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Keywords: Digital learning; Information and technology education; Educational policy; Literature review and The National Digital Library of Thesis and Dissertations in Taiwan

Mini Review

The policy development and current situation of information technology education in Taiwan

Min-Ying Tsai*

Department of Special Education, National Pingtung University, Taiwan

***Correspondence:** Min-Ying Tsai, Department of Special Education, National Pingtung University, Taiwan, Email: minying@mail.nptu.edu.tw

Abstract

With the development of science and technology, almost everyone uses 3C (Computer, Communication, and Consumer Electronics) products and can search for information online, play games, chat with others, etc. at any time. Coupled with the impact of the pandemic, school teachers and students cannot go to school and can only use online teaching and distance learning. This requires teachers to quickly learn the relevant knowledge of using information technology for teaching, such as the operation of equipment, online teaching, etc. Establishment of meeting rooms. To this day, the Ministry of Education actively promotes digital teaching in primary and secondary schools based on international trends and domestic policy developments. The paper introduced the policy and current state of the application of educational technology in Taiwan.

Introduction

According to the Ministry of Education [1], 11% of elementary students in grades four through six had a high internet addiction tendency, followed by 14.3% of junior high school students and 12.8% of high school students. It seems that one elementary and secondary school student out of every ten could become addicted to the Internet. However, what's noteworthy is that boys are more likely than girls to have a strong predisposition to use and indulge, and this tendency develops gradually as grades rise which is in line with every survey's global findings [1]. Girls' rates of high internet addiction tendency increased gradually from elementary school to high school, despite the fact that their rates were not higher than those of boys. Therefore, educators need to be concerned about this internet addiction issue, especially for boys.

Regardless of their academic system, students utilize computers and the Internet (94.4% - 99.6% usage rate in the last three months) and own smartphones or tablets (68.7% - 99.0% ownership rate in the past three months) [1]. Regardless of the academic system, the majority of students use the Internet primarily to view videos that have been posted online [1]. Social networking sites are frequently used by middle school and high school students while playing mobile games online is another popular online pastime among elementary school children [1]. Evidently, students use the Internet mostly for pleasure and recreation, as well as to build and maintain relationships with others. Instructors need to help students use digital media for learning in the proper manner, not just for entertainment. The paper introduced the policy and status quo of information and technology education in Taiwan.

The policy about information and technology education

The UNESCO consensus on "Artificial Intelligence and Education" released in 2019 pointed out that an adaptive, fair, diverse, and inclusive learning experience based on artificial intelligence technology can provide everyone with access to high-quality education. Opportunity (cited in [2]. Catalyzed by the epidemic, digital technology has flipped the definition and context of learning and teaching [2]. We should rethink the roles of teachers and students. Therefore, the National Development Council of the Executive Yuan passed the "National Development Plan (110–113 Years), Development Strategy—Digital Innovation, and launched a new economic development model 2.0, of which item (5) is to create a "Digital Country·Smart Island", and the government implemented "The next phase (2021–2025) of the "Digital Country and Innovative Economic Development Plan" will continue to promote digital learning, promote Internet awareness and media literacy of all age

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groups, provide sufficient digital education teachers, and enhance digital accessibility and digital inclusion.

To this end, the Ministry of Education proposed a "digital learning improvement plan for primary and secondary schools," which includes "digital content enrichment," "mobile vehicles and network enhancement," and "education big data analysis [3]." The five goals of the Ministry of Education are to achieve "teaching materials are more vivid," "schoolbags are lighter," "teaching is more diverse," "learning is more effective," and "urban and rural areas are more balanced [3]." In addition to using textbooks and the internet to look for and learn new material, students could also utilize additional software (or applications) to arrange and condense the information. Therefore, the Ministry of Education in Taiwan funded $117 billion to support digital learning for students in first through twelfth grades [4]. Under this concept, every student gets a tablet to help with learning, and teachers create technology- or information-based courses to teach kids how to use tablets for learning.

