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Research Article

The effect of artificial intelligence-supported visualization applications on students' writing disposition in the creative writing process

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This study aimed to investigate the effects of artificial intelligence (AI)-supported visualization applications on students' writing disposition during the creative writing process. An explanatory sequential design, a type of mixed methods approach, was adopted. In the quantitative phase, a quasi-experimental design with a pretest-posttest control group was employed, while the qualitative phase involved semi-structured interviews. The study group comprised 29 fourth-grade primary school students enrolled in the 2023–2024 academic year. Quantitative data were collected using the *Writing Disposition Scale*, and qualitative data were gathered through semi-structured interview forms. The findings indicated that AI-supported visualization applications had a positive impact on students' writing dispositions during the creative writing process. Students in the experimental group demonstrated significant improvements in the confidence, continuity, and passion dimensions of writing disposition, whereas the control group exhibited significant decreases in the confidence and passion dimensions. Qualitative results revealed that students experienced positive emotional engagement, enhanced cognitive development, and benefited from collaborative learning experiences. Furthermore, the use of visualization tools was found to stimulate creative thinking and enrich the writing process. These findings suggest that AI-supported visualization applications can serve as effective tools in writing instruction.

Keywords: Artificial intelligence; Visualization; Creative writing; Writing disposition

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1. Introduction

Technological advancements continue to drive innovation and transformation in the field of education, as in many other domains. With the rapid development of technology, educators and students now have access to new learning methods (Siemens, 2006). Among the innovative tools employed in educational settings are robots, virtual reality (VR), augmented reality (AR), 3D printing, the internet, and AI technologies. Of these, AI has received considerable attention in recent years (Holmes, 2018; Iqbal, 2017). AI refers to the simulation of human intelligence by computer systems (Coşkun & Gülleroğlu, 2021). It encompasses cognitive functions such as learning, problem-solving, decision-making, language processing, visual recognition, and the development of models (du Boulay, 2016).

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A review of the literature reveals that AI is being applied in education in diverse and impactful ways. Holmes (2018) reported that AI can be effectively used to personalize learning, monitor student progress, and evaluate performance. Similarly, Chen et al. (2020) emphasized that AI enhances global access for both students and teachers and improves educational efficiency. Hooda et al. (2022) found that AI technologies boost student motivation and support the development of critical thinking, problem-solving, and communication skills. In their study, İşler and Kılıç (2021) concluded that effective integration of AI in education not only improves academic achievement and supports time management but also reduces teachers' workloads, enables ongoing assessment and instant feedback, and facilitates remote personalized instruction.

One of the emerging areas in which artificial intelligence (AI) is applied in education is the creative writing process. The theoretical foundation of writing disposition is rooted in social cognitive theory and self-regulated learning perspectives (Zimmerman & Bandura, 1994). According to Graham and Harris (2016), writing disposition encompasses students' attitudes, beliefs, and motivation toward writing, all of which significantly influence writing performance and development. The integration of AI-supported learning processes aligns with constructivist learning theory, particularly in terms of scaffolding and cognitive apprenticeship models (Collins & Kapur, 2014). As Cope and Kalantzis (2020) emphasize, technology-enhanced writing instruction should be grounded in multimodal learning principles, allowing students to engage with writing through diverse representational modes. This approach is particularly relevant when considering the potential of AI-supported visualization tools to enhance students' cognitive processes and metacognitive awareness during writing (Öztürk & Çakıroğlu, 2021). The pedagogical integration of technology in writing instruction necessitates careful consideration of both the cognitive and affective dimensions of learning, as demonstrated by research on technology-supported collaborative learning environments (Zheng & Warschauer, 2015).

The intersection of AI, visualization, and creative writing forms a complex and dynamic theoretical framework that foregrounds the role of multimodal literacy in contemporary education. As Godhe and Magnusson (2017) argue, visual literacy and digital competencies have become essential elements of modern writing practices. The theoretical relationship between AI-supported visualization and creative writing is further informed by cognitive load theory and dual coding theory (Mayer & Fiorella, 2021), which suggest that visual representations enhance cognitive processing and foster creative ideation. Moreover, digital literacy skills play a crucial mediating role in this relationship, as students must navigate digital tools while preserving their creative agency (Knobel & Lankshear, 2022). This integration is supported by research demonstrating how digital tools can scaffold the creative writing process by providing diverse entry points for idea generation and narrative construction (Cope & Kalantzis, 2015). The framework also draws upon sociocultural perspectives on literacy, recognizing how digital tools and AI-supported visualization mediate students' meaning-making processes in writing (Elola & Oskoz, 2017).

