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Effects of Teachers' Media Utilization and Computational Thinking on Sustainable Development in Early Childhood Education

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Abstract: (1) Background: The study aims to analyze the degree of media use among early childhood teachers and the correlations between their computational thinking, playfulness, creativity, and problem-solving abilities. It confirms a strong correlation between playfulness and problem-solving abilities and investigates whether higher levels of computational thinking are associated with higher levels of playfulness. This research is positioned within the context of sustainable development in early childhood education, emphasizing the importance of integrating digital literacy and computational thinking skills to promote sustainability. (2) Methods: The research was conducted on teachers working in daycare centers and kindergartens in Jeju Island, South Korea. A total of 203 questionnaires were collected, employing descriptive statistics, frequency analysis, Pearson's correlation coefficient analysis, one-way ANOVA, and multiple regression analysis. (3) Results: The study found that teachers' degree of media literacy affects their media use. Additionally, the higher the degree of computational thinking, the more significant the effect on early childhood teachers' playfulness. Furthermore, early childhood teachers' playfulness, creativity, and problem-solving skills were all significantly correlated overall. (4) Conclusions: The findings suggest that if teachers take an interest in IT media and find ways to use it positively, it will have a positive effect on early childhood education. Moreover, increasing computational thinking skills will enable the effective use of various tools, positively impacting teachers' roles. The study proposes that enhancing early childhood teachers' playfulness, creativity, and problem-solving skills will contribute to sustainable development in early childhood education.

Keywords: sustainable development; computational thinking; playfulness; creativity; problem solving

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1. Introduction

With the advancement of artificial intelligence, there has been an increase in productivity through digital utilization, necessitating the future workforce to develop creativity, digital literacy, problem-solving abilities, and skills in collaboration and communication. The importance of computational thinking, which uses AI to efficiently manage and resolve complex problems required by future societies, is increasingly emphasized [1,2]. Additionally, the importance of software is more emphasized than ever, making human creativity crucial for generating necessary knowledge [3,4]. Various efforts are being made in educational settings to use technology and enhance digital capabilities [5–7]. With the advancement of educational technology, teaching media have evolved from visual to audio-visual formats, and with developments in communication and technology, digital and new complex forms of media are being utilized. Traditional analog media are being replaced, converted, or integrated into digital formats, leading to the use of new, computer-centered hybrid teaching media [8]. Media literacy refers to the ability to access, analyze, evaluate,

and create media in various forms. It involves understanding the role of media in society and developing critical thinking skills to interpret the information presented through different media channels.

Play is an essential and overt activity for leading a healthy life for both children and adults, serving as a vital element of human life. Playfulness is a psychological construct that denotes a propensity or attitude that drives behavior, characterized as an individual personality trait evidenced by characteristics or attributes from the environment [9]. Although the concept of playfulness has previously been associated with the term "play", play is used as a specialized experience and can be considered a state of playfulness. Due to the belief that playfulness in childhood disappears in adulthood, serious attention has not been given to adult playfulness, and research on playfulness has mainly focused on infants and children [10,11]. It has been emphasized that playfulness is more important than play itself, existing throughout the entire life cycle and playing a vital role in invigorating life. A person rich in playfulness has been described as someone "who can manage their mind and make any situation fun and enjoyable" [12,13]. Altogether, playfulness acts as an important factor enhancing personal quality of life and positively impacting interpersonal relationships. It is particularly necessary for relieving internal stress and can be viewed as a mental attitude that greatly assists in role-playing.

Teaching creatively refers to the act of teaching where educators operate creatively to expand the latent potentials of learners, involving teachers using their professional instructional skills to make lessons more interesting and efficient. Additionally, teaching creativity implies that early childhood educators creatively conduct their lessons to expand the hidden potentials of young learners during the teaching process. Thus, teaching creatively can be defined as the ability of early childhood educators to contemplate the correct judgment and perception of how to apply traditional teaching and learning methods according to the situation, thereby eliciting creative thinking in children [14].

