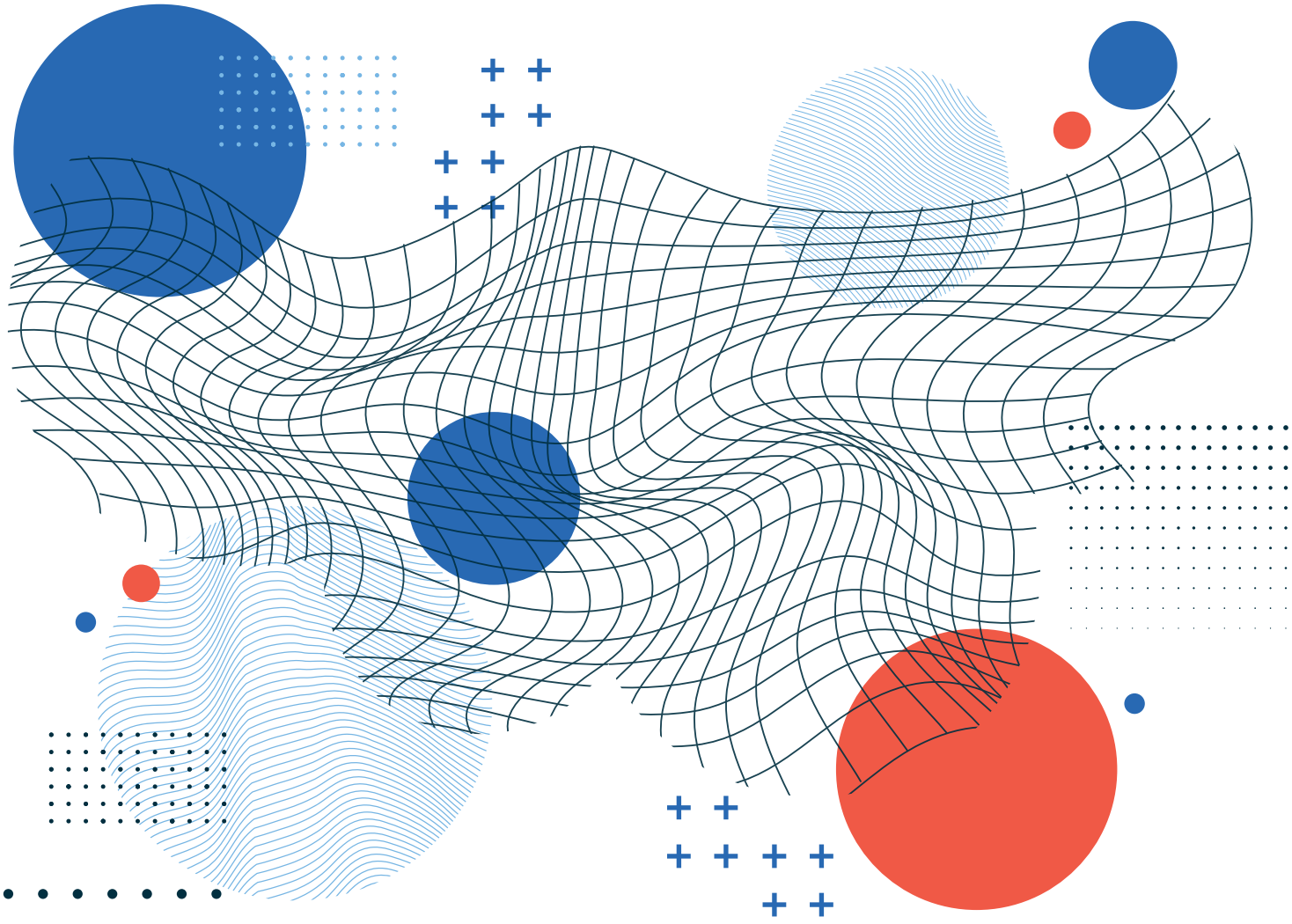
2026 ICEET

第十五屆 數位學習與教育科技國際研討會

International Conference on E-learning and Educational Technology

智慧教育×永續共榮

論文集 PROCEEDINGS



AI素養導向課程對學習者AI知識、對AI的態度和AI使用動機的影響

鄭子善[1] 張容君[2] 詹予緻[3] 張以辰[4]