Recent research has highlighted the potential of AI in supporting creativity within writing. Ghajargar et al. (2022) found that AI can enhance creative writing processes, foster creative expression, and unlock new creative possibilities. There are various educational applications of AI (Arslan, 2020), among which visualization-based tools are particularly engaging for students. Chassignol et al. (2018) stress that the quality of content generated through such tools depends on students' thinking, imagination, and expressive capacities.

The visualization affordances provided by AI technologies open new avenues for students to exercise imagination and creative thought. These capabilities align naturally with the goals of creative writing, one of the foundational elements of education. In this context, AI applications and the creative writing process share common ground in activating similar cognitive functions. Creative writing itself is a powerful pedagogical tool, enabling students to develop and express their thinking, imagination, language, and critical thinking skills (Sotelo, 2024). Nevertheless, traditional writing practices often lead to reduced student motivation and various learning challenges (Hooda et al., 2022). Thus, integrating AI-supported visualization tools into the creative

writing process holds the potential to positively influence students' writing dispositions (İşeri & Ünal, 2010).

The current research aims to examine the effects of AI-supported visualization applications on students' writing dispositions. In particular, analyzing changes in the dimensions of confidence, continuity, and passion is critical for understanding the effectiveness of technology-enhanced writing instruction. As Roll and Wylie (2016) point out, the use of AI in education has the capacity to transform learning processes. In this regard, a detailed examination of students' experiences with AI-supported visualization applications can offer valuable insights into the pedagogical potential of educational technologies in writing instruction.

1.1. The Aim

This study aims to investigate the effect of artificial intelligence (AI)-supported visualization applications on students' writing disposition during the creative writing process. In line with this objective, the study seeks to answer the following research questions:

RQ 1) What is the effect of AI-supported visualization applications on students' writing dispositions in the creative writing process?

RQ 1a) Is there a significant difference between the pre-test writing disposition scores of the experimental and control groups?

RQ 1b) Is there a significant difference between the pre-test and post-test writing disposition scores within the experimental group?

RQ 1c) Is there a significant difference between the pre-test and post-test writing disposition scores within the control group?

RQ 1d) Is there a significant difference between the post-test writing disposition scores of the experimental and control groups?

RQ 2) What are the students' experiences regarding the use of AI-supported visualization tools in the creative writing process?

2. Method

In this study, quantitative data were collected first, followed by qualitative data, to investigate the effect of AI-supported visualization applications on students' writing dispositions during the creative writing process. Accordingly, an explanatory sequential design, one of the mixed methods designs, was employed. This design involves the initial collection and analysis of quantitative data, which is subsequently followed by the collection of qualitative data to provide a deeper understanding of the quantitative findings. Explanatory sequential design is particularly well-suited for exploring multiple dimensions of complex phenomena and for enriching statistical results with explanatory insights derived from qualitative data (Creswell & Plano Clark, 2018).

2.1. Population and Sample

The research was conducted with fourth-grade students in Erzurum Province, Türkiye, during the 2023–2024 academic year. The study was limited to a total of 29 students who voluntarily agreed to participate, with 12 students assigned to the experimental group and 17 to the control group. While the study offers valuable insights, certain methodological limitations should be acknowledged. The relatively small sample size (N = 29) and unequal group sizes (experimental = 12, control = 17) may influence the generalizability of the findings. These limitations stem primarily from the voluntary nature of participation and the practical challenges inherent in conducting experimental research within an educational setting.

Nevertheless, the use of a mixed methods design helped to mitigate these constraints by incorporating rich qualitative data to complement the quantitative results (Creswell & Plano Clark, 2018). Additionally, appropriate statistical procedures were applied to account for unequal group sizes during data analysis. In the quantitative phase, purposive sampling was employed, with participants assigned to groups based on the significance of their pre-test scores. This sampling strategy aligns with the research objective and allows for the inclusion of a diverse participant

profile (Patton, 2015). In the qualitative phase, semi-structured interviews were conducted with 10 students randomly selected from the experimental group using simple random sampling. This method ensures equal probability of selection for each participant and enhances the representativeness of the qualitative sample (Creswell, 2013).

