BOARD #124: Equipping Academic Makerspaces with Artificial Intelligence Elements

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Throughout his academic journey, Ryan has excelled in various engineering projects and research endeavors. He has been actively involved in designing workshops on cutting-edge technologies such as embedded systems, ROS and IoT. Additionally, Ryan has led a undergraduate student research team on robotics, developing various types of smart robots.

Moreover, Ryan has been contributing to the community of Robotics through volunteer means. He has served as an Adviser for BREED and Nestspace at HKU, where he offers consultation and guidance on various projects. Ryan's technical proficiency includes 3D Printing, robotics, 3D modeling and mechanical machining.

With a passion for creating a better learning environment for fellow engineers, Ryan is dedicated to enhancing his skills and contributing to the advancement of mechanical engineering.

Equipping Academic Makerspaces with Artificial Intelligence Elements

Abstract: The rise of Large Language Models and other artificial intelligence (AI) technologies has sparked significant interest among students and industrial employers. Consequently, there is a growing need for academic makerspaces to incorporate AI elements—such as AI-powered chatbots and robotics. These AI-related practical experiences are expected to complement the theoretical knowledge acquired in the classroom for computer science (CS) students, while also providing foundational exposure for students from other engineering disciplines. However, many makerspaces, even within universities, face substantial challenges in adapting to this rapidly evolving landscape.

To address this challenge, this paper presents an experiential learning framework implemented in a university's student innovation center and makerspace from June 2023 to December 2024. This framework is designed to accommodate students from various fields, effectively integrating AI elements into their extracurricular activities in the makerspace. Specifically, we adopt a project-based learning approach that invites students with either technical backgrounds or professional training related to the problems being tackled. For example, we assembled teams of CS students and social work students to develop a chatbot for interactive coaching of social workers. Recognizing that AI applications extend beyond chatbots, we encourage exploration of diverse topics (e.g., AI and robotics), seamlessly integrating AI elements into the traditional focus areas of makerspaces.

For students with limited experience, a series of hands-on workshops were carefully designed, starting from foundational concepts in training a neural network to more practical experience of building their own chatbots. These series of workshops are expected to progressively build up their skills for involving in or initiating AI-related innovations. We have also made the teaching materials of the workshops publicly available to our makerspace community.

In addition to the educational content, computing facilities are a significant concern for many makerspaces, as AI-related projects often require substantial computational resources. To address this, we devised a cost-effective strategy for establishing the necessary facilities to support these activities. While high-performance computing workstations may be essential for some real-world projects, cloud services can be leveraged to facilitate hands-on workshops, providing scalable resources without the need for significant investment.

To assess the effectiveness of our proposed framework, we have collected and analyzed post-workshop surveys. Additionally, we invited students working on projects to reflect on their learning experiences, providing qualitative insights to our designed framework. We position our makerspace within the classification system proposed by Wilczynski (2017) to facilitate comparisons with other university makerspaces in terms of resources. Surveying feedback were reported, which demonstrates the preliminary effectiveness of the proposed framework and highlight both the successes and the challenges. We hope this initial discussion on integrating AI into makerspaces will be inspiring to other institutions to respond to the shifting demands of the AI era.

Introduction

Since the maker movement, the number of makerspaces around the globe has drastically increased. Most makerspaces are equipped with tools that enable users to build and test prototypes, including toolboxes for woodworking, CNC machinery for metal manufacturing, and 3D printers for digital fabrication. While the equipment may appear similar across different makerspaces, their missions can vary significantly, leading to a rough categorization into public, business, and academic makerspaces. Public makerspaces, such as those found in libraries and universities, focus on promoting the making culture among general users by providing basic tools, essential services, and knowledge exchange events, such as seminars and tech talks [1]. Business makerspaces emphasize entrepreneurship (e.g., UnternehmerTUM) and support start-ups and small businesses.

