

AI Curriculum Design for Korea K-12 AI Education Through Analyzing AI Education Curriculum

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Abstract: This paper deals with the curriculum design of Korean K-12 AI education. AI is the core technology of the 4th wave, and its impact is broad and strong. Therefore, every country has a robust nurturing system for AI talent. However, there are few materials available about curriculum design and operational experience documentation because AI has been an area of interest since 2016, and its educational applications are relatively new. In Korea, a program for teacher manpower education was initiated in 2020. Therefore, there is a lack of manpower with experience in designing and operating the K-12 AI curriculum. The AI curriculum is a core parameter for AI manpower. Therefore, AI-advanced countries are attempting to develop AI education methods. This paper analyses the K-12 AI curricula of advanced countries and then designs and suggests Korea's K-12 AI curriculum.

Keywords: Computer Education, AI, AI Curriculum, K-12, AI Education.

I. INTRODUCTION

Many countries have special AI policies to have an initiative because AI and related technologies impact everywhere [35, 37]. Chat GPT has been released, and its influence is increasing in many areas, such as industry, education, coding technology literature, etc., and some analyzers describe its impact as the steam engine industrial revolution of the 1700s [1, 2]. ChatGPT utilises basic reinforcement learning and RLHF (Reinforcement Learning with Human Feedback) in deep learning. Students can use it only when they have a good understanding of AI structure and development. Therefore, they have had a policy to introduce AI into education since 2016. At that time, DeepMind won against humans at matching play Go (Baduck) [3]. However, most countries do not have a policy to introduce AI education into their education program.

Humans have been implementing AI using logical and mathematical methods [4], and they have tried inference for AI using fuzzy since 1965 [5]. There are many tools, such as PSO (Particle Swarm Optimal), BF (Bacterial Foraging),

and ANIS (Artificial Immune System), for obtaining the optimal solution as one AI [6, 7, 8]. Still, they lack widespread interest due to their limited application. Many are interested in machine learning and deep learning, but these tools are one of many AI areas, as mentioned [9]. The education method, curriculum, and teaching method for K-12 are pretty crucial because AI areas are vast, and implementation methods depend on the curriculum and the teacher's AI thinking method [10-13]. Most countries, including South Korea, lack experts with experience in AI education in the K-12 sector. K-12 education is not a developing area for high technology; it is education for the AI of K12. It is one stage to provide manpower education for high-technology development. It is essential to teach because when we build a good AI curriculum, students can have interests (or motivation) and select this topic to study. Therefore, it is essential to have an experience through education [14-16]. There are two kinds to link with AI. The first one is to manage and operate in the education area. It involves document writing, a hobby of students, and statistics about educational operations. The second one is directly aimed at teaching AI, including coding, AI thinking, applications, economic impact, and job patterns, to prepare students for their future. Therefore, there are many subjects to teach, and one needs a lot of experience. In the case of South Korea, they began to nurture AI teaching in 2020. It means they do not have much time for a correct curriculum for AI teaching in the K-12 site [17][18]. Some teachers started to learn AI in 2019 at the master's course of the university, and they are publishing some papers to finish their course [19-22, 27-29]. This paper aims to develop a curriculum design method for Korean K-12 AI education based on the know-how obtained through long-term AI teaching experience at a university. This paper also provides several materials for the K-12 curriculum design.

II. SUMMARY OF AI EDUCATION HISTORY

Many areas, such as information technology, game theory, computer programming, and computer science, have long influenced AI education and development. It began in 1943 at the Dartmouth conference, and many game companies have been studying games using AI (machine learning). The most significant event was the AlphaGo accident with humans (Lee, Se-Dol) in 2016 [3] and the Litribus AI tool of AI team of Carnegie Melon University, in 2017, won at game matching completely in 2017. Figure 1 illustrates the history of AI and games, while Figure 2 represents the impact of information technology on the vast network of AI.

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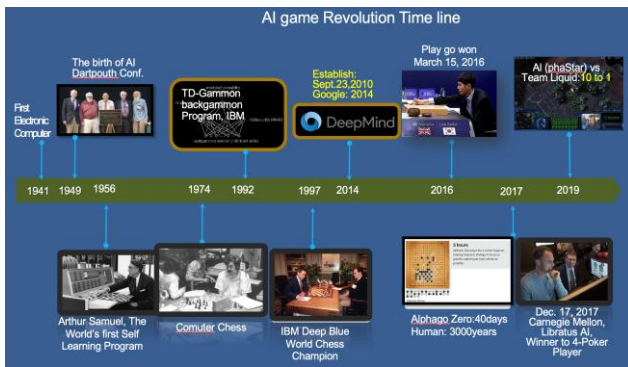


Figure 1. The history of AI and games [30, 31]