[1]國立臺灣師範大學師資培育與就業輔導處 兼任助理教授
E-mail：ferragamogift@gmail.com

[2]臺南市安定國民小學 教務主任
E-mail：rongchun1030@gmail.com

[3]南臺科技大學人文社會學院教育經營碩士在職專班 研究生
E-mail：lawrence.chan@adps.tn.edu.tw

[4]國立臺灣師範大學機電工程學系 大學生
E-mail：41273114h@gapps.ntnu.edu.tw

摘要

本研究旨在探討AI素養導向課程對學習者的影響。藉由具有AI素養導向的機器人設計課程，探討其對學習者AI知識、對AI的態度和對AI動機的影響。研究採用問卷調查法，向臺灣南部某國小的五年級全體學生進行施測。研究運用成對樣本*t*檢定來比較課程實施前後學習者在AI知識、對AI態度和AI使用動機的差異，以探討此課程學習者的影響。

研究結果呈現，AI素養導向課程對學習者的AI知識具有顯著性差異且正向的提升；在對AI的態度之不同維度上，同樣呈現顯著性差異；在AI的使用動機的期望維度和成就維度上，同樣呈現顯著差異。整體而言，本研究驗證AI素養導向課程確實能對學習者於AI素養相關的AI知識、對AI的態度和AI使用動機造成部分影響，而未能呈現顯著提升的維度，則為未來發展AI素養導向課程的提供可能可改善的方向。

關鍵字：AI素養; 對AI的態度; AI使用動機; AI動機; 機器人設計

Effects of the AI Literacy-Oriented Curriculum on Students' AI Knowledge, Attitudes toward AI, and AI Use Motives

Cheng, Tzu-Shan[1] Chang, Rong-Chun[2] Chan, Yu-Chih[3] Chang, Yi-Chen[4]

[1]School of Teacher Education, National Taiwan Normal University,
Adjunct Assistant Professor
E-mail：ferragamogift@gmail.com

[2]Tainan Municipal Anding Elementary School,
Director of Academic Affair
E-mail：rongchun1030@gmail.com

[3]College of Humanities & Social Sciences Master of Education Administration,
Graduate Student
E-mail：lawrence.chan@adps.tn.edu.tw

[4]Department Of Mechatronic Engineering, National Taiwan Normal University
Student
E-mail：41273114h@gapps.ntnu.edu.tw

Abstract

This study aimed to examine the effects of an AI literacy-oriented course on students. Through a robot design course with an AI literacy orientation, this study explored its effects on students' AI knowledge, attitudes toward AI, and AI use motives. A questionnaire survey was used, and all fifth-grade students at an elementary school in southern Taiwan were invited to participate. Paired-samples *t* test was conducted to compare students' differences in AI knowledge, attitudes toward AI, and AI use motives before and after the course, so as to examine the effects of the course on students.

The results showed that the AI literacy-oriented course led to a significant and positive improvement in students' AI knowledge. Significant differences were also found in different dimensions of attitudes toward AI. In addition, significant differences were found in the expectancy and attainment dimensions of AI use motives. Overall, this study confirmed that the AI literacy-oriented course had some effects on students' AI literacy-related AI knowledge, attitudes toward AI, and AI use motives. The dimensions that did not show significant improvement may provide useful directions for the future development of AI literacy-oriented course.

Keywords: AI Literacy; Attitudes Toward AI; AI Use Motives; Robot Design; Robot Course

Introduction

With the rapid development of Artificial Intelligence (AI), AI has widely influenced society and education systems. Therefore, developing students' AI literacy has become an important issue in basic education. Previous studies indicated that AI literacy referred to the basic abilities individuals should have in a knowledge-based society. It included AI knowledge, attitudes toward AI, and AI use motives, such as understanding core AI concepts, developing computational thinking and programming skills, and thinking critically about the social effect of AI (Bawden, 2008; Long & Magerko, 2020; Kim et al., 2021). In addition, the five big ideas proposed by AI for K–12 emphasized the importance of helping students understand how AI works and its social impact from an early stage (Touretzky et al., 2019), which showed the need to develop AI literacy in basic education.

In instructional practice, robotics design course has been viewed as an effective way to develop AI literacy. The Students as AI Learning Designers (SAILD) framework used iterative design cycles and inquiry processes to guide students in problem solving, hands-on practice, and reflection. This process helped integrate the development of knowledge, attitudes, and AI use motives (Yue et al., 2025).

