Report for the Outreach of OXCCAI:

AI + Ethics Club in 2023

Executive Summary

Artificial Intelligence (AI) systems have proliferated and impacted children's daily lives. AI has the potential to enhance children's learning, provide personalised experiences, and improve efficiency in various domains. However, apprehensions have emerged regarding the ethical challenges in AI systems, including data security, algorithmic biases, and their potential remediation on children's development and well-being.

These apprehensions underscore the pressing necessity of fostering children's critical thinking and ethical awareness in the realm of AI. AI ethics education for children can empower them to think critically and make well-informed decisions when they navigate the landscape of AI applications.

In the Spring of 2023, we conducted a four-week afterschool club with 6 children aged 9-11 in Whitchurch Primary School, Oxfordshire, UK on the theme of AI + Ethics, aiming to help them think more critically about AI.

This report provides an overview of our work, including the background of the project, the design methodology employed, an analysis of children's participation and feedback within the club, a reflection of children's AI ethics awareness, the curriculum design and pedagogical strategies implemented, and a summary of the limitations encountered along with future plans. To find out more about our workshop format and material, please see our website: https://oxfordccai.org/outreach/.

1 Background

1.1 AI Ethics: Scope and Definition

Artificial Intelligence (AI) is the theory and development of computer systems that imitate human intelligence to acquire knowledge, learn, and exhibit intelligent behaviour (Dubber et al., 2020; Jobin et al.,2019). AI has experienced rapid proliferation and has profoundly transformed the world. While AI has contributed significantly to economic growth, social development, as well as human well-being and safety improvement, it has also raised ethical concerns. Due to the gathering, utilisation, and misuse of data employed to train the AI model, as well as the algorithm's black-box feature, AI may expose people to unknown risks (Borenstein & Howard, 2021; Siau & Wang, 2020), which have raised emerging ethical concerns through the process of AI's design, deployment, and use. These ethical concerns have prompted discussion among industry, professions, academic researchers, and the general public (Jobin et al.,2019), which tries to establish the boundary of AI's accountability, regulate AI applications, and guide its future innovation towards a more promising and responsible trajectory.

"Ethics" is *"a body of human knowledge that helps agents (humans today, but perhaps eventually robots and other AIs) decide how they and others should behave"*(Dubber et al., 2020). **"AI ethics"** has emerged as a burgeoning field that addresses ethical considerations and challenges associated with artificial intelligence (AI). Scholarly discourse has yielded various definitions of AI ethics (Christoforaki & Beyan, 2022; Jobin et al., 2019; Schiff et al., 2021). Siau and Wang (2020), for instance, delineated AI ethics as encompassing two distinct dimensions: the ethics of AI, which pertains to the ethical principles, rules, guidelines, policies, and regulations governing AI, and ethical AI, which refers to AI systems that exhibit ethical behaviour. The ethics of AI assumes a critical role in the pursuit of ethical AI development and the promotion of ethical conduct. It entails the deliberation of moral values and principles that underpin judgments of moral rightness and wrongness(Huang et al., 2022).

Some similar terminology has also emerged related to AI ethics. Take 'data ethics' as an example, Floridi & Taddeo (2016) define data ethics "*as a new branch of ethics that studies and evaluates moral problems related to data (including generation, recording, curation, processing, dissemination, sharing and use), algorithms (including artificial intelligence, artificial agents, machine learning and robots) and corresponding practices (including responsible innovation, programming, hacking and professional codes), to formulate and support morally good solutions (e.g., right conducts or right values)"()*, which shares a similar definition with "AI ethics", especially considering the AI in the big-data era(Christoforaki & Beyan, 2022). **In conclusion, AI ethics challenges encompass challenges in the realm of robot ethics, machine ethics, and data ethics, which are further complicated by unique characteristics (e.g. low-interpretability) of AI systems.**