Problem-solving skills are emphasized as an essential competency crucial for thriving in the era of the Fourth Industrial Revolution, aiming to foster creative individuals by inventing information and values based on new knowledge [15]. The term "problem" is defined in the Korean dictionary as "a question that requires an answer, a matter to be resolved through research". The etymology of "problem" combines "pro" (forward) and "ballein" (to throw), implying "unknown", "wants to know", and "is being solved". Anderson and his colleagues have highlighted the importance of problem-solving across various issues, stating that problem-solving involves exposing young children to various problem situations and helping them navigate solutions. Therefore, the problem-solving process is an exploratory and developmental inquiry that begins when children encounter a question within their experiences, recognizing difficult and ambiguous obstacles. Teachers should therefore assist children in developing divergent thinking to structure their problem-solving experiences [16].

Instructional media have long been used for teaching and learning, offering various approaches in the instructional process and assisting teachers in achieving educational objectives in the classroom. Media provide learners with concrete experiences and influence them to integrate their prior experiences into new learning, thus constructing knowledge. Instructional media are all means that help teachers concretize or supplement explanations in the teaching and learning process, and can be seen as various media that facilitate communication between teachers, students, and learning. Therefore, instructional media, which help restructure learners' knowledge and provide concrete experiences, are essential educational materials in the educational field. The use of instructional media in educational settings is influenced by the advancements in science and technology [17].

Digital media are being utilized in early childhood education for various purposes. They allow users to selectively use content based on their needs and maintain the interest of young children with realistic audio-visual effects and quick responses, thus being used as new learning media [18]. In the early stages of introducing computers into early childhood education, it was believed that computers did not align with the developmental

characteristics of young children and could lead to social isolation, leading to a negative perception of children's computer activities [19]. Digital media have not been introduced into early childhood education settings for long, and as science and technology advance, the introduction of new digital media continues; hence, there is ongoing discussions about their developmental appropriateness for young children. Today, most teachers in early childhood education settings use digital media to conduct activities. The perception of teachers regarding the use of digital media shows not only positive or negative views but also mixed perceptions. However, the use of multimedia is deemed necessary, as it facilitates curiosity and concentration in young children and enhances learning effects. On the other hand, there are concerns regarding whether the educational materials, methods, and content are appropriate for the development of young children [20].

Furthermore, as the integration of digital tools and games for learning purposes in early childhood education becomes increasingly important, recent research by Barman and Kjällander (2022) emphasizes the need for aligning these tools with the curriculum, facilitating meaningful and guided play, and involving both teachers and children in the collaborative design and implementation process to ensure that learning outcomes and playful activities resonate with educational practice [21].

Computational thinking is defined as "thinking like a computer scientist when faced with a problem to solve", and includes "problem-solving based on fundamental concepts of computer science, system design, and understanding human behavior". The concept of computational thinking was first defined and introduced as encompassing these ideas. If humans know what they can do better than computers, and what computers can perform better than them, they can effectively solve problems by leveraging these capabilities. Additionally, knowing the advantages of computing devices and thinking through problem-solving processes is argued to be a fundamental attitude and skill that everyone should possess in the 21st century. Computational thinking is described as a form of analytical thinking that shares mathematical thinking in the general approach to problem-solving, shares engineering thinking in the approach to designing and evaluating large and complex systems that operate within the constraints of the real world, and shares scientific thinking in the approach to understanding human behavior, mind, intelligence, and computability. Additionally, one reason for the spread of computational thinking is that, just as the basic abilities of reading, writing, and arithmetic became widely disseminated and normalized with the advent of printing, computers are now spreading computational thinking today [22].