Based on this, this study was grounded in AI literacy theory and the SAILD framework. It also integrated the cross-disciplinary indicators of the 12-Year Basic Education Curriculum to develop an AI literacy-oriented course for elementary school students. The study further analyzed the differences in students' AI knowledge, attitudes toward AI, and AI use motives before and after the course implementation, in order to examine the effectiveness of the AI literacy-oriented course. The purposes of this study were as follows: 1. to analyze the effect of the AI literacy-oriented course on students' AI knowledge; 2. to analyze the effect of the AI literacy-oriented course on students' attitudes toward AI; and 3. to analyze the effect of the AI literacy-oriented course on students' AI use motives. Based on these purposes, the following research questions were proposed:

1. What was the effect of the AI literacy-oriented robotics course on students' AI knowledge?
2. What was the effect of the AI literacy-oriented robotics course on students' attitudes toward AI?
3. What was the effect of the AI literacy-oriented robotics course on students' AI use motives?

Literature Review

1 AI Literacy-Oriented Course

(1) The Concept of AI Literacy

The term literacy refers to the essential abilities that every citizen should have. Therefore, AI literacy has been defined as the basic abilities related to AI that individuals need in a knowledge-based society, so that they can have equal opportunities in the workplace (Bawden, 2008). Long and Magerko (2020) divided AI literacy into three dimensions: AI knowledge, AI skills, and AI attitudes. AI knowledge refers to understanding core AI concepts, such as definitions, types, problem solving, reasoning, data, machine learning, and applications. AI skills refer to computational thinking and programming abilities, including the use of AI tools. AI attitudes refer to understanding the social impact of AI, including human–AI interaction and both

positive and negative effects, as well as developing critical views toward AI use (Kim et al., 2021).

Based on this, the "AI for K-12" initiative proposed five big ideas as guidelines for AI education from kindergarten to elementary school levels: (1) computers use sensors to perceive the world; (2) agents maintain representations of the world and use them for reasoning; (3) computers learn from data; (4) enabling natural interaction between humans and agents is a major challenge; and (5) AI applications may have both positive and negative impacts on society (Touretzky et al., 2019).

(2) Framework of AI Literacy-Oriented Course

Because robotics design course had strong potential to support the development of AI literacy, Yue et al. (2025) developed a framework called students as AI literate designers (SAILD). This framework explained how students' AI literacy was improved in robotics design activities. The SAILD framework included two interactive parts: design and research.

The design part guided students to engage in a design cycle, including problem identification, generation of design solutions, creation of digital products, and evaluation. The research part included students' participation in brainstorming, hands-on exploration, critical discussion, and reflection. In this instructional framework, activities from both parts were conducted in an iterative and alternating process, which helped improve students' AI literacy.

In this study, the robotics course was designed based on the SAILD framework. First, students were motivated to identify real-life problems. Based on the introduction to robotics design knowledge, they proposed initial design solutions to solve these problems. Then, the teacher provided guidance to help students understand difficult concepts in the design process. Students used this new knowledge to further improve their designs. After that, the teacher introduced more advanced knowledge to support further design iteration. Students then adjusted and optimized their solutions, reflected on their designs, and conducted evaluation under the teacher's guidance.

Research Method

1. Research Design

Based on the SAILD instructional framework, this research team selected and integrated AI literacy, AI core topics, and AI competency indicators (Long & Magerko, 2020), as well as the cross-curricular indicators of the 12-Year Basic Education Curriculum, to design and implement an AI literacy-oriented robotics course for the elementary school level. Before and after the course implementation, questionnaire surveys were used to collect data on students' AI knowledge, attitudes toward AI, and AI use motives. After that, a paired-samples *t* test was used to examine the effects of this course on students.

2. Population and Sample

This study aimed to examine the effects of the AI literacy-oriented robotics course on students, in order to clarify the effectiveness of this course. Therefore, all fifth-grade students from two classes at one elementary school in southern Taiwan were selected as the research participants, with a total of 51 students. From September 2025 to April 2026, these students participated in two semesters and 10 instructional units of the AI literacy-oriented robotics course. They also completed surveys on AI knowledge,

attitudes toward AI, and AI use motives before and after the course.

3. Research Instrument

To address the research questions, the researchers developed the *Questionnaire on AI Literacy-Oriented Course* and administered it to 51 fifth-grade students who received this course. The questionnaire mainly included four sections. The section 1 was an introduction that explained the purpose of the survey. The section 2 included items on AI knowledge. The section 3 and section 4 included items on attitudes toward AI and AI use motives. The details of the second, third, and fourth parts are described below.