1.2 AI Ethics Education: empower future AI community

AI ethical challenges and their potential impacts on people suggest an urgent need for AI ethics education. AI ethics education was first introduced to future AI technical professionals, who design, develop, deploy and apply AI frequently (Burton et al., 2015; Hoffmann & Cross, 2021; Kiemde & Kora, 2022) , including medical students (Lee et al., 2021) and computer science students (Garrett, 2020). To empower these future AI technical professionals to consider the individual, social, economic, political, and environmental costs of their design, manufacture, and use of the AI, while being able to make mindful judgments independently, AI ethics education aims to develop the skills in future technical professionals to be able to analyse the ethical strengths and weaknesses of existing AI, as well as empower them to imagine intended uses and possible ramifications of technology before it is released into the world (Goldsmith, et al., 2020). To accomplish these goals, AI ethical education for them is often based on basic AI knowledge and real AI application scenarios. For example, the Embedded EthiCS programme embedded ethical reasoning throughout the entire CS curriculum to habituate computer science students to thinking ethically as they develop algorithms and build systems, both in their studies and as they pursue technical work in their careers (Grosz et al., 2019).

Future technical professionals hold a specific responsibility in constructing an ethical landscape of AI, given their expertise and involvement in AI development and implementation (Goldsmith, et al., 2020). However, as AI increasingly becomes integrated into various aspects of daily life, it is equally important for the general public (including K-12 children) to be informed and aware of AI ethics around them to make informed decisions when interacting with AI systems. The public should also have a basic understanding of AI ethics to protect their privacy, mitigate biases, and responsibly engage with AI. Introducing

potential ethical issues to the public becomes imperative. Tackling AI ethical challenges such as data privacy, systematic bias, and the filter bubble is an essential skill and literacy that need to be addressed to ensure a sustainable and responsible interaction with artificial intelligence (Ng et al., 2021) . I**ncreasing interest has arisen in empowering teenagers, the future members of the AI community (AI users, designers, and other stakeholders), to navigate the ethical challenges, critically analyse AI's impact, make informed decisions, and embrace their responsibilities to develop ethical AI** (Borenstein & Howard, 2021; Castro et al., 2022; Kim, 2022; Li, 2022) . AI ethics has been regarded as an essential component of AI literacy, which is the essential competency for children to live, learn and work in a future AI-driven digital world(Long & Magerko, 2020; Ng et al., 2022).

1.3 AI Ethics Education for K-12: practices and limitations

AI ethics education poses a greater challenge in K-12 education compared to higher education due to the varying cognitive development stages of children and their limitations in accessing digital resources. One of the challenges stems from the lack of AI-related background knowledge among children (Ali et al., 2021a), especially for children in primary school. For example, children in Grades 5 to 8 are likely to conflate AI with robotics or voice agents and are unable to distinguish between concepts such as programming, hardware, electronics and algorithms (Payne, 2020), let alone comprehend the abstract ethical issues. Therefore, it is essential to tailor the learning objectives of AI ethics education to suit children's learning capabilities and prior knowledge. Various efforts have been made in this field (Payne, 2020; Touretzky, 2019).Take AI4K12 initiative (sponsored by AAAI and CSTA) as an example, it has identified "AI can impact society in both positive and negative ways" as one of the 5 Big Ideas in AI for K-12 education and designed a detailed progression chart for learning objectives and enduring understandings of concepts included in this big idea (Touretzky, 2019). The lack of assessment tools to evaluate AI ethics education learning outcomes remains another open challenge. Although previous research has assessed whether AI curricula can develop students' AI knowledge and skills, learning attitudes, and interests (Su et al., 2022), limited attention has been paid on the evaluation of the effect of AI ethics education. Ng et al.(2022) recruited 82 primary students in Hong Kong to attend a 7-day workshop to learn digital story creation and AI knowledge in three months and interviewed 16 best-achieving students to evaluate the learning outcome of the curriculum and understand how they formulate AI understandings, including AI ethics. Further exploration of assessment tools for AI ethics education remains necessary.

