I. INTRODUCTION

In New Mexico, only 44% of all public high schools teach a foundational computer science course. To conquer this issue, the Randolph program in the Department of Computer Science and Engineering collaborated with the Master of Science Teaching (MST) in New Mexico Tech to support a CS Buzz course for the K-12 teachers in New Mexico. There are two components in the CS Buzz: (1) the MST course in Summer for K-12 teachers; and (2) three one-week long summer camps for middle and high school students in different age groups (7th to 8th, 9th to 10th, and 11th to 12th).

II. CS BUZZ

CS Buzz is a two-week-long, on-campus course designed for K-12 teachers to use as professional development or as part of the MST program to earn 2 graduate credits. The K-12 teachers enrolled in the CS Buzz course will learn different topics in Computer Science and teach these topics in one of the one-week summer camps for middle or high school students hosted by the Computer Science Department at New Mexico Tech.

By the end of this course, teachers will be able to:
- Understand topics (e.g., cybersecurity, machine learning) in Computer Science and relay that knowledge to middle and high school students.
- Understand how to integrate different Computer Science topics into a single hands-on project.
- Understand how to mentor students conducting a Computer Science related project.

A stipend of approximately $500 will be available for K-12 teachers completing the CS Buzz course along with an additional scholarship to cover the full tuition of the 2-credit graduate course. On-campus housing will be provided on a first come first serve basis.

The first week of CS Buzz in 2022 Summer is from June 13 to June 17. The K-12 teachers arrive on campus to learn topics in Computer Science with different guest instructors. The K-12 teachers work on the assignment they will present during the summer camps for middle and high school students. For the assignment, K-12 teachers will design a hands-on project which integrates at least two of the topics introduced during Week 1.

The K-12 teachers choose one of the three weeks available for the summer camps as the second week course of CS Buzz. They will:
- teach one part of the environment setup and the programming language used in the course;
- implement their integrated hands-on project during the summer to one group of summer camp students;
- instruct summer camp students on their designed hands-on, interactive project during one of the five-day summer camps;
- aid summer camp students in the completion of their designed hands-on, interactive project during one of the five-day summer camps.

III. CS BUZZ SUMMER CAMPS

The sections in the three, one-week long summer camps in 2022 Summer are:
- July 11 - July 15 (11th & 12th grade students)
- July 18 - July 22 (9th & 10th grade students)
- July 25 - July 29 (7th & 8th grade students)

The K-12 teachers in the CS Buzz will teach the students the same topics they learnt previously and demonstrate how to integrate different computer science topics into an interesting project in the first two days. On the morning of the third day, the students and the K-12 teachers will brainstorm ideas to design a project that the students are interested in and start working on the project in the next two days with support from college students. On the last day of the summer camps, the students will demonstrate their work with the K-12 teachers. The college professor will give comments and feedback.

IV. WEBSITES

We encourage K-12 teachers to join the CS Buzz during the summer and encourage them to recruit their students to join the summer camps. The related websites are:
- CS Buzz for K-12 teachers: https://sites.google.com/view/cs-buzz/
- CS Buzz Summer Camps for middle and high school students: https://sites.google.com/view/csbuzz-summer-camp/

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