

Importance-Performance Analysis of Early Childhood Teachers' Perceptions of Digital Competence

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Abstract

This study aims to identify strengths and areas for improvement in early childhood teachers' perceived digital competence through importance-performance analysis (IPA) and suggest effective support measures and directions for strengthening their digital competence. To achieve this, the study surveyed 223 early childhood teachers in South Korea and analyzed the importance and performance of digital competence among them. The results showed that in all sub-areas and items of early childhood teachers' digital competence, importance was rated higher than performance, with statistically significant differences across areas. Notably, relatively large gaps were identified in the areas of implementing digital education and creating content, operating a digital education environment, and developing digital expertise. According to the IPA, the distribution of quadrants varied depending on the teachers' digital competence. Acquiring digital information and literacy and cultivating digital citizenship were identified as strengths, while understanding digital education policies and the curriculum emerged as an area requiring priority improvement. The areas of implementing digital education and creating content, operating a digital education environment, and developing digital expertise were identified as requiring long-term improvement, while promoting digital communication and collaboration showed relatively high performance compared to its importance. In other words, teachers recognize digital competence as necessary but feel they have not yet sufficiently developed it. These findings are expected to contribute to the development of efficient and effective teacher training programs and policy directions by suggesting priorities based on the importance and performance of digital competence among early childhood teachers.

Keywords : *Digital Competence, Early Childhood Teachers, Importance-Performance Analysis*

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Introduction

The rapid development of new technologies and artificial intelligence, especially during the COVID-19 pandemic in the 2020s, has led to a rapid digital transformation across all sectors of society including education (Matsieli & Mutula, 2024). In an era of digital transformation, the field of education faces the challenge of appropriately integrating digital technology to improve teaching and learning (Organisation for Economic Co-operation and Development [OECD], 2021;2025).

To address this challenge, international organizations have underscored the significance of strengthening teachers' digital competence for successful digital transformation in education practices. For example, the United Nations Educational, Scientific and Cultural Organization (Claro & Castro-Grau, 2023) emphasizes teachers' ability to select and use appropriate digital technology that enhances students' learning experience, as well as to strategically design meaningful digital learning environment. OECD (2025) also addresses the need to support teachers' pedagogical ability to use digital resources effectively in the classroom, going beyond mere technical proficiency, and suggests continuing professional learning.

Digital competence is a broad and complex concept, but in general, it refers to the ability to use digital technology critically and responsibly, based on knowledge, skills, and attitudes towards digital technology (Vuorikari et al., 2022). The European Commission's Joint Research Centre developed the European Framework for the Digital Competence of Educators (DigCompEdu). DigCompEdu (Redecker, 2017) is a framework for developing educator-specific digital competences in six main digital competence areas: Professional engagement, Digital resources, Teaching and learning, Assessment, Empowering learners, and Facilitating learners' digital competence (Redecker, 2017). UNESCO's (2018) ICT competency framework for teachers defined digital competence, including policy and administrative aspects, across six areas: Understanding ICT in education policy, Curriculum and assessment, Pedagogy, Application of digital skills, Organization and administration, and Teacher professional learning. Additionally, it proposed a three-stage development model: Knowledge acquisition, Knowledge deepening, and Knowledge creation. Similarly, Starkey (2020) reviewed several studies on digital competence and found that teacher digital

competence tends to be defined as generic digital competence, digital teaching competence, and professional digital competence. Although the previous studies have contributed to defining and specifying teacher digital competence, expanding the concept beyond simple technical skills to include pedagogical and curriculum-related expertise, these conceptualizations do not sufficiently reflect the specific context of early childhood education.

As young children are naturally exposed to digital environments from an early age both at home and in educational settings, early childhood education emphasizes the natural use of digital technology in play and daily activities (Lindeman et al., 2021). In the South Korean context, the 2019 revised Nuri curriculum aims for a play-centered curriculum (Ministry of Education & Ministry of Health and Welfare of the Republic of Korea, 2019), with an emphasis on teachers supporting the natural use of digital technology in early childhood play. Therefore, the digital competence of early childhood teachers must reflect the specificity of early childhood education. In early childhood education, teachers' digital competence contributes to providing a more meaningful learning environment for young children by combining digital technology with play and exploration activities, enhancing children's creativity, collaboration and problem-solving skills (Pires Pereira et al., 2021). Accordingly, the role of early childhood educators has expanded to include designing and mediating digital experiences that align with play-based learning, requiring specialized forms of digital competence.