Practice and efforts have been contributed in AI ethics education for K12, especially for secondary education. For example, Payne (2020) developed an open source curriculum for middle school students(10-14 years old) on the topic of artificial intelligence. Through a series of lessons and activities, students learn technical concepts and the ethical implications those technical concepts entail, such as algorithmic bias, which enables students to see artificial intelligence as manipulable and to empower students with tools to design AI with ethics in mind. Based on "liberation tools[1]", Walker et al. (2022) developed a six-week "liberatory computing" class to teach activism skills, essential skills to prepare African Americans to "fight for" racial liberation, suggesting that computing curricula can motivate and provide African American students with practical skills to address the racism embedded in society. However, research on AI education, including AI ethics education in early

[1] Coined by Dr. El-Amin's. "liberation tools" states how a sound racial identity, critical consciousness, liberation centred achievement identity, collective obligation, along with activism skills are essential to preparing African Americans to "fight for" racial liberation

childhood education is scarce. Considering early AI studies are beneficial for kids cognitively, intellectually, and socially, Su & Zhong(2022) provided lessons and learning objectives guidelines of AI education for kindergarten children according to AI4K12's guidelines, designed a curriculum and the lesson plan for each Module, advocated problem-based learning as teaching strategies, and defined AI literacy as an ideal assessment factor. Despite the existing research efforts and practices in AI ethics education for K-12, **there is a need for further empirical exploration in designing activities and learning materials that effectively scaffold children's understanding of AI ethics, especially for children in primary school.** Moreover, previous efforts primarily focused on raising children's awareness and understanding of AI ethics, **with limited attention given to the higher goal of empowering children to solve and even design AI solutions for AI ethical problems.**

In this context, this work aims to address these challenges by contributing to the first piloting AI + Ethics club for K2 children in the UK. The club was carefully designed based on existing literature, incorporating learning objectives, activities, pedagogical strategies and assessment tools. A four-week afterschool club was conducted with 6 children aged 9-11 in Whitchurch Primary School, Oxfordshire, UK, focusing on the theme of AI + Ethics. The primary objective was to help them think more critically about AI.

2 Outreach design--picture required

2.1 Protocol

The AI + Ethics club was conducted at Whitchurch Primary School, Oxfordshire, UK. Six children aged 9-11 participated in four-week after-school clubs on Wednesday. Each session lasted approximately 90 minutes. Children either work in groups (randomly) or work in the whole class. Two or three instructors were engaged in this club to help children. One instructor (a DPhil student majoring in educational technology) led the club, and one or two research faculties (both are experienced in teaching and working with children) supervised the club and helped to prompt children's group discussions. DBS of research faculties were checked before we entered the classroom. An action research method is applied throughout this club(Avison et al., 1999). Before each session, all instructors went through the design materials, revised the design, and got familiar with the activities. Reflection and discussion for improving the club took place at the end of each session. Children were given a pre-assessment and post-assessment at the beginning and end of the club lesson, which reflected their learning outcomes of this club.

2.2 Learning objectives

(Revised) Bloom's Taxonomy serves as a valuable tool for educators to guide curriculum development, lesson planning, and assessment practices (Su & Osisek, 2011). We followed the hierarchical ordering of cognitive skills in the (revised) Bloom's taxonomy: remember, understand, apply, analyse, evaluate, and create (Krathwohl, 2002; Ali et al., 2021b). By incorporating the experiences and suggestions of AI ethics education practices, this curriculum aims to foster critical thinking skills in children as they explore the concepts and applications of AI, solve problems in the storybook, and make connections between the storybook and real-world scenarios.

2.3 Pedagogical strategies

To stimulate children's thinking about AI ethical issues and maintain their engagement, curriculum developers have also employed various Pedagogical strategies, such as game-based learning (Kalelioğlu, 2015) , project-based learning (Williams et al., 2021) and unplugged hands-on activities (Williams et al., 2022) . Based on the learning objectives, this club is carefully crafted to engage children in AI through a combination of game-based learning, problem-based learning, and hands-on activities.