Higher education makerspaces, on the other hand, carry the mission of revolutionizing the means of teaching and learning, moving from a teacher-driven mode to a learner-driven paradigm, fostering learning through hands-on experiences, encouraging peer collaboration, and facilitating experiential learning to address real-world challenges. This unique educational mission distinguishes academic makerspaces from public and business ones and entails a dedicated effort to guide students in learning through making while ensuring the space remains open, exploratory, and collaborative.

Recent advancements in Artificial Intelligence (AI) urge higher education institutions to actively integrate AI into the curricula, promoting AI literacy and developing students' competency in AI. While students majoring in Computer Science (CS) may have gained foundational knowledge of AI in the classroom, the lack of experiential learning environments hinders their ability to apply this knowledge in real-world contexts. Conversely, students from other engineering or science disciplines, despite their enthusiasm for these technologies, often struggle to initiate their AI learning journey. Academic makerspaces, therefore, serve as ideal entry points for those interested but lacking experience, while also providing a valuable extension to computing-related courses.

A question arises regarding what learning opportunities an academic makerspace should and could curate for its users concerning AI technologies, given the limited operational capacity and professional expertise of the space. This question is, on the one hand, crucial for designing and providing experiential learning opportunities to the makerspace users; and, on the other, critical to avoid possible burnout of the human resources.

To address these questions, we share our recent efforts and experiences in equipping Innovation Wing of The University of Hong Kong (or HKU InnoWing in the following) with AI elements to provide our students with experiential learning opportunities in this field. Recognizing that students' interests in and exposure to AI vary significantly due to factors such as their educational backgrounds and specialized training, we have designed an *engage-equip-apply* framework to meet their diverse needs. This *engage-equip-apply* framework also provides a sustainable model for generating learning materials.

Experienced students are encouraged to develop beginner-level, hands-on workshops situated in tangible real-world problems. The resulting workshops serve as the first course for students with little experience in AI. We adopt a peer-to-peer learning approach to engage both groups of students in the workshops and equip them with different skill sets. To demonstrate the practical values of technologies, we invite external collaborators to co-design scenario-based project learning opportunities based on real-world problems they encounter. This model offers our students real-world testbeds to apply techniques they learned or even develop novel tools. Recently, we have made these tutorial materials publicly available at this link[1] to maximize their impact on our student community as well as the academic makerspaces sharing the same interest across the globe.

The staffing and equipment necessary for implementing the framework will be described in detail. Support from external collaborators, academic faculty, and teaching professionals is indispensable for providing real-life challenges, feasible solutions, and continuous mentorship. Although the equipment needed for teaching AI can be expensive for most academic makerspaces, we share our experience in leveraging various computing resources to create an affordable model for equipping these spaces with AI-related learning opportunities.

Related works

Missions of Academic Makerspaces. As summarized by the report on the first International Symposium of Academic Makerspaces, the primary mission of an academic makerspace is to support curricular, extra-curricular, personal, or entrepreneurship activities to provide a learning environment for space users [2]. This underlines the critical difference between academic makerspaces and other makerspaces outside of educational institutions, signifying "the purpose of inspiring deeper learning through deep questioning" [3] for academic makerspaces. Besides its functionality in teaching and learning, an academic makerspace carries another important purpose of building an open community for knowledge exchange and sharing among the student fellows, encouraging a peer-to-peer learning experience [2] [3] where activities should be learner-driven and academic staff and space managers focus on the strategic design to create learning environments and guidance during the learning activities. Growths in sciences and technologies urge close collaborations across disciplines to push forward the frontiers of our knowledge. An open community to expose our current students to knowledge and experiences from diverse disciplines is beneficial to cultivating future scientists, engineers, innovators, and entrepreneurs. Therefore, while many originated as an extension of engineering programs, academic makerspaces have shifted to integrate engineering with other disciplines and novel technologies [4].

