Kids AI Design Thinking Education for Creativity Development

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Abstract

Background Artificial intelligence (AI) developments will change the way humans think about problems. Recent advances in design education have been significant in both the technology and applications of AI and related generative AI. Often, AI education for children is centered on technical education, such as robotics or programming. However, few programs combine AI, technology, creativity, philosophy, and logical reasoning to leverage design expertise. We explore this combination to allow students to creatively use AI to design and think. This paper reports on our vision, curriculum framework, and learning activities, with a focus on proposing a new framework for thinking with AI for Kids, the KAI Thinking Model(KAIT), and exploring its impact on student creativity.

Methods To illustrate the practical application of the KAIT model, we briefly presented two cases of AI thinking programs conducted among Chinese primary and secondary school students. We also used interviews to understand the students' attitudes toward the course content.

Results Students believed that the novelty and uniqueness of the content can help them think outside the box.

Conclusions We hope to provide a new vision of how design in the age of artificial intelligence can serve as a new medium for influencing and facilitating the growth of students as creators of the future.

Keywords Design Education, AI Thinking, Creativity, AI Literacy Education

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Citation: Rong, J., Terzidis, K., & Ding, J. (2024). Kids AI Design Thinking Education for Creativity Development. *Archives of Design Research, 37*(3), 119-133.

http://dx.doi.org/10.15187/adr.2024.07.37.3.119

Received : Feb. 01. 2024 ; **Reviewed :** July. 02. 2024 ; **Accepted :** July. 02. 2024
pISSN 1226-8046 **eISSN** 2288-2987

1. Introduction

With the rapid changes in technology, economy and society in today's world, creative thinking has become one of the most important skills for people to survive and agapt to change. As a key factor in the advancement of civilization and the positive development of society, creativity plays a central role in the current educational environment(Lasky & Yoon, 2011). In creativity-centered education, STEM education can help students more effectively identify and solve the complex problems they encounter in life and cope with an evolving world(Parkhurst, 1999). The interdisciplinary nature of project-based learning helps students apply knowledge from different disciplines to create new products. And it is considered one of the most effective ways to foster creativity(Harris & de Bruin, 2018). The emergence and development of AI technology has led to dramatic changes in work, production methods and daily activities. Furthermore, AI will continue to challenge the ways and methods of human cognition(Huang et al., 2023). In this context, Artificial intelligence in Education (AIED) as the process of using AI methods to facilitate teaching, learning, and decision-making is rapidly evolving(Roll & Wylie, 2016). However, current AI education and training courses focus primarily on technology education and lack the relevant content that students should understand regarding AI's diverse applications. To ensure students understand the implications of AI and capitalize on associated opportunities, it is imperative to equip them with essential skills to comprehend AI and its various functions.

Therefore, this study explores the feasibility of introducing AI as a way of thinking into young people's education. Section 2 surveys relevant research conducted by previous researchers in the field. Section 3 proposes a practical AI curriculum for developing children's AI thinking, named 'Kids AID'. This curriculum consists of three phases: basic knowledge, philosophical arguments and practical exercises. An aiming to cultivate children's philosophical arguments, logical reasoning and decision-making skills. Additionally, two cases studies of the curriculum in section 4 are presented to illustrate its implementation. The section 5 discusses the curriculum practice, suggesting that students can master AI thinking through engaging and interactive methods to enhance their creativity.

This paper proposes a Kid's Artificial Intelligence Thinking Model, offering a novel perspective on AI education for adolescents. In this study, we recruited students at the primary education level to implement this curriculum design. The course yielded two student-created projects, where students explored different innovative themes based on given foundational code and objectives. These two cases are used to (1) illustrate the unique direction of AI literacy cultivation taken by the KAIT model and (2) test the influence of the KAIT model on the creativity of adolescents. In conclusion, we review our methodologies and address the challenges faced, considering the viewpoints of both teachers and students.

2. Related Work

In the field of education, artificial intelligence (AI) technology demonstrates its unique advantages. AI-based learning tools, such as intelligent assessment systems and intelligent tutoring systems, have been widely adopted by governments, education administrators, and educational institutions worldwide(Chen et al., 2020).Concepts and research related to AI in education, AI literacy, and the AI thinking skills that students need to acquire are emerging rapidly. It is important to note that as AI's impact on the education sector intensifies, researchers and educators need to have a clear understanding of these related concepts. This understanding is crucial for conducting in-depth research in this field in the future.

