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Artificial Intelligence Supported Analysis of Children's Pictures: Preschool Period Applications*

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Abstract

The aim of this research is to investigate the role of artificial intelligence tools in the analysis of preschool children's drawings and to determine whether they are effective in the analysis of children's drawings. The study group consists of 4 preschool students aged 5 and studying at Melik Ahmet Gazi Primary School in Tokat province. The research is based on a qualitative research method called multiple case study, and documents and semi-structured interview forms were used to collect data. The study group determined by simple random sampling method was applied human, family, tree and house drawing tests, and each child drew 4 pictures in each test. The data was examined in detail and compared with the content analysis method using the MaxQDA analysis program. The research results show that both methods have strengths and weaknesses. While the researchers evaluate the first impression of the pictures, suitability for the development level and positioning in detail, artificial intelligence has the advantages of speed and objectivity. Artificial intelligence is effective in identifying certain patterns and structures and is superior in the fast and accurate processing of objective data. Researchers are more successful in contextual and qualitative data.

Keywords: Art education, children's drawing, picture interpretation, artificial intelligence.

Yapay Zekâ Destekli Çocuk Resimleri Analizi: Okul Öncesi Dönem Uygulamaları

Öz

Bu araştırmanın amacı, okul öncesi dönem çocuklarının resimlerinin çözümlenmesinde yapay zekâ araçlarının rolü araştırılarak, çocuk resimlerinin çözümlenmesinde etkili olup olmadığının belirlenmesidir. Araştırmanın çalışma grubunu Tokat ilinde Melik Ahmet Gazi İlkokulu kapsamında yer alan 5 yaş grubunda bulunan 4 okul öncesi öğrencisinden oluşmaktadır. Araştırma, çoklu durum çalışması adı verilen nitel araştırma yöntemine dayalı olup veri toplamak için dokümanlar ve yarı yapılandırılmış görüşme formları kullanılmıştır. Basit tesadüfi örnekleme yöntemiyle belirlenen çalışma grubuna, insan, aile, ağaç ve ev çizim testleri uygulanmış ve her çocuk her testten 4 resim çizmiştir. Veriler, MaxQDA analiz programı kullanılarak içerik analizi yöntemiyle detaylı bir şekilde incelenmiş ve karşılaştırılmıştır. Araştırma sonuçları, her iki yöntemin de güçlü ve zayıf yönlere sahip olduğunu göstermektedir. Araştırmacılar, resimlerin ilk izlenimi, gelişim düzeyine uygunluk ve konumlandırma gibi unsurları detaylı olarak değerlendirirken, yapay zekâ hız ve nesnellik avantajlarına sahiptir. Yapay zekâ, belirli desen ve yapıların tanımlanmasında etkili olup, nesnel verilerin hızlı ve doğru işlenmesinde üstündür. Araştırmacılar ise bağlamsal ve niteliksel verilerde daha başarılıdır.

Keywords: Sanat eğitimi, çocuk resmi, resim yorumlama, yapay zekâ.

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1. Introduction

Preschool education is an educational phase that supports the emotional, mental, social and physical development of children who have not reached the age of compulsory education in a systematic environment, helping them develop their talents and prepare for primary school (Diğler, 2012: 8). The Preschool Education Program, developed by the Ministry of National Education in 2013, is a program that aims to support the comprehensive development of children. This program focuses on achievements and indicators, is supported by monthly activity plans and offers an organization that includes an activity book for teachers and a family support program. The main features of the program include elements such as being child-centered, flexibility, using themes as tools rather than goals, a game-based approach, prioritizing learning through discovery, the importance of learning centers, a balanced inclusion of various types of activities, encouraging creativity, using daily life experiences and environmental opportunities in education, emphasizing universal and social values, teacher freedom, using various evaluation methods, the importance of family education and participation, ensuring inclusiveness by making adaptations for children with special needs, and focusing on guidance services (MEB, 2013).