Digital learning and curriculum development of information and technology education

Digital learning means that students have appropriate digital literacy and can apply digital tools and resources accordingly, utilize learning strategies, and interact with teachers or peers to achieve set learning goals and enhance learning interest [2]. In order to realize a digital learning situation, every student and teacher needs information and communication equipment, networks, digital platforms and tools, learning resources, digital skills, and digital learning specifications and guidelines. There are three types of digital learning, including teachable, collaborative, and autonomous ways [2] as described below. Firstly, instructional digital learning: Teachers plan digital learning mainly based on the learning objectives, tasks, content, methods, evaluation, etc. Students use digital tools or resources to listen, imitate, or practice under the guidance of the teacher to complete the learning tasks according to the steps. For example, based on demonstrations or assignments, students can read texts, practice exercises, and evaluate learning through digital platforms or digital vehicles (such as tablets). For example: Based on demonstrations or assignments, students can read texts, practice exercises, and evaluate learning through digital platforms or digital vehicles (such as tablets).

Next, collaborative digital learning: Students collaborate with teachers, and students participate in learning design. In the learning process, teachers and students become each other's learning partners through questioning, dialogue, supervision, coaching, etc. For example, in open tasks or problems, through digital technology-assisted cooperative learning, students work in groups to discuss, share, interact, and solve problems, and through group self-evaluation and feedback to improve learning effectiveness, etc. Lastly, autonomous digital learning means student-led learning. Students decide on learning topics and problems, set learning goals, strategies, and processes, search and manage resources, select digital tools and platforms according to needs, conduct learning, self-evaluation, and adjustments to achieve the set learning goals.

Instructional digital learning was similar to technology integration in teaching, which is the most common teaching method in Taiwan. In order to promote students' digital learning, the Ministry of Education developed the curriculum syllabus for Information and Technology Education for primary teachers to arrange the relevant curriculum [5]. In primary school, information or technology topics are integrated into learning courses or flexible learning courses in various fields. Teachers followed the curriculum syllabus to design the learning content and focused on learning integration, problem-solving, life connections, and integrated exploration and practice. In addition, teachers also need to be concerned about their cognitive and affective development to inspire their learning interests. The key learning points of curriculum development in technology education are seen in Tables 1, 2, including learning performance and content.

The current state of digital learning in Taiwan

ViewSonic and flipped education investigated the current state of digital learning in Taiwan and found that the rate of information technology integration in teaching reached 65% to 89% in 2020 [6] and the results were as follows: Teachers mentioned that the three main challenges of integrating information technology into teaching were frequently the use of hardware equipment, interactive teaching capabilities, and digital teaching tools [6]. Firstly, concerning hardware equipment, as many as 96% of teachers agree that having handwriting devices is very useful for integrating information technology into teaching; 48% of them believe that classrooms need large-size digital interactive displays to improve the interactivity of classroom teaching; and 44% believe that touch-and-write electronic lecturers are needed. Table and other equipment such as physical projectors, writing tablets, and tablet computers. Currently, classrooms on campus are still dominated by one-way output equipment such as desktop computers (82%), projectors and screens (71%), microphones and amplifiers (58%), and there is a general lack of digital interactive equipment. Nearly 50% of the teachers surveyed said that there are no digital interactive displays in the classroom, and 19% of teachers do not know their uses.

74% of the teachers surveyed believe that improving hardware equipment is the most helpful for digital interactive teaching. When the hardware equipment is well established, teachers can conduct digital interactive teaching in the classroom at any time and naturally accumulate abilities and experience. In addition, 72% of teachers believe that online co-preparation courses and software teaching videos or live courses can effectively help teaching on-site. Secondly, about the usage of digital teaching tools, 89% of teachers use Google Classroom, which is the digital teaching system used by most teachers, followed by myViewBoard at 35%. In addition, when actually conducting digital interactive teaching, 58% of teachers will use Jamboard to obtain instant feedback, followed by Kahoot (47%) and myViewBoard (34%). The teaching site has also been deeply recognized by teachers and has become one of the digital teaching systems commonly used by teachers. In addition to the challenges of hardware equipment, many teachers interviewed also pointed out that students' lack of independent learning ability and motivation are key factors in promoting the development of digital teaching. It's

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Table 1: Learning performance in technology and information education.