2.4 Activities and materials for each week

In the first week, children share their general perception of AI, choose a scenario card, and draw how AI may help them in these scenarios. We design this drawing activity so that children can more comfortably convey the ideas in their mental world about their perceptions, knowledge, interest, and experiences about AI (Brooks, 2009; Parker et al., 2018). Then, children learn about how recommendation algorithms work by reading a storybook between an AI-based recommendation app for family weekend destinations (FamilyFun) and its users (different families), discussing how FamilyFun used and learned from different data to personalise recommendations and how feedback could affect AI results. Empirical evidence has shown that children gain more knowledge when they discuss everyday scenarios (e.g. facial recognition on the phone) with an ethical matrix (a tool to scaffold children to analyse stakeholders' value) than they critique and discuss ethical issues related to CCTV in the airport (Payne, 2020). Thus, we introduce FamilyFun as a learning context because children could better understand AI. We expect children to get a big idea about AI, especially from a perspective of datafication's three aspects, i.e. data collection (privacy), datafying (algorithm), and data inference (influence). During this activity, we adopt a game developed by Liz et al. (2020). The game was originally designed for young people aged 13-18 to raise their awareness of online privacy risks, encourage their critical thinking, and co-design with them. Considering the children in our workshop are younger than Liz's, we simplify the data card game by deleting the 'currency cards' and encouraging children to categorise these data cards into three categories, i.e. willing to share with AI, not sure, not willing to share with AI. We then design discussion questions according to their categorising results. We expect children to be aware of data privacy issues in AI systems.

In the second week, children role-play as different family members to discuss users' different values and different data to be collected by the AI-based recommendation system(FamilyFun), role-play as FamilyFun to design an algorithm for the other group, and role-play as the same family again to give feedback to FamilyFun and reflect these processes. This role-playing game is inspired by MIT's experiences in AI ethics education for K-12, which suggests that having students represent different stakeholder groups can make designing activities more successful and avoid destructive discussions among children(Payne, 2020). We adjust our research accordingly to see if a game in which individual role-plays as different stakeholders could better help children to realise different values in AI, which may further lead to ethical challenges in AI development and deployment. Furthermore, empirical evidence suggests that children within this age group possess the cognitive ability to analyse data and draw appropriate inferences (Nguyen S., 2020). This implies that analysing the other group's data card, making inferences about the family, designing an algorithm for the other group, and reflecting on their design motivation are not excessively challenging tasks for them. We expect this activity to help them understand how algorithms work. In the feedback section, we introduced the ethical matrix (we called it 'value matrix' in the material), which has been proven to be an effective tool for children (Ali et al., 2019), to scaffold children to

analyse and reflect different stakeholders' values. We expect children to understand and analyse AI systems' impact on stakeholders, reflect and analyse how the values of different stakeholders are considered in an AI system design process and perceive AI's recommendations more critically.

In the third week and fourth week, we develop storybooks for five ethical challenges (i.e. filter bubbles and system bias for week 3; fairness, advertisement and user consent for week 4) according to Paraschakis's ethical recommendation framework (Paraschakis, 2017). In each challenge, children read about the story between FamilyFun and its users, share their feelings about these challenges, redesign FamilyFun in groups to address these challenges, and share them with the whole class. Empirical evidence suggested that re-design hands-on activity could help children learn ethical issues on the YouTube platform while it was time-consuming without further scaffolding (Payne, 2020). Meanwhile, problem-based learning as a teaching strategy in group projects is recommended in early AI education, which can enhance critical thinking, problem-solving, and cooperation skills. (Su & Zhong, 2022). Thus, we design storybooks to embark children on a problem-based learning experience. Through this activity, we expect children to be aware of AI platforms' limitations, and understand and analyse the ethical issues associated with AI systems.

In the third week, children also design their own AI-based platforms through four sections, including: 1) creating a story for the users of your AI app; 2) identifying user preferences and dislikes for this AI app; 3) translating your stories into a paper-based design of your app; and finally; 4) discussing how your app can help with ethical challenges. We start this task with storytelling, which could effectively foster senior primary students' AI literacy in using and applying AI knowledge to solve real-life problems, far beyond merely knowing and understanding related concepts (NG et al., 2022). We expect children to apply the knowledge they learnt in the storybook and create an AI platform by analysing users' different values and needs.