2.2. Implementation Process

To facilitate the effective execution of instructional activities, students in the experimental group were divided into small groups. These groups were formed collaboratively by the researcher and the classroom teacher to ensure a heterogeneous composition based on students' academic achievement levels, social skills, and writing competencies. This grouping strategy enabled students with diverse abilities to work together, thereby fostering rich intra-group interactions.

The instructional process followed a lesson plan developed by the researchers. Initially, students were provided with a detailed explanation of the creative writing process and an introduction to the AI-supported visualization tools to be used. Following this orientation, the creative writing activity was conducted in groups, with the goal of enhancing students' collaborative writing skills and their ability to work cooperatively. The researcher, acting as the instructor, adopted a guiding role throughout this process. One class hour was allocated for the group-based creative writing task, followed by another class hour dedicated to the visualization of the written texts. During the visualization phase, students converted their collaboratively written narratives into digital visuals using *Canva* and *DALL·E*. This phase was carried out with the active participation of students and under the supervision of the researcher-teacher.

For the quantitative component of the study, the *Writing Disposition Scale* developed by İşeri and Ünal (2010) was administered to both the experimental and control groups as a pre-test and post-test. Based on the results of the pre-test, group equivalence was confirmed prior to the intervention. A pre-test–post-test control group design was employed to evaluate the impact of the intervention on students' writing dispositions.

Table 1
Quantitative stages followed in the research process according to the selected design

Group	*Pre-test*	*Treatment (X)*	*Post-test*
E (Experimental)	M	Creative writing with AI-supported visualization	O
C (Control)	M	Creative writing with standard method	O

In the qualitative phase of the research, semi-structured interviews were conducted with 10 students randomly selected from the experimental group following the completion of the implementation process. Semi-structured interviewing is a flexible qualitative data collection method in which the researcher prepares a set of predetermined questions focused on a specific topic but may also pose additional questions based on the direction of the conversation. This method is particularly effective in exploring participants' experiences and perspectives in depth (Kvale, 2009). Creswell (2013) describes semi-structured interviews as a strategy that maintains a general structure while allowing the researcher to adapt or rearrange questions in response to participants' answers, thus ensuring both consistency and responsiveness in the data collection process.

2.2.1. Details of implementation process

The implementation process involved distinct procedures for the experimental and control groups to assess the effect of AI-supported visualization applications on students' writing dispositions.

In the experimental group, students first participated in creative writing activities centered on predetermined themes. The creative writing process was scaffolded using instructional strategies such as free writing, story mapping, and character design. Students collaborated in small groups to compose stories, descriptions, or short narratives. Following the writing phase, students' texts were systematically segmented into meaningful parts based on narrative elements such as plot

progression, characters, settings, and central themes. Typically, stories were divided into sections—introduction, development, and conclusion—to support the visualization process. The AI-supported visualization was carried out in two main stages using DALL·E and Canva. In the first stage, each text segment was transformed into visual content using DALL·E. Descriptive prompts were carefully crafted for each segment and entered into DALL·E to generate multiple visual outputs. The visuals that best aligned with the corresponding text were selected based on relevance and clarity.

In the second stage, Canva was used to refine the selected visuals. This included integrating images with corresponding text segments and making aesthetic adjustments—such as color coordination, contrast, typography, and layout—to ensure consistency with the tone and structure of the written content. The final product was compiled into a cohesive presentation format resembling a digital storybook.

In the control group, students engaged in creative writing activities using the same themes and instructional strategies (free writing, story diagramming, and character design). However, no visualization tools were employed. Students collaborated in groups under conditions equivalent to those of the experimental group, but their writing products remained in traditional text form without any visual representation. At the conclusion of the implementation, students' writing dispositions were assessed using the Writing Disposition Scale developed by İşeri and Ünal (2010). This approach enabled a comparative analysis of the impact of AI-supported visualization on writing disposition by contrasting it with outcomes from a conventional writing instruction model.

2.3. Data Collection Tool

To collect quantitative data, the Writing Disposition Scale adapted into Turkish by İşeri and Ünal (2010) was employed. The scale comprises 21 items designed to assess students' writing dispositions and is structured as a five-point Likert-type instrument. It includes three sub-dimensions: Passion, Confidence, and Continuity.