Recent studies have begun to conceptualize teachers' digital competence in the context of early childhood education. Cho & Choi (2022) organized the content of digital competence for early childhood teachers by considering the operation of early childhood-centered curriculum and play support. They conducted a literature analysis, interviews with early childhood teachers and education experts, and a needs analysis with in-service teachers to derive the digital competence of early childhood teachers. Through this process, seven competencies were identified: Understanding digital education policies and the curriculum, Acquiring digital information and literacy, Implementing digital education and creating content, Operating a digital education environment, Promoting digital communication and collaboration, Cultivating digital citizenship, and Developing digital expertise.

With the growing emphasis on teachers' digital competence in response to the changes in teachers' roles, countries worldwide are making policy efforts to systematically enhance teachers' digital competence. OECD (2023) reported on the guidelines for developing teachers' digital competence in 29 countries through its Digital Education Outlook. Consequently, all but two of the responding countries were found to have rules or guidelines in place to develop teachers' digital competence for both pre-service and in-service teachers. In South Korea, in line with this international trend, the Detailed Standards for Acquiring Teacher Certification (Ministry of Education, Republic of Korea, 2023) was revised to include "digital education" as part of teacher qualifications, and teachers' digital literacy and digital competence are now required as essential components (Ministry of Education, Republic of Korea, 2024). The prior research demonstrates the various efforts being made globally to cultivate teachers' digital competence.

As such, countries are creating policies to strengthen teachers' digital competence, and research on curriculum improvements aimed at advancing digital competence continues (Merjovaara et al., 2024; Momdjian et al., 2025; Tomczyk, 2024). However, despite these efforts, Undheim & Ploog (2023), in their study based on Norway's early childhood teachers' curriculum, evaluated that while digital education is emphasized in the official curriculum, its reflection in the actual curriculum documents and its implementation are insufficient.

Despite many previous studies and support for early childhood teachers' digital competence, teachers have reported difficulties in implementing digital practices in the field and expressed that they have not received adequate support (Casillas Martín et al., 2020). Therefore, beyond merely investigating teachers' perceptions of digital competence, systematic analysis of both the perceived importance and the implementation levels of digital competence is necessary. Previous studies have primarily focused on teachers' awareness of their digital competence or training needs, but they have rarely compared the relative perceived importance of different components of digital competence with their perceived performance. This highlights the need for a research approach that bridges the gap between theoretical recognition of digital competence and its practical enactment in educational settings.

Claro et al. (2024) reviewed the literature on in-service teachers' digital competence from

2016 to 2021 and reported that much of the research was conducted in Europe, with limited studies conducted in developing countries and non-Western nations. Notably, research from Asia, including South Korea where a play-centered curriculum is nationally emphasized, has been scarcely represented in the international setting, leaving a critical gap in reflecting diverse educational contexts. Therefore, there is a need for research that captures the regional specificities of early childhood education, so that teachers' digital competence can be understood and supported in a more practical and context-sensitive manner.

Accordingly, this study aims to analyze the South Korean early childhood teachers' perceived importance and performance levels of their digital competence. To this end, this study uses the importance-performance analysis (IPA) method, based on the concept of digital competence that Cho & Choi (2022) developed for early childhood teachers in the South Korean context. IPA does not simply evaluate importance and performance individually but analyzes them simultaneously, allowing for a relative comparison (Ortinou et al., 1989). It is particularly useful for visually identifying areas with high importance but low performance as teachers perceive to set strategic improvement directions (Siniscalchi et al., 2008). It is also useful for analyzing areas requiring urgent improvement, gradual improvement, and areas with current over-support (Ortinou et al., 1989).

Therefore, this study analyzes the differences between perceived importance and performance of early childhood educators' digital competence, with the aim of providing practical directions for improvement in early childhood education. IPA was chosen because it allows for a systematic and visually intuitive identification of priority areas for improvement, offering clear implications for teacher training and educational policy than alternative methods (Chien & Chang, 2023; Kim & Jang, 2025). Addressing the limitations of prior literature that has largely been dominated by European contexts, this study expands the geographical and cultural scope of digital competence research by providing empirical evidence from an East-Asian play-centered early childhood education perspective. Reflecting on these objectives and contributions, the following research questions are proposed.