Area	Dimension	Third and Fourth grade	Fifth and Sixth-grader
Technology education	Daily technology cognitively	1. To know common technology products 2. To summarize the process of technology development and innovation	1. To state the usage and operation of common technology products 2. To give an example of the reasons for technology development and innovation
	The usage aptitude of daily technology	1. To state the effect of technology on one's daily life 2. To feel an interest in hands-on practice	1. To be aware of the importance of technology in life. 2. To express an interest in hands-on practice and a positive technology attitude.
	The operation skills of daily technology	1. To draw a brief draft to present the idea. 2. To identify the common tools and materials in daily life	1. To make up the framework to present the design idea. 2. To adopt the common tools and materials in daily life
	The integration ability of technology applications	1. To do something based on specific steps 2. To understand the skills of creative thinking 3. To be aware of the importance of cooperatively solving problems.	1. To do hands-on practice based on the design idea. 2. To use the skills of creative thinking 3. To display the ability to cooperatively solve problems
Information education	Computational thinking and problem-solving	1. To learn common information system 2. To understand the process of problem-solving through information technology 3. To know the process of problem-solving through computational thinking	1. To use a common information system 2. To solve the problem through information technology 3. To solve the problem through computational thinking
	Information technology and cooperation to create	1. To learn how to communicate and work together with others using technology.	1. Utilize information technology to exchange ideas or produce things in collaboration with others.
	Information technology and communication	1. To know the communication way in information technology 2. To state the way to arrange the digital information 3. To give an example, share resources through information technology.	1. To interact with others through information technology 2. To use the way to arrange digital information 3. To share learning resources and experiences through information technology.
	Attitude toward the use of information technology	1. To perceive the importance of technology used in daily life 2. To state the healthy habit of using information technology. 3. To understand the importance of information ethics 4. To perceive the fun of learning information technology.	1. To understand the importance of technology used in daily life 2. To establish the healthy habit and attitude of using information technology 3. To follow the rules of information technology and its relative ethics 4. To display a positive attitude toward learning information technology

Table 2: Learning content in technology and information education.

Area	Dimension	Content	Statement
Technology Education	The essence of technology	1. The relation between the technology and daily life.	Technology is used in life for a variety of purposes, such as shelter, food, clothes, transportation, and education. The benefits and drawbacks that technology may offer, including electrical appliances and modes of mobility.
		2. The basic characteristics of technology	The variation and characteristics of daily technology products in different eras, and their effect on human beings.
	Design and construction	1. The basic shaping concept	Ideas can be expressed by modeling, sketching, or discourse, among other basic modeling components, including a larger picture, a floor layout, etc.
		2. The basic shaping and design	To design and create goods, basic creative concepts, stylistic cues, design images, and everyday materials are integrated.
		3. The introduction and experience of tools and materials	Types, applications, and everyday use of typical household items and equipment, such as hammers, wire saws, blades, wooden and plastic boards, etc.
		4. The way to use tools and materials	To design and create items, one can utilize conventional equipment and materials.
	Application of technology	1. The introduction of daily technology products	The classifications, applications, and fundamental functions of commonplace technological devices including gears, levers, wheels, and pulleys.
		2. The way to use daily technology products	Appropriate usage of everyday technological products and security protocols
		3. The basic operation of daily technology products	Basic scientific understanding and the structural principles of everyday technological products. For example, a car's gearbox, a bridge's support, the energy of a lightbulb, etc.
		4. The basic design and manufacturing of technology products	Apply scientific principles, instruments, and materials to the design and manufacture of simple products.
	Technology and society	1. The impact of technology on people and society	The potential impact of technology on individual demands and societal advancement, as well as its advantages and drawbacks. For instance, while transportation increases human potential, it also has negative effects like increased energy usage and pollution.