Painting is an art education activity in which children express their personal creativity and mental images on a specific surface using various materials. In other words, painting is the art of creating images by using one or more colors on a surface with spots or lines, as well as drawing techniques in visual arts (Deniz, 2016). Visual arts education is a multifaceted educational activity that aims to provide children with a creative and entertaining experience. Children have developed various methods to express their feelings and thoughts, one of which is defined as painting education. Educational efforts that carry children's feelings, thoughts and impressions to an aesthetic level are also art education activities (Artut, 2001: 89).

The importance and development of art education in educational institutions can be achieved by educators who believe in this field. Educators who are trained with an effective program with an adequate education policy and determination will develop children's artistic talents to the highest level and contribute to the education system (Yolcu, 2004: 99). Art education allows teachers to develop students' talents and creativity, and to understand their cultural and social content by analyzing children's drawings (Uysal and Yavuzer, 2005). Children's drawings reflect their cultural and social interactions through the themes and figures they choose and provide teachers with the opportunity to interact deeply with students. The analysis of these drawings can provide teachers with valuable information about the emotional and psychological states of students. The integration of artificial intelligence technologies with this process can offer innovative perspectives in the analysis and interpretation of children's drawings (Esperón et al., 2009; Ishii et al., 2020). By automatically evaluating the patterns, color use, and composition of images, AI-based tools can provide detailed feedback on important elements such as order, location, and orientation in student artwork (Zaarour et al., 2004). This allows teachers to evaluate children's drawings more objectively and support their creativity processes more effectively (Johnson, 2019). Artificial intelligence stands out as an innovative tool in art education that expands teachers' ability to evaluate student work and allows them to understand students' individual, cultural and social development with a more holistic approach (Souillard-Mandar et al., 2021). The integration of this technology can transform pedagogical approaches in art education and strengthen student-teacher interaction. Thus, it can contribute

to a more inclusive and effective educational process. Artificial intelligence (AI) is the process of designing and programming machines to mimic human intelligence, such as learning, problem solving and decision making (Russell and Norvig, 2010). In the field of education, artificial intelligence can be used to analyze student performance, offer personalized learning experiences and provide support to teachers (Luckin et al., 2016). For example, artificial intelligence-supported systems analyze students' learning styles and needs and recommend appropriate learning materials and activities for each student (Zawacki-Richter et al., 2019). In addition, AI-based educational platforms can track students' progress and guide teachers in identifying weak areas, which allows for more effective interventions to be planned (Holmes et al., 2019). The integration of these technologies can make educational processes more efficient and provide students with a more personalized learning experience. Changing educational policies in the 21st century and art education approaches that have been shaped accordingly have brought about the need to keep up with the current situation at the preschool education level. Can artificial intelligence tools used in various branches of science, health sciences and social sciences be used as a tool in the analysis of children's drawings in art education activities in the preschool period? This question constitutes the basic problem statement of the research.

The purpose of this research is to investigate the role of artificial intelligence tools in the analysis of preschool children's drawings and to determine whether these tools are effective in the analysis of children's drawings. In this context, answers were sought to questions in line with the sub-objectives regarding whether there was a significant difference in the comparison of the analyses of educators and artificial intelligence tools within the scope of the “Draw a Person Test”, “Family Picture Test”, “Draw a House Test” and “Tree Picture Test”.

This research is important because it is a tool that helps teachers understand and evaluate students' artistic expressions in visual arts classes, and it can be used at all levels and in all areas of education, and it contributes to student recognition and evaluation studies, emphasizes the importance of individual recognition in teaching programs, and is the first study on this subject in the field of fine arts education.

2. Methods

2.1. Research Method

This research used a case study as a qualitative method. Case study is defined as the process of describing and analysing a system with defined boundaries in detail (Merriam, 2018). Creswell explains this method as examining one or more cases in detail over a certain period of time. Case studies can be singular, instrumental, internal, or multiple types (Creswell, 2020: 99). Multiple case studies involve multiple cases deliberately selected to provide in-depth information about the research topic (Stake: 1995). A multiple case study was chosen in this research because it was desired to conduct an in-depth examination in a real-life context within two different bounded systems.