Research Question 1. How do early childhood teachers' perceptions of the importance of digital competence differ from their perceptions of their performance in early childhood education?

Research Question 2. What does the IPA reveal about early childhood teachers' perceptions of their digital competence?

Method

Participants

This study included 223 early childhood teachers from the metropolitan areas of South Korea, who were responsible for teaching 3-, 4-, and 5-year-old children. Table 1 presents an overview of the participants' demographic characteristics.

Table 1. *Overview of the participants' demographic characteristics* N=223

	Category	n (%)
Age	20s (under 30)	134 (60.1)
	30s (30–39)	70 (31.4)
	40 and over	19 (8.5)
	Subtotal	223 (100.0)
Education	Vocational college graduate	39 (17.5)
	Bachelor's degree	152 (68.2)
	Master's degree or higher	32 (14.3)
	Subtotal	223 (100.0)
Experience	Less than 3 years	73 (32.7)
	3 to less than 5 years	68 (30.5)
	5 to less than 10 years	48 (21.5)
	10 years or more	34 (15.3)
	Subtotal	223 (100.0)
Age group of the class responsible for	3 years old	60 (26.9)
	4 years old	80 (35.9)
	5 years old	83 (37.2)
	Subtotal	223 (100.0)

Measure

To assess the importance and performance of digital competence among early childhood teachers, the digital competence assessment tool for early childhood teachers developed by Cho & Choi (2022) was used. The tool consists of 28 evaluation items across 7 factors, with respondents rating the importance and performance of each item on a 5-point Likert scale. The number of items and the reliability for each area are presented in Table 2.

Table 2. *Questionnaire Items and Reliability by Factors*

Factors	Number of items	Cronbach's α	
		Importance	Performance
1. Understanding digital education policies and the curriculum	3 items	.769	.855
2. Acquiring digital information and literacy	3 items	.778	.797
3. Implementing digital education and creating content	5 items	.859	.878
4. Operating a digital education environment	5 items	.837	.900
5. Promoting digital communication and collaboration	5 items	.866	.897
6. Cultivating digital citizenship	4 items	.820	.877
7. Developing digital expertise	3 items	.825	.900
Total	28 items	.961	.970

Data Collection and Analysis

The survey for this study was conducted online using Google Forms. The participants were fully informed of the purpose and content of the study before they responded to the survey and were only allowed to complete the survey after providing consent. The teachers who agreed to participate in the study were sent a link to the questionnaire via text message, social networking services (SNS), and email. The data collection took place between August 30 and September 20, 2024, with 223 early childhood teachers ultimately completing the survey. Participation in this study was voluntary, and respondents were reassured that their responses

would be kept confidential and anonymous. Efforts were made to minimize risks by ensuring that survey items did not pose any psychological or professional harm.

The collected data were analyzed using SPSS 28.0. The mean and standard deviation of the importance and performance of each of the 7 areas and 28 items were calculated according to the research questions, and a paired sample t-test was conducted to evaluate the difference between the two variables. Subsequently, the IPA was conducted to compare the importance and performance of each area and to place the results in quadrants based on the scores.

Matilla & James (1977) developed IPA as a technique to visually analyze the relationship between the importance and performance of specific attributes. In this study, it was conducted to analyze the perceptions of early childhood teachers' digital competence, and the overall mean scores of importance and performance were used as the cut-off values. Scores above the mean were categorized as “high importance” or “high performance,” while those below the mean were categorized as “low importance” or “low performance.” This procedure follows established practices in IPA research. The results were categorized into four quadrants based on the mean values of importance and performance. The first quadrant (Keep

