International Journal of Educational Studies and Policy (IJESP)

Volume: 6, Issue: 2, November 2025

Evaluating Learning and Innovation Skills of 48–60-Month-Old Children Through a Rubric*

Çiğdem Karakaya Akçadağ[1], Fatma Alisinanoğlu[2]

ABSTRACT

This study aims to evaluate the critical thinking, creativity, communication, and collaboration skills of children aged 48–60 months by using the "Learning and Innovation (4C) Skills Rubric." The research was conducted in independent kindergartens and preschool classrooms located in a district of Maltepe, Istanbul. The study group consisted of 60 preschool children between 48 and 60 months of age. The rubric includes four subskills and is scored across four performance levels. Data were collected by scoring the performances observed during sessions referred to as "Scientifically Based Tasks," where four children participated in each session, lasting approximately 40–45 minutes. The findings revealed that children generally exhibited high levels of performance in Learning and Innovation skills. The highest scores were observed in communication and collaboration skills, while creativity also showed significant development. In contrast, critical thinking skills displayed a more balanced distribution, indicating the need for more structured support. The results demonstrate the usability of the rubric in early childhood education and highlight its value as an effective tool for providing developmental feedback to teachers. Additionally, the findings offer guidance for curriculum development, particularly in enhancing critical thinking skills.

Keywords: 21st century competencies, critical thinking, creativity, communication, collaboration, holistic assessment, early childhood

DOI: https://doi.org/10.63612/ijesp.1683571

Article Info:

Received: 25.04.2025 **Accepted:** 22.07.2025 **Article Type:** Research Article

Cite as: Akçadağ, Ç. K. & Alisinanoğlu, F (2023). Evaluating learning and innovation skills of 48–60-month-old children through a rubric. *International Journal of Educational Studies and Policy, 6*(2), 329-342.

[1]Corresponding Author: Dr. Çiğdem Karakaya Akçadağ, Fatih Sultan Mehmet Vakıf University, Graduate Studies Institute, Istanbul-Türkiye, cigdemk1983@gmail.com ORCID: 0000-0002-6034-3895

[2]Prof. Dr. Fatma Alisinanoğlu, Gazi University, Faculty of Education, Ankara-Türkiye, alisinanf@gmail.com ORCID: 0009-0004-8805-1941

*The article is derived from the doctoral dissertation conducted within the Department of Primary Education at the Graduate School of Education, Fatih Sultan Mehmet Vakıf University

Introduction

Problem Statement

In the 21st century, the competencies expected of individuals are no longer limited to academic knowledge alone; they also encompass complex cognitive and social skills such as learning to learn, creative and critical thinking, effective communication, and collaboration (Partnership for 21st Century Skills [P21], 2019; Trilling & Fadel, 2009). Within this framework, critical thinking, creativity, communication, and collaboration – referred to as the “4Cs”, and defined in the “P21 Learning Framework”- are considered foundational skills essential for individuals’ lifelong learning processes and social adaptation. These “Learning and Innovation Skills” are recognized as key competencies that should be cultivated from early ages within educational systems (Elçi, 2021; Gelen, 2017; Güler, 2023). The emphasis on fostering these skills in early childhood stems from the understanding that this developmental period lays the groundwork for cognitive, linguistic, social, and physical development (Saavedra & Opfer, 2012).

The basic skills acquired during childhood significantly influence an individual’s capacity to cope with future academic demands and challenges. Consequently, many countries have developed educational policies that prioritize the early integration of 21st-century skills into curricula. However, the scarcity of tools that allow for systematic observation and evaluation of these skills in early childhood represents a critical gap in the literature. In preschool education, where development across multiple domains is targeted simultaneously, holistic assessment becomes essential. Unlike traditional methods, holistic assessment aims to evaluate a child's developmental progress in cognitive, social, emotional, and motor domains within an integrated framework (Shepard, 2000). Işıkoğlu Erdoğan and Canbeldek (2017) also emphasize the need for specialized assessment tools tailored to early childhood education, distinct from those used at later educational stages.