For qualitative data collection, a semi-structured interview form was developed by the researchers. The initial draft of the interview form was subjected to expert review. Based on expert feedback, several revisions were made: (1) some questions were reworded to be more open-ended and age-appropriate for the target group, (2) additional probing questions were incorporated to explore students' emotional experiences with AI-supported visualization tools, and (3) items addressing the challenges encountered during the implementation process were included.

Following these revisions, the interview form was piloted with three students. Each pilot interview lasted approximately 20–25 minutes. Minor adjustments were made based on the pilot results to enhance the clarity and comprehensibility of the questions. After finalizing the form, individual interviews were conducted in a quiet room within the school setting. Each interview lasted approximately 25–30 minutes and was carried out in a one-on-one format to ensure comfort and focus for the participants.

2.4. Data Analysis

The analysis of quantitative and qualitative data in the study was conducted through separate processes.

For the quantitative data analysis, the assumptions of normality were first examined. The Kolmogorov-Smirnov test was applied to determine whether the pre-test and post-test scores of the experimental and control groups followed a normal distribution. In addition, skewness and kurtosis values were reviewed. The results indicated that the data were normally distributed ($p > .05$). Skewness values ranged from -0.22 to -1.13, and kurtosis values ranged from -0.99 to 1.09. As these values fell within the acceptable range of ±1.96, the normality assumption was confirmed (Field, 2018).

Given that the normality assumption was met, parametric tests were employed. An independent samples *t*-test was used to examine differences between the experimental and control groups' pre-test and post-test scores, while a paired samples *t*-test was applied to assess the

significance of within-group differences between pre- and post-test scores. The significance level for all statistical analyses was set at .05.

In the qualitative dimension of the study, the data were analyzed using the content analysis method. The interview recordings were first transcribed verbatim, and each participant was assigned a code name to ensure anonymity. During the coding process, meaningful data segments were identified based on the research objectives, and conceptual meanings were assigned to each segment. These codes were then organized into overarching themes that captured the broader patterns within the data.

To ensure coding reliability, an independent field expert also coded the data. Inter-coder agreement was calculated using the formula proposed by Miles and Huberman (1994): Agreement Percentage = Agreement / (Agreement + Disagreement) × 100 The inter-coder agreement rate was determined to be 83%, indicating a high level of reliability.

2.5. Research Validity and Reliability

To ensure the validity and reliability of the research, multiple strategies were employed for both the quantitative and qualitative dimensions of the mixed methods design.

In terms of internal validity, the roles of the researchers were clearly defined, and the implementation and data collection procedures were carried out consistently by the same individuals. Data triangulation was achieved through the use of multiple data sources and instruments, and the accuracy of findings was confirmed through participant feedback. Furthermore, expert consultation was sought at various stages of the research to ensure scientific consistency. Efforts were made to minimize participant attrition, and long-term interactions were maintained with students throughout the intervention period.

Within the experimental design, equivalence between the experimental and control groups was verified based on pre-test scores. To reduce threats to internal validity, the intervention period was limited to three weeks, and procedures were applied simultaneously in both groups. The researcher followed a systematic process to standardize experimental implementation across groups.

In the qualitative component, steps were taken to ensure credibility (internal validity). The semi-structured interview form was developed based on expert input and piloted for comprehensibility and age-appropriateness. All interviews were audio-recorded, and member checks (participant confirmation) were conducted to validate the accuracy of the recorded responses.

To enhance external validity, detailed descriptions of the sample characteristics and school context were provided. The participant selection was aligned with the research objectives to ensure relevance and representativeness. The research methods, application procedures, and data analysis techniques were clearly and systematically explained, enabling readers to understand and evaluate the study. At the conclusion of the research, limitations were outlined, and recommendations for future research were presented. The school setting, characteristics of the participants, and experimental procedures were thoroughly documented to facilitate transferability.

For the quantitative phase, the Writing Disposition Scale developed by İşeri and Ünal (2010) was used. In their Turkish adaptation study, the overall Cronbach's alpha reliability coefficient of the scale was reported as .893. Sub-dimension reliability coefficients were .91 for the *Passion* dimension, .80 for *Confidence*, and .74 for *Continuity*. The three factors explained 46.26% of the total variance in the original scale.

In the current study, reliability analyses were conducted again with the sample group. The Cronbach's alpha coefficient was calculated as .85 for the overall scale. Sub-dimension reliability values were .84 for *Passion*, .62 for *Confidence*, and .64 for *Continuity*, indicating an acceptable level of internal consistency, particularly for exploratory research contexts.