2.2. Study Group

The study group consists of 4 preschool students aged 60-66 months who are studying in the kindergarten of Melik Ahmet Gazi Primary School affiliated to the Ministry of National Education (MEB) in Tokat province.

2.3. Data Collection

This study uses documents related to artificial intelligence and researcher analysis as data sources. In qualitative research, such documents provide important information for an in-depth understanding of the subject (Creswell, 2017). In the study, pictures drawn by 60-66 month-old children were used to compare the effectiveness of artificial intelligence and human analysis. The semi-structured interview form was designed to collect background information for four psychological picture tests applied to children. The data collection process is based on the analysis of four different pictures obtained from children's human, family, tree and house drawing tests. These pictures were evaluated to reflect the emotional states, creativity and cognitive abilities of children.

2.4. Data Analysis

Data analysis was carried out using content analysis, a qualitative research method. Content analysis allows data to be systematically examined and categorized within certain orders (Creswell, 2020; Büyüköztürk, 2018). This method provides an objective framework for revealing the differences and similarities between artificial intelligence and human analysis through detailed examination of documents. Using the MAXQDA program, the data were analyzed and compared in detail. This analysis aimed to systematically determine the similarities, differences, and features between artificial intelligence and human analysis and to create a reference for future studies in this field by revealing the strengths and limitations of both methods.

3. Findings

This section presents the findings obtained as a result of the analyses of the researcher and artificial intelligence regarding the students' pictures.

3.1. Researcher and Artificial Intelligence Analyses

Below are the findings and interpretations of the analyses made by the researcher and artificial intelligence for the images produced by the participants with the nicknames M/5, Z/5, M2/5 and C/5 in the study group in the "Draw a Person", "Draw a Family", "Draw a House" and "Draw a Tree" tests.

Figure 1: Draw a Person Test C/5

3.1.1. Researcher Analysis of the Draw a Person Test

The drawing is a picture suitable for the child's developmental period and is located on the left side of the paper. The left side of the paper represents the past or insecurity. At first glance, the picture gives a happy but anxious impression. The arms being open to both sides can indicate that the child is open to communication. The expression in the eyes can indicate feelings of curiosity and doubt. Deficiencies or problems in the hands can indicate problems experienced within the family.

3.1.2. Artificial Intelligence Analysis of the Draw a Human Test

In this drawing, the head being quite large compared to the body may indicate that the child sees himself/herself as inferior to other children in terms of intelligence or has difficulties in academic success. The round and prominent drawing of the eyes may indicate that the child is curious and suspicious and thinks that a secret is being kept from him/her. The mouth being drawn with a neutral expression indicates that the child is exhibiting a neutral attitude in expressing his/her emotional state. The nose not being prominent may indicate that his/her sexual curiosity is suppressed, while the absence of ears may indicate that he/she has difficulties in social relationships. The neck not being drawn indicates that the child may not be emotionally and socially developed. The shoulders being round and soft may indicate that the child is eager to establish social relationships. The hair being short and prominent may be interpreted as a symbol of masculinity and authority. The arms being drawn open to both sides may indicate that the child is inclined to establish relationships with people, while the fingers being prominent but not detailed may be considered a normal situation. The legs being drawn but not prominent may indicate that the child has difficulty standing on his/her own feet. This analysis provides general psychological clues that can be derived from the drawing, but more information and a professional assessment are required to understand the child's exact situation.