Children between the ages of 48 and 60 months undergo rapid cognitive, social, and language development, and the educational support provided during this period has a significant impact on their thinking, communication, and problem-solving skills (Piaget, 1952; Vygotsky, 1978). The objective measurement of these “Learning and Innovation” (4C) Skills -key components of 21st-century competencies- is crucial for offering developmental feedback to teachers and practitioners, enabling them to plan appropriate instructional interventions (Chu et al., 2016; Gelen, 2017). Accordingly, this study descriptively analyzes the current levels of 4C skills among 48-60-month-old children using the “Learning and Innovation (4C) Skills Rubric” developed by the researchers. The purpose of the study is not only to test the applicability of the rubric but also to identify children’s developmental levels in the 4C domains and contribute to the enrichment of educational environments accordingly. In the literature, various methods have been used to assess Learning and Innovation skills (4Cs), including standardized testing, teacher observations, and performance-based assessments (Işıkoğlu Erdoğan & Canbeldek, 2017; Shepard, 2000). However, many of these tools have been developed for older age groups and focus primarily on academic competencies, making them less suitable for capturing the holistic and developmental nature of early childhood learning (Chu et al., 2016; Gelen, 2017). This highlights the need for contextually appropriate assessment instruments that reliably evaluate critical thinking, creativity, communication, and collaboration within early childhood settings (Trilling & Fadel, 2009). The “Learning and Innovation (4C) Skills Rubric” developed in this study aims to fill this gap by providing an assessment tool tailored to the developmental characteristics of children aged 48–60 months.

Research Problem

What are the levels of Learning and Innovation (4C) Skills among 48-60-month-old children attending 2 independent kindergartens and 1 preschool classroom in the Maltepe district of İstanbul?

1. What is the level of children's critical thinking skills?
2. What is the level of children's creativity skills?
3. What is the level of children's communication skills?
4. What is the level of children's collaboration skills?

Method

This study employed a quantitative research design to evaluate the Learning and Innovation Skills of children aged 48-60 months. Using the "Learning and Innovation (4C) Skills Rubric" developed by the researchers, children's performance levels in critical thinking, creativity, communication, and collaboration were assessed through observation. The following sections present detailed information regarding the research design, study group, data collection process, and data analysis methods.

Research Design

This research was structured within the framework of the descriptive survey model, one of the quantitative research methods. This model aims to describe a phenomenon as it exists in its natural context, reflecting conditions observed and identified appropriately (Karasar, 2008). In alignment with this approach, the current study aimed to determine and evaluate the existing levels of Learning and Innovation Skills among children aged 48-60 months through observational methods.

Study Group

The research was conducted in 2 independent kindergartens and 1 preschool classroom located in the Maltepe district of Istanbul, an area that includes a diverse range of socioeconomic profiles. The sample comprised 60 children (34 girls, 26 boys) aged 48–60 months, who were enrolled in these institutions during the 2024-2025 academic year. The participants were selected using a convenience sampling method, as the primary goal of this pilot application was to test the "Learning and Innovation (4C) Skills Rubric" developed for this doctoral dissertation. In line with expert recommendations for scale development, a sample of at least 50 children was deemed adequate for this phase. As the researcher worked in Maltepe, initial invitations were extended to schools where access was feasible. Upon obtaining consent from three institutions, data were collected exclusively from these settings, and no further schools were approached. Participation was based on parental consent and the children's voluntary assent. All children were drawn from different schools and classrooms but represented the same developmental age group.

Data Collection Tool

The data were collected using the "Learning and Innovation (4C) Skills Rubric" developed within the scope of the doctoral dissertation. The performance-based, holistic rubric was designed to assess four core domains of early childhood Learning and Innovation Skills – critical thinking, creativity, communication, and collaboration – across four performance levels. Its initial development involved a comprehensive review of relevant literature, including early childhood education standards, 21st-century skill frameworks, and existing assessment tools. The theoretical foundation of the rubric is grounded in early childhood developmental theory (Piaget, 1952; Vygotsky, 1978) and the 21st-century skills framework (Trilling & Fadel, 2009; Partnership for 21st Century Skills [P21], 2019), which emphasize the role of critical thinking, creativity, communication, and collaboration as core competencies for lifelong learning. In this context, the rubric was shaped by holistic assessment principles (Shepard, 2000) to capture the interplay of these competencies within early childhood settings. An item pool was created, consisting of four indicators for each skill area (e.g., questioning, evaluating different perspectives, problem-solving, and evidence-based reasoning for critical thinking). An example item for critical thinking is: "The child asks questions to understand and investigate the situation", rated from 1 (not observed) to 4 (consistently observed).