AI in Makerspaces. Given the rapid advancement of AI over the past decade, developing AI competencies among students has become a trend in universities [5] and academic libraries [6]. Recent works also report applications of AI technologies in facilitate teaching and learning [7] [8] and the equipment management [9] in makerspaces. For instance, Sun et al. reported on a university-level curriculum that includes a theoretical course in AI alongside multiple practical training courses [10]. While this integrated course serves as a promising example, it restricts its outcomes to an autonomous driving robotic car and follows a teacher-driven model, which does not align with the philosophy of academic makerspaces that advocate for peer-to-peer learning. Another study presents a summer program structured around progressive stages of "use, modify, and create" to develop computational thinking skills within a making environment [11]. Despite its strong alignment with the

[1] https://innoacademy.engg.hku.hk/workshop/

principles of academic makerspaces, this program acknowledges the challenge of providing structured learning opportunities.

Integration of AI into Maker Education

HKU InnoWing is classified as a S2-A4-U3-F4-M3[2] academic makerspace according to the classification system proposed by Wilczynski [12]. We aim to develop a comprehensive learning environment for all members, regardless of their diverse academic programs and educational backgrounds. To this end, we present an **engage-equip-apply** (EEA) framework to integrate AI elements at various levels into the extrac-curricular maker education of our Student Innovation Center. Specifically, we offer entry-level workshops to **Engage** students with little exposure to computing or AI technologies. Knowledge workshops are designed to **Equip** students with practical skills for using or customizing AI technologies. Both types of workshops are conducted in a peer-to-peer learning manner. The **Apply** phase is realized through an experiential learning approach, where students commit to the application or development of AI tools to address real-world problems. This extra-curricular framework effectively extends the classroom with a hands-on, experiential learning environment that engages and equips students with additional skill sets and provides them with a real-world context to apply their knowledge. Table 1 summarizes the learning activities related to AI technologies, including five hands-on workshops (HW) and five experiential learning projects (EP). Among the five experiential learning projects, three of them are collaborations with external parties. We hire undergraduate student research assistants (SRAs) to work on the experiential learning projects while generating hands-on workshops to share the knowledge they learned from these experiential learning projects.

Table 1: Learning outcomes of our engage-equip-apply framework.

Levels	Learning outcomes
Engage	Elevated awareness and interest in AI
Equip	Recall and differentiate relevant AI concepts; Recognize and use AI tools
Apply	Use, implement, or develop AI tools to address a real-world problem
	Explain the AI tools to others

Hands-on Workshops—Engage and Equip. Workshops covering topics on LLMs (see Table 2, IDs 1-4) were conducted to help students from diverse backgrounds acquire skills in applying LLMs and developing LLM-based applications. The *Building Your Own AI Chatbot* workshop held in October 2023 is the first AI workshop conducted. It provides a gentle and comprehensive introduction to recent AI technologies for participants. It features hands-on practice in creating an AI chatbot using multiple APIs from cloud services, including the retrieval-augmented generation technique, text-to-speech, speech-to-text, and animated avatars. This workshop attracted a total of 40 registrations and thus was conducted three times due to the maximum capacity of 16 participants in our digital learning studio, demonstrating its effectiveness in **engaging** students in hands-on AI

[2] This is based on the classification protocol proposed in [12], where S-2: Programs that significantly support at least one university mission; A-4: Access provided to the entire University community; U-3: 1,000-3,000 members; F-4: greater than 20,000 square feet; M-3: Faculty/Professionally managed with a hybrid (professional and students) staff

practices. We would like to highlight two responses from participants. One remarked, “It was my first exposure to generative AI (GenAI) backend, and despite only running the code, I learned how to give instructions to AI models.” Another participant noted, “I learned new things that were taught in a really easy-to-understand way. The source code also allowed me to explore how theoretical knowledge can be applied.”

On the other end of the spectrum, we observe a demand for more technical workshops from students from computing-related majors. In response to this request, the *News Headline Generation* workshop provided advanced content on training an LLM using supervised fine-tuning techniques. During this workshop, our student RAs explained several essential skills to participants, including the data preparation process for training a neural network, monitoring the training process, and evaluating the trained models. This workshop also offers extensive hands-on practice, complementing the AI curriculum that emphasizes theoretical concepts. Sixteen participants, the full capacity of our learning studio, attended this workshop. One postgraduate participant responded to our questionnaire, expressing a desire for more workshops of this nature. Another participant noted, “The explanation of hyperparameters was clear and demystified what they are,” indicating that this workshop engaging students who have some prior exposure to AI knowledge.