AI has been applied in the field of education for nearly 40 years. It refers to the use of AI technologies or applications in educational settings to enhance teaching, learning, assessment, or decision-making, while also understanding and improving the application of AI technologies in teaching(Chen et al., 2020; Hwang et al., 2020; Timms, 2016). For instance, adaptive learning systems help students adjust their learning status and meet personalized learning needs(Xie et al., 2019). Additionally, intelligent tutoring systems can grade students and provide feedback, thereby improving teachers' efficiency(Rus et al., 2013).It is evident that AI in education (AIED) focuses on using AI technologies to enhance and optimize educational objectives.

The incorporation of artificial intelligence into curriculum teaching can be traced back to the 1980s. The study of AI in higher education became established with the publication of standard textbooks in the AI field(Russell & Norvig, 2016). However, for students in primary and secondary education, AI learning has not received sufficient formal attention from society and the educational community. This gap has only been addressed with the advent of new age-appropriate AI tools(D. T. K. Ng et al., 2022). Utilizing tools such as the Blockly programming interface and user-friendly machine learning model builders, learners at the primary and secondary levels can effectively grasp and learn AI concepts. Consequently, the notion of AI literacy has emerged(Long & Magerko, 2020, Touretzky et al., 2019). Burgsteiner et al. define AI literacy as the ability to understand the knowledge behind AI-driven technologies, which includes not only learning and using AI but also effectively communicating and collaborating with AI(Burgsteiner et al., 2016). Although comprehensive guidelines and reviews on teaching AI literacy have yet to appear, pedagogies and curricula for imparting AI knowledge and skills to students have undoubtedly become a focal point for educators. For instance, gamification has been used to stimulate students' interest in AI courses(T. K. Ng & Chu, 2021), and frameworks for AI curricula have been developed to systematically cultivate students' AI literacy(Burgsteiner et al., 2016). This indicates that AI literacy education focuses more on how educators teach AI to students.

In AI literacy education, digital competence(Vuorikari et al., 2022), interdisciplinary skills(Druga et al., 2019), creativity, and computational thinking (D. T. K. Ng, Su, Leung, et al., 2023)have long been recognized. Numerous studies continue to explore how effective teaching methods, instructional content, and both technical and non-technical tools can

help students enhance these skills (Kong et al., 2023; D. T. K. Ng, Su, & Chu, 2023). However, research on developing students' AI thinking abilities is relatively scarce. Zeng(2013) introduced the term "AI thinking" and attempted to conceptualize and operationalize it. AI thinking, as a composite thinking style that utilizes AI as an analytical tool, represents complex knowledge and AI development, resembling human cognitive processes and enabling more intuitive solutions to real-world uncertainties(Minsky, 1961). Given that computational thinking and AI thinking are intertwined and overlapping, many elements of computational thinking can be directly applied to AI thinking(Silapachote & Srisuphab, 2017). Nevertheless, AI thinking evidently surpasses computational thinking, suggesting its potential as a pedagogical strategy for addressing interdisciplinary issues in science and humanities(Seoane-Pardo, 2016; Wing, 2010). As a sophisticated form of human cognition, AI thinking is not a linear process; it encompasses complex and simultaneous thought patterns (Davis, 2008). Applying AI thinking in education can provide learners with a more comprehensive understanding and interpretation of concepts. For instance, research has shown that integrating mathematics with AI can elicit students' AI thinking, and students can significantly benefit from AI thinking in STEAM-related education(How & Hung, 2019). Ng et al.(2022)argued that due to the lack of a comprehensive framework in AI education research, establishing consensus on AI education terminology prior to research is crucial for refining and advancing AI studies. Therefore, to better illustrate the relationship between AIED, AI literacy education, and AI thinking, we visually organized them as depicted in Figure 1. The visualization of "AI thinking" can provide a stronger foundation for future researchers to enhance their understanding and to delineate further studies on cultivating AI thinking in educational design.