The initial version of the rubric was reviewed by 12 experts (early childhood education specialists, child development researchers, and assessment experts) for content and linguistic clarity. The content validity ratio (CVR) values ranged from .67 to 1.00, yielding an overall Content Validity Index (CVI) of .85, indicating strong expert agreement. To assess inter-rater reliability, each child was independently rated by two trained assessors, yielding a Cohen's Kappa coefficient of .88 for the total scale, interpreted as "almost perfect agreement" (Landis & Koch, 1977).

The rubric was implemented within the context of a structured activity (which lasted 40–45 minutes for a group of four children), and it took approximately 10–12 minutes per child to observe and rate their performance across all four domains.

Importantly, the data presented in this study were collected from the same sample used to develop and validate the "Learning and Innovation (4C) Skills Rubric." This approach is common in scale development research, where pilot and validity studies are conducted on the same sample to assess both the psychometric properties of the instrument and its applicability in early childhood settings (DeVellis, 2016).

Data Collection Process

The "Learning and Innovation (4C) Skills Rubric" was completed individually for each child. To facilitate this, a structured activity entitled "Scientifically Based Tasks" was implemented, developed by the researchers. The sessions were conducted in appropriately arranged classroom environments under the guidance of the researcher and were designed to increase children's engagement and participation. Each session was carried out with a group of four children, paying attention to group dynamics, and included the following phases: a warm-up dance to the song *Ali Baba's Farm*, a group discussion on animals and fossils, collaborative fossil prediction and assembly tasks, individual presentations, and a creative drawing activity titled *My Dream Super Animal*.

At each stage, children's critical thinking, communication, collaboration, and creativity skills were elicited and assessed based on their observable performance. The entire process was video recorded. The rubric was later applied by two independent evaluators who observed the video recordings. Each child was assessed individually. In cases where the raters reached a consensus, the agreed-upon score was used; if no consensus was achieved, the final score was determined based on the researcher's observation and professional judgment.

To allow for statistical analysis of the scores, rubric results were categorized using a four-level classification system based on total scores:

- 53–64 points: Excellent (Level 4)
- 41–52 points: Good (Level 3)
- 29–40 points: Developing (Level 2)
- 16–28 points: Inadequate (Level 1)

The same method was also applied to the sub-skills, which each consisted of four items. For these subdomains, scores ranged from a minimum of 4 to a maximum of 16. Accordingly, the classification system was as follows:

- 14–16 points: Excellent

- 11–13 points: Good
- 8–10 points: Developing
- 4–7 points: Inadequate

Data Analysis

The collected data were analysed using descriptive statistics. The rubric scores were categorized based on total points, and the frequency and percentage distributions of children within each classification level were calculated and presented. The analysis revealed the performance levels of children both in terms of their overall Learning and Innovation Skills and across each sub-skill domain. The findings were presented in tabular form, and each table was accompanied by interpretative commentary relevant to the results.

Ethics committee approval process

Ethical approval for this study was obtained from the Fatih Sultan Mehmet Vakıf University Ethics Committee (Approval No: 35/13, Date: 09/05/2024). The ethics application for the study was submitted on 03/05/2024.

Findings

Within the scope of the study, the general and sub-skill scores of each child aged 48–60 months were calculated using the “Learning and Innovation (4C) Skills Rubric”. Based on the ratings of the 16 items included in the rubric, the children's overall skill levels and their performances in the sub-domains of critical thinking (C1), creativity (C2), communication (C3), and collaboration (C4) were determined. The data were classified into four performance levels according to score ranges, and frequency and percentage distributions were calculated for each skill area. Table 1 below presents the performance levels of the children both in the overall 4C domain and in each sub-skill area.