Figure 2: Draw a Family Test M2/5

3.1.3. Researcher Analysis of the Draw a Person Test

This drawing can be considered a slightly backward drawing compared to the child's developmental level. The order of the drawings is as follows: the child him/herself, his/her father and his/her mother. The fact that s/he does not include his/her brother in the drawing may suggest that s/he has a problem with his brother. The fact that the mother and father's eyes are drawn suspiciously may indicate that the child feels suspicious or insecure about his/her family. The fact that all family members are drawn in the same size may indicate that there is no hierarchy within the family. S/he may have drawn his/her father after him/herself because s/he feels closer to him, but the fact that the father does not have a mouth may suggest that his/her father cannot express himself, his thoughts are not valued or his voice is not heard. The fact that s/he drew the mother last may indicate that the father's responsibilities in the family are undertaken by his mother. The fact that the drawings are generally similar to each other may indicate that the child identifies with his/her mother. The fact that the hands are drawn large and clearly may symbolize excessive intervention, oppression or domestic violence. The presence of hearts may indicate that the child wants to be supported.

3.1.4. Artificial Intelligence Analysis of the Draw a Human Test

This study shows that the drawing of a five-year-old child reflects his/her relationships with his/her family and emotional state. The fact that the child draws himself/herself, his/her father and mother but does not include his/her older brother in his/her drawing may indicate sibling jealousy or a problem with his/her older brother. When the order in which the family members are drawn is examined, it is seen that the child draws himself/herself first, then his/her father and finally his/her mother. This order may suggest that the child places the person he/she identifies with the most, his/her father, in second place and that the mother, who is drawn last, is generally perceived as the person who is outgoing and assumes paternal functions. The fact that the figures in the drawing are of similar size may indicate that there is no hierarchical structure in the family or that the child sees the family members as equals. However, the fact that the father's figure is drawn a little larger may indicate that the father has a dominant role and holds an important place in the child's eyes. The large hands that the child draws for himself/herself, his/her mother and his/her father may reflect a feeling of excessive intervention or pressure. The presence of hearts in the drawing indicates that the child feels love and connection within the family. The happy expressions on the faces indicate that the child dreams of a happy family environment or wants to reflect on this. However, considering the possibility of domestic violence, the drawing style of large hands or figures may also reflect possible feelings of oppression and control. As a result, the child's drawing reflects a desire for love and commitment in relationships within the family, but also a possible feeling of oppression and control. The fact that the brother is not drawn can be interpreted as a sign of a break or jealousy in this relationship.

Figure 3: Draw a Tree Test Z/5

3.1.5. Researcher Analysis of the Draw a Person Test

The drawing is appropriate for the development level. The picture placed on the left side of the page symbolizes the past. The size of the tree reflects the subconscious thoughts of the individual about his/her own position and can express the current situation or the situation he/she imagines. The branches of the tree extending upwards can indicate that intellectual activities and skills are high. The fact that the tree is covered with leaves is a positive sign as it symbolizes the efforts of the individual. When we asked the child what tree this was, he/she stated that it was a tree with leaves. These answers suggest that the child feels like he/she belongs somewhere, but has met his/her needs on his/her own and may have felt a lack of support. The trunk of the tree may indicate pathological symptoms. The child may feel inferior or want to appear older than he/she is, which may reflect a feeling of inadequacy in meeting basic needs. As a result of these analyses, when the teacher was interviewed, it was learned that Z's general family situation was that he/she was receiving psychological treatment due to his/her father's dismissal from the civil service, and that his/her mother left the house for this reason and rarely came home. He/she is a child who is not paid attention by his/her mother and is usually taken to and brought from school by his/her father. He/she has a shy character by nature. He has an older brother and his father and grandmother take care of him.

3.1.6. Artificial Intelligence Analysis of the Draw a Human Test

The single tree in this drawing may indicate that the child feels lonely or isolated or has a need for communication. The branches of the tree extending upwards indicate that the child has high intellectual skills. The wide trunk may indicate that the child wants to appear older than he/she is or has difficulty meeting his/her basic needs. The absence of fruit or flowers in the drawing may reflect that the child sees himself/herself as ordinary or does not think he/she is useful in accordance with the expectations of his/her environment. The trunk being drawn clearly and thickly may indicate that the child is trying to protect and defend himself/herself. The branches of the tree being drawn in an undetailed and simple manner may indicate that the child experiences a certain anxiety or insecurity in his/her communication with his/her environment.