(1) Measurement of AI Knowledge

The AI knowledge items were developed by four researchers, including an elementary school information teacher, a student from the Department of Mechanical and Electromechanical Engineering, an elementary school administrator, and a university teacher. These items were developed based on AI competency indicators and were revised three times. Table 1 showed that the AI knowledge items were divided into two dimensions, which represented the Lego and NKNU Block robotics design systems that students would learn in the AI literacy-oriented robotics course. The Lego system included five course units, and the NKNU Block system included four course topics. Each course unit had two items. In addition, there was a final achievement presentation that combined both systems. In the course unit for this presentation, one item was designed for each of the two systems. Therefore, the total number of items was 20.

Table 1. Distribution of Questionnaire Items on AI Knowledge

Dimension	Unit	Item Numbers	Number of Items
Lego	Unit 1-Unit 5、Unit 10	1-10、19	11
NKNU Block	Unit 6-Unit 9、Unit 10	11-18、20	9
Total	10	1-20	20

(2) Measurement of AI Knowledge

The measurement of attitudes toward AI used the *General Attitudes Towards Artificial Intelligence Scale* (GAAIS) developed by Schepman & Rodway (2020). Table 2 showed that the GAAIS included two dimensions: positive attitudes and negative attitude. The positive attitude dimension included 12 items, and the negative attitude dimension included 8 items with reverse scoring. Therefore, the total number of items was 20. The Cronbach's α values for all dimensions were above .80, which indicated good reliability.

Table 2. Item Distribution and Reliability for GAAIS

Dimension	Item Numbers	Number of Items	Cronbach's α
Positive Attitude	1-2、4、5、7、11、12、13、14、16、17、18	12	.88
Negative Attitude	3、6、8、9、10、15、19、20	8	.83
Total	1-20	20	

(Source: Schepman & Rodway, 2020)

Table 3 showed the validity of attitudes toward AI. The KMO value of the scale was .86, which was higher than .80, indicating that the data were suitable for factor analysis. The Bartlett's test showed a chi-square value of 817 with $p < .05$, indicating statistical significance and suitability for factor analysis. After two-factor rotation, the cumulative variance explained reached 41.6%. In addition, the model fit test conducted using AMOS 21.0 showed that all fit indices met the required standards, which indicated that the scale had good validity.

Table 3. KMO and Bartlett for GAAIS

KMO measure of sampling adequacy		.86
Bartlett's Test of Sphericity	Approx. Chi-Square	817
	df	190
	Sig.	.00

(Source: Schepman & Rodway, 2020)

(3) Measurement of AI Use Motives

The measurement of AI use motives adopted the *Questionnaire on AI Use Motives* (QAIUM) developed by Yurt & Kasarci (2024). The scale included five dimensions: expectancy, attainment, utility value, intrinsic value, and cost. Table 4 showed that each dimension included four items, with a total of 20 items. The Cronbach's α values for all dimensions were above .80, which indicated good reliability.

Table 5 showed the validity of the QAIUM scale. The KMO value was .96, which was higher than .90, indicating that the data were highly suitable for factor analysis. The Bartlett's test showed a chi-square value of 10291.85 with $p < .001$, indicating statistical significance and suitability for factor analysis. After five-factor rotation, the cumulative variance explained reached 82.85%, which was higher than 50%, indicating that the scale had high validity.

In summary, the GAAIS and QAIUM scales showed sufficient reliability and validity. Therefore, they were suitable for measuring attitudes toward AI and AI use motives in this study.

Table 4. Item Distribution and Reliability for QAIUM

Dimension	Item Numbers	Number of Items	Cronbach's Alpha
Expectancy	4	1-4	.88
Attainment	4	5-8	.92
Utility Value	4	9-12	.92
Cost	4	12-16	.87
Intrinsic Value	4	17-20	.94
Total	20	1-20	

(Source: Yurt & Kasarci, 2024)

Table 5. KMO and Bartlett for QAIUM

KMO measure of sampling adequacy		.96
Bartlett's Test of Sphericity)	Approx. Chi-Square	10291.85
	df	523
	Sig.	.000

(Source: Yurt & Kasarci, 2024)

Results and Discussion

1. Effect of the AI Literacy Course on Students' AI Knowledge

Table 6 showed the results of the paired-samples *t* test on the differences in students' AI knowledge before and after the course. According to Table 6, for the Lego dimension, the pretest (M = 2.40, SD = .90) and posttest (M = 3.17, SD = .63) showed a significant difference, t (50) = -4.758, p < .001. This indicated that students' AI knowledge in the Lego dimension significantly improved after the course.