Table 1. Frequency (f) and percentage (%) distributions of children’s scores in the overall “Learning and Innovation (4C) Skills Rubric” and its sub-domains

Skills	**4**				**3**				**2**				**1**			
	f_{Girl}	**f_{Boy}**	**f**	**%**	**f_{Girl}**	**f_{Boy}**	**f**	**%**	**f_{Girl}**	**f_{Boy}**	**f**	**%**	**f_{Girl}**	**f_{Boy}**	**f**	**%**
C1	11	7	**18**	**30**	10	14	**24**	**40**	6	7	**13**	**21.7**	3	2	**5**	**8.3**
C2	15	18	**33**	**55**	9	2	**11**	**18.3**	4	5	**9**	**15**	2	5	**7**	**11.7**
C3	23	17	**40**	**66.7**	5	8	**13**	**21.7**	2	3	**5**	**8.3**	0	2	**2**	**3.3**
C4	19	14	**33**	**55**	4	11	**15**	**25**	6	3	**9**	**15**	1	2	**3**	**5**
Overall 4C Score	**19**	**17**	**36**	**60**	**9**	**7**	**16**	**26.7**	**2**	**4**	**6**	**10**	**0**	**2**	**2**	**3.3**

Table 1 presents the frequency and percentage distributions of the children’s scores based on the overall “Learning and Innovation (4C) Skills Rubric” and each of its sub-dimensions. The data indicate that children generally performed at a high level in the 4C competencies. While 60% of the children achieved the highest score (4), 26.7% scored 3, 10% scored 2, and only 3.3% were rated at level 1. This finding suggests that, overall, the children demonstrated a strong command of Learning and Innovation Skills.

When the sub-skills are examined separately, the highest performance was observed in the communication domain. A notable 66.7% of the children received the highest score in communication, whereas only 3.3% were evaluated at the lowest level. Collaboration was the second strongest area, with 55% of the children rated at level 4, and only 5% at level 1. These results indicate that communication and collaboration skills are highly developed in early childhood and are supported by social interactions and group-based activities.

Similarly, 55% of the children also scored level 4 in creativity, indicating that a significant proportion were able to utilise their creative thinking effectively across various tasks. However, 11.7% of the children scored at level 1, suggesting that there may be notable individual differences in creativity.

In contrast, critical thinking showed a more balanced distribution compared to the other skills. While 30% of the children received a level 4 score in critical thinking, 40% scored 3, 21.7% scored 2, and 8.3% scored 1. This result may reflect the developmental complexity of critical thinking, implying that it requires more structured support to foster.

In terms of gender, girls tended to score higher in communication, collaboration, and overall 4C performance, whereas boys were more likely to achieve the highest score in the creativity domain. This suggests that boys and girls may exhibit different developmental profiles across various skill areas.

Critical Thinking

Critical thinking is a complex cognitive skill that requires intentional support during early childhood. It encompasses higher-order mental functions such as structuring thought processes, reasoning, and generating solutions. In this study, in order to provide a more detailed understanding of children's current levels of critical thinking, performance was evaluated across four sub-components: asking questions, evaluating different perspectives, problem-solving, and evidence-based reasoning. Table 2 below presents the frequency and percentage distributions of scores obtained in each of these sub-skills.

Table 2. Frequency (f) and percentage (%) distributions of children's scores in the critical thinking dimension of the "Learning and Innovation (4C) Skills Rubric"

Critical Thinking	4				3				2				1			
	f_{Girl}	f_{Boy}	f	%	f_{Girl}	f_{Boy}	f	%	f_{Girl}	f_{Boy}	f	%	f_{Girl}	f_{Boy}	f	%
Questioning	3	3	**6**	**10**	9	11	**20**	**33.3**	11	12	**23**	**38.3**	7	4	**11**	**18.3**
Evaluating Different Views	16	11	**27**	**45**	10	13	**23**	**38.3**	3	3	**6**	**10.0**	1	3	**4**	**6.7**
Problem Solving	14	11	**25**	**41.7**	11	13	**24**	**40.0**	3	5	**8**	**13.3**	2	1	**3**	**5.0**
Evidence-Based Learning	13	12	**25**	**41.7**	12	9	**21**	**35.0**	3	6	**9**	**15.0**	2	3	**5**	**8.3**