In the fourth week, children modify their designs, i.e. AI platform they designed in Week 3 and their drawings of "How does AI help" in Week 1, based on their new understanding of what makes a good AI platform or app. Through analysing, evaluating, and refining their designs in the same group, we expect children to apply the knowledge they learnt to re-create their designs. We also expect to prove the feasibility of reflecting on the learning outcomes of this AI + Ethics club through a comparison of their drawings.

3 Result

3.1 What did children already know about AI?

All children have heard about AI and its applications from their families before this club. **They have heard about terms like "algorithm", and "Chat-GPT", while they were confused about the relationship between these terms and how they were related to AI.**

In the "How can AI help" session, **children demonstrated great abilities to talk about AI as being beneficial and impactful in various aspects of life.** Group 1 (Fig 2. left) created "Evil Chips for Home Party", which is a Chat-GPT-based AI agent' party, which described AI agents with facial expressions and bodies that could chat with people at the party. Group 2 (Fig 2. right) "AI-based shopping system", which described how AI could be used to assist a smart shopping experience. We were overall impressed by the extension of knowledge about AI shown by the pupils.

3.2 What have children learned?

In the first week, **children learned that AI needed to collect many kinds of data, while the users might not want all data to be collected.** For example, they were unhappy to share postcode data with AI. When deciding whether specific data should be shared with AI or not, children had different opinions. For example, some of them were willing to share gender data while some were not. Through this process, **children noticed that different users had different preferences for data sharing and that users should have the right to decide whether to share the data or not. Children began to mention both the positive and negative impacts of AI on its users.** For example, some children mentioned that AI should make recommendations for its users, while it should also present all choices to the users (at the bottom of the app). To evaluate recommendation system results, children created a feedback chat box for users to give feedback on both the recommendation results and the AI system. During this process, **they found that it was important for AI to understand the root causes and real needs of user feedback.**

In the second week, **children realised that people with different backgrounds valued different things**. For example, a trendy mom may value fashion show places for weekends, and a boy who loves reading may expect some places with books. In the data card activity, children critically assessed the type of data that they were willing to/not sure/not willing to share with the AI system and discussed the reason behind their decisions. For example, one group was not sure whether they would like to share their VIP membership of a coffee shop because they were not sure how it would be used by AI. In general, **children demonstrated a good awareness of data privacy, especially related to sensitive personal data**. One group preferred not to share little personal data with recommendation systems; whilst the other group was more willing to share their data. **By comparing the data worksheet of the two groups, they understood different users had different values and preferences for data sharing and AI utilisation.** When children role-played AI, designing algorithms to make inferences based on users' data, they **learned that the more and better data people provided, the better the AI algorithm would learn and make references. However, they also recognised the importance of balancing privacy concerns with the desired functionality of AI systems.** By reflecting on their motivation as AI and as family members, **children realised the different values AI might contain.** They thought users(family) should make the final decision and be responsible for their weekend experience (i.e. family should evaluate the recommendation, decide where to go and take responsibility for the outcome).

In the third week, when children discussed filter bubbles and gender bias, **most of them were not aware of the chamber effect and system bias challenges before, but they showed interest in these two challenges and recognised the need for better-designed AI systems.** By reading the storybook, **children understood these two AI ethical challenges and unanimously agreed that improvements should be made to address them.** They brainstormed ideas to solve these challenges. For example, they designed a "cool-down settings" in which users specify a time gap for similar recommendations to avoid chamber effects. When children design their own good AI platform prototype, both groups chose to design a recommendation system. **Children loved this design activity very much and drew with great passion.** Children's AI platform paper prototypes included the home page, setting page, details page and profile page. **Children demonstrated great creativity and design skills.** One group designed a game-recommendation system for people; the other group designed a location recommendation system for pets. **Children also demonstrated their value to an inclusive AI system.** For example, they hoped to design inclusive apps. One group designed a game-recommendation system for anyone in the world; the other group designed a location recommendation system for all people's (young or old, boy or girls, etc.) pets in the world. **Children demonstrated critical thinking when they created the stories**

between their AI platform and its users. For example, one group thought users may not always be satisfied with their products.