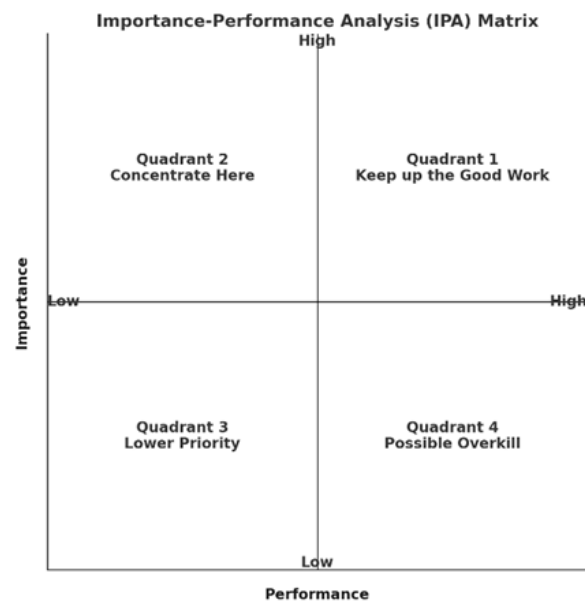


Figure 1. Importance-Performance Analysis Matrix

up the good work) contains areas where both importance and performance are high, indicating elements whose strengths should be maintained. The second quadrant (Concentrate here) includes areas where importance is high but performance is low, highlighting elements that need immediate improvement. The third quadrant (Low priority) represents areas where both importance and performance are low, suggesting elements with relatively lower priority. The fourth quadrant (Possible overkill) contains areas where performance exceeds importance, implying that resource reallocation could be considered. Figure 1 visually represents the IPA matrix.

Results

Differences in the Early Childhood Teachers' Importance- and Performance-Related Perceptions of Early Childhood Language and Literacy Education

This study analyzed the importance and performance of digital competence as perceived by early childhood teachers, and the differences are presented in Table 3. The analysis showed that overall, the importance of digital competence as perceived by the early childhood teachers ($M = 4.24$, $SD = 0.53$) was significantly higher than their performance ($M = 3.79$, $SD = 0.72$), and the difference ($t = 10.73$, $p < .001$) was statistically significant. In all sub-areas, importance ($M = 4.31$ to 4.36) was rated higher than performance ($M = 3.63$ to 4.01), and the differences between each area were statistically significant. In particular, relatively large differences were identified in the areas of implementing digital education and creating content (importance $M = 4.17$, performance $M = 3.71$, $t = 9.32^{***}$), operating a digital education environment (importance $M = 4.23$, performance $M = 3.66$, $t = 10.24^{***}$), and developing digital expertise (importance $M = 4.18$, performance $M = 3.63$, $t = 9.67^{***}$).

In terms of individual items, all 28 items showed a higher perception of importance than performance, and the differences were statistically significant. Specifically, the items with the highest importance ratings among the 28 items were Item 6-4. Complying with digital etiquette and laws ($M = 4.39$, $SD = 0.75$), Item 1-1. Understanding future society and changes

Table 3. *Differences in Early Childhood Teachers' Perceptions of Importance and Performance in Digital Competence N=223*

Factors	Sub-factors	Importance		Performance		<i>t</i>
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
1. Understanding digital education policies and the curriculum	1-1. Understanding future society and changes in education policies.	4.38	0.75	3.75	0.92	9.55***
	1-2. Understanding the characteristics of young children and curricula in future society.	4.29	0.73	3.77	0.85	8.07***
	1-3. Perceiving teachers' digital competence for curriculum implementation.	4.25	0.68	3.82	0.93	7.24***
	Subtotal	4.31	0.60	3.78	0.79	9.91***
2. Acquiring digital information and literacy	2-1. Exploring, searching, and filtering information, data, and digital content.	4.29	0.72	3.94	0.88	5.61***
	2-2. Storing (managing) and utilizing information, data, and digital content.	4.25	0.75	4.00	0.89	4.08***
	2-3. Selecting digital resources for play and activities.	4.26	0.77	3.85	0.90	6.52***
	Subtotal	4.27	0.62	3.93	0.75	6.78***
3. Implementing digital education and creating content	3-1. Utilizing digital tools in the teaching-learning process (play and activities).	4.19	0.74	3.88	0.90	5.25***
	3-2. Developing innovative teaching methods using digital tools.	4.12	0.77	3.48	1.13	8.73***
	3-3. Supporting young children using digital tools.	4.19	0.75	3.83	0.89	5.66***
	3-4. Assessing young children and the curriculum using digital tools.	4.11	0.82	3.67	0.96	6.76***
	3-5. Creating and sharing digital content and educational materials.	4.22	0.78	3.68	1.02	8.11***
	Subtotal	4.17	0.62	3.71	0.81	9.32***
4. Operating a digital education environment	4-1. Finding solutions to technical issues encountered in a digital environment.	4.14	0.80	3.58	1.09	7.75***
	4-2. Establishing a digital environment that supports various teaching methods.	4.23	0.75	3.67	1.01	8.14***
	4-3. Inspecting the digital environment of early childhood education institutions.	4.25	0.74	3.67	1.00	8.10***
	4-4. Creating a digital environment suitable for young children.	4.29	0.72	3.78	0.97	7.81***
	4-5. Providing support to address the digital competence gap among young children.	4.25	0.73	3.63	1.01	8.16***
	Subtotal	4.23	0.58	3.66	0.86	10.24***