In this context, during early childhood, software education should naturally occur through play and experiences, and it is anticipated that the development of educational multimedia content and devices for young children, as well as the use of e-learning, will become more active. Children can gain a wide range of learning opportunities through play, interacting with their environment during processes such as problem exploration, selection, and decision making, which are expected to positively impact learning outcomes. Providing systematic experiences that are sequential and interconnected through play from early childhood can enable the organization of computational thinking, and enhance creative and logical thinking abilities during the problem-solving process [23–25]. Therefore, education in the field should involve teaching that enables the learning of computational thinking and problem-solving processes using computational thinking. Teaching creativity acts as a necessary variable in this context. The study can be utilized in teacher education and development in educational settings, and is expected to contribute to improving the learning environment for young children and cultivating talents with the competencies required by future societies. The research questions for the study are as follows:

- RQ 1: Does the degree of media literacy of a teacher affect the degree of media use of a teacher?
- RQ 2: Is there a relationship between early childhood teachers' playfulness, creativity, and problem-solving skills?

- RQ 3: Does the degree of computational thinking affect early childhood teachers' playfulness, creativity, and problem-solving skills?

2. Materials and Methods

2.1. Inspection Tools

Computational thinking ability, adult playfulness scale, teaching creativity, and problem-solving ability test tools were selected to analyze the correlation and influence between the degree of media use and computational thinking ability of early childhood teachers and the playfulness, creativity and problem-solving ability of early childhood teachers. Overall, the reliability of these instruments was confirmed with a Cronbach's alpha of 0.873, indicating high internal consistency. Here is what each inspection tool looks like:

A. Computational Thinking

In the study, we used questions from the Computational Thinking Ability Test, a mock test provided by the Korea Chamber of Commerce and Industry's Qualification Evaluation Project Group, to measure teachers' computational thinking ability. It tests creative solutions and efficient decision-making in daily life based on computational thinking, and measures the ability to design and implement software using educational programming languages at an elementary level. The passing criterion is at least 60 points out of 100, and the duration of the exam is 40 min. The computational thinking test questions include 10 questions and 30 points of computational thinking knowledge (handwritten), which includes 4 sub-items: data and information, information management, problem understanding, and the problem-solving procedure, and the detailed items include 10 sub-items: the concept of data and information, digital representation of data, data sharing technology, information management tools, understanding of the problem, problem analysis and structuring, problem abstraction, the problem-solving process and method, the concept of an algorithm, and the expression of an algorithm.

B. Adult Play Scale

In the study, 25 items of "The Adult Playfulness Scale" were modified and adapted to measure teacher playfulness [12]. Each item on the scale consists of 25 pairs of adjectives, and the answer to the adjective that is closer to the self is answered on a seven-point scale up to the middle score of "moderately". Each adjective scale pair of items was scored with higher scores, and questions 22 and 24 were reverse-scored. Excluding question 16 and the 5 factors, the total score ranges from 22 to 154, and the higher the score, the higher the teacher's playfulness.

C. Faculty Creativity

In the study, the tools for measuring the teaching creativity of early childhood teachers were used based on Urban's model of creativity elements and Cropley's creative teaching test items, and the teaching creativity of early childhood teachers was modified and supplemented by Paik Y. and Kim W. [8]. Teaching creativity measurement tools are broadly divided into cognitive factors and definitional factors. It consists of six sub-factors, including diffuse thinking and behavior, general knowledge and thinking base, knowledge base and skills in a specific area, focusing on performing tasks, motivation, and tolerance of openness and ambiguity, and consists of a total of 35 questions. All items were rated on a five-point Likert scale, and they were rated as "not at all (one point)", "not at all (two points)", "moderate (three points)", "yes (four points)", and "very much (five points)". The higher the score, the higher the teaching creativity.

D. Problem-Solving Ability Scale

The problem-solving ability scale used was an adaptation of the Social Problem Solving Inventory [26]. The problem-solving ability scale consists of a total of 70 items and is divided into two main scales: the Problem Orientation Scale and the Problem-Solving Skill Scale. The Problem-Solving Skill Scale comprises four subscales directly related to

problem solving: defining the problem, generating alternatives, decision making, and implementation checking, with each subscale consisting of 10 items, making a total of 40 items. Table 1 shows the distribution of items by subscale in the Problem-Solving Skill Scale. All items are rated on a five-point scale ranging from "not at all" to "very much so".