In the fourth week, when children designed to solve ethical challenges, **they understood three ethical challenges well** (i.e. fairness, data sharing with the third party, advertising and user experiment) **and learnt to think about AI impacts on different stakeholders** (e.g. service providers rather than only end users). They modified FamilyFun (e.g. showing more information and creating a "self-rating" page to help people evaluate the recommendation critically, adding "data shared with advertisement service" control panels and a "local mode" option) and designed a user-informed consent. Through this process, **they were aware of the limitations of AI and believed that users should autotomize their data-sharing practice and decide whether to receive advertisements or not.** Children also looked forward to ads-free AI apps. By designing the users' consent, **they realised that programmers and designers may lead users to agree to some "not-so-good " consent for the AI company's benefit**.

For the reflection activities on "Design your own AI platform"(Week 3), **children were enlightened by previous discussions and added patterns and functions to make their AI platform more user-friendly and fairer** (Fig 11.). One group added a review page for the recommendation and designed a data control panel to help its users control and manage data shared with both this app and third-party apps; another group added a search function, scroll bars, and an alarm to inform users of this app's potential threat and impact, and a page where users can delete search/browse history.

For the reflection activities on "How does AI help?"(Week 1), **children showed critical thinking about AI and its impact on humans.** Specifically, children had several modifications for their AI drawings. For example, one group mentioned that "we need more guidelines to make sure that AI is fair and accurate". The child created "stabilised training wheels" and thought AI should be trained on these wheels to guarantee stabilisation. Another group mentioned that AI should remind people about their initial goal (e.g. budget limitation) to avoid negative impacts.

To sum up, children were able to think more critically about AI's impact on people. They migrated and applied the knowledge they learnt through previous discussions to improve the platforms and drawings they created. They collectively mentioned that AI plays a more and more important role in everyday life but it may not be perfect.

3.3 How did children feel about this club?

Overall, students expressed that they enjoyed the co-design, role-playing, and drawing activities the most, because they enjoyed the more interactive and hands-on learning experience. This is very helpful for us to reflect on future workshop activities.

One pupil said they **didn't like the activity where they had to choose where Alice's family would like to go** (which is Week 1's activity). They found it **hard to think from the perspectives of the families and to make decisions for others**. We agree that this way of interacting with a fictional character may have been unfamiliar to them; however, we noticed that children had less trouble role-playing the character in the follow-up sessions and we also simplified the fictional scenarios based on children's initial reactions.

One pupil expected **a hybrid club**, i.e. a mixture of online (interacting with technology) and offline activities. We explain to them that computer science research involves a significant

proportion of critical thinking and designing, which hopefully helped the children to have a better understanding of computer science generally speaking.

4 Reflection

4.1 Reflection on children's awareness of AI ethics

Even though most of the children were not aware of the ethical challenges before the club, they understood most AI ethical challenges well and unanimously agreed that improvements should be made to address them. They showed incredible capabilities to brainstorm and re-design a "good" AI-based recommendation system to solve these challenges. These results support the notion that addressing AI ethics with children can foster their ethical awareness, critical thinking abilities, and responsible engagement with AI systems. The results of our study also shed light on children's capability to learn about AI ethics and validated the feasibility of providing AI ethics education to children aged 9-11.

4.2 Reflection on the curriculum design

Elegant & reusable: post-it as a better learning tool

During Week 1's data card game, we found that post-it notes may be the proper choice for data cards, which need to be moved from time to time. We widely applied Post-it in the following weeks and found other benefits of it. Children liked to write down their thoughts and questions on them and discussed them in class. The hands-on experience of moving and posting these Post-it notes also fostered peer interaction during the class and engage children in the activity.