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		2. The invention and innovation of technology	Examples of technological inventions and innovations at home and abroad and their impact on society
Information education	Algorithm	1. Simple problem-solving representation approach	1. Using a graph or voice recording, explain how to solve basic problems in daily life or at school.
		2. Method for organizing and displaying problem solution sheets.	2. Using structured diagrams (ex, mind mapping or flow charts) to present the procedure of problem-solving and to be understood by others.
	Programming	Introduction and experience with programming tools	Introduction to the operation of graphical programming tools and the use of programs to perform simple tasks such as output, input, and calculations.
		The basic application of programming tools	Basic functions and operations of graphical programming tools, such as using the control panel to connect programs and objects.
	System platform	1. Functional experience with common network equipment, mobile devices, and system platforms 2. Functional applications of common network equipment, mobile devices, and system platforms.	1. Various software and hardware, system platforms, network equipment, and simple functions of mobile devices, such as browsers, computers, mobile vehicles, communication and email software, etc. 2. The operation of various information tools can be applied to study, life, or the completion of digital works.
	Data presentation, processing, and analysis	1. Common digital data storage methods 2. Common digital data types and storage architectures 3. An introduction to a systematic approach to digital data management 4. Systematic digital data management method.	1. Types, storage devices, and storage methods of digital files of text, pictures, images, and sounds 2. The digital data type conversion method converts and processes data through various file formats. 3. Storage, copying, deletion, and management of digital files, including naming, classification, search rules, etc. 4. A systematic way to construct personalized digital data management
	Information technology application	1. The basics of how data-processing software operates 2. Data processing software applications. 3. The basics of how network service tools operate 4. Application of network service tools. 5. Digital learning websites and resources experience 6. Digital learning websites and resources are used.	1. Introduction and functional experience with data processing software, such as documents, graphics, images, audio, presentations, and other software. 2. Apply data processing software to state events, express concepts, and communicate effectively. 3. Introduction and functional experience of online service tools, such as browsers, search engines, online communication software, cloud service platforms, and other tools 4. Apply online service tools to solve problems, communicate, interact, and collaborate to create. 5. Experience with common learning websites and related resources. 6. Use appropriate digital learning online resources to solve problems in daily life and academic studies.
	Information Technology and Human Society	1. An introduction to healthy digital habits 2. The practice of healthy digital habits. 3. An introduction to the principles of fair use of information technology 4. Understanding and application of the principles of fair use of information technology 5. Basic concepts of information security. 6. The relationship between information security and life	1. Appropriate timing, time planning, posture habits, etc. for using technology products 2. Correct ways to use technology products, develop behavioral habits and avoid Internet addiction, Internet bullying, etc. 3. Media literacy, Internet etiquette, Internet copyright, etc. 4. Media literacy, Internet etiquette, Internet copyright, fair use scope, etc. 5. Introduction to information security concepts, such as Internet virus prevention, intellectual property rights, personal data protection, Internet fraud, etc. 6. Personal data protection and privacy, intellectual property rights and laws, etc.

necessary to improve students' ability to operate the digital learning tools automatically and cultivate their willingness to learn actively.

Thirdly, regarding the opinion of digital learning from parents and students, 41% agree that digital teaching can achieve learning outcomes, 40% have no special opinion, and only 19% of parents do not believe that digital teaching can achieve learning outcomes for their children. In terms of learning motivation, 41% of the parents surveyed agreed that digital teaching can improve learning motivation, 36% had no special opinion, and only 16% of parents did not believe that digital teaching could improve their children's learning motivation. Moreover, as many as 87% of the students surveyed believe that teachers using computers or tablets combined with digital content in class are helpful for understanding class content. Currently, the most common digital teaching applications used by teachers are to play slideshows (95%), followed by playing videos (57%), conducting group activities (53%), and answering questions (51%). Consequently, most parents and students have a positive attitude toward digital learning. Therefore, the study tried to analyze the current state of digital learning from primary school to high school based on the National Digital Library of Thesis and Dissertations in Taiwan.

Methods

The study conducted a literature review to understand the

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current state of digital learning in Taiwan. The study searched for the National Digital Library of Thesis and Dissertations in Taiwan based on the keywords, including information, technology, primary school, junior high school, and senior high school. The study first searched for information, technology, and primary school in the National Digital Library of Thesis and Dissertations in Taiwan, and found 225 papers. Secondly, the study searched for information, technology, and junior high school in the National Digital Library of Thesis and Dissertations in Taiwan, and found 117 papers. Lastly, the study searched for information, technology, and high school in the National Digital Library of Thesis and Dissertations in Taiwan, and found 42 papers. The total amount of the relative paper was 411, and all these were master's degrees. Descriptive analysis was conducted to analyze the data based on the publication year, title, academic category, and college, based on the learning phase.