In general, this drawing reflects that the child is lonely and in need of communication, and that he/she feels ordinary or inadequate despite having high intellectual skills.

3.2. Cross Case Findings

In this multiple case study, cross-case analysis was conducted to identify similarities and differences between the two cases.

Table 1: Cross-Case Findings on Researcher and Artificial Intelligence Analysis

	Researcher Analyses	Artificial Intelligence Analyses
Tree Branch Analysis	2	7
Tree Trunk Analysis	3	4
Tree Root Analysis	2	2
Lack of Family Members	3	4
Family Line Order	4	4
Head Analysis	4	7
Leg Foot Analysis	1	3
Lack of Leg	2	3
Height Hierarchy	3	4
Apple Tree in Children	1	0
Hand Arm Analysis	10	5
House Ground Line	0	4
General Evaluation	3	16
Suitability to Development Level	15	1
Door and Lock Analysis	3	3
Meaning of Red Color	2	0
Window Analysis	3	4
Additional Figures in the Picture	3	2
Positioning the Picture	14	1
First Impression of the Picture	12	3

Tree branch analysis is included in the analyses of both the researcher and the artificial intelligence system, and it was determined that the artificial intelligence analysis was dominant. Tree trunk analysis did not show a significant difference between the two analysis methods, and showed that artificial intelligence systems can produce similar results to human experts in the analysis of the absence of family members.

Tree root analysis revealed that both analysis methods produced equivalent results. Similarly, no significant difference was found between the two methods in the analysis of missing family members. These findings indicate that AI systems have comparable success to human researchers in analyzing family order.

In the head and leg-foot analyses, it was determined that artificial intelligence analyses were dominant. In the absence of legs and height hierarchy analyses, no significant difference was found between the two different analysis methods.

In children, the apple tree analysis is only included in the analysis performed by the researcher, and artificial intelligence systems may not have been able to correctly analyze this image. In the hand-arm analysis, it was determined that the researcher's analysis was dominant.

The home ground line analysis was performed solely by AI, demonstrating the potential of AI systems to reduce reliance on human expertise in certain analyses. The overall assessment analysis was dominated by AI analysis, highlighting the effectiveness of AI systems.

In the analysis of suitability for development level, researcher analyses were found to be dominant. In the door and lock analysis, both analysis methods produced equivalent results. In

the analysis of the meaning of the red color, artificial intelligence could not correctly analyze the image.

In the window, additional figures in the picture, positioning of the picture and first impression analyses, no significant difference was found between the researcher and artificial intelligence analyses, and these findings showed that artificial intelligence systems can produce similar results to human experts.

3.3. Examination of Artificial Intelligence and Researcher Analyzes of Participant Pictures with Two-Cases Model

This study investigated whether there was a significant difference in comparing the educator and artificial intelligence analyses for the "Draw a Person Test", "Family Picture Test", "Draw a House Test" and "Tree Picture Test." The study evaluated the effectiveness of the analysis of preschool children's drawings with artificial intelligence tools. The findings are presented in the following figures.