The data in Table 2 indicate the performance levels of children in each sub-dimension of critical thinking. A considerable proportion of children demonstrated high performance in the sub-skills of evaluating different viewpoints (45%) and problem-solving (41.7%), suggesting that these abilities may develop naturally during early childhood. Similarly, 41.7% of children achieved the highest score in the evidence-based reasoning sub-skill; however, a total of 23.3% were rated at levels 1 and 2, indicating that some children are still in the process of developing this competence. On the other hand, the questioning sub-skill recorded the lowest proportion of level 4 scores (10%), highlighting that children's inquisitive thinking processes may still be in the early stages of development and may require further structured support. Furthermore, the data reveal that girls were more likely than boys to achieve level 4 in both evaluating different viewpoints and problem-solving, pointing towards gender-related differences in these specific sub-skills.

Creativity

Creativity refers to an individual's capacity to generate original ideas, develop alternative perspectives, and express thoughts through various means. In this study, children's creative thinking skills were assessed across four sub-components: fluency, flexibility, originality, and elaboration. Table 3 below presents the distribution of the children's scores and percentages for each sub-skill.

Table 3. Frequency (f) and percentage (%) distributions of children's scores on the creativity dimension of the "Learning and Innovation (4C) Skills Rubric"

Creativity	**4**				**3**				**2**				**1**			
	f_{Girl}	**f_{Boy}**	**f**	**%**	**f_{Girl}**	**f_{Boy}**	**f**	**%**	**f_{Girl}**	**f_{Boy}**	**f**	**%**	**f_{Girl}**	**f_{Boy}**	**f**	**%**
Fluency	15	17	**32**	**53.3**	9	4	**13**	**21.7**	5	5	**10**	**16.7**	1	4	**5**	**8.3**
Flexibility	14	16	**30**	**50.0**	13	5	**18**	**30.0**	3	5	**8**	**13.3**	0	4	**4**	**6.7**
Originality	14	12	**26**	**43.3**	9	9	**18**	**30.0**	5	6	**11**	**18.3**	2	3	**5**	**8.3**
Elaboration	16	16	**32**	**53.3**	9	7	**16**	**26.7**	5	4	**9**	**15.0**	0	3	**3**	**5.0**

As shown in Table 3, children generally performed at a high level across all four sub-dimensions of creativity. More than half or nearly half of the children received the highest score (4) in each of the sub-skills. Fluency and elaboration emerged as the most prominent areas, with 53.3% of the children achieving the top level. Flexibility was also demonstrated at level 4 by 50% of the children, indicating a strong capacity to explore different thinking strategies. The originality sub-skill, on the other hand, had a slightly lower proportion of children at level 4 (43.3%), suggesting this may be a more variable domain. Originality scores were relatively lower, which may be due to the strong focus on following instructions and concrete outcomes in early childhood settings, potentially limiting opportunities for more divergent or unconventional ideas. A close examination of the table also reveals a relatively balanced distribution between genders in the creativity domain. In fluency, flexibility, and elaboration, the percentages of boys and girls who scored at level 4 were quite similar. This finding suggests that gender does not appear to be a differentiating factor in creativity for this age group. Overall, the data on creative thinking indicate that children aged 48-60 months have acquired fundamental competencies in this area. However, structured activities may be needed to further support development in sub-skills where individual differences are more pronounced.

Communication

Communication is a skill that develops rapidly during early childhood and plays a fundamental role in both social and cognitive interactions. Within the scope of this study, children's communication skills were evaluated across four subcomponents: verbal expression and intelligibility, body language and eye contact, active listening, and scientific communication. Table 4 below presents the frequency and percentage distributions of performance levels for each of these sub-skills.

Table 4. Frequency (f) and percentage (%) distributions of children's scores in the communication dimension of the "Learning and Innovation (4C) Skills Rubric"

Communication	4				3				2				1			
	f_{Girl}	f_{Boy}	f	%	f_{Girl}	f_{Boy}	f	%	f_{Girl}	f_{Boy}	f	%	f_{Girl}	f_{Boy}	f	%
Verbal expression and intelligibility	27	20	**47**	**78.3**	2	6	**8**	**13.3**	1	4	**5**	**8.3**	0	0	**0**	**0.0**
Body language and eye contact	21	16	**37**	**61.7**	7	7	**14**	**23.3**	2	6	**8**	**13.3**	0	1	**1**	**1.7**
Active listening	20	18	**38**	**63.3**	9	7	**16**	**26.7**	1	3	**4**	**6.7**	0	2	**2**	**3.3**
Scientific communication	18	12	**30**	**50.0**	9	11	**20**	**33.3**	3	5	**8**	**13.3**	0	2	**2**	**3.3**