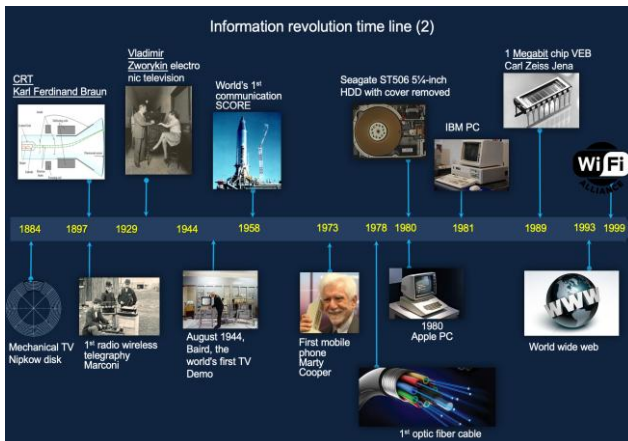


Figure 2. The history of information for AI [32, 33]

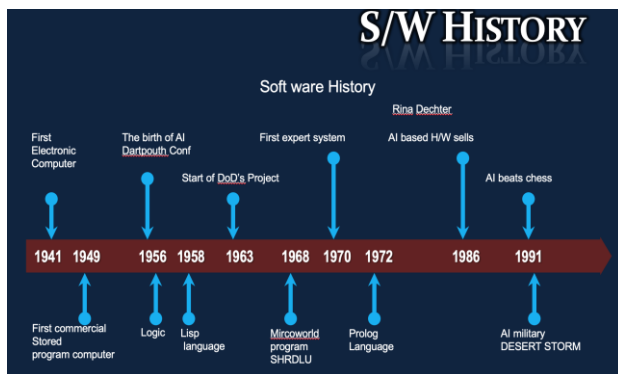


Figure 3. The History of AI S/W [34, 35]

With this mega network, the technology of current AI was developed. This history can differ depending on a person's opinion. Figure 3 illustrates the S/W development history. The influence of Python and PyTorch on AI history.

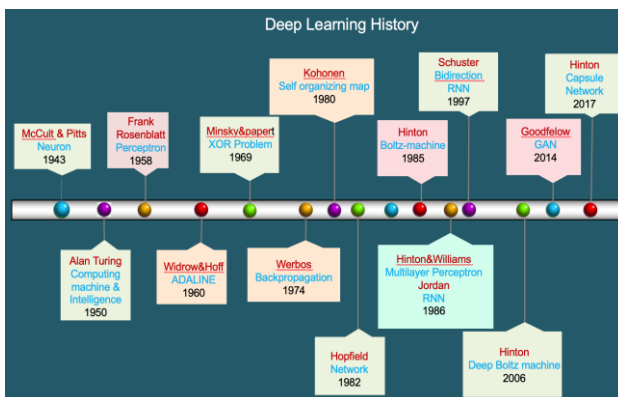


Figure 4. The History of Deep Learning [34, 36, 37]

Figure 4 illustrates the history of deep learning development. Many AI theories have been developed, such as RNN, GAN, and others.

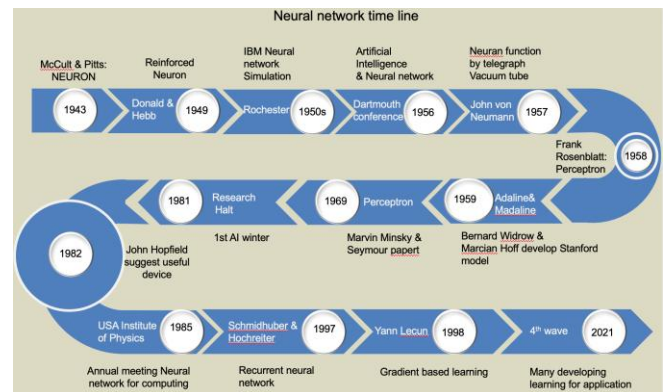


Figure 5. The History of Neural Networks

Figure 5 shows the history of deep learning. Deep learning has an overlapping history with neural network structure because it originated from neural networks. Figure 6 summarises Figures 3, 4, and 5. AI has two winter seasons. The first is 1974-1980, and the second is 1987-1993. During these seasons, many researchers thought that AI was not helpful. However, the ReLU function was developed, and its application has since increased rapidly.

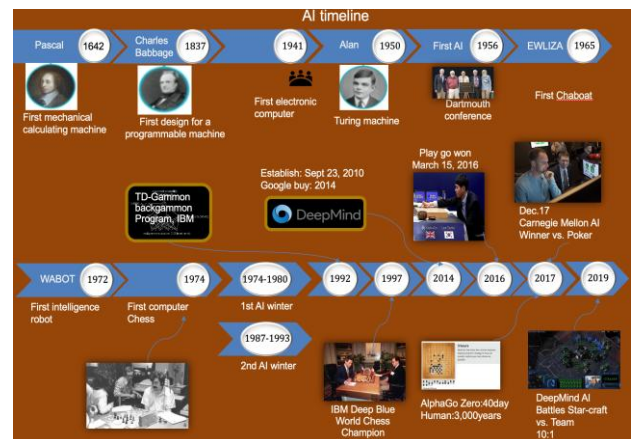


Figure 6. The History of AI

III. ANALYSIS OF AI EDUCATION

Many have been interested in AI for a long time. However, as of 2018, most countries had implemented a policy. China introduced AI education for K-12 in 2018. Other countries have been concerned about AI education for K-12 since 2019 [24]. Therefore, there are very few materials for K-12 AI education and curriculum design. Ref. [25] illustrates the curriculum for the level of K-12. The general level and the exceptional level show it. Ref. reports on ETRI in S. Korea and shows effective AI education. References are presented from the USA, China, the UK, and Japan; however, this discussion is not specifically focused on AI education. Ref. describes the EU AI education curriculum.