Table 2: Learning activities and the required computing resources. HW and EP represent hands-on workshops and the experiential learning projects, respectively. The trailing -C denotes a collaborative project between the HKU InnoWing and external collaborators. #A denotes the total attendance.

ID	Learning activities	Nature	#A	Computing resources
1	Building your own AI chatbot	HW	40	Cloud
2	Retrieval-augmented generation (RAG)	HW	14	Cloud
3	Multi-modal RAG	HW	14	Cloud
4	News headline generation	HW	16	Desktop
5	Open-set object detection	HW	28	GPU Desktop/Cloud
6	AI historian assistant	EP	5	GPU Desktop/Cloud
7	Community legal question chatbot	EP-C	5	Cloud
8	Social worker interactive training chatbot	EP-C	3	GPU Desktop/Cloud
9	Robot arm for automatic grasping	EP-C	4	Desktop
10	Verbally instructed mobile robot	EP	5	Desktop/Cloud

Both the examples and the listed workshops **equipping** participants with the skills necessary to begin building their LLM applications or to enhance their practical knowledge and experience, covering everything from data preprocessing to hosting LLM-based web applications. We adopt a peer-to-peer learning approach for all our workshops, with student RAs serving as instructors. This arrangement aims to equip our student RAs with advanced technical and interpersonal skills. Through the preparation and delivery of workshops, they not only develop a deeper understanding of the technologies they teach but also acquire new skill sets, such as organizing teaching materials, presenting to beginners, and collaborating with teammates.

AI technologies extend beyond chatbots and computer interfaces; they can be easily integrated into robots and IoT devices to enhance commonly used hardware in makerspaces with advanced intelligence. In light of this, the student team working on the *Verbally Instructed Mobile Robot* project is planning to deliver a workshop on this topic. Specifically, they utilize large language models (LLMs) to translate natural language instructions into movement plans for a mobile robot, enabling users to interactively command the robots with natural utterances.

Experiential learning projects—Apply the technologies. Student RAs, in addition to serving as instructors for workshops, have another important responsibility—They are expected to apply relevant AI technologies to solve real-world challenges. Ongoing projects are listed in Table 2 (IDs 7—9) and are based on real-world challenges provided by our external partners. In these experiential learning projects, the teaching staff plays an assistive role in the process by monitoring progress and directing students to do independent studies, which will be detailed later.

For example, the Law & Technology Centre at The University of Hong Kong maintains a website that provides legal information to the general public[3]. Although the website is written in plain language for accessibility, the sheer volume of information can make it difficult for users to find what they need. Through talking with legal professionals and technicians from the Law & Technology Centre, the student team spotted this real-world challenge. They employed the Retrieval-Augmented Generation (RAG) technology and developed a legal chatbot that assists users in phrasing questions, retrieving webpages with relevant information, and composing summarized answers based on the retrieved content. This legal chatbot effectively addresses the hallucination problem (e.g., the chatbot generates unfaithful responses) and delivers accurate, up-to-date information.

Another example is a cross-disciplinary project in collaboration with the Social Work Department of The University of Hong Kong and a local NGO providing counselling training and services to develop the *Social Work Interactive Training Chatbot (SWITCH)*. In the training of social workers, one element in the learning process is scenario-based learning [13], in which students role-play social workers and clients in a counseling session. A challenge noted by our collaborator, a lecturer from the Social Work Department, is that students with limited experience find it hard to role-play clients suffering from mental diseases such as depression or family issues such as tension with their spouse. While the collaborating NGO developed a chatbot to provide simulated training to the social work students, our student team noted that the chatbot consistently acted rudely, despite their efforts and patience. This unsatisfactory experience motivated the student team to create the SWITCH, designed to mimic common clients who will change their trust level towards the counselor based on their conversation. This provides a more rewarding experience for social work students when interacting with an AI-empowered chatbot. The student team employed prompt engineering techniques to modify the behavior of their developed chatbot. They are currently working on building a feedback control mechanism to automate this behavioral adjustment by assessing the counseling skills demonstrated by the trainees.