Table 4 demonstrates the performance levels observed in the subcomponents of communication skills among children. The findings indicate that children aged 48-60 months generally exhibit well-developed communication competencies. The highest proportion of children attaining level 4 was found in the domain of verbal expression and intelligibility (78.3%), suggesting that children can express their emotions and thoughts clearly, understandably, and accurately. Likewise, high performance levels were also observed in the sub-skills of active listening (63.3%) and body language and eye contact (61.7%), indicating that most children actively participate in communication processes and effectively utilise both verbal and non-verbal modes of expression. In contrast, the proportion of children achieving the highest score in scientific communication was 50%, which, while still relatively high, is lower compared to the other sub-skills. The relatively lower performance in scientific communication could be attributed to the abstract nature of this skill, which is still emerging at this developmental stage and may require more targeted support and practice. This suggests that children may require additional support in using more abstract, information-based forms of communication.

Moreover, in all sub-skills, girls were more frequently represented at level 4 compared to boys. This suggests that girls in early childhood may use linguistic and social communication skills more effectively. Overall, the findings reveal that communication skills are largely well developed in early childhood and are strongly supported by both natural developmental processes and structured educational environments.

Collaboration

Collaboration is a fundamental social competency encompassing children's ability to establish social relationships, assume responsibilities within a group, and act in accordance with shared goals. In this study, children's collaboration skills were evaluated across four sub-dimensions: participation, taking responsibility, teamwork and cooperation, and leadership. Table 5 below presents the frequency and percentage distributions of performance levels in each sub-dimension.

Table 5. Frequency (f) and percentage (%) distributions of children's scores in the collaboration domain of the "Learning and Innovation (4C) Skills Rubric"

Collaboration	4				3				2				1			
	f_{Girl}	f_{Boy}	f	%	f_{Girl}	f_{Boy}	f	%	f_{Girl}	f_{Boy}	f	%	f_{Girl}	f_{Boy}	f	%
Participation	21	19	**40**	**66.7**	5	6	**11**	**18.3**	2	4	**6**	**10.0**	2	1	**3**	**5.0**
Taking responsibility	20	16	**36**	**60.0**	6	11	**17**	**28.3**	4	1	**5**	**8.3**	0	2	**2**	**3.3**
Teamwork and cooperation	16	13	**29**	**48.3**	10	13	**23**	**38.3**	4	1	**5**	**8.3**	0	3	**3**	**5.0**
Leadership	14	7	**21**	**35.0**	8	12	**20**	**33.3**	4	9	**13**	**21.7**	4	2	**6**	**10.0**

As shown in Table 5, children's performance in the collaboration domain indicates that this is a relatively strong area of competence. Particularly in the sub-dimensions of participation (66.7%) and taking responsibility (60.0%), a high proportion of children scored at level 4. In the teamwork and cooperation sub-dimension, 48.3% of children achieved the highest score, while 38.3% were rated at level 3. In contrast, leadership emerged as the sub-dimension with the lowest proportion of level 4 scores (35.0%). Notably, 31.7% of children were rated at levels 1 or 2 in leadership, indicating that more targeted developmental support may be necessary in cultivating this complex social role. The lower scores in leadership may also reflect developmental characteristics of this age group, as assuming and expressing leadership roles is still an emerging competence for many children between 48 and 60 months. Additionally, the data reveal that girls were more frequently represented at level 4 in the leadership sub-dimension compared to boys, who were more commonly observed at levels 2 and 3. Overall, while most children demonstrated strong performance in the core components of collaboration, further support may be needed for the development of leadership skills, which are more nuanced and require a higher level of social and communicative maturity.