Results

About the publication year in three learning phases

The study found all the theses were proposed from 2000 to 2023. Except that only one paper was proposed in 2000 and three papers were proposed after 2021, the study analyzed the publication year of the theses from primary school to high school in terms of five years. In Table 3, the highest publication amount was between 2001 and 2005 in primary school and junior high school. In addition, the highest publication amount was between 2006 and 2010 in high school. Although the Ministry of Education promoted digital learning in 2021, the research didn't focus on this issue very much between 2021 and 2023.

About the title in three learning phases: From elementary school to high school, information technology was the most prominent title in Table 4, followed by technology integration and finally information technology integration. The words "information technology," "technology integration," "information technology integration," "integrating information technology into teaching," "integrate teaching," and "integrating technology into teaching" were synonymous with "digital learning" from 2000 and 2023. Furthermore, there were 92 papers regarding students and 95 papers about teachers. Moreover, remedial instruction, field teaching, arithmetic, music, physical education, electrical engineering, and nature were among the disciplines that teachers merged with information or technology. It appeared that the majority of educators were using technology or information to instruct pupils in a variety of areas.

Table 3: The results of the publication year in the descriptive analysis.

Number	Year	Primary school	Junior high school	Senior high school	Total
1	2000	0	0	1	1
2	2001-2005	33	13	3	49
3	2006-2010	79	43	10	132
4	2011-2015	72	37	16	125
5	2016-2020	44	18	5	67
6	2021-2023	24	6	7	37
Total	24	252	117	42	411

Table 4: The results of the title in the descriptive analysis.

Number	Title	Primary school	Junior high school	Senior high school	Total
1	Information technology	267	122	44	433
2	Technology integration	234	100	33	367
3	Information technology integration	232	100	33	365
4	Integrating information technology into teaching	163	76	25	264
5	Integrate teaching	97	53	17	167
6	Integrating technology into teaching	90	47	17	154
7	Teacher	67	20	8	95
8	Learning effectiveness (achievement)	41	26	11	78
9	Action research	39	11	2	52
10	Integrating information into teaching	25	16	2	43
11	Student	45	43	4	92
12	Technology acceptance model	21	0	3	24
13	Information literacy	20	0	3	23
14	Use information technology	17	11	0	28
15	Nature and living technology	65	34	0	99
16	Field teaching	16	0	0	16
17	Math	0	13	15	28
18	Music	0	0	2	2
19	Physical education	0	0	2	2
20	Electrical engineering	0	0	4	4
21	Remedial teaching	0	0	2	2
22	Learning attitude	0	9	0	9
	Total	1439	681	227	2347

About the academic category in the three learning phases: Most theses were from the Department of Education in three learning stages, next were from the Department of Computer Science and Department of Engineering in Table 5. In three subjects, all primary school teachers conducted information or technology instruction more than junior high school and senior high school. Moreover, teachers from different learning phases studied different academic subjects.

About the publication universities in three learning phases: In Table 6, there were sixteen private colleges and twenty-four public colleges. Nine universities of education offered sixty-four percent for elementary instruction. Furthermore, three regular universities suggested fifty-six percent for junior high school. It revealed that over half of the papers from junior high and elementary school were from different colleges. The National University of Tainan submitted the most theses, followed by the National Kaohsiung Normal University with the second most and the National Taipei University of Education with the third most. Merely 34% of papers submitted in senior high school came from three regular colleges. Nearly 70% of the papers came from various academic institutions. It seems that an increasing number of university scholars who are not in education are interested in issues related to information or technology education.

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Table 5: The results of the academic category in the descriptive analysis.