For the NKNU Block dimension, the pretest (M = 2.28, SD = .91) and posttest (M = 3.01, SD = .72) also showed a significant difference, t (50) = -4.362, p < .001. This indicated that students' AI knowledge in the NKNU Block dimension significantly improved after the course.

For total AI knowledge, the pretest (M = 2.34, SD = .91) and posttest (M = 3.09, SD = .51) showed a significant difference, t (50) = -5.448, p < .001. This indicated that students' total AI knowledge significantly improved after the course.

Table 6. Results of Paired-Samples T-Test on Students' AI Knowledge

Dimension	Pre-Test		Post-Test		*t*	*p*
	M	*SD*	*M*	*SD*		
Lego	2.40	.90	3.17	.63	-4.758	＜.001***
NKNU Block	2.28	.91	3.01	.72	-4.362	＜.001***
Total	2.34	.72	3.09	.51	-5.448	＜.001***

*p < .05, **p < .01, ***p < .001

2. Effect of the AI Literacy Course on Students' Attitudes Toward AI

Table 7 showed the results of the paired-samples *t* test on the differences in students' attitudes toward AI before and after the course.

According to Table 7, for the positive attitude dimension, the pretest (M = 2.58, SD = .80) and posttest (M = 3.12, SD = .68) showed a significant difference, t (50) = -4.151, p < .001. This indicated that students' positive attitudes significantly increased after the course.

For the negative attitude dimension, the pretest (M = 2.58, SD = .80) and posttest (M = 2.95, SD = .65) also showed a significant difference, t (50) = 2.734, p < .01. This indicated that students' negative attitudes significantly increased after the course.

For total attitudes toward AI, the pretest (M = 2.58, SD = .80) and posttest (M = 3.03, SD = .33) also showed a significant difference, t (50) = -4.308, p < .001. This indicated that there was a significant change in students' total attitudes toward AI after

the course.

Table 7 Results of Paired-Samples T-Test on Students' Attitudes toward AI

Dimension	Pre-Test		Post-Test		*t*	*p*
	M	*SD*	*M*	*SD*		
Positive Attitudes	2.58	.80	3.12	.68	-4.151	.000***
Negative Attitudes	2.58	.80	2.95	.65	-2.707	.009**
Total	2.58	.80	3.03	.33	-4.308	.000***

*$p < .05$, **$p < .01$, ***$p < .001$

3. Effect of the AI Literacy Course on Students' AI Use Motives

Table 8 showed the results of the paired-samples *t* test on the differences in students' AI use motives before and after the curriculum. According to Table 8, for the expectancy dimension, the pretest ($M = 2.73$, $SD = .74$) and posttest ($M = 3.09$, $SD = .74$) showed a significant difference, t (50) = -2.447, $p < .05$. For the attainment dimension, the pretest ($M = 2.77$, $SD = .80$) and posttest ($M = 3.16$, $SD = .81$) also showed a significant difference, t (50) = -2.418, $p < .05$. These results indicated that students' scores in expectancy and attainment significantly increased after the course.

For the utility value dimension, the pretest ($M = 2.99$, $SD = .80$) and posttest ($M = 3.13$, $SD = .77$) did not show a significant difference, t (50) = -0.817, $p = .418$. For the cost dimension, the pretest ($M = 2.93$, $SD = 1.03$) and posttest ($M = 3.04$, $SD = .88$) also did not show a significant difference, t (50) = -0.621, $p = .537$. For the intrinsic value dimension, the pretest ($M = 2.64$, $SD = .97$) and posttest ($M = 2.96$, $SD = .85$) did not show a significant difference, t (50) = -1.744, $p = .087$.

For total AI use motives, the pretest ($M = 2.81$, $SD = .73$) and posttest ($M = 3.08$, $SD = .73$) did not show a significant difference, t (50) = -1.787, $p = .080$. This indicated that although students' AI use motives slightly increased after the course, the difference was not statistically significant.