Sustainable learning content creation. Computer technologies in AI, such as generative pre-training transformers and their applications in large language models, have rapidly evolved over the past few years. Consequently, the timely introduction of the latest technologies for experiential learning in the makerspace presents a unique challenge. To ensure sustainability in our AI workshops for training students, we harness the

[3]Law & Technology Centre at The University of Hong Kong, https://www.clic.org.hk/en

strong connection between hands-on workshops and experiential learning projects by inviting student project teams to curate workshop materials based on their practical experiences in solving real-world challenges. Teachers will guide these teams in developing their workshops, ensuring that they engage students with varying knowledge levels and training backgrounds. As the workshops are designed to accommodate different levels of training, they foster a sustainable model where students proficient in the content can transition into research assistants, contributing to ongoing projects. This approach not only promotes sustainability in workshop design and personnel training but also engages students through diverse applications of the latest technologies

Collaboration with external parties is indispensable for this approach, which brings in real-world problems and testbeds to our experiential learning projects as is showcased by the collaborative projects with the Legal & Technology Centre and Social Work Department. Besides collaborations with faculty members in the University, we actively seek partnerships with industrial companies and government departments. Noting the complexity of University-Industry collaborations, our collaborative projects are carefully designed to align the expectations of both parties [14]. For example, we have identified a niche in our collaboration with industrial partners, aiming to transfer knowledge to improve their employees' exposure to and capability of adopting novel AI-related technologies.

Resources for Implementation

Staffing resource. Staffing is the primary concern of makerspaces due to their limited operational resources. We share our experience with staffing to prepare the Engage-Equip-Apply framework for students. In total, we have four teaching staff (two lecturers and two technical staff). Four full-time employees are not sufficient to provide a range of workshops that cover a variety of topics in AI as shown in Table 2. Therefore, undergraduate students are hired to provide help in preparing and delivering workshops.

According to the annual development plan of the HKU InnoWing, the lecturers propose topics that will be covered by the AI-related hands-on workshops for **engaging** and **equipping** purposes. They also develop experiential learning projects that emphasize developing and **applying** AI-based solutions to real-world scenarios. Besides general planning, the lecturers are responsible for mentoring the student RAs through regular meetings and ad-hoc discussions. The two technical staff offer technical and operational support for all activities (both hands-on workshops and experiential learning projects), such as managing the computing resources, preparing the software necessary for the projects, purchasing consumables and equipment, and organizing meetings with and providing feedback for the student RAs.

Undergraduate students are hired as student research assistants (RAs) to curate learning materials while also working on scenario-based projects. The selection criteria for these student RAs include a passion for sharing knowledge and the capability to learn quickly. We anticipate that our student RAs will be fast learners and, more importantly, eager to share their experiences and insights with their peers. This enthusiasm ensures the quality of workshop teaching materials.

Computing resources. Computing resources are another concern when an academic makerspace plans to incorporate AI into its teaching and learning activities. As we note, the required computing resources vary depending on the goals of such teaching and learning activities. Two types of computing resources are predominantly used for the hands-on workshops: 1) APIs provided by cloud services and 2) consumer-grade desktops with NVIDIA graphic cards.

Retrieval-augmented generation (RAG) is the focus of the workshops (ID: 1-3) listed in Table 1, which requires an LLM for response generation and a text embedding model to digitize (or vectorize) the input texts. For these workshops, we utilized relevant APIs (e.g., Alibaba QWen APIs) on cloud services, as they are the minimal building blocks of the final chatbot system. These cloud services are often charged in the pay-as-you-go mode. Each workshop typically requires a tiny budget (less than US$8 at the time of hosting the workshop back in 2023 and 2024) to support sixteen participants. Another advantage of running these types of workshops with cloud services is to streamline the logistic issue, since installing LLMs on a local computer may require extra effort to set up a correct coding environment which is time-consuming.