Importance-Performance Analysis of Early Childhood Teachers' Perceptions of Digital Competence

Table 3. Differences in Early Childhood Teachers' Perceptions of Importance and Performance in Digital Competence N=223 (continued)

Factors	Sub-factors	Importance		Performance		<i>t</i>
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
5. Promoting digital communication and collaboration	5-1. Promoting communication among educational members using digital tools.	4.21	0.81	3.83	0.96	5.97***
	5-2. Sharing information and digital content.	4.26	0.75	3.93	0.91	5.40***
	5-3. Actively engaging in communication through educational networks and digital platforms.	4.20	0.79	3.75	1.01	6.97***
	5-4. Collaborating and building knowledge through digital tools.	4.12	0.69	3.72	1.00	6.26***
	5-5. Using cloud services to share information and content.	4.12	0.84	3.79	1.12	5.15***
	Subtotal	4.18	0.63	3.80	0.84	7.88***
6. Cultivating digital citizenship	6-1. Protecting basic rights regarding personal information and identity when using digital technology.	4.35	0.72	3.95	0.94	6.45***
	6-2. Managing digital devices and content securely.	4.34	0.68	3.95	0.89	6.60***
	6-3. Recognizing and respecting the importance of digital intellectual property and licenses.	4.36	0.74	3.98	1.00	6.05***
	6-4. Complying with digital etiquette and laws.	4.39	0.75	4.15	0.89	3.82***
	Subtotal	4.36	0.58	4.01	0.80	7.45***
7. Developing digital expertise	7-1. Participating in education and training related to digital technology.	4.24	0.74	3.72	1.08	7.74***
	7-2. Participating in education innovation based on digital technologies.	4.16	0.79	3.59	1.03	8.99***
	7-3. Participating in learning communities for developing digital expertise.	4.14	0.84	3.59	1.16	8.00***
	Subtotal	4.18	0.68	3.63	0.99	9.67***
Total		4.24	0.53	3.79	0.72	10.73***

*** $p < .001$

in education policies ($M = 4.38$, $SD = 0.75$), Item 6-3. Recognizing and respecting the importance of digital intellectual property and licenses ($M = 4.36$, $SD = 0.74$), Item 6-1. Protecting personal information and identity when using digital technology ($M = 4.35$, $SD =$

0.72), and Item 6-2. Managing digital devices and content securely ($M = 4.34$, $SD = 0.68$).

Contrarily, the items with low performance ratings among the 28 items were Item 3-2. Developing innovative teaching methods using digital tools ($M = 3.48$, $SD = 1.13$), Item 4-1. Finding solutions to technical issues encountered in a digital environment ($M = 3.58$, $SD = 1.09$), Item 7-2. Participating in education innovation based on digital technologies ($M = 3.59$, $SD = 1.03$), Item 7-3. Participating in learning communities for developing digital expertise ($M = 3.59$, $SD = 1.16$), and Item 4-5. Providing support to address the digital competence gap among young children ($M = 3.63$, $SD = 1.01$).

Results of the IPA for Early Childhood Teachers' Digital Competence

IPA Analysis by Factors

For the IPA of the early childhood teachers' digital competence, the 7 areas were plotted on quadrants based on the overall average score of 4.24 for importance (Y-axis) and 3.79 for performance (X-axis). The results of the IPA for each area of the early childhood teachers' digital competence are demonstrated in Figure 2.