Table 8. Results of Paired-Samples T-Test on Students' AI Use Motives

Dimension	Pre-Test		Post-Test		*t*	*p*
	M	*SD*	*M*	*SD*		
Expectancy	2.73	.74	3.09	.74	-2.447	.018*
Attainment	2.77	.80	3.16	.81	-2.418	.019*
Utility Value	2.99	.88	3.13	.77	-.817	.418
Cost	2.93	1.03	3.04	.88	-.621	.537
Intrinsic Value	2.64	.97	2.96	.85	-1.744	.087
Total	2.81	.73	3.08	.73	-1.787	.080

*$p < .05$, **$p < .01$, ***$p < .001$

Conclusions and Recommendations

1. Conclusions

This study examined the effects of the AI literacy-oriented robotics course on elementary school students. The results showed that students' AI knowledge significantly

improved ($p < .001$), which indicated that the course effectively enhanced their understanding of AI concepts and attitudes toward AI For AI use motives, only the expectancy and attainment dimensions showed significant improvement ($p < .05$), while overall motivation did not show a significant difference. Overall, the AI literacy-oriented course had positive effects on AI knowledge, attitudes toward AI, and some dimensions of AI use motives, which showed initial effectiveness of the course.

2. Recommendations

It is suggested that future course design should strengthen learning activities related to intrinsic value and utility value to improve overall motivation. In teaching, more long-term and cross-disciplinary learning contexts should be added to deepen students' overall attitudes toward AI. In addition, future studies should increase the sample size and use longitudinal design to improve the generalizability and external validity of the results.

References

Bawden, D. (2008). Origins and concepts of digital literacy. *Digital Literacies: Concepts, Policies and Practices, 30*, 17–32.

Fetzer, J. H. (1990). What is artificial intelligence? In *Artificial intelligence: Its scope and limits* (pp. 3-27). Dordrecht: Springer Netherlands.

Fortus, D., Dershimer, R. C., Krajcik, J., Marx, R. W., & Mamlok-Naaman, R. (2004). Design-based science and student learning. *Journal of Research in Science Teaching, 41*(10), 1081-1110.

Trinter, C. P., Moon, T. R., & Brighton, C. M. (2015). Characteristics of students' mathematical promise when engaging with problem-based learning units in primary classrooms. *Journal of Advanced Academics*, *26*(1), 24–58.

Kim, S., Jang, Y., Kim, W., Choi, S., Jung, H., Kim, S., & Kim, H. (2021, May). Why and what to teach: AI curriculum for elementary school. In *proceedings of the AAAI Conference on Artificial Intelligence* (Vol. 35, No. 17, pp. 15569-15576).

Long, D., & Magerko, B. (2020, April). What is AI literacy? Competencies and design considerations. In *Proceedings of the 2020 CHI conference on human factors in computing systems* (pp. 1-16).

Russell, S. J., & Norvig, P. (2016). *Artificial intelligence: a modern approach*. London: Pearson.

Schank, R. C. (1987). What is AI, anyway? *AI magazine, 8*(4), 59-59.

Schepman, A., & Rodway, P. (2020). Initial validation of the general attitudes towards Artificial Intelligence Scale. *Computers in human behavior reports, 1*, 100014.

Touretzky, D., Gardner-McCune, C., Martin, F., & Seehorn, D. (2019, July). Envisioning AI for K-12: What should every child know about AI?. In *Proceedings of the AAAI conference on artificial intelligence* (Vol. 33, No. 01, pp. 9795-9799).

Yue, M., Jong, M. S. Y., Dai, Y., & Lau, W. W. F. (2025). Students as AI literate designers: a pedagogical framework for learning and teaching AI literacy in elementary education. *Jounal of Research on Technology in Education*, 1-22.

Yurt, E. & Kasarci, I. (2024). A Questionnaire of Artificial Intelligence Use Motives: A contribution to investigating the connection between AI and motivation. *International Journal of Technology in Education (IJTE), 7*(2), 308-325.

指導單位：國家科學及技術委員會
主辦單位：國立臺北教育大學資訊科學系｜中華資訊與科技教育學會 **承辦單位**：國立臺北教育大學資訊科學系｜中華資訊與科技教育學會
協辦單位：國立臺北教育大學人工智慧產學發展中心｜國立政治大學資訊科學系｜國立臺北教育大學課程與教學傳播科技研究所
台灣教育傳播暨科技學會｜碩陽數位科技有限公司
國家科學及技術委員會補助