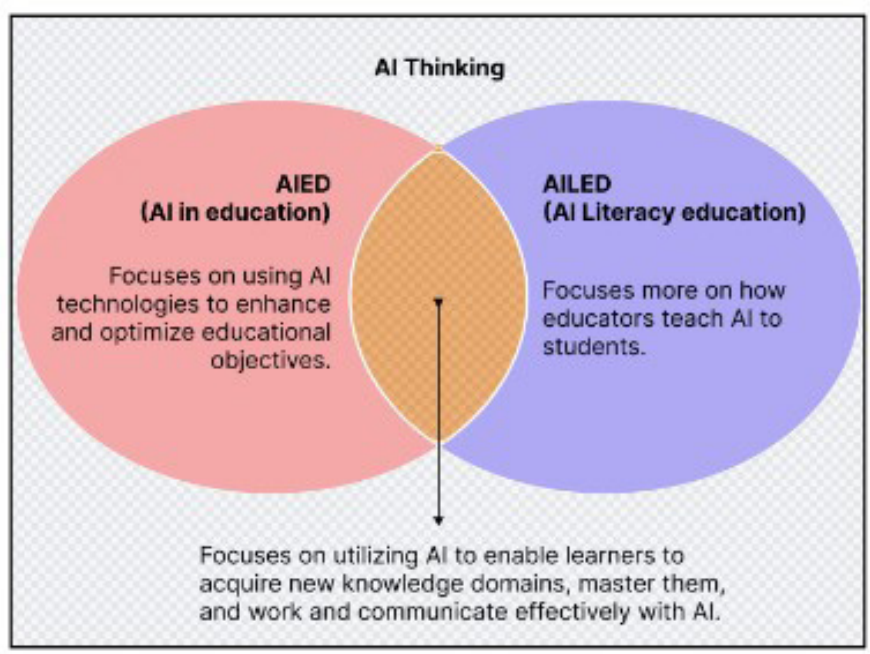

Figure 1 Relationship between AI thinking, AIED and AI Literacy

3. Method

This section outlines a methodology and process for exploring AI thinking framework. We will detail the overall structure of the course, the projects, and the outcomes. The main goal of is to enable students to explore AI and stimulate creativity through Kids AI thinking models.

3. 1. Design Concepts

Our design concepts are greatly influenced by constructivism, particularly the theories of Jean Piaget, which encourage students to actively explore and create through project-based learning and hands-on activities in real-world contexts(Ali et al., 2019). Additionally, we emphasize the importance of self-dialogue. As future leaders of society, students need to develop the ability to actively engage in self-reflection and continuously adapt their thinking.

There are similar studies that have been conducted. Su & Yang(2024)have been working on education for digital equal opportunities for young children and contributing to curriculum development. However, they are different from us in that they focus mainly on the development of AI curriculum in early childhood. Our uniqueness lies in strengthening youngsters' sense of identity and mission in learning AI by incorporating cultural traditions with Chinese characteristics in the process of AI education and encouraging students to adopt the spirit of boldness for process exploration.

3. 2. Overall Structure

Exploring AI thinking involves understanding how computers think, learn, create, make decisions, and comprehend. Currently, most schools teach AI through a series of programming and algorithm courses. However, as discussed in Section 2, these courses are not particularly effective for students at the primary education level. As concrete thinkers and active learners, these students have the potential to greatly benefit from interdisciplinary and practical learning approaches.

Nevertheless, the inherent technical complexity of AI concepts and applications poses a significant barrier. Consequently, teaching AI solely through the lens of robotics or programming is somewhat superficial and limited. To address this issue, a more comprehensive approach is necessary, integrating AI thinking into a broader educational context. This would provide students with a more holistic understanding of AI, fostering their creativity and critical thinking skills.

Based on the research of relevant literature and practices, we have categorized AI thinking into four components: Philosophical Argumentation (PA), Logical Reasoning (LR), Critical Analysis (CA), and Decision Making (DM). For each component, we have designed a corresponding learning framework, referred to as the KAIT model, as illustrated in Figure 2. Figure 2 shows the structure of the KAIT model and the relationships between its components, highlighting the role each part plays in developing students' AI thinking.