Our center has sixteen consumer-grade desktops with NVIDIA graphic cards. Therefore, workshops involving training deep neural network models (e.g., Workshops IDs 4 and 5 listed in Table 1) make use of these desktops with graphical cards. A primary purpose is to provide the participants with higher efficiency in training a neural network model, such as for generating news headlines from input stories or detecting objects from a customized dataset. For makerspaces without this equipment, they may consider using Google Colab[4] or other similar online computing resources that provide remote computers with graphic cards for training the deep neural network models. We make use of the same computing resources to support the experiential learning projects.

In preparation for our AI workshops, the coding environment must be set up to contain the correct versions of the required software packages. Two different AI workshops may require different versions of the same package or incompatible packages and installing them in the same space may contaminate each other, leading to dysfunctional codes. By utilizing containers and virtual machines (such as Docker [5]or VirtualBox[6]), our technical staff streamlines the preparation of AI workshops. All the programs run in the virtual machine (a literally virtual computer in the physical computer) with required software packages to support a workshop. Two virtual machines on the same physical computer are separated, thereby avoiding the contamination issue.

Despite the cost and human resources to support the AI workshops, we note that these workshops do not require a spacial room to accommodate the equipment and participants, which is different from traditional making where much space is required for the equipment.

Discussion

We evaluated the teaching effectiveness of our workshops by collecting feedback from students after each session. The feedback collection was administered after each workshop session as an option for the participants. While the questions for each workshop session were asked in a different way to fit in the context of that workshop, these questions mainly focus on 1) the increase in the interest or knowledge of the participants, 2) the

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[4] Google Colab: https://colab.research.google.com
[5] Docker: https://www.docker.com
[6] Virtual Box: https://www.virtualbox.org

influence of workshop on participants' confidence regarding the technology presented in the workshop, 3) the participants' preferences in term of the way the workshop is delivered, and 4) the participants' interest in future workshops, along with an option to write us an open-ended remark for the workshop. At the time of drafting this report, we received 58 comments from a total of 112 participants.

Nearly half (41%) of respondents mentioned technical terms taught in the workshops, such as "RAG", "Finetuning", "LLM", and "YOLO" in their feedback. This demonstrates that the workshops have given them a grasp of the knowledge. One-third of the respondents explicitly expressed that they had acquired new knowledge, such as "I learnt a brand new model I have never heard", "I always wondered how things like Perplexity AI worked, and it was very nice learning about how RAG is implemented", or "Deepen my understanding the differences between RAG and finetuning, and the usage of RAG". They also showed enthusiasm for learning more about AI, for example, "triggers me to learn more about AI". These responses indicate the success of our workshops in elevating students' interest in AI.

Some respondents mentioned the workshops are "very friendly to beginners" and the content was taught "in a really easy-to-understand way", which is crucial for guiding students into the field of AI. Some participants further expressed that they were confident in making use of the learned technologies, such as "able to make my own RAG for my class", and "I can choose the suitable LLMs". A respondent commented that "I find it easier to implement my own project now if I want to in the foreseeable future, I am finding the topic of machine learning and LLMs less intimidating now", showing the effectiveness of workshops in equipping students.

Several respondents commented favorably on the teaching materials and student instructors such as "provides some hands-on notebook [codes] which really help with the experience", "practical coding and explanations are nice experiences", or "teachers taught us very patiently and clearly". This reflects the student instructors have a strong grasp of the knowledge delivered in the workshops and can explain it effectively to others. The satisfactory performance of our student instructors can be partially attributed to the way the workshops were produced. The technologies introduced are those they acquired through their experiential learning projects. This allows them to understand the difficulties faced by learners and the explanations to support their understanding.

Furthermore, we sought to understand participants' preferences regarding content type: practical or theoretical. As depicted in Figure 1: Type of content in which students are more interested, practical, theoretical, or combined**.**, 72% of participants expressed interest in a combined style of content; 21% preferred only practical content; and the remaining leaned towards theoretical content. This indicates a general preference towards workshops with hands-on elements, reflecting their complementary nature to curricula that emphasize on theoretical knowledge.