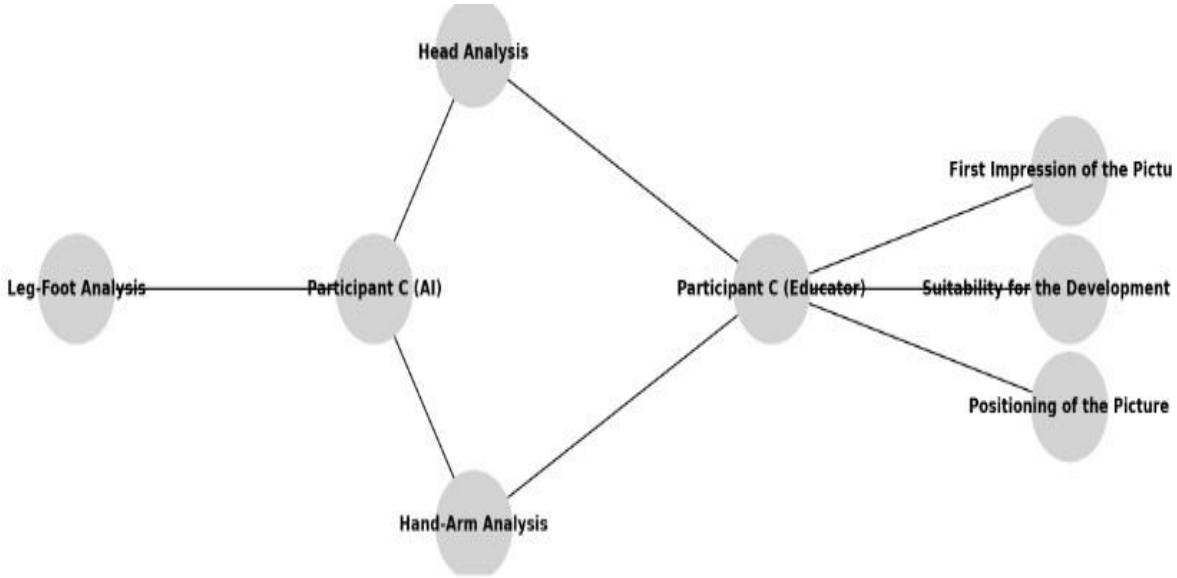

Figure 1: Participant C, Draw a Person Test, two cases model

The hand arm and head analysis were handled by both the researcher and the AI application. In contrast, only the researcher touched upon the first impression of the picture, the suitability for the development level and the positioning of the picture. Finally, only the AI application examined the leg analysis.

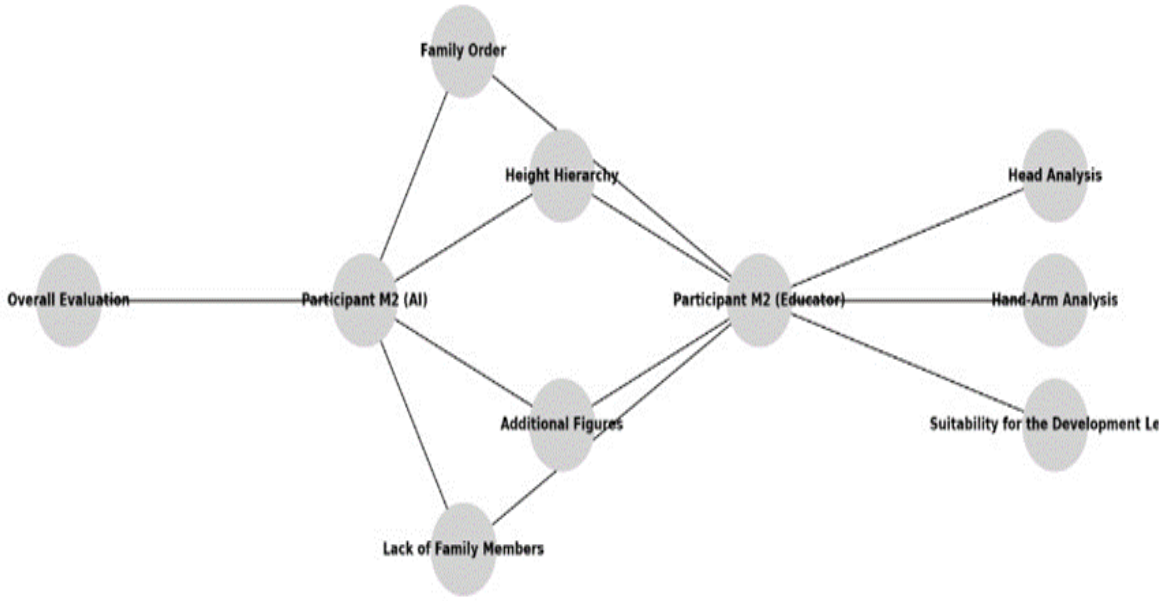

Figure 2: Participant M2, Draw a Family test, two cases model

Family order, lack of family members, height hierarchy and additional figures in the picture were addressed by both the researcher and artificial intelligence applications. However, head analysis, hand-arm analysis and the suitability for the development level issues were only examined by the researcher. In addition, the overall evaluation was performed only by artificial intelligence.