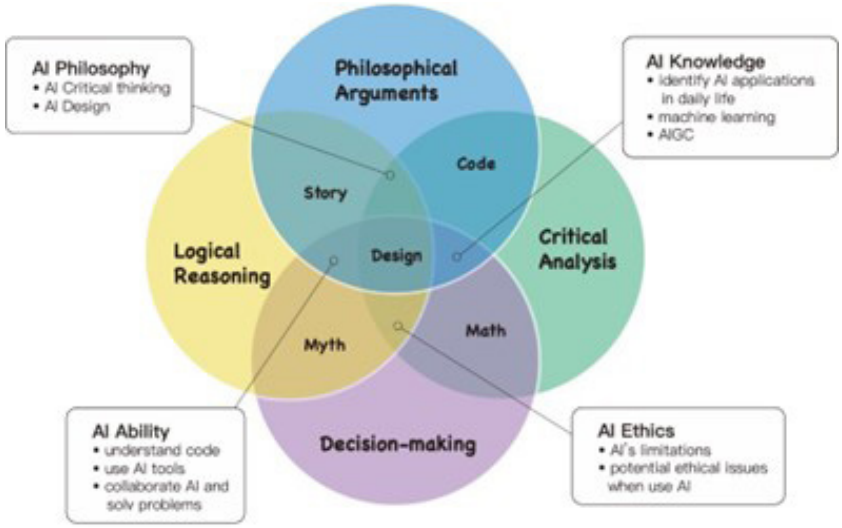

Figure 2 The KAIT Model

Fostering PA & CA through mythology

One of our goals is to use mythological stories with cultural genes to exercise students' philosophical arguments thinking skills and lead them to the door of AI. AI is not only a science that studies how the mind works to simulate human intelligence, but also a technology that realizes intelligence simulation on the computer, for example, the core technology of robots is data mining, but it is also a philosophy (Schiaffonati, 2003;Dennett, 1998;Glymour, 1988). Epistemology takes human cognition as its object, and it is human cognition that is simulated by AI, which can be understood as a human cognitive phenomenon presented on an artificial technological device. Thus, AI and philosophical epistemology pursue the same theme of studying how the mind works (the nature of the cognitive activity of the human brain intelligent activity, which is then further realized by AI than on a computer by technical means. And myths, as products of thought and consciousness, can be studied to infer human feelings and ways of thinking.

The study of myth is not only a matter of language and history of ideas, but also of logic and epistemology (Cassirer, 1946). Some researchers argue that cognition is both individual and collective. Each individual has unique experiences and beliefs about the world, but people within the same geographical, cultural, and linguistic sphere have a communal perception of the world, which is also known as a stereotype of thinking. Therefore, myths are considered to be the interpretation of cognition and thinking, and the carrier of collective human thought, which makes them valuable and meaningful for cognitive studies (Renfrew & Bahn, 2012). In the meantime, myth is also semiotic in that "language, myth, and art are the parts of the symbolic universe, the different threads that weave the web of symbols, the interwoven web of human experience, and all the advances that man has made in thought and experience have made this web of symbols more refined and stronger" (Cassirer, 2021). How people understand artificial intelligence depends heavily on how they understand their perception, intelligence, mind, etc. in terms of philosophical epistemology. For example, in the course, we let students understand "what is design and AI design" by telling them a mythical story

based on Pygmalion (Figure 3). Through the Greek mythological story of Hat Maker & The king and robot, students are introduced to the theme of androids and machines evolving intelligence through autonomous choice.