Some negative comments were received. A respondent mentioned the workshops may aim "for someone who knows the terminologies beforehand", showing that explaining in a layperson's terms is crucial to engage beginners. Some expected the teaching of a workshop could be "more into the code" and not just "copying the code" from the teaching materials. At times, our student instructors were eager to share as much content as possible with the participants. However, this cramming brings adverse effects, leading to limited time for explaining the code, which should be improved in our future workshops.

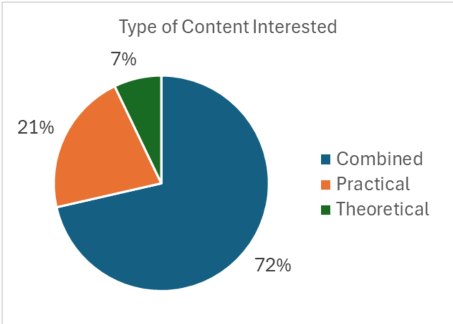

Figure 1: Type of content in which students are more interested, practical, theoretical, or combined.

Some suggestions for improvement on the logistics include "reducing the waiting time for the model to train during the workshop" and "[providing] more quotas by training on GPU remotely". The former may be addressed by redesigning the flow of a workshop to upfront the neural network training session while explaining the theoretical parts afterward. The latter may be addressed by utilizing university computing resources, if available, or collaborating with large technology firms.

What AI topics to cover in the future? Since the beginning of the 2023/24 academic year, five different AI workshops have been delivered. Four of these workshops (Workshops IDs 1-4 in Table 2) progressively introduce technologies related to large language models (LLMs) to the students. Looking ahead, we are considering extending the AI workshop topics to include other domains. Therefore, we conducted a separate survey to learn our members' interests in the listed AI topics, and the result is shown in Figure 2.

We observed that Reinforcement Learning receives 10 votes, ranking the highest among the eleven choices. We plan to showcase reinforcement learning as a control algorithm of a robot dog, which enables the robot dog to traverse different terrains. It is followed by 3D reconstruction (7 votes) and Object Detection (6 votes). We have observed a low participation rate among civil engineering students. To better engage this group, digitalizing a construction site via 3D reconstruction techniques may serve as a promising starting point. Finally, Project 9 in Table 2 utilizes object detection techniques to automate robotic grasping, providing an interesting topic for future workshops.

Conclusion

In this paper we introduce HKU Innovation Wing's effort in incorporating AI elements into its experiential maker education since the beginning of 23/24 academic year. An engage-equip-apply framework is proposed as the governing rationale behind the design and development of the experiential learning activities. Specifically, a peer-to-peer learning approach is adopted to prepare, develop, and deliver the engaging and equipping workshops focusing on hands-on practices. The student instructors have another role--student research assistants--who also work on real-world challenges defined together by the HKU InnoWing teaching staff and external collaborators. These real-world challenges provide the students with authentic, experiential learning opportunities, allowing them to apply the learned techniques and equipping them with deeper technical and soft skills. This, in turn, benefits the generation of workshops, forming a sustainable cycle. We also demonstrate the feasibility of implementing this framework at other academic makerspaces through the discussion of required staffing and computing resources. Finally, we demonstrate the efficacy of the workshop in engaging students and equipping them with AI competencies through an analysis of the workshop feedback, partially validating the presented framework.

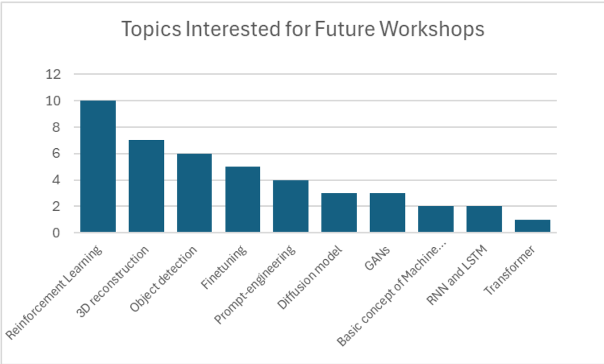

Figure 2: Votes for AI-related topics in the future workshops

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