Level	Unit	Topics	Tool	Hours	Weeks	Project
FIRST YEAR	1	AI Introduction	Google Slides	4	2	Web search real AI application
	2	App Inventor tutorial		8	4	-
	3	Perception and Actuation		6	3	The School Path Guide I
	4	Representation and reasoning	App Inventor	8	4	The School Path Guide II
	5	Learning		8	4	Capture I I
	6	Collective Intelligence		4	2	Capture II II
	6	Sustainability, ethics and legal aspects	Genial.ly	4	2	Myths & Truths
		Total		42	21	
	7	Perception and Actuation (IR-motors-encoders)	Robobo & Scratch	6	3	Open-ended movement
	8	Perception and Actuation (orientation-camera)		6	3	Color search and collect
SECOND YEAR	9	Natural interaction (screen, speaker)	Robobo pet	8	4	AI tutoring systems
	10	Human-robot interaction (Impact of AI)	Podcast	2	1	
		Total		22	11	
		TOTAL		64	32	
	11	Python fundamentals		10	5	-
	12	Transition from Scratch to Python	Robobo & Python	8	4	TUT & TUB
	13	Advanced perception & machine learning		8	4	Recycling
	14	Reinforcement Learning		8	4	Coverage with Q-learning
	15	Representation & Reasoning		10	5	Path Planning
	15	Motivation (Impact of AI)	Canva	4	2	Artificial General Intelligence
		Total		48	24	
	16	Home Assistant Tutorial	Home Assistant	4	2	-
Smart Environments	17	Ambient Intelligence	Home Assistant & Python	8	4	Classroom automation
	17	Smart Environments (Impact of AI)	Thinglink	4	2	Sustainable Development Goals
		Total		16	8	
		TOTAL		64	32	

Figure 7 (a). The Curriculum Structure of Reference

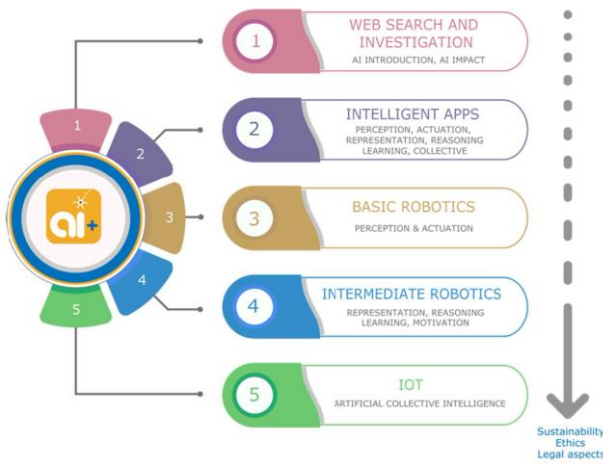


Figure 7 (b). The Application Curriculum Structure of Reference

Figure (7a) is described in detail in Units 1-17. Figure 7b introduces application areas for AI curriculum design. Ref. illustrates the K-12 curriculum of the UK, Poland, Israel, and New Zealand. Ref. describes the kindergarten curriculum. Ref. shows an AI curriculum example from the CSTA (Computer Science Teachers Association). Ref. introduces AI tools for K-12 education. Ref. describes the characteristics of AI education in the USA, Finland, Australia, and South Korea. The reference provides an overview of AI education, highlighting its impact on the economy and society. Ref. [5] describes the importance of AI education in K-12. Ref. introduces an example of AI education for K-12. Ref. introduces AI software for K-12 education, and Ref. is a paper on AI confusion. Ref. also showcases AI education in kindergarten. Ref. illustrates the core contents for AI education of K-12. Ref. explains why we should teach AI. From these analysis materials, we can see that there was no curriculum for K-12 AI education. Therefore, we must develop a curriculum for our AI education that combines both experience and study.

IV. AI AND EDUCATION

There are two kinds of AI and education. The first is to utilise AI as a complement to traditional education, and the second is to teach AI technology and its applications. Many small works include management, homework, quiz assignments, and student credit statistics for class operation

and teaching activities. We can use AI tools for those activities. For those, the UNESCO report suggests AWS, Bidu, Easy DL, TensorFlow, IBM Watson, and Azure. The second AI education includes AI basics, principles, applications, coding, and other related topics. For those, we must design a good AI curriculum.

Table I: UNESCO AI Curriculum Areas.