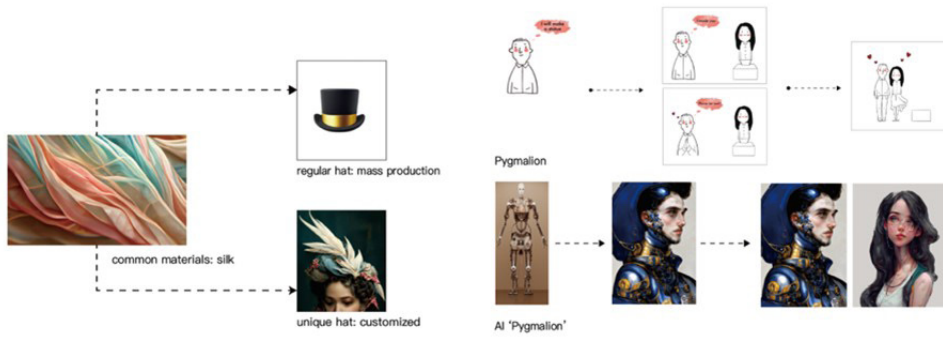

Figure 3 Story: Hat Maker & The king and Robot

Mythology, as a logical being (Lévi-Strauss,1995), is not fundamentally different from modern science. We do not need to abandon mythology because of science; on the contrary, mythology can bring science and society into greater harmony because it has the function of harmonizing nature and culture in a way that science does not. At the same time, myths usually involve symbolic language and metaphorical intentions that need to be interpreted and analyzed. By learning how to interpret these symbols and understand their meaning in the context of a story, students can help develop their analytical skills and learn how to make connections between different ideas.

Enhancing LR through knowledge of mathematic

As one of the essential core technologies of artificial intelligence, logical reasoning techniques, such as automatic reasoning and decision-making, intelligent analysis, etc., can effectively help the computer to simulate human thinking, thus improving the intelligence and application value of artificial intelligence. As mathematics is an important core of logical reasoning, the importance of mastering mathematical knowledge for students to learn and develop artificial intelligence thinking cannot be exaggerated. Therefore, we adopted lectures with story and programming exercises to develop and exercise students' rational thinking. Confucius was a famous philosopher, thinker, and educator in ancient China. A famous Chinese idiom "Ju Yi Fan San" is based on his thought "*When I have presented one corner of a subject to anyone, and he cannot from it learn the other three, I do not repeat my lesson.*" The truth behind this phrase is "The learner is expected to be able to know many other things by analogy from one thing and to learn to learn from this to the other." In this quote, Confucius suggests that the key to teaching and learning is to inspire students to think independently and to oppose the mechanical logic of duck-fill teaching. It is important to be adaptable.We visualize this characteristic Chinese knowledge through creative programming based on it. This is used to teach students about mathematics while encouraging them to develop their ideas and create new content. This process is designed to help students question and exercise their logical reasoning thinking skill. By exploring the origins of problems,

students will be able to build their own models of good thinking.

Developing DM through design games

Games are a powerful tool for identifying the neural and psychological mechanisms behind interpersonal and group cooperation and coordination. Playing games can promote a wide range of cognitive skills (Granic, Lobel & Engels, 2014). Learning is undoubtedly a daunting task for students as they struggle to understand the knowledge, issues, and developmental plans that society requires them to value. Therefore, some researchers argue that we need games to "sweeten" the idea of students' learning difficulties (Kafai, 2006). It is important to note that in this research, "games" does not mean that the teacher assigns a game and embeds it in the classroom for the students to play. "Games" refers to "making games" that provide students with more opportunities, ideas, and ways to build their own games and make connections to what they have learned in the process. Constructivist educators believe that this can be a great motivator for students and a valuable body of learning experiences. Students are involved in all game design decisions, and they need to understand how to use, test, modify and refine their games to become more optimized and fluid in addition to how to use new technological tools to create games. Students' attitudes toward mathematics become more positive after creating games through the tool, and the process of game design also helps to activate students' reflections on their daily mathematical experiences and better develop their decision-making skills (Denner, Werner & Ortiz,2012; Kafai,2015).