The development of the qualitative interview form began with a comprehensive review of relevant literature, followed by the creation of draft questions aligned with the study's objectives.

The draft form was reviewed by two experts in Turkish Education and one expert in qualitative research methods. Revisions were made based on their feedback. A pilot test was conducted with three students outside the study sample to assess the clarity and appropriateness of the questions. The finalized form consisted of 7 main questions and 7 sub-questions, designed to explore students' experiences with AI-supported visualization tools and their perceptions of the creative writing process.

3. Results

This study employed an explanatory sequential mixed methods design to investigate the effect of AI-supported visualization applications on students' writing dispositions. In line with this design, the results are presented in two phases. First, the quantitative findings obtained through a quasi-experimental pretest–posttest control group design are presented. These are followed by the qualitative findings, which were collected to provide a deeper understanding and explanation of the quantitative results.

3.1. Quantitative Findings

This section presents the results of the experimental phase conducted to examine the effect of AI-supported visualization applications on students' writing dispositions. The analysis was carried out across the three sub-dimensions of the *Writing Disposition Scale*: confidence, continuity, and passion. To determine the equivalence of writing disposition levels between the experimental and control groups prior to the intervention, an independent samples *t*-test was conducted on the pre-test scores. The results of this analysis are displayed in Table 2.

Table 2
Independent samples t-test analysis of experimental and control groups' pre-implementation writing disposition scores

Dimension	*N*	*Mean*	*SD*	*t*	*df*	*p*
Confidence						
Experimental	12	21.83	3.93	−1.53	27	.30
Control	17	23.24	3.23			
Continuity						
Experimental	12	11.25	3.47	−1.89	27	.07
Control	17	13.53	3.00			
Passion						
Experimental	12	39.75	9.96	−0.7	27	.49
Control	17	41.82	5.94			

In the confidence dimension, no statistically significant difference was found between the experimental group (M = 21.83, SD=3.93) and the control group (M = 23.24, SD = 3.23) [$t(27) = -1.53$, $p = .30$]. Similarly, no significant difference was observed in the continuity dimension between the experimental group (M = 11.25, SD = 3.47) and the control group (M = 13.53, SD = 3.00) [$t(27) = -1.89$, $p = .07$]. In the passion dimension, no significant difference was detected between the experimental group (M = 39.75, SD = 9.96) and the control group (M = 41.82, SD=5.94) [$t(27) = -0.70$, $p = .49$]. These findings indicate that the groups were equivalent in terms of writing disposition prior to implementation.

After establishing group equivalence pre-implementation, the experimental group's pre-test and post-test scores were compared to determine the effect of AI-supported visualization applications on writing disposition. A paired samples *t*-test analysis was conducted to examine the effect of AI-supported visualization applications on the experimental group. The analysis results are presented in Table 3.

Table 3
Paired samples t-test analysis of experimental group pre-test and post-test writing disposition scores

Dimension	*N*	*Mean*	*SD*	*t*	*df*	*p*
Confidence						
Pre-test	12	21.83	3.93	−2.34	11	.04
Post-test	12	24.75	2.49			
Continuity						
Pre-test	12	11.25	3.47	−3.02	11	.01
Post-test	12	14.67	2.06			
Passion						
Pre-test	12	39.75	9.96	−2.26	11	.04
Post-test	12	46.75	1.42			

The analysis of the experimental group's scores revealed significant improvements across all three dimensions of writing disposition following the implementation of AI-supported visualization applications. In the confidence dimension, students' post-test scores (M = 24.75, SD = 2.49) were significantly higher than their pre-test scores (M = 21.83, SD = 3.93), $t(11) = -2.34$, $p < .05$. The effect size was calculated as d = 0.89, indicating a large effect. In the continuity dimension, post-test scores (M = 14.67, SD = 2.06) also demonstrated a significant increase compared to pre-test scores (M = 11.25, SD = 3.47), $t(11) = -3.02$, $p < .05$, with a very large effect size (d = 1.20). Similarly, in the passion dimension, students' post-test scores (M = 46.75, SD = 1.42) were significantly higher than their pre-test scores (M = 39.75, SD = 9.96), $t(11) = -2.26$, $p < .05$. The effect size was d = 0.98, indicating a large effect.