Category	Topic area	Competency and Curriculum Considerations
AI foundations	Algorithms and Programming	Together with data literacy, algorithms and programming can be viewed as the basis of technical management with AI.
	Data literacy	A major of AI applications run on big data. Managing the data cycle from collection to cleaning, labelling, analysis and reporting forms one of the foundations for technical engagement with using and/or developing AI. An understanding of data and its functions can also help students understand the causes of some of the ethical and logistical challenges with AI and its role in society.
	Contextual problem-solving	AI is often framed as a potential solution to business-related or social challenges. Engaging at this level requires a framework for problem-solving in context, encompassing elements such as design thinking and project management. t-based learning
Ethics and social impact	The ethics of AI	Regardless of technical expertise, students in future societies will engage with AI in their personal and professional lives – many do so from a young age already. It will be essential for every citizen to understand the ethical challenges of AI and the avenues for redress in cases of unethical or illegal AI use, such as instances that contain harmful bias or violate privacy rights.
	The social or societal implications of AI	The social impacts of AI range from requiring adjustments to legal frameworks for liability to inspiring transformations of the workforce. Survey respondents were asked about the extent to which their curricula targeted these issues. Trends such as workforce displacement, changes to legal frameworks, and the creation of new governance mechanisms were given as examples.

	Applications of AI to domains other than ICT	AI has a wide range of applications outside of computer science. The survey asked participants whether and to what extent AI applications in other domains were considered. Art, music, social studies, science and health were given as examples.			which can lead to support for policies that restrict how firms can utilise AI. [17] [38]
	Understanding and using AI techniques	This area included (1) the extent to which theoretical understandings of AI processes were developed (e.g. defining or demonstrating patterns, or labelling parts of a machine learning model); and (2) the extent to which students used existing AI algorithms to produce outputs (e.g. training a classifier). Machine learning, including supervised and unsupervised learning, reinforcement learning, deep learning, and neural networks, was presented as examples of AI techniques.	Data and AI	Data accessibility	. Relevant federal agencies should support the development of shared pools of high-quality, application-specific training and validation data in key areas of public interest, such as agriculture, education, healthcare, public safety and law enforcement, and transportation. [17] [38]
	Understanding and using AI technologies	AI technologies are often human-facing applications which may be offered 'as a service'. NLP and computer vision were given as examples. Respondents were asked about the extent to which learners used existing AI technologies to complete tasks of projects, and/or study the processes of creating these technologies.	Data and AI	Data development and trust	. Relevant federal agencies, including the Department of Commerce and the Department of Health and Human Services, should develop and pilot data trusts to facilitate data sharing in specific application areas among academia, businesses, and government agencies. [17] [38]
Understanding, using and developing AI	Understanding and using AI technologies	AI technologies are often human-facing applications which may be offered 'as a service'. NLP and computer vision were given as examples. Respondents were asked about the extent to which learners used existing AI technologies to complete tasks of projects, and/or study the processes of creating these technologies.	Data and AI	Digital transformation	. Federal agencies, such as the Department of Housing and Urban Development (HUD), the Department of Health and Human Services (HHS), the Department of Transportation (DOT), and the Federal Energy Regulatory Commission (FERC), should identify and implement policies that can drive digital transformation in their respective sectors. [17] [38]
	Developing AI technologies	Developing AI technologies involves creating new AI applications that address social challenges or provide innovative services. It is a specialised field that requires knowledge of a range of complex techniques and skills in coding, mathematics (especially statistics), and data science.	Data and AI	Policymakers	Policymakers should consider a range of approaches to encourage the private sector to share data for the public benefit. [17] [38]
			Data and AI	Data open	Congress should pass legislation codifying the federal government's responsibility to publish open data. [17] [38]
			Data and AI	Data poverty	Relevant federal agencies should ensure that data collection efforts emphasise reducing the "data divide" and combating data poverty. [17] [38]
			Data and AI	AI data sharing	Congress should ensure that any national legislation addressing privacy considers the importance of data for the development and use of AI. [17] [38]
			Developing AT talent	Investment in AI	Congress should invest in cultivating AI talent.
			Developing AT talent	AI manpower	Congress should fund and authorise a program at the NSF to provide competitive awards for up to 1,000 academic AI researchers for five years. [17] [38]
			Developing AT talent	Foreigner VISA for AI	Congress should enable more foreign AI talent to work in the United States by increasing the cap on H-1B visas to ensure U.S. firms can hire as much AI talent as they need. [17] [38]
			Developing AT talent	No-barriers	Federal agencies should address barriers that limit the number of students able to take computer science courses at the university level. [17] [38]

Table II (a): USA AI Strategy Report (2018)

Item		Description
National AI strategy	Support key AI organizational inputs	High-value data, AI skills, publicly funded R&D
National AI strategy	Accelerate public-sector adoption of AI, including national security	One of the most straightforward and practical steps the government can take to spur AI progress is to adopt AI in support of its missions rapidly. [17] [38]
National AI strategy	Spur AI development and adoption in industry, including through sector-specific AI strategy	Federal agencies should be charged with developing sector-specific AI strategies to shape their policies affecting these industries in ways that support A. I transformation [17] [38]
National AI strategy	Support digital free trade policies.	Data is at the core of AI, and many nations are enacting policies that restrict cross-border data flows. [17] [38]
National AI strategy	Foster innovation-friendly regulation	If poorly implemented, AI can produce undesirable outcomes [17] [38]
National AI strategy	Provide workers with better tools to manage AI-driven workforce transitions.	AI-enabled automation is expected to increase productivity and per-capita incomes. Still, it will also likely modestly increase the rate of worker displacement,

AI R&D	R&D funding for AI basics	Congress should substantially increase funding for research and development (R&D) in AI, with an emphasis on both basic and applied research.
AI R&D	R&D funding for AI applications	Federal agencies should support R&D for all kinds of AI applications.
AI R&D	Tax-free for AI R&D	Congress should increase the R&D tax credit to keep pace with the tax credits offered by competing countries.