Discussion and Conclusion

The findings of this study indicate that children aged 48-60 months exhibit generally high levels of Learning and Innovation Skills, particularly excelling in communication and collaboration. This can be attributed to their early enrolment in preschool education institutions. Compared to children with more limited social interaction at home, preschool settings contribute significantly to the development of these skills through group-based interaction and structured learning processes (Vygotsky, 1978; Elçi, 2021). Structured group activities, guided play, and open-ended materials support both the cognitive and social development of children, thereby contributing positively to the development of 21st-century skills (Jaruchainiwat et al., 2024). However, resource limitations, insufficient teacher training opportunities, and policy-level uncertainties present certain barriers to the acquisition of these skills (Çetingöz, 2023; Soderlund, 2020). Overall, the findings reveal a relatively strong performance in communication, collaboration, and creativity, highlighting the role of early childhood environments in supporting these competencies. At the same time, certain areas, such as critical thinking, originality, scientific communication, and leadership, appeared to be more variable, suggesting that these competencies may be still in early stages of development or influenced by a range of factors beyond the preschool context. These results point to the need for more targeted support and further research to better understand the interplay between early childhood settings, individual characteristics, and skill development across the 4C domains. These observations should be considered within the limitations of the present study. Although higher performance levels in certain skill areas were associated with early childhood education settings, it is important to interpret these findings with caution. This study did not include a comparison group of children who had not participated in preschool programmes, making it challenging to draw direct conclusions about the effects of early childhood education alone. Other factors, such as individual developmental differences, family environments, or the quality of teacher-child interactions, may also have contributed to the observed outcomes. Similar studies that compare preschool-attending children with those who have not participated in early education would be valuable for further exploring these relationships and providing a more comprehensive understanding of the role of early childhood education in supporting the development of Learning and Innovation Skills. While more comparative studies are needed, the available evidence suggests that early childhood settings play a pivotal role in nurturing these competencies. Despite these challenges, schools generally offer more effective opportunities than home environments for the development of Learning and Innovation Skills. The inclusion of these skills in national education programmes (Koçin & Tuğluk, 2020), and the use of teaching materials such as children's literature (Aydın-Gönül & Dilidüzgün, 2022; Bayraktar & Geçgel, 2023), educational songs (Erdi-Bıyık & Sever, 2024), and science magazines (Aşkar et al., 2024) support this development.

Communication and collaboration emerged as the domains in which children performed at the highest level. Regarding collaboration, children's early ability to take responsibility and cooperate within groups is particularly notable in the sub-skills of participation and assuming responsibility. Burns et al. (2024) highlight that collaboration in school environments can be supported through strategies such as effective grouping, role assignment, and adult guidance. The relatively lower performance in teamwork and helping others suggests that more structured and supportive activities may be effective in certain cases. The lower scores in leadership compared to other sub-skills underscore the importance of integrated experiences that involve language and creativity for the development of this skill (Denli, 2022; Duran, 2019). In terms of communication skills, children performed highly in verbal expression, body language, and listening. However, the scientific communication sub-skill scored comparatively lower, indicating that additional support may be needed to enhance children's ability to engage in abstract and information-based communication. Furthermore, across all sub-skills, girls obtained higher scores than boys. This finding aligns with developmental theories suggesting that girls' language development progresses more rapidly than that of boys (Bornstein & Haynes, 1998; Huttenlocher et al., 1991; Shaywitz et al., 1995).

Regarding creativity skills, high scores in fluent thinking, flexible thinking, and elaboration indicate children's strong potential for generating and developing ideas. Educational environments appear to contribute significantly to this development. The relationship between social and creative skills (Kiper, 2016) and the emphasis on supporting creative thinking within structured educational settings (Kasioura et al., 2024; Siew et al., 2017) reinforce these findings. However, the relatively lower scores in originality warrant attention. Bayanova & Chulyukin (2018) reported that children who highly conform to cultural norms tend to have lower levels of originality. This suggests that the socialisation process, which begins in early childhood, may influence the development of originality. From a gender perspective, the similar performance levels of girls and boys in creative skills imply that creativity may develop independently of gender.