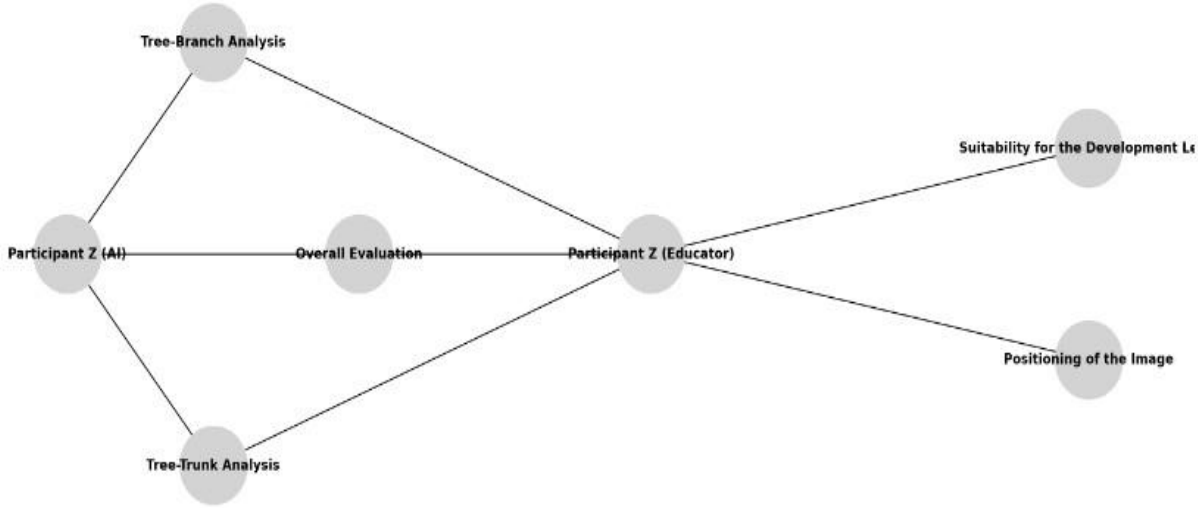

Figure 3: Participant Z, Draw a Tree test, two cases model

Tree-branch analysis, tree-trunk analysis and overall evaluation were addressed by both the researcher and the AI applications. However, the issues of suitability for the development level and positioning of the image were examined only by the researcher.

4. Conclusion, Discussion and Recommendations

In this study, a comparison of image analyses performed by researchers and artificial intelligence systems was made. The findings of the study revealed that both methods have various strengths and weaknesses. In particular, it was determined that detailed and context-based evaluations were prominent in researcher analyses, while advantages such as speed and objectivity were evident in artificial intelligence analyses.

In the researchers' analyses, elements such as the first impression of the pictures, suitability for the development level and positioning of the picture were discussed in detail. These findings show that researchers have the ability to evaluate visual materials more deeply and in context. On the other hand, artificial intelligence systems exhibit a faster and more systematic approach in the analysis processes, and play an active role especially in the identification of certain patterns and structures.

In the analyses conducted in certain categories such as tree branch analysis, hand-arm analysis and head analysis, it was observed that both methods provided significant contributions. However, it was concluded that artificial intelligence systems were superior in processing objective data quickly and accurately, while researchers were more successful in contextual and qualitative data. These findings reveal that artificial intelligence and human-based analyses are complementary to each other.