Table 1. Demographic characteristics of the study subjects.

Variables	Category	Frequency	Ratio
Age	20–29	96	47.3
	30–39	63	31.0
	40–49	31	15.3
	50 years of age or older	13	6.4
Education	College graduate	129	63.5
	Graduated from a four-year university	70	34.5
	Graduate or higher	4	2.0
Certificate of possession (multiple responses)	Kindergarten teacher level 1	38	
	Kindergarten teacher level 2	107	
	Nursery teacher level 1	92	
	Nursery teacher level 2	91	
Career	Less than 1 year	27	13.3
	1–3 years	57	28.1
	3–5 years	39	19.2
	Over 5 years	80	39.4
The type of organization you work for	Public kindergartens	8	3.9
	Private kindergartens	20	9.9
	Private daycare center	37	18.2
	Corporate daycare center	64	31.5
	Public daycare center	29	14.3
	Workplace daycare center	45	22.2
Class age	1 year old	44	21.7
	2 years old	44	21.7
	3 years old	48	23.6
	4 years old	31	15.3
	5 years old	21	10.3
	etc.	15	7.4
Sum		203	100.0

2.2. Collection of Research Objects and Materials

The study analyzes the impact and correlation of early childhood teachers' computational thinking skills with teachers' playfulness, creativity, and problem-solving skills, and was conducted as a questionnaire for 3 weeks in October and November 2022 among 218 teachers working in daycare centers and kindergartens located in cities A and B. The 203 recovered questionnaires were analyzed using the SPSS 18.0 statistical program for descriptive statistics, frequency analysis, Pearson's correlation coefficient analysis, one-way ANOVA, and multiple regression. The demographic characteristics of the subjects of the study are shown in Table 1.

Of the teachers who participated in the study, 96 (47.3%) were between the ages of 20–29, 63 (31.0%) between the ages of 30–39, 31 (15.3%) between the ages of 40–49, and 13 (4.2%) teachers were over the age of 50. In terms of educational background, 129 students (63.5%) graduated from junior colleges, 70 students (34.5%) graduated from four-year universities, and 4 students (2.0%) graduated from graduate school or higher. A total of 80 (39.4%) had more than 5 years of experience, followed by 27 (13.3%) who had less than 1 year, 57 (28.1%) who had 1–3 years, and 39 (19.2%) who had 3–5 years. The age of the class was 44 (21.7%) 1-year-olds, 44 (21.7%) 2-year-olds, 48 (23.6%) 3-year-olds, 31 (15.3%) 4-year-olds, 21 (10.3%) 5-year-olds, and 15 (7.4%) others.

3. Results

3.1. Degree of Media Utilization by Early Childhood Teachers

If we look at the teachers' usual interest in media, the time spent using media, and the degree of correlation between media use and the director's values, it is shown in Table 2. Regarding the level of interest they usually have in the media, 98 (48.3%) answered that they are "moderate", while 71 (35.3%) answered that they are interested, which is higher than the 34 (16.7%) who said they are not interested. The time spent using media in early childhood education was the highest with 79 people, followed by 74 in the morning, 31 in the afternoon, 12 in the afternoon, and 11 in the same. When asked about the relationship between media use and the director's values, 83 (40.9%) answered "moderately", while 101 (49.8%) thought it had an impact, which was higher than 19 (9.3%) who thought it had no impact.

Table 2. Degree of media utilization by early childhood teachers.