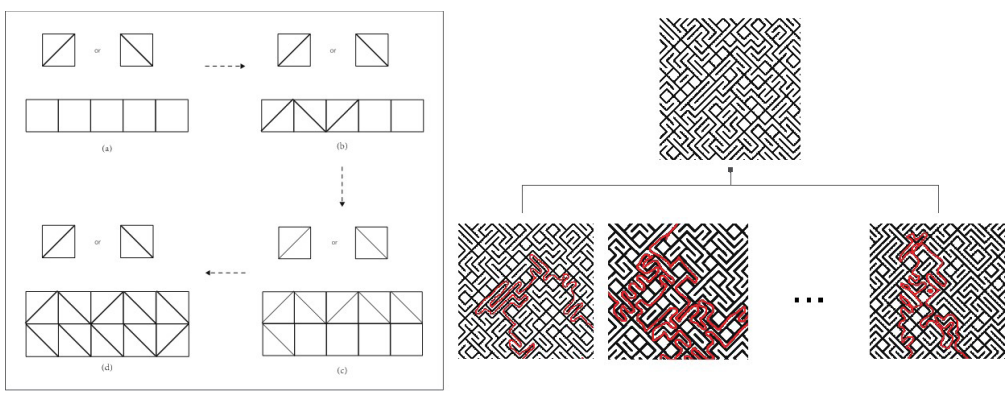

Figure 4 Composition of the Minos

For example, shown in Figure 4, during the program we tell the students myth of Minos. Using this story as a model, we lead the students to design a labyrinth game that mimics the dwelling of the Minotaur. During the game design process, students learn how to create a maze map in code and try to find a way out of the maze they have created.

3. 3. Instructional Practice Design

Based on the model illustrated in Figure 2, we have developed a five-day instructional practice workshop "Kids AID," aimed at fostering students' creativity by applying the Kids AI thinking model in classroom settings. The "Kids AID" workshop course structure is divided into three parts(see in Table 1): (1) AI Basic Knowledge (AIK), (2) AI Application Skills

(AIA), and (3) AI Creativity (AIC). The first two parts follow a similar learning structure, comprising the explanation of fundamental concepts and individual practical exercises. The practical exercises involve completing two assigned projects: "Ju Yi Fan San" and "Minos Maze." The third part integrates the first two parts, where participants utilize the knowledge and skills acquired from AIK and AIA to complete the final project "AI-Infused Art." In this project, students employ their aesthetic and creative abilities to explore AI foundational knowledge and coding principles, balance and evaluate their ideas, and continually refine and perfect their outputs. Finally, students are required to share and present their work to all participants.

Participants

Recruitment information was disseminated through the official platform of the researchers' university. A total of 43 eligible students from Shanghai, China, were recruited for this study, with 36 data points retained (20 boys and 16 girls, with an average age of 14 years). Seven participants who already had some prior knowledge of AI were excluded to ensure that all participants had an equal understanding of AI. Both the participants and their guardians were informed about the nature of the study and provided informed consent.

Instruments

AI Basic Knowledge (AIK) On the first and second days of the workshop course, students will be introduced to fundamental AI concepts, including the history of AI, basic algorithms, and key technologies, supplemented with programming exercises (AIK1). The goal is to provide students with a sufficient foundation of AI knowledge through interactive lectures and multimedia presentations (AIK2).

AI Ability (AIA) On the third and fourth days, the focus shifts to developing practical AI skills. Students will engage in hands-on activities, such as machine learning exercises (AIA1) and completing predefined projects like "Ju Yi Fan San" and "Minos Maze." These activities aim to enhance students' understanding of AI tools and their problem-solving abilities. Additionally, traditional mythological stories will be integrated into the cultivation of philosophical arguments, helping students to exercise their argumentative thinking skills through the rich cultural heritage of China (AIA2). These philosophical discussions will also assist students in understanding the ethical issues and limitations of AI (AIA3). Students will explore the applications of AI in different cultural and historical contexts, thus gaining a more comprehensive understanding of AI's diversity and complexity.

AI Creativity (AIC) On the final day, students will be tasked with completing the "AI-Infused Art" project, which synthesizes the knowledge and skills acquired in the previous days. This project encourages students to use AI tools creatively (AIC1), integrating aesthetic and technical elements to produce unique works (AIC2). Students will present their projects, explaining their thought processes, challenges encountered, and solutions developed, thereby fostering a comprehensive understanding of AI's creative applications (AIC3).