Table II (b) USA AI Strategy Report (2018)

Item	Description
Transforming Government With AI	Community
	Ventur capital
	Spur AI
	The role of the White House
	GSA (General Services administery)
	Defence AI using
	Defence and Industry
	Cross-agency of DoD
	Procurement of DoD
	Relationship of DoD
	AI's new program for the DoD
	AI adoption in the DoD
	AI adoption for National security
	AI Benefits for

Spurring AI Development and Adoption in Industry	National Security	should recognise the benefits of AI to national security.
	Supporting AI adoption	Federal agencies should collaborate with industry to develop strategies for promoting AI adoption in relevant sectors. of the economy
	AI application	The Department of Commerce should establish organisations dedicated to advancing the development of innovative AI applications across various sectors.
	Foster AI	Congress should direct the Economic Development Administration to enable state governments to foster the development of the AI industry.
Ensuring trade policy supports AI	Foster AI	The United States Trade Representative (USTR) should continue to advocate for cross-border data flow protections in all future trade negotiations.
	Intellectual property	USTR should continue to fight source code disclosure requirements that other nations may enact to unfairly disadvantage U.S. firms or exploit their intellectual property.

A. UNESCO K-12 Curriculum

[Table 1](#) shows the contents suggested by UNESCO for the K-12 AI curriculum. This table comprises three primary sections: AI Basics, AI Ethics and Social Issues, and AI Development. Of course, an AI teacher or school should decide the detailed contents or subjects. Finland has a strong education system in K-12, and it fosters competitiveness because teachers can choose their subjects based on their own opinions and ideas. AI education results can vary depending on the teacher's ideas and teaching style (H/W, S/W, and teaching content) because there are few education experts and limited experienced materials.

B. USA AI Curriculum

a. AI education policy

Ref. Joshua New has suggested an idea for teaching as part of the USA AI initiative. He insists that China, France, and the UK have a firm policy for AI education, whereas the USA has a weak policy in this area. He suggests that the USA should establish and implement initiatives for national security (Table 2). Table 2 outlines the need for a national AI policy, AI security, data research and development, and defence AI.

[Table 2](#) © deals with AI regular issues, data, AI applications, and a new law for AI.

b. Discussion about USA AI education

USA describes AI education in the references. In Table 2, they suggest computing, networking, data, algorithms, programming, and AI research and development.

C. Canada AI curriculum

a. The Basic AI curriculum

Canada's AI technology and its capabilities rank among the strongest in the AI area. McGill



University and the University of Toronto have excellent capabilities and infrastructure, thanks to their effective policies and AI education systems. Samsung built its R&D centre in 2018 (https://research.samsung.com/aicenter_toronto).

To understand the Canadian AI system, we must realise the Canadian S&T education system because Canada has an AI education system within the S&T education system [22]. Within this area, AI education has basic content:

- All students can have their digital projects.
- Critically assess how technology works and shapes our world.
- Use technology to improve our world [24].

Table III: Canada AI Education Basic.

Ares	Contents
Programming	Algorithms, Data structures, Modularity, Modelling & Abstraction, Debugging
Computing and Network	H/W & S/W Connected device Troubleshooting Digital connectivity Cyber-security
Data	Storing data, Collecting, Organising, & Visualizing data, Modelling & Interfacing Applications of AI & Machine learning, Data governance
Technology and Society	Social impacts of digital technologies Digital communication Ethics, Safety, & the law Technology & the environment History of technology Technology & Wellbeing
Design	Program design, User design, Visual design, Universal design

b. Discussion about Canada AI education

Table 3 illustrates the basic contents of AI education in Canada [22, 27]. This content includes algorithms, modelling, debugging, and computer networks (hardware and software), as well as digital security. They have strategies such as data saving, data connection, data visualisation, and applications of deep learning and machine learning. Data is crucial for AI, as the system requires it to function effectively.

D. Finland AI Education Curriculum

a. Basic AI curriculum

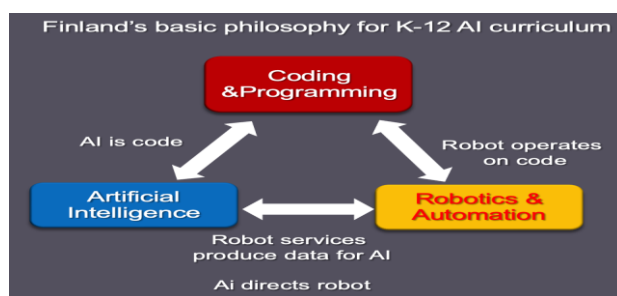


Fig. 8. Finland AI Basic Philosophy.

Figure 8 shows the Finnish AI education concept [26]. They have a basic philosophy centred on AI, coding, and robotics. It is essential to code for AI education and to implement it to achieve AI education results. So, they use robot implementation methods. The AI education stage is a 10-step process that encompasses positive steps, thinking styles, technology, and computational thinking.