Variables	Category	Frequency	Ratio
Usual media interest	I'm not interested at all	7	3.4
	I'm relatively uninterested	27	13.3
	It's normal	98	48.3
	I'm relatively interested	45	22.2
	I'm very interested	26	12.8
	Sum	203	100.0
Media usage time (Multiple responses)	morning	74	
	afternoon	31	
	It's different from time to time	79	
	similar	11	
	I do not understand	12	
	Sum	207	
The connection between media use and the director's values	There is no effect at all	9	4.4
	It doesn't have an impact	10	4.9
	It's normal	83	40.9
	It tends to have an impact	32	15.8
	It is very influential	69	34.0
	Sum	203	100.0

If we look at the degree of teachers' ability to use teaching media, it is shown in Table 3. In terms of the media used by teachers for teaching and learning, and the media used directly by infants, computers accounted for the largest number of 95 students, followed by Hangul with 26 students, Photoshop with 16 students, digital TV with 67 students, tablet PCs with 34 students, and others with 1 person. The Internet was the most used program with 105 users, followed by PowerPoint with 53, Hangul with 47, others with 25, and Plush with 23. As for how to prepare materials for classes, 102 students found materials on the Internet, 37 students used materials purchased directly or from schools, 17 students used materials distributed by local education offices, 43 students used paid learning sites, and 67 students used their own materials. As for the reasons for using media in class, 77 people used it because it was thought to have an educational effect, followed by 74 people who used it because it was convenient for the class, 50 people who used it because it helped toddlers pay attention, 29 people who used it because there were no other materials, and 9 people who said it was other. The average time spent on a single medium was between 5 and 15 min.

Table 3. Media utilization by early childhood teachers.

Variables	Category	Frequency	Radio
The media used by teachers for teaching and learning and the media used directly by infants (Multiple responses)	hangul	26	
	Photoshop	16	
	computer	95	
	Digital TV	67	
	Tablet PC	34	
	etc.	1	
Commonly used programs for computer media (Multiple responses)	hangul	47	
	PowerPoint	53	
	flash	23	
	Internet	105	
	etc.	25	
How to prepare class materials (Multiple responses)	Use what you bought for yourself or at school	37	
	Obtain resources on the Internet	102	
	Use what is available from your local school board	17	
	Use paid learning sites	43	
Use the medium in class Why use it?	Make your own and use them	67	
	Use it because it is convenient for conducting classes	74	
	I use it because it is thought to have an educational effect	29	
	I use it because there is no other material	50	
	Toddlers use it because they are able to concentrate well	9	
Average one-time use time for media	5 min or less	55	27.1
	5–10 min or less	64	31.5
	10–15 min or less	53	26.1
	15–20 min or more	31	15.3
	Sum	203	100.0

3.2. Correlation between Computational Thinking Skills, Early Childhood Teachers' Playfulness, Creativity, and Problem-Solving Skills

The correlation between early childhood teachers' computational thinking skills and playfulness, creativity, and problem-solving skills is shown in Table 4. The correlation with the computational thinking ability of early childhood teachers did not show significant statistics overall, but the playfulness, creativity, and problem-solving skills of early childhood teachers were statistically significant. Among them, the correlation coefficient between creativity and problem-solving ability was 0.766, which showed a strong correlation, and it was estimated to be a very closely related variable. On the other hand, the correlation coefficient between playfulness and problem-solving ability was 0.458, which is relatively lower than creativity and problem-solving ability, and the correlation coefficient of playfulness and creativity was 0.447, which can be said to be the group of variables with the lowest relevance. Early childhood teachers demonstrated a strong relationship between creativity and problem-solving skills.

When examining the correlation of the sub-factors of computational thinking, playfulness, creativity, and problem-solving ability of early childhood teachers, there was no statistically significant relationship with the problem-solving ability of early childhood teachers, but a statistically significant correlation with some sub-factors of playfulness and creativity of early childhood teachers was found, as shown in Tables 5 and 6. It reads as follows: among the sub-factors of early childhood teachers' computational thinking ability and early childhood teachers' playfulness, spontaneity showed a statistically significant correlation with a significance level of 0.01 to −0.181.

Table 4. Correlation between computational thinking, problem-solving skills scale, playfulness, and creativity.