Table 1 The outline of Kids AID workshop design for kids

AI Basic Knowledge(AIK)	AI Ability(AIA)	AI Creativity(AIC)
AIK1: coding exercise AIK2: AI Knowledge	AIA1: machine learning AIA2:cultural gene for critical AIA3: ethical issues and limitations of AI	AIC1: use AI tools AIC2: integrate aesthetic and technical AIC3: AI's creative applications

4. Workshop Course Outcomes: Two Design Cases

4. 1. Case1: demonstrate kids' ability to use AI

As mentioned in section 3.2, we integrated traditional Chinese stories with programming exercises in our course to stimulate students' logical and critical thinking while enhancing their coding skills through the application of mathematical knowledge. These elements can serve as sources of inspiration for children's project creation. With the advancement of AI technology, myths and stories can be adapted to fit contemporary contexts and match children's visual literacy abilities. In this section, we present the myth of "cháng é bēn yuè" as conveyed in the workshop, along with the AI knowledge it encompasses (see in Table 2).

Table 2 Course outline (extract)

Learning List	Learning Content
Myth	"cháng é bēn yuè" is a beloved Chinese myth that tells the story of Chang'e, the moon goddess. Long ago, ten suns scorched the earth, causing great suffering to the people. The hero Hou Yi shot down nine of the suns, saving the world. As a reward, he received a pill of immortality from the Queen Mother of the West. Hou Yi decided to hide the pill until he could take it with his wife, Chang e. However, Hou Yi's apprentice attempted to steal the pill. In desperation, Chang e swallowed it. As a result, she ascended to the moon and arrived at the Moon Palace. Inside the palace, she was accompanied by the rabbit who guards the palace and the toad that pounds the medicine. They have lived there together ever since.
Picture of the moon	
Animals of the moon	Rabbit, Toad
Question to consider	The two animals, the toad and the rabbit, appear from time to time in the story. Have you ever wondered why these two animals and not others?
Filter in AI processed images of the moon	 
AI Exercise 1	Use your knowledge of filter codes from the course (AIK1&2) to see if you can find Toad and Rabbit in a picture of the Moon(AIA2, AIA3).
AI Exercise 2	Please write a code for a lunar eclipse based on the photo of the eclipse(AIA,AIC2).
AI Exercise 3	Please draw a picture of a solar eclipse based on the code for a lunar eclipse.(AIK,AIA,AIC3)

4. 2. Case2: demonstrate kids' AI Creativity

Creativity is beautiful because it demonstrates human nature and who we are. However, creating things that can create other things on their own has a different meaning; it is not

only a leap in technology, but also a promise for the future. This process signals who we want to be. This kind of creativity demands responsibility from the user, and although the thing created is non-human, it has a "mind" of its own. It is something we awe and love, but at the same time worry about, because its behaviour is always unpredictable. Design is essentially the creativity to shape something. While designing with artificial intelligence is a re-creation of the creative process itself. While traditional design endeavours to create something beautiful, unique and functional, AI design goes a step further by not only creating objects, but also giving them intelligence and charm.

In this case study, we present the project "AI-Infused Art." This project tasks students with using AI, programming languages, and logical reasoning to create art that expresses human emotions or feelings. By merging human creativity with AI, we aim to foster innovation in AI-era art and enhance the creativity of young people, resulting in imaginative and groundbreaking works (see in Table 3).

Table 3 AI–Infused Art

Project Requirements	Learning Content
Task	Expressing a particular human emotion or mood with a graphical work and a paragraph expressing the inner meaning of the work（AIC）.
Tools	Use AI technologies such as Image Colorization,Deep Dream Fast Style Transfer etc（AIK1，AIA).
Example	
Content Images	 huangpu river
AI Technology	Fast Style Transfer
Style images	 time tunnel
Work Gallery	
Work Description	The artwork is mainly to show the colourfulness of Shanghai. The Huangpu River passing through the city, as the mother river of Shanghai, has nurtured this great city, and the water of the Huangpu River nourishes the people on this land day after day. It is a long river of time witnessing the development of the city, and at the same time a time tunnel inscribing the vicissitudes of city's century–long history. In order to achieve the effect of this piece of work, the creator chose to use fast style conversion AI technology combined with our own style style images to achieve this purpose. The main body of the content is the Bund, the style image is the "time tunnel" written in code, and finally the work is processed using AI technology.