Decrease cognitive load: No duplicate text and fewer words

In week 1's storybook, the same paragraph has been presented twice for children, which has increased children's cognitive load, learning children to spend more time clarifying and understanding the story. We paid attention to this problem in the rest of the club. Further, long sentences may distract or confuse children of this age group, plain and simple expressions would help them to get the point.

For challenging Tasks: Something to mock up

In the activity of "Design your own AI platform", both groups chose to design great recommendation systems. We found that their designs were similar to FamilyFun, from the user's story to the user's interface. This might be due to children's limited knowledge of AI, apart from the recommendation system (as we created a recommendation system, FamilyFun, as a context for them to discuss in early sessions). This implies that designing other AI platforms without prompts/examples will be a little bit hard and destructive for children.

Laying the groundwork: hints for discussion at the beginning

For five ethical challenges, especially for challenge 3, children took more time to understand the story. Some had difficulties thinking in the shoes of service providers to be aware of the dual impact that an AI system has on stakeholders other than end users. They also need prompts and examples to understand user experiments (i.e. A-B tests) and user consent. Stories in week 1 and week 2 could be better designed to include some hints for ethical discussions.

4.3 Reflection on the pedagogical strategies

Add more fun: Role play to read the storybook

In week 3's ethical challenges story, one or two children got bored quickly when they needed to read long sentences. We addressed this in week 4 by designing characters' conversations and inviting children to act them out. This strategy worked well.

Keep groups on the same page: Group allocation strategies and Additional questions for advanced group

There were two groups in the club, and they were not always on the same page, especially in week 3, where four activities were implemented in groups before the whole-class discussion. We found implementing group allocation strategies and providing additional questions for advanced groups can be valuable to ensure effective collaboration and keep groups aligned. Groups should be allocated more deliberately. For example, it may be beneficial to occasionally separate friends who like excessive small talk, to minimise destruction and maintain focus. A potential approach for future implementation is assessing children's strengths, interests, and complementary skills at the beginning of the club, and subsequently assigning students to groups accordingly. This may help to create more diverse and balanced teams that can benefit from each member's unique contributions. Furthermore, providing additional questions beforehand for advanced groups ensures that they are appropriately challenged and encouraged to delve deeper into the topic.

Comparison evokes deeper thinking

In week 1's data card activity, each group was allocated different data cards to discuss whether they were willing to share them or not. Even though some data cards represented similar things, it took extra effort for the instructor to prompt children to compare their results and discuss the differences between their works. In the following weeks, we provided the same tasks for each group and children could reflect and discuss the other group's work much more easily and think more deeply about their differences.

4.4 Limitation and future plan

This work is limited in several ways, which provides an opportunity for further investigation. The first limitation of this work is the small sample size and the setting in which the study took place. Only six children participated in this self-selected after-school club. All children were interested in technology and had some background knowledge. In other words, the participants were a very homogeneous group. Future work could aim to implement this club in a more diverse classroom and broader age-group children.

Secondly, we did not pay enough attention to the group allocation. Thus, children often worked in similar groups every week, which may influence children's learning experience. Group collaboration should be better designed in future practices.

Thirdly, as this work is only a pilot research, which means we only validate our design while an incredible amount of research questions remain to be explored in the future. For example, how have children's past experiences influenced their perceptions of AI ethics? How does group collaboration influence children's learning outcomes? Whether children have developed competencies other than AI ethics? What is the long-term impact of our club? Are children able to migrate AI ethics challenges to AI applications other than recommendation systems? These are interesting questions for future research.

Moreover, due to time constraints, we only focused on AI-based recommendation systems and related ethical challenges in this club. Based on children's performances in this club, more AI-based applications encountered in children's daily life could be incorporated as the learning context for children to discuss and learn about AI ethical challenges.

Finally, due to the limitation of the learning environment (classroom without digital devices), activities in this work were all offline and unplugged. An online version of this work is likely to increase the accessibility and efficiency of AI ethics education, as well as meet children's expectations of interacting with computers.

5 Reference

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