	Computational Thinking	Problem-Solving Skills Scale	Playfulness	Creativity
Problem-solving skills scale				
Pearson correlation	−0.021			
Significance (both sides)	0.765			
N	203			
Playfulness				
Pearson correlation	−0.109	0.458 **		
Significance (both sides)	0.122	0.000		
N	203	203		
Creativity				
Pearson correlation	0.106	0.766 **	0.447 **	1
Significance (both sides)	0.131	0.000	0.000	
N	203	203	203	203

** $p > 0.01$.

Table 5. Correlation between computational thinking ability and playfulness of early childhood teachers.

	Computational Thinking	Playfulness Whimsy
Playfulness		
Pearson correlation	−0.109	−0.181 **
Significance (both sides)	0.122	0.010
N	203	203

** $p > 0.01$.

Table 6. Correlation between computational thinking ability and creativity of early childhood teachers.

	Creativity in Total	Creativity Knowledge Base and Skills in a Specific Area	Motivation and Motivation (Defining Factor)
Creativity			
Pearson correlation	0.106	0.192 **	0.164 *
Significance (both sides)	0.131	0.006	0.019
N	203	203	203

* $p > 0.05$, ** $p > 0.01$.

In the sub-factors of the computational thinking ability of early childhood teachers and the creativity of early childhood teachers, the knowledge base and skills of specific areas among cognitive factors and motivation among the defining factors showed statistically significant correlations, with significance levels of 0.01 to 0.192 and significance levels of 0.05 to 0.164, respectively.

3.3. Degree of Computational Thinking Ability and the Effect of Early Childhood Teachers' Playfulness, Creativity, and Problem-Solving Skills

As a result of using the questions of the Computational Thinking Ability Test, a mock test provided by the Qualification Evaluation Project Group of the Korea Chamber of Commerce and Industry, the degree of teachers' computational thinking ability was divided into three groups based on grades. Among them, 149 students (72.9%) scored 11–20 points, 29 students (14.3%) scored 21–30 points, and 26 students (12.6%) scored 0–10 points, as shown in Table 7. As a result of the analysis of one-way ANOVA on the playfulness of early childhood teachers according to the degree of computational thinking ability, there was a statistically significant difference from the significance level of 0.05 to F = 3.046 and $p = 0.05$. A score of 0–10 points showed relatively low playfulness

compared to 11–20 points, and 11–20 points showed relatively high playfulness compared to 21–30 points. On the other hand, there was no statistically significant difference in the degree of creativity and problem-solving ability of early childhood teachers according to the degree of computational thinking ability.

Table 7. Analysis of computational thinking ability and playfulness of early childhood teachers (one-way ANOVA).

Computational Thinking Degree	Frequency	Average	Standard Deviation	F (p)	Duncan's Test
0–10 points (a)	26	4.65	0.76		
11–20 points (B)	148	4.73	0.82	3.046 (0.05)	a < b < a > b
21–30 points (C)	29	4.34	0.69		
Sum	203	4.67	0.81		

The regression analysis results for early childhood teachers' computational thinking, playfulness, creativity, and problem-solving abilities indicate that each of these factors has a statistically significant impact on the teachers' computational thinking. However, it is important to clarify that the statistically significant effect described does not imply causation, but rather indicates a correlation between these variables. The degree of computational thinking among early childhood teachers shows a significant difference between groups with higher playfulness levels increased as shown in Table 8. However, the significant differences between groups are smaller for problem-solving abilities and creativity compared to playfulness. The magnitude of the influence of each factor can be compared using the standardized coefficient β. When comparing the influences using the β coefficient, creativity is 0.335, problem-solving ability is 0.201, and playfulness is 0.166. The significant differences in computational thinking among groups are in the order of playfulness, creativity, and problem-solving ability, with playfulness having a relatively greater impact on computational thinking than both problem-solving ability and creativity.

Table 8. Regression analysis of the degree of computational thinking and early childhood teachers' playfulness, creativity, and problem-solving ability.