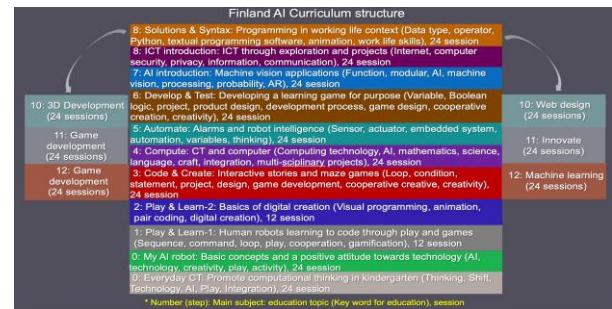


Figure 9. The Structure of Finland AI Education [26]

E. China AI Education Curriculum

China's AI capability, the number of researchers, and technology are at a top level in the world [23, 24]. The AI education at Chain Primary School focuses on real-life applications using a bike robot, traffic signals, AI robots, and Arduino programming. This is intended to provide students with a deeper understanding of AI and offer some motivation for its development. They provide knowledge for Junior high school AI education by a strong strategy [24, 25].



Figure 10. Global AI index [23]

China has an AI roadmap, as illustrated in Figure 11, which extends to 2030. Table 4 shows China AI content for primary and high school [26]. China has an AI education program from kindergarten and uses simple traffic signals, chairs, and desks for AI teaching [24, 25, 26].

However, they do not describe more detailed contents.

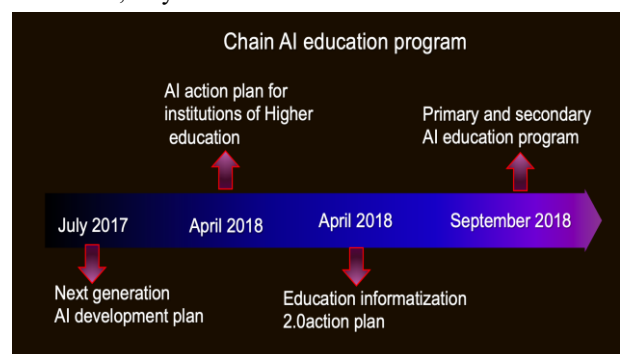


Figure 11. China's AI Education Program for K-12 [24]

In high school, they introduce AI engineering concepts for visual expression, programming, and experience expression. They

teach theory, programming, inference, search engines, logical inference, and knowledge.

Table IV: AI Curriculum of China K-12 (* is This Paper Author's Opinion, not in the Original Curriculum).

Item	Contents	Goals
Pre-school	Unplugged activities for those familiar with robots or intelligent agents	Expression Song, Wake-up Song, Dress-up Song, Small Mirror, Ting-a-Ling, Magazines, Take a Walk in Park, Chairs, Desk, TV, Mom's Couch, My Tiny Closet, Knife, Small Bridge, I Love Guitar, Small Sheep, Fox, Monkey, Tricycle, Red Light Green Light, Greedy Bear Bobby, Monkey goes to School)
Elementary school	Introductory Programming with Scratch and Python	Programs named 'New Friend', 'Twinkling Star', etc., Sensing the surrounding environment with Arduino, Familiar with a variety of robots (e.g., AI Robot, Motorcycle Robot, Traffic Light Robot, etc.)
Middle school	*Understand the working principle of AI algorithms. Conduct preliminary programming	Introduction to AI, Perceptions of AI, Use many sensors, Solve problems through data and algorithms, Python programming (basic and application)
High school	*Working principle of AI algorithms. Conduct mediate programming	Weak AI, AI Ethics, Introduction to NLP, AI Language, Parts of Speech, Natural Language Processing, Word Vectors, Syntax Parsing, Information Extraction, Knowledge Map, Problem Solving, Logic Inference, Expanding Logic Inference, Recognition Framework, Train Decision Tree, Search Engines

Table V: S/W Education (AI Curriculum) of Primary school (Korea).

Category	Grades 1-2	Grades 3-4	Grades 5-6
AI Understanding	AI story (smart robot)	Strong AI Weak AI	Understanding of big data Conceptual understanding of AI Implementation
AI and Data	Various data (video, image, sound, text)	Number guessing with hints	Make aware in a new situation based on the previous data Make a new situation based on the data
AI Algorithm	Classification Finding	Reactions under conditions	Classification by data
AI implementation	AI robot	Machine learning (Classification)	AI-derived artefacts
AI and Impacts	Changing by AI	Commonalities & Differences of human-AI	The fourth industrial revolution AI ethics

V. KOREA AI EDUCATION AND CURRICULUM

A. Why We Must Design an AI Curriculum?

Korea AI curriculum program from September 2020 [27, 28, 29]. So, there was no public school before March 2020. The Korean government recognises the importance of AI education. Therefore, they announced that primary school will be introduced in Sept 2020 for grades 1 and 2 of primary school [28] The vice ministry of education of the South Korean government announced that they will offer an AI education program for primary schools from September