A study found that analyzing children's drawings can be used as a complementary tool to identify emotional problems and provide therapy (Edwards, 2016). This result is consistent with the findings of the current study. This approach aims to benefit from the advantages of AI systems in terms of speed and objectivity, while combining the strengths of human analysis in terms of context and depth.

The findings also point to the development potential of AI-based systems. In particular, it is anticipated that AI systems can make progress in contextual analysis with deep learning algorithms and more advanced modeling. However, these systems are not expected to completely replace the human factor, but rather, they are aimed to function as auxiliary tools for researchers and support analytical processes. A study has shown that artificial intelligence can be used as a supportive tool in visual design and can offer new perspectives in creative processes (Arslan, 2020). In another study, it was stated that AI cannot fully assume the roles of teachers and school principals, but it can be more useful as an assistant (Çetin and Aktaş, 2021).

As a result, the integration of artificial intelligence and human-based analyses into educational and psychological assessment processes will allow for more effective and comprehensive assessments. In this context, it should be emphasized that both methods need to be continuously developed and improved. This study is an important reference for future research and demonstrates the potential of artificial intelligence applications in educational sciences.

This study was conducted using a single researcher and a single AI system. In future studies, it is recommended that studies be conducted with two different AI tools and two different expert interpretations. This approach can increase the diversity of the data obtained and the depth of the analysis, thus reinforcing the reliability and validity of the results. In addition, this study was conducted with children in the 5-year-old group, and it was observed that the AI tool was limited due to the nature of the drawings of children in this age group. Therefore, it is recommended

that studies be conducted with different age groups in the future. This approach can analyze the drawings of various age groups and provide more comprehensive and generally valid results.

In future studies, it is recommended that more comprehensive and in-depth analyses be conducted using both methods together. This will allow the research results to be supported with richer and more diverse data. In addition, this study was conducted in Tokat province with four participants. Repeating future studies in different provinces and regions with participants from different cultural backgrounds can provide a better understanding of the generalizability of the results and the effects on cultural diversity. Studies with participants at different demographic levels will allow the effects of demographic factors to be examined. Using qualitative and quantitative research methods together will allow the examination of both numerical data and the personal experiences of the participants. In addition, multidisciplinary studies that will bring together experts from different disciplines (psychology, sociology, education science, visual arts, etc.) can provide the subject to be addressed from different perspectives and a richer understanding to be developed.

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Appendix

Appendix-1: Ethics Committee Certificate

Evrak Tarih ve Sayısı: 20.05.2024-E.951067

T.C.
GAZİ ÜNİVERSİTESİ REKTÖRLÜĞÜ
Etik Komisyonu

Sayı : E-77082166-302.08.01-951067 20.05.2024
Konu : Bilimsel ve Eğitim Amaçlı

DAĞITIM YERLERİNE

Üniversitemiz Eğitim Bilimleri Enstitüsü Güzel Sanatlar Eğitimi Ana Bilim Dalı **Yüksek Lisans Öğrencisi Hande DERİNOĞLU'nun, Doç.Dr.Kerim LAÇİNBAY'ın** danışmanlığında yürüttüğü ***"Okul Öncesi Dönemi Çocuk Resimlerinin Çözümlenmesinde Yapay Zeka Araçlarının Rolü"*** adlı tez çalışması ile ilgili konu Komisyonumuzun **30.04.2024** tarih ve **08** sayılı toplantısında görüşülmüş olup,

İlgilinin çalışmasının, yapılması planlanan yerlerden izin alınması koşuluyla yapılmasında etik açıdan bir sakınca bulunmadığına oybirliği ile karar verilmiş ve karara ilişkin imza listesi ekte gönderilmiştir.

Bilgilerinizi rica ederim.

Araştırma Kod No: 2024 - 800

Prof. Dr. İsmail KARAKAYA
Komisyon Başkanı

Ek:1 Liste
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Gereği:
Sayın Doç. Dr. Kerim LAÇİNBAY

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