5. Discussion

As far as we know, we are starting a design exploration approach aimed at developing children's AI thinking. After all, the technological context of AI and the expectations of children and parents learning about AI make this a challenge: firstly, we have very few

educational resources to draw on. Especially in the context of integrating AI technology and design. Secondly, we are open and explorable to the learning environments in which our students find themselves, which increases the proportion of uncertainty in the process of pedagogical practice, but at the same time subverts the rigidity and homogeneity of traditional education. Thirdly, allowing students to bring their own judgements and decisions into the discussion is a fundamentally challenging approach in a curriculum that incorporates myths, stories and jokes with cultural enigmas. Rather than seeing students as whiteboards who need to be explained the composition of AI by the book, we will use AI for teaching and learning. Using design as a vehicle to understand what students are learning in this course. Also observe creativity occurring in diverse forms at different stages.

In addition, the results of our post-course survey (see Table 4) indicate that there is value in our KAIT model and approach. Interviews with the students showed that 75% of them said that the five days of learning and practice not only broadened their understanding of AI, but also allowed them to think out of the box, understand and add new perspectives to the way they look at things. As one student said, "...I've never taken a class like this before. Here I can take ownership of my design program and I'm responsible for it. The teacher told us a lot of different stories, myths and jokes, which may sound simple, but when we went to think hard we could realize that they weren't simple. At the same time, the process really kept me thinking outside the box and I felt like my imagination was opened up...".

Table 4 Results of kids' perspecives on course content (n=36)

Category of Perspectives	n
Opened New Perspectives	27
Increased Novelty	19
Needs time to digest	7
AI Tools Expanded Creativity	20
Lessons are too relaxed in format	10

While 52.7 % of the students said that this format of the course was novel, "In the course the teacher told us many myths and jokes, which we had heard many times but never thought that we could still understand them in this format! It was incredible! For me, it definitely changed the way I think about things..." . However, 19.4% of the students felt that the course covered a lot of concepts and content, which was difficult to fully digest in 5 days, "... I need to take out extra time in the evening when I go home to organise myself in order to ensure that I understand and remember all the points that the teacher has produced in the class, which is a bit difficult for me...". Meanwhile, another 27% of the students felt that the format of the class would distract them because it was different from the serious atmosphere of a traditional classroom.

However, 55.6% of the students felt that this hands-on session that prompted them to explore new techniques and methods deepened their understanding of the concepts and enabled live learning. Student feedback said, "... This course combines philosophy and technology so well that I won't be afraid of AI technology because I'm not good at maths. Instead, I can use my imagination with AI tools, the process is really inspiring creativity and I feel empowered and unlimited possibilities..." . Because of this, although the project has some flaws in the

curriculum design, this evidence still serves to show the desirability and success of this approach.

6. Conclusion and Future Work

New technologies represented by AI are rapidly changing the way we live, learn, organize, and work. In addition to vigorously enhancing the teaching and learning of the technical aspects of AI, there should be a shift in the way students are trained to think. The purpose of this study is to explore whether the constructed AI thinking framework can help students to develop their creativity. In this process, we will ignore the content related to copyright and ethics that may give rise to negative messages, because once students are exposed to AI, these will be an integral part of the teaching and learning process, and it needs to be critically presented in the curriculum through the lecturer.

We are more concerned with the hope that the process can give students a sense of the power of algorithms and AI thinking. It can influence not only what people create and how they use these systems for use, but also if the products generated by AI are used to influence and change social behavior and structures. These changes will make students aware that they are not learning for the environment they are in today, but for the place, they will arrive at later. We have an obligation to bring to students the skills they may use in the future and to clarify what should be taught and how it should be taught in the education system and teaching methods of the present.

But as many of our colleagues are studying and working on, this is a newly emerging area of research, and more research must be conducted to obtain sufficient evidence. In this sense, we are now developing a new model of AI thinking. The aim is to conduct a deeper exploration. And to draw some contrasting conclusions about our initial question: Is it possible to teach modern AI thinking based on computational thinking, design, philosophy and genetically relevant to culture in primary and secondary schools to foster creativity in students? We will use this as a starting point for continuous experimentation and practice, with the aim of designing ways of thinking that are consistent with students in the age of AI and help them better become the creators of the future. We also hope to initiate discussions and encourage researchers, educational institutions, and teachers to work together to further explore and critically evaluate these educational pathways.

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