	B	β	t (p)	Standard Deviation		F (p)	Adj-R^2
				TOL	VIF		
(Constants)	1.792		5.71 *** (0.000)	1.174	2.410		
Problem-solving skills scale	−0.190	-0.201	−1.84 * (0.06)	−0.394	0.013		
Playfulness	−0.108	−0.166	−2.1 ** (0.035)	−0.208	−0.007	4.08 (0.00)	0.008 [a]
Creativity	0.357	0.335	3.08 ** (0.002)	0.129	0.584		

* $p > 0.1$, ** $p > 0.05$, *** $p > 0.01$.

4. Discussion

The study measured the degree of computational thinking, playfulness, creativity, and problem-solving ability among 203 teachers working in daycare centers and kindergartens in cities A and B to analyze the correlation and influence between the degree of media use and computational thinking ability of early childhood teachers and the playfulness, creativity, and problem-solving ability of early childhood teachers.

In terms of the demographic characteristics of the subjects of the study, 96 (47.3%) teachers were 20~29 years old, 63 (31.0%) were 30~39 years old, 31 (15.3%) were 40~49 years old, and 13 teachers (4.2%) were 50 years old or older. In terms of educational background, 129 students (63.5%) graduated from junior colleges, 70 students (34.5%) graduated from four-year universities, and 4 students (2.0%) graduated from graduate school or higher. A total of 80 (39.4%) had more than 5 years of experience, followed by 27 (13.3%) who had less than 1 year, 57 (28.1%) who had 1~3 years, and 39 (19.2%) who had 3~5 years. The age of the class was 44 (21.7%) 1-year-olds, 44 (21.7%) 2-year-olds, 48 (23.6%) 3-year-

olds, 31 (15.3%) 4-year-olds, 21 (10.3%) 5-year-olds, and 15 (7.4%) others. The purpose of the study was to explore the differences in playfulness, creativity, and problem-solving ability of early childhood teachers according to the degree of media use and computational thinking ability of early childhood teachers, and to investigate the correlation between playfulness, creativity, and problem-solving ability of early childhood teachers.

First, when looking at the degree of media literacy of professors, 71 (35%) answered that they were interested in the level of interest they usually have in the media, which is higher than the 34 (16.7%) who answered that they are not interested. The time spent using media in early childhood education varied from time to time, with 79 people showing the highest number of students. When asked about the relationship between media use and the director's values, 101 people (49.8 percent) thought it had an impact, which was higher than 19 people (9.3 percent) who thought it had no influence. Teachers who are usually interested in the media use the media positively when they need it, but they are influenced by the director's values regarding the use of the media. These findings are consistent with Jeong, D. W. [17] , who found that if the information and content required for the teachers' level of personal interest are provided appropriately, it will be possible to reach the level of cooperation by operating education using digital media and producing results of educational value, An Wo. and Jun H. [16] found that public kindergartens had the highest number of environments where computers and monitors could be used at all times, while private daycare centers and other types of facilities were lower than other types of institutions. In terms of the degree of teaching media literacy, the media used by teachers for teaching and learning and the media used directly by infants were computers, with 95 students. The Internet was the most commonly used program for computer media with 105 students, and the Internet was the most popular way to prepare class materials with 102 students. As for the reason for using media in class, it was thought to have an educational effect, and the highest number of students (77) showed that the average time spent using media was between 5 and 15 min. As a medium of instruction, it means that when materials are obtained on the computer via the Internet and the class is conducted for 5 to 15 min, it has an educational effect. The findings align with the research results of An Wo. and Jun H. [16], who found that most of the respondents said that it was necessary for education using smart media, and that the reason was effective class delivery.