Number	Academic category	Primary school	Junior high school	Senior high school	Total
1	Education	174	72	17	263
2	Computer Science	44	21	4	69
3	Engineering Department	28	9	4	41
4	Humanities	14	5	2	21
5	Communication	13	1	2	16
6	Business and Management	10	16	4	30
7	Social and Behavioral Sciences	4	0	1	5
8	People's Livelihood	4	1	2	7
9	Transportation Services	3	0	0	3
10	Art	3	2	2	7
11	Mathematics and Statistics	2	0	7	9
12	Architecture and Urban Planning	2	0	0	2
13	Design	1	0	0	1
14	Social Services	1	0	0	1
15	Natural Sciences	0	4	1	5
16	Life Sciences	0	2	0	2
17	Agricultural Sciences	0	1	0	1
	Total	303	134	46	483

Table 6: The results of the publication universities in the descriptive analysis.

Number	College	Primary school	Junior high school	Senior high school	Total
1	National Taiwan University	0	0	1	1
2	Taipei National University of the Arts	0	2	1	3
3	National Taiwan Normal University	0	20	2	22
4	National Changhua Normal University	0	15	12	27
5	National Kaohsiung Normal University	22	14	3	39
6	National Taiwan University of Science and Technology	0	2	2	4
7	National Taipei University of Technology	0	0	2	2
8	National Yunlin University of Science and Technology	0	0	2	2
9	National Kaohsiung First University of Science and Technology	0	2	0	2
10	Chaoyang University of Technology	0	0	1	1
11	Yu Da University of Science and Technology	0	0	1	1
12	National Pingtung University of Science and Technology	0	0	1	1
13	Shu-Te University	15	3	0	18
14	National Chengchi University	0	0	2	2
15	National Tsing Hua University	0	2	2	4
16	National Chiao Tung University	0	2	1	3
17	National Chung Hsing University	0	0	1	1
18	National Chung Cheng University	0	2	1	3
19	National Sun Yat-sen University	0	0	2	2
20	University of Taipei	10	0	0	10
21	National Taipei University of Education	36	0	1	37
22	National Taichung University of Education	21	2	0	23
23	National Hsinchu University of Education	7	0	0	7
24	National Chiayi University	14	0	2	16
25	National University of Tainan	26	6	0	32
26	National Pingtung University	22	0	0	22
27	National Taitung University	5	0	1	6
28	Soochow University	0	0	1	1
29	Chung Hua University	0	10	0	10
30	I-Shou University	0	4	0	4
31	Ming Chuan University	0	3	0	3
32	Fo Guang University	0	3	0	3
33	Asia University	7	0	0	7
34	Chung Hua University	7	0	0	7
35	Nanhua University	6	0	0	6
36	China University of Technology	5	0	0	5
37	Leader University	0	3	2	5
38	University of Kang Ning	9	0	1	10
39	Dayeh University	9	5	1	15
40	Tamkang University	0	3	0	3
	Total	221	100	46	367

Conclusion

Almost half of the theses related to information and technology issues were proposed between 2000 and 2015. From elementary school to high school, information technology was the most prominent title. From elementary school to high school, almost half of the theses belonged to the education category. The National University of Tainan submitted the most theses, followed by the National Kaohsiung Normal University with the second most and the National Taipei University of Education with the third most. In addition, an increasing number of university scholars who are not in education are interested in issues related to information or technology education. Based on the results of the study, there were not many studies about information and technology from 2021. Apparently, with the promotion of the Ministry of Education, more and more teachers and researchers were encouraged to adopt information and technology into their instruction or studies to enhance students' learning effect and information literature in the future.

To promote digital learning in primary school, both teachers and students need to enhance their digital application skills and add digital media equipment. Until now, the Ministry of Education has invested a lot of money to add digital media equipment. Each student has a platform to assist their learning. Teachers need to explore how to use the tablet to guide students' learning or master the operation of interactive teaching software or hardware equivalents. We look forward to creating a digital learning environment for every teacher and student, making full use of digital tools and platform resources

to enhance the spontaneity, interaction, fun, and effectiveness of teaching and learning, cultivating students' ability to use technology for independent learning, and also using online media to shorten learning gap. What should worry us all together is that when the Internet and digital technologies play a significant role in how kids discover the world, they might spend a lot of time online, interact with social media, and take in and share a lot of information. Media literacy and digital security concerns are educational subjects that should be covered in digital instruction.

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