In the domain of critical thinking, a more balanced distribution of scores was observed compared to other skill areas. This may suggest that these skills are still in the early stages of developmental maturation (Piaget, 1952) and that children may not be given sufficient opportunities to engage in thinking processes in educational environments. Gelen (2017) noted that in Türkiye's early childhood education system, the concept of "activity" is often perceived as physical production and constant movement, with limited time allocated for thinking. However, critical thinking develops through processes that require time and attention. To support these processes, the systematic implementation of philosophical inquiry-based methods (Erkol et al., 2022; Okur, 2008), Prediction–Observation–Explanation (POE) strategies (Kırıktaş & Şahin, 2021), scientific process skills (Haenilah et al., 2021), and design thinking approaches (Yalçın, 2022) is recommended. In terms of gender, the higher scores of girls in problem solving and evaluating different perspectives suggest that cognitive development during early childhood may vary according to individual differences.

The findings of the study also revealed notable gender-based differences. While girls outperformed boys in communication, collaboration, and overall skill scores, boys demonstrated greater strengths in certain sub-skills of creativity. Vygotsky's (1978) sociocultural theory suggests that such differences can be explained by social roles and patterns of interaction. While some studies support the presence of such gender differences (Kol & Tunçeli, 2022), others suggest no significant differences exist (Dinler et al., 2021; Bolat & Kahveci, 2016). Therefore, it is essential to ensure equal learning opportunities in educational environments and to avoid gender-based distinctions.

In conclusion, this study shows that preschool children demonstrate high performance in Learning and Innovation Skills, particularly in communication and collaboration. While creativity and critical thinking skills were also found to be at promising levels, the findings indicate that more structured support may be necessary, especially in areas such as originality and questioning. In this context, the pivotal role of teachers, educational content, and school environments in supporting the development of these skills becomes evident. It is therefore essential to prioritise pedagogical practices that foster these competencies from an early age.

Recommendations

The findings of this study reveal that children in early childhood generally demonstrate a high level of Learning and Innovation Skills. Children in the 48-60-month age group were particularly proficient in communication, collaboration, and creativity. However, a more balanced distribution was observed in more complex socio-cognitive skills such as critical thinking and leadership. This suggests that these skills may require more structured instructional support to foster their development effectively.

The "Learning and Innovation (4C) Skills Rubric" used in the study has proven to be a practical assessment tool for teachers, offering ease of implementation and valuable developmental feedback. The rubric allowed for the identification of children's strengths and areas for improvement and enabled a systematic classification of their skill levels.

Based on the findings, the following recommendations are proposed:

- In-service training programmes for preschool teachers should be expanded to effectively foster 21st-century skills (4Cs). These trainings should focus on equipping teachers with expertise in teaching critical thinking, creative thinking, and collaborative learning strategies.
- Preschools should be encouraged to diversify the learning materials used, including open-ended resources, scientific magazines, children's literature, and cooperative play environments.
- Curricula should incorporate a greater number of structured thinking activities, providing children with opportunities to ask questions, engage in discussion, and practise reasoning. Approaches such as the Predict-Observe-Explain (POE) strategy, philosophy-based

activities, and design thinking should be integrated into early childhood education programmes.

- To foster originality, increased time should be allocated to creative activities such as art, drama, play, and storytelling. Environments should be created where children feel free to express their ideas.
- To support abstract skills such as science communication, access to age-appropriate scientific content and experiential learning opportunities should be expanded.
- Educational processes should be designed with gender awareness in mind, ensuring equal opportunities for all children to develop social competencies such as communication, leadership, and collaboration.
- Families should be provided with guidance and information on how to support these skills at home. Strengthening home-school collaboration is essential in this regard.
- Early childhood education policies should endorse pedagogical approaches that prioritise 21st-century skills and promote the use of valid and reliable tools for their assessment and development.

Acknowledgements

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sector.

Conflicts of Interest

This study was conducted by two authors. The first author is a PhD candidate, and the second author is the academic advisor. There is no conflict of interest between the authors.

Ethics

The ethics application for the study was made on 03/05/2024, and the research was carried out with the approval of Fatih Sultan Mehmet Vakıf University Ethics Committee dated 09/05/2024 and numbered 35/13.

Ethics committee approval was obtained for this research involving children, and informed consent was also received from the parents of all participants.

Official permissions were granted by the Ministry of National Education for the implementation of the study in selected schools. The research was conducted in accordance with the "Directive on Research and Publication Ethics of Higher Education Institutions" in Türkiye.

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