Second, if we look at the correlation between early childhood teachers' playfulness, creativity, and problem-solving skills, it is as follows. Overall, there was a beneficial correlation, with creativity and problem-solving being the most closely related, and playfulness and creativity being associated with a lower correlation. Early childhood teachers' playfulness, creativity, and problem-solving skills will influence each other. If we look at the correlation of each sub-factor of early childhood teachers' playfulness, creativity, and problem-solving ability, it is as follows. The playfulness sub-factor spontaneity and problem-solving ability sub-factor decision-making show a high relationship, and the playfulness sub-factor imagination and problem-solving ability sub-factor decision making are shown to have a relatively low relationship. If a teacher has a high level of spontaneous play, it means that the teacher has a high level of decision-making ability in problem-solving skills, which affects the role of the teacher. The findings can be contextualized in the study by Lee M., Kim J. H., and Chung M.-R. [13], which shows that parents' high creative problem-solving skills and playfulness influence their parenting roles. The creativity sub-factor cognitive factors and problem-solving ability sub-factors indicate a high relationship with problem definition, while creativity and the problem-solving ability sub-factor decision-making have a relatively low relationship. The higher the cognitive factor, the lower the creativity sub-factor, and the higher the problem-solving ability. It also means that even if creativity is high, problem-solving skills have a low impact on decision making. The research by Lee, K.H., Lew, K., and Kim, U. [15] contextualizes these findings, showing that the process of solving problems and a higher tendency to manipulate and practice are associated with increased creative ability and propensity. Playfulness sub-factors, playfulness and creativity sub-factors, cognitive factors, diffuse thinking and behavior show a high relationship, and

playfulness sub-factors, spontaneity and creativity sub-factors, defining factors, and concentration and task performance have a relatively low relationship. The higher the playfulness sub-factor, the higher the motivational sub-factor, the higher the cognitive factor, and the higher the diffuse thinking and behavior. In addition, the higher the playfulness sub-factor and spontaneity, the lower the impact on the creativity sub-factor and the defining factor, and the ability to concentrate on the task is lower. The study by Lee Y. J. [9] contextualizes these findings, indicating that higher levels of pleasantness, whimsy, and imagination, coupled with lower spontaneity, have a positive effect on teaching creativity.

Third, when the degree of computational thinking ability was measured, 26 students scored 0~10, 148 students scored 11~20, 29 students scored 21~30, and 11~20 points were the most. Based on these results, as a result of the analysis of the one-way variance on the playfulness of early childhood teachers according to the degree of computational thinking ability, it was found that the higher the degree of computational thinking, the more significant the effect on the playfulness of the early childhood teacher. Greater degrees of computational thinking correspond to higher levels of playfulness in early childhood teachers. These findings can be contextualized in the study by Lee M., Kim J. H., and Chung M.-R. [13], which suggests that early childhood teachers should effectively utilize various tools and equipment necessary for relationships with infants as well as play to promote their computational thinking skills, enabling them to perform their roles effectively and solve problems efficiently in their work.

Teachers with high media usage can utilize more effective and creative educational methods to improve children's learning outcomes. Additionally, teachers' computational thinking and problem-solving skills contribute to providing high-quality education even in complex educational environments. Early childhood educators use various media in designing and implementing educational activities. Digital media can provide diversity in educational materials and promote creative and play-based learning experiences. The level and frequency of media use vary depending on teachers' personal experiences and educational philosophies. Computational thinking is defined as the ability to logically analyze problems and solve them algorithmically. Teachers' media use can enhance computational thinking. For example, activities using coding education or digital games can improve logical thinking and problem-solving skills.

5. Conclusions

The study analyzed the degree of media use among early childhood teachers. It also examined the correlations between computational thinking, playfulness, creativity, and problem-solving abilities, confirming a strong correlation between creativity and problem-solving abilities. Additionally, it analyzed the impact of the degree of computational thinking on early childhood teachers' playfulness, creativity, and problem-solving abilities, concluding that higher levels of computational thinking are associated with higher levels of playfulness among early childhood teachers. Therefore, developing computational thinking enhances early childhood teachers' playfulness. The findings imply that enhancing computational thinking skills can foster playfulness, thereby creating a more engaging learning environment for young children. Promoting creativity in teachers can also improve their problem-solving abilities. These insights are valuable for designing teacher education programs. However, the study has limitations, including a sample limited to specific regions and reliance on self-reported data, which may introduce biases. The cross-sectional design also limits the ability to infer causality. Future research should include a more diverse sample and consider longitudinal or experimental designs to better understand the causal relationships between these variables and validate the current findings.

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