2020, after testing in March 2019 [28]. They also provided an AI education program for high school students from September 2021. The local education office planned an AI education program linked with software education for Primary school and middle school. They plan to provide an advanced AI curriculum for K-12 AI education until 2025. [Table 5:](#) AI education curriculum of primary school. For these educations, the government announced that the plans for the nurture program of AI teachers' master course for schools on Nov. 7, 2019 [29]. Therefore, the teacher's master's degree in AI education is expected to be completed by the end of 2022. It means there is no experience in education and AI curriculum design. [18, 19, 20, 21, 27, 28, 29]. This paper aims to provide a good AI curriculum through AI education and site experiences. It is quite an experience to nurture manpower. Especially, the curriculum design for AI education requires AI education experience for effective teaching as a specialised knowledge area. However, there are still very few people in K-12 with expertise. Herein, we have to provide an AI education curriculum.

B. Analysis for a Good AI Curriculum Design

UNESCO has three core contents:

- AI algorithm and programming with data, data collection, labelling, and analysis, and business and social related AI for K-12 AI education;
- Understanding the ethical challenges of AI for Personal & citizen, social impacts of AI for the workplace, AI applications outside of computer science for frameworks;
- Theoretical understanding of AI, Human-facing applications, and the creation of new AI.

C. K-12 AI Curriculum



Figure 12. Education Philosophy.

As the previous part of this paper described, South Korea started its K-12 AI education program in November 2019, and officially, there were no AI teachers in the K-12 education system. They started the AI teacher's master's program in 2020. It means that there are no experts in the K-12 education site. To address this issue, this paper aims to develop a K-12 AI education curriculum and documentation materials in a Korean style. Essentially, AI education is a program within the K-12 education system. Therefore, it encompasses the fundamental national philosophy and the school's purpose. [Figure 12](#) illustrates the primary purpose of education for these targets. For this purpose, teachers must develop their teaching style through seminars, workshops, and other

professional development opportunities.

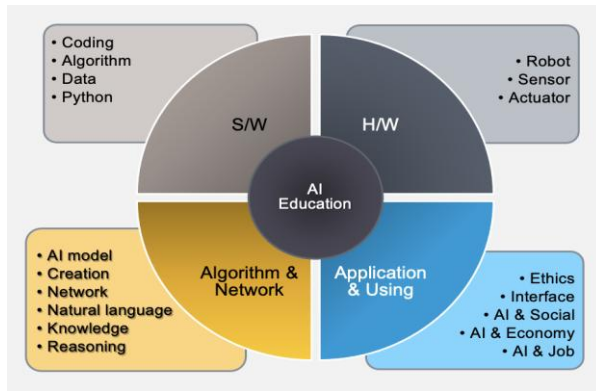


Figure 13. AI Basic Education Contents.

[Figure 13](#) illustrates the fundamental concept of this paper for a K-12 AI education curriculum. This basic idea of the paper is used and written for this purpose. AI is one of the technologies. To use it effectively, we must understand related technologies and literature. [Figure 14](#) illustrates the designed AI curriculum for K-12, including kindergarten.

Table VI: Suggested AI Curriculum for K-12.

Category	Education area	Curriculum Contents
AI foundations	Algorithms and Programming	AI algorithms (machine learning model, training a classifier, Machine learning in general, supervised and unsupervised learning, reinforcement learning, deep learning, and neural networks), AI programming (Loop, Condition, Statement, Modeling/A&Abstract, Debugging), Machining/Deep learning, Pyhton, Pytorch, AI Model, Speech recognition, Image classification, Text recognition, Multi-recognition
AI foundations	Data literacy	AI applications run on big data. Managing the data cycle from collection to cleaning, labelling, developing/using for AI. Understanding of data and its functions, Data ethics, Data for AI and society, Data and Machine Learning.
AI foundations	Contextual problem-solving	AI for the solution to business-related or societal,
AI foundations	Knowledge & Computational thinking	AI-based thinking, Thinking-based AI, Knowledge development for new AI, Inferences and AI, Natural and AI, Smart life, AI and human being mind
Country Philosophy & Ethics	The ethics of AI	Philosophy and Korean culture, AI ethics, AI law and safety, AI and society, ChatGPT and AI, Global society and AI trend
Social & Job	Economy & Job	Technology and Economic Development, Digital Technology and Impact, Technology and Smart Life, AI Technology and Economy, AI and New Jobs/Disappearing Jobs, ChatGPT, Preparing for the Future/J. Oh, Job changing

Social & Job	The social impact of AI	AI and social impact, Job transforming & pattern
Developing & Using AI	Using AI techniques	AI and computer science, AI and industry, AI and data, AI and music, AI and art (Music, Figure, Design, Novel, Story-telling), ChatGPT
Developing & Using AI	Developing AI technologies	Knowledge for the creation of new AI applications AI Knowledge and service for a social challenge, or provide (coding, mathematics, data science, program design, visual design, universal design, user design)

Course	Content	Student Evaluation	Teacher Evaluation
Adult Informal	<ul style="list-style-type: none"> Ethics, culture Application Using method Technology pattern 	Adult	No
University (4-year)	<ul style="list-style-type: none"> Ethics, culture 4th Concept, crisp math. Fuzzy math, Natural society, Computer science, Internet & network, Optimization concept, Robot & AI essential, Economic & High tech, Personal characteristics and work, Science & Engineering, IoT, Data science, Blockchain, Distributed system, Digital money and Economy, Leadership, Science & Technology policy, Technology pattern, Economy & Job & Modern technology, AI application, AI & Data & IoT & Blockchain network technology Technology application, AR/VR Chat GPT using Natural & AI Knowledge & AI 	Student's self evaluation (Test or project)	Student's self evaluation. No evaluation for teacher (prof.)