According to Figure 2, in the first quadrant (Keep up the Good Work), which represents areas where both importance and performance are high, 6. Cultivating digital citizenship and 2. Acquiring digital information and literacy were located. These areas are characterized by high performance, indicating that teachers are already well-equipped in these areas, and efforts to maintain these strengths are needed. Contrarily, in the second quadrant (Concentrate Here), where importance is high but performance is low, 1. Understanding digital education policies and curriculum was located. This suggests that although teachers recognize the importance of this area, the relatively low performance indicates the need for prioritized support and education. In the third quadrant (Low Priority), where both importance and performance are low, and long-term improvement is needed with relatively lower priority, 3. Implementing digital education and creating content, 4. Operating a digital education environment, and 7. Developing digital expertise were located. These areas require efforts for long-term capacity building but are considered to have relatively low urgency. Finally, in the fourth quadrant (Possible Overkill), where performance exceeds importance

and resource reallocation may be considered, 5. Promoting digital communication and collaboration was located. This indicates that while teachers perform well in this area, resources may be overinvested relative to its importance.

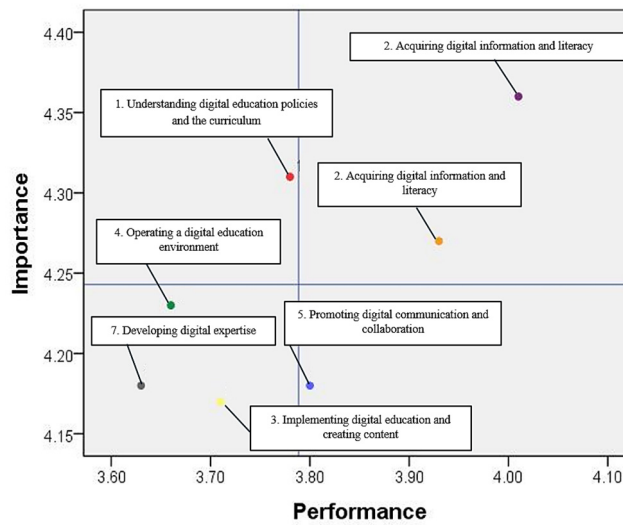


Figure 2. IPA Analysis Results by Factors of Digital Competence

IPA Analysis by Items

Figure 3 demonstrates the results of the item-by-item IPA of the early childhood teachers' digital competence. Based on the analysis of the areas, each item within the respective area was compared for importance and performance and then placed into quadrants.

In the first quadrant (Keep up the Good Work), cultivating digital citizenship (6-1, 6-2, 6-3, 6-4) and acquiring digital information and literacy (2-1, 2-2, 2-3) were located. Also included in this area were promoting digital communication and collaboration (5-2) and perceiving digital competence for curriculum implementation (1-3). In the second quadrant (Concentrate Here), understanding future society and changes in education policies (1-1), understanding the characteristics of young children and curricula in future society (1-2), inspecting the digital environment of early childhood education institutions (4-3), creating a digital environment suitable for young children (4-4), providing support to address the digital

competence gap among young children (4-5), and participating in education and training related to digital technology (7-1) were located. These items showed high importance but low performance, indicating that they require priority improvement and support. In particular, providing support to address the digital competence gap among young children (4-5) showed the lowest performance.

The third quadrant (Low Priority) included developing innovative teaching methods using digital tools (3-2), assessing young children and the curriculum using digital tools (3-4), finding solutions to technical issues (4-1), establishing a digital environment that supports various teaching methods (4-2), participating in education innovation based on digital technologies (7-2), participating in learning communities for developing digital expertise (7-3), collaborating and building knowledge through digital tools (5-4), creating and sharing digital content and educational materials (3-5), and actively engaging in communication through educational networks and digital platforms (5-3).

In the fourth quadrant (Possible Overkill), promoting communication among educational members using digital tools (5-1), using cloud services to share information (5-5), utilizing digital tools in the teaching–learning process (3-1), and supporting young children using digital tools (3-3) were located.