Figure 14. AI Curriculum for Adult Course.

Course	Content	Student Evaluation	Teacher Evaluation
High school (3-year)	<ul style="list-style-type: none"> Ethics, Culture 4th Concept, crisp math. Fuzzy math, Natural society, Computer science, Internet & network, Optimization concept, Robot & AI basic, Economic & High tech. Personal characteristics and work, Science & Engineering, Data science, Network principle, Distributed system, Network device, IoT society & Job, Leadership, Digital money, VR, AR, Knowledge thinking, Project and Creative 	The level of student's understanding of subject	The level of student's understanding of subject
Middle school (3-year)	<ul style="list-style-type: none"> Ethics, Culture 4th Concept, crisp math. Fuzzy math, Natural society, Computer science, Internet & network, Optimization concept, Robot & AI basic, Economic & High tech. Personal characteristic and work, Data principle, Network principle, Digital money, Knowledge & creative thinking Project 		
Primary Course (6-year)	<ul style="list-style-type: none"> Ethics, Culture, 4th concept, toy-based AI, Tech. & Leadership, AI algorithm, Data, Creative thinking project 		
Kindergarten	<ul style="list-style-type: none"> AI-thinking, Positive tech. Play & Toy based AI learning & Teaching 	play and toy	Evaluation for teacher's playing

Figure 15. AI Curriculum for K-12.

Suggested AI Korea Curriculum structure for K-12	
AI and solution	5: AI & Solutions & Network: AI and society (Safety, Impact), AI and Economy (Job, Impact), Speech and Image recognition, Knowledge and Inference, AI Programming in working life, AI ethics, Data governance, Python, Team multi-disciplinary project, AI and Innovation, Work life skills for Targeted project, and Gap(GPT, Network operation, textual programming software, animation, Web design.)
Deeper AI develop and implementation	8: AI and ICTNetwork: Network and AI, AI robot, AI ethics, ChatGPT, AI and ICT (Internet, computer security, privacy, information, communication, Team multi-disciplinary project and Current AI)
Wide understanding AI	7: AI deep technology: AI category and implementation method, AI ethics, ChatGPT, AR/VR, and MachineDeep learning (Function, modular, AI, machine vision, processing, probability, Team multi-disciplinary project)
AI deep understanding	6: AI and developing: Developing a learning, AI ethics, Knowledge development, and ChatGPT (Variable, Boolean logic, project, product design, development process, game design, cooperative creation, creativity, knowledge development, Team multi-disciplinary project)
AI foundation	5: AI and implementation: AI and intelligent robot, coding (Python and scratch), Knowledge inference, AI ethics, ChatGPT (Sensor, actuator, embedded system, automation, variables, knowledge and creative thinking, Team multi-disciplinary project)
Kindergarten	4: Computing and AI: Computing technology, Coding and AI, AI robot, AI ethics, and ChatGPT (AI, mathematics, science, language, creativity, integration, Knowledge inference, multi-disciplinary projects)
	3: Code & Creative AI: Code AI, game AI, AI ethics, AI speech and recognition, AI and Data, and ChatGPT(Loop, condition, statement, project, design, game development, cooperative and creative.)
	2: Coding & Learn AI: AI basic principle and coding, Code and robot (Smart machine), Data principle and AI, AI and Smart life, AI Ethics, and Chat GPT (Visual programming, animation, coding and playing, digital creation, cooperation, Team multi-disciplinary project)
	1: Play & Coding AI: Human robots and code Introductions through play and games, Data, AI ethics, and Chat GPT (Sequence, command, loop, play, cooperation, animation)
	0: Playing game AI: Basic concepts and creative knowledge, Basic programming, ethics (AI, technology, creativity, play, activity, Useful using)
	0: AI play and Game: Computational & Knowledge thinking, AI definition (Thinking, Technology, AI play, and Cooperation with AI, Ethics and AI)

Figure 16. Designed an AI Curriculum for K-12

VI. CONCLUSION

This paper provides materials and methods for how lecturers can effectively teach students and beginners, drawing on the author's teaching experience. OpenAI released ChatGPT3.5 in December 2021, and they opened ChatGPT4.0 in March 2023. Its impact is profound in education systems, such as K-12. This means that the education system should prepare for the effects of AI on traditional education. Table 6 and Figure 16 show the designed Korean AI education curriculum. Of course, for this design, this paper analysed the previous material. Provides educational material for machine learning and deep learning by using simple tools online. The left column of Figure 16 represents the education level of AI. An AI will have an impact on student and their job. Therefore, the curriculum should prepare them for their lives [37].

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I am the sole author. of the article

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