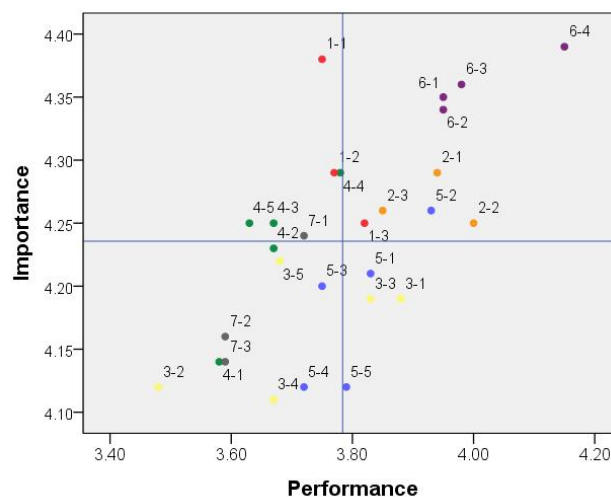


Figure 3. IPA Analysis Results by Items of Digital Competence

Discussion

This study analyzed the differences between the importance and performance of early childhood teachers' digital competence and investigated their perceptions of digital competence through IPA. Consequently, statistically significant differences were obtained in all sub-areas. The IPA of early childhood teachers' digital competence in each area revealed competencies across the first, second, third, and fourth quadrants. Based on these findings, the important points for discussion are summarized as follows.

First, systematic and practical support is required, particularly in areas where a large gap exists between the importance and performance of digital competence as perceived by early childhood teachers. The difference between the importance and performance of the early childhood teachers' digital competence showed statistically significant differences across all domains, aligning with the research by Undheim & Ploog (2023). This indicates that the integration of digital education into actual school curricula is insufficient. In particular, significant differences were observed in the areas of implementing digital education and creating content, operating a digital education environment, and developing digital expertise. The areas of implementing digital education and creating content, as well as operating a digital education environment, are connected to teachers' digital competence in instructional methods that are essential for supporting and expanding children's play and experiences. In the area of implementing digital education and creating content, items such as developing innovative teaching methods using digital tools (3-2) and creating and sharing digital content (3-5) showed the largest differences, highlighting the need for practical support to enable teachers to actively develop and creatively apply digital teaching methods. In the area of operating a digital education environment, the largest differences were observed in items such as providing support to address the digital competence gap among young children (4-5) and finding solutions to technical issues (4-1), which indicates that teachers are facing challenges in reducing the digital accessibility gap among young children and resolving technical issues. In the area of developing digital expertise, the largest differences were found in items such as participating in education innovation based on digital technologies (7-2) and participating in learning communities for developing digital expertise (7-3), which indicates

that while teachers perceive the need for digital technologies and education innovation, they are struggling with actual participation in education innovation due to lack of participation in related training or learning communities.

Second, the results of the IPA highlighted a need for resource reallocation and effective support strategies, focusing on areas where digital competence support for teachers is most urgent. The area of understanding digital education policies and curriculum, located in the second quadrant (Concentrate Here), was identified as the most pressing element requiring improvement. The teachers recognized the importance of understanding future society and changes in education policies (1-1), understanding the characteristics of curricula in future society (1-2), and perceiving their digital competence (1-3), but their implementation levels were low. This indicates that support is needed not only for acquiring technical skills but also for enabling teachers to implement digital education based on a deep understanding of changes in education policies. For teachers to effectively demonstrate digital competence, promoting technical knowledge is essential, along with a background in digital and future education and a philosophical understanding (Daskalaki et al., 2024; Hizam et al., 2021). Considering that early childhood education values the natural use of digital technology in play and daily life (Lindeman et al., 2021), a deep understanding and empathy for the context of digital education implementation is crucial for teachers to meaningfully apply digital education. Therefore, as Falloon (2020) argued, it is necessary to move beyond the traditional technology-focused approach to digital literacy and adopt a more comprehensive approach to teacher education that considers critical thinking, ethical usage, and social impacts within the concept of digital competence.

The areas of implementing digital education and creating content, operating a digital education environment, and developing digital expertise, which were located in the third quadrant (Low Priority), were evaluated as requiring long-term improvement but their priority was not high. In particular, low execution levels were observed in areas such as developing innovative teaching methods using digital tools (3-2), finding solutions to technical issues (4-1), and participating in education innovation (7-2). This shows a lack of training and support needed for teachers to innovatively utilize digital education. In addition, developing innovative teaching methods using digital tools and solving various technical

issues to engage in education innovation requires a long-term approach with clear goals. The area of promoting digital communication and collaboration, located in the fourth quadrant (Possible Overkill), showed a tendency for performance to exceed importance. This suggests that teachers are already performing well in digital communication and collaboration within the digital environment. While teachers' performance levels in this area are already high, a potential for excessive resource allocation remains; thus, implementing support measures that consider resource reallocation is necessary.

Based on the findings, the following conclusions can be drawn. First, applying a comprehensive concept of teachers' digital competence, grounded in understanding digital education policies and the curriculum, is necessary when designing and supporting teacher education programs. In addition to technical competence, areas such as ethical competencies, which involve understanding the impact of digital technology on society and the environment, and professional competencies, which involve ongoing professional development through networks and learning communities, should be integrated through a deeper understanding of digital education policies and the curriculum. To achieve this, a collaborative framework involving the Ministry of Education, universities (for pre-service teacher training), and kindergartens is required to enhance teachers' overall digital competence. Furthermore, to prioritize the development of understanding digital education policies and the curriculum, the mandatory establishment of related core courses and teachers' participation in training programs are recommended. The systematic nature of the importance-performance gaps identified in this study has significant implications for international digital education policy development. The OECD's Digital Education Outlook (2023) reported that 27 out of 29 surveyed countries have established guidelines for developing teachers' digital competence, yet this research demonstrates that policy development alone is insufficient without corresponding implementation strategies and ongoing professional support systems.

To improve the performance levels of teachers, providing practical and systematic training support and systems that account for their level of competence at each stage, by setting short- and long-term goals in areas such as implementing digital education, creating a digital education environment, and developing expertise, is necessary. Various teacher education programs that align with short- and long-term goals should be developed and provided, and

training programs focusing on real-life cases of digital education innovation should be expanded. The operation of learning communities that share research and practical cases related to digital education policies to help continuously develop expertise must also be actively supported. Most importantly, various incentive systems (e.g., certification for training completion and reward systems) are needed to encourage teachers to participate in training and education. Providing a direction for comprehensive digital education from early childhood to middle and high school in education policies, along with integrating and practically supporting the competencies needed for early childhood teachers to use digital tools to support children's play and experiences in diverse everyday contexts, is necessary. The international significance of these findings is amplified by their emergence from South Korea's play-centered early childhood education context, which provides valuable non-Western perspectives often absent from the predominantly European-focused literature. As noted by Claro et al. (2024), research from Asian contexts, particularly those emphasizing play-centered curricula, has been underrepresented in digital competence research. This study addresses that gap while providing insights applicable to other countries implementing similar pedagogical approaches.

This study acknowledges several important limitations that influence the interpretation and generalizability of its findings. The reliance on self-reported data represents a significant methodological constraint extensively documented in educational research literature. Self-report measures are susceptible to various biases including social desirability bias, where participants may overestimate their importance ratings or underestimate their performance gaps to appear more professionally competent. The phenomenon of reference bias, identified in research examining self-regulation measures, may also affect these results, as participants' judgments of their own performance may be influenced by their immediate peer groups and institutional contexts rather than reflecting absolute competence levels.

The regional representativeness of the study presents another significant limitation. Data collection focused exclusively on early childhood teachers from metropolitan areas of South Korea, potentially limiting generalizability to rural contexts, other educational levels, and different national educational systems. Research has shown that digital infrastructure, professional development opportunities, and cultural attitudes toward technology can vary

substantially between urban and rural areas, suggesting that these findings may not fully represent the broader early childhood education landscape.

This study's findings highlight several important directions for future research that could strengthen understanding of digital competence development in early childhood education contexts. The systematic nature of the importance-performance gaps identified suggests that longitudinal research tracking teachers' competence development over time would provide valuable insights into effective intervention strategies and natural progression patterns. The reliance on self-reported data, while providing important insights into teacher perceptions and priorities, represents a methodological limitation that future research should address through mixed-methods approaches that combine observational data, artifact analysis, and outcome measures. Such approaches would strengthen understanding of how perceived competence relates to actual practice and student outcomes.

The regional specificity of this study suggests the need for cross-cultural comparative research that examines how different policy contexts, cultural factors, and educational systems influence digital competence development patterns. Such research would help distinguish universal aspects of digital competence development from context-specific factors and inform more effective international policy development. The early childhood focus of this research also suggests the need for comparative studies across different educational levels to understand how digital competence requirements and development patterns vary according to student developmental stages and curricular emphases. Such research could inform more targeted and effective approaches to professional development across educational systems.

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