To more clearly determine whether the observed changes in the experimental group were attributable to the AI-supported visualization applications, changes in the control group—which did not receive any intervention—were also analyzed. For this purpose, a paired samples *t*-test was conducted to compare the control group's pre-test and post-test scores across the three dimensions of writing disposition. This analysis aimed to assess whether any significant changes occurred over time in the absence of AI-supported instruction. The results of the analysis are presented in Table 4.

Table 4
Paired samples t-test analysis of control group pre-test and post-test writing disposition scores

Dimension	*N*	*Mean*	*SD*	*t*	*df*	*p*
Confidence						
Pre-test	17	23.24	3.23	2.57	16	.02
Post-test	17	19.94	4.51			
Continuity						
Pre-test	17	13.53	3.00	1.33	16	.20
Post-test	17	11.76	3.95			
Passion						
Pre-test	17	41.82	5.94	3.00	16	.01
Post-test	17	33.24	9.24			

In the control group, post-test scores in the *confidence* dimension (M = 19.94, SD = 4.51) showed a significant decrease compared to pre-test scores (M = 23.24, SD = 3.23), $t(16) = 2.57$, $p < .05$, with a large effect size (d = 0.84). In the *continuity* dimension, no significant difference was observed between post-test scores (M = 11.76, SD = 3.95) and pre-test scores (M = 13.53, SD = 3.00), $t(16) = 1.33$, $p = .20$, although a medium effect size was found (d = 0.50). In the *passion* dimension, post-test scores (M = 33.24, SD = 9.24) were significantly lower than pre-test scores (M = 41.82, SD = 5.94), $t(16) = 3.00$, $p < .05$, with a very large effect size (d = 1.10).

Following these within-group analyses, which revealed opposite directional changes in the experimental and control groups, a comparison of post-test scores between the two groups was

conducted. This comparison aimed to directly assess the impact of the AI-supported visualization applications. The results of the independent samples *t*-test are presented in Table 5.

Table 5
Independent samples t-test analysis of experimental and control groups' post-implementation writing disposition scores

Dimension	*N*	*Mean*	*SD*	*t*	*df*	*p*
Confidence						
Experimental	12	24.75	2.49	3.68	27	<.01
Control	17	19.94	4.51			
Continuity						
Experimental	12	14.67	2.06	2.58	27	.02
Control	17	11.76	3.95			
Passion						
Experimental	12	46.75	1.42	5.93	27	<.01
Control	17	33.24	9.24			

An independent samples *t*-test was conducted to examine post-intervention differences between the experimental and control groups. The results of this analysis are presented in Table 5.

In the confidence dimension, the experimental group (M = 24.75, SD = 2.49) scored significantly higher than the control group (M = 19.94, SD = 4.51), $t(27) = 3.68$, $p < .001$, with a very large effect size (d = 1.26). In the continuity dimension, the experimental group (M = 14.67, SD = 2.06) also achieved significantly higher scores than the control group (M = 11.76, SD = 3.95), $t(27) = 2.58$, $p < .05$, indicating a large effect size (d = 0.88). Similarly, in the passion dimension, the experimental group (M = 46.75, SD = 1.42) outperformed the control group (M = 33.24, SD = 9.24), $t(27) = 5.93$, $p < .001$, with a very large effect size (d = 1.88).

Taken together, these quantitative findings suggest that AI-supported visualization applications had a positive and significant impact on students' writing dispositions. Students in the experimental group demonstrated notable increases across all three dimensions—*confidence*, *continuity*, and *passion*—while students in the control group experienced decreases in some areas.

To explore the underlying causes of these quantitative results and to gain a deeper understanding of students' experiences with AI-supported visualization tools, qualitative data were collected during the second phase of the explanatory sequential design. These qualitative findings not only provide context for interpreting the statistical outcomes but also offer rich insights into students' perceptions, emotional responses, and cognitive engagement throughout the implementation process.

3.2. Qualitative Findings

This section presents the findings obtained from semi-structured interviews conducted to gain a deeper understanding of students' experiences with AI-supported visualization applications during the creative writing process. The interviews were carried out with 10 randomly selected students from the experimental group. The qualitative data were analyzed using content analysis. To ensure participant confidentiality, students were assigned pseudonyms in the form of codes (e.g., S1, S2, etc.). The interview transcripts were systematically reviewed, and recurring patterns were coded. Based on this analysis, seven main themes, along with associated categories and codes, were identified. These thematic structures are illustrated in Table 6.

The semi-structured interviews conducted with 10 students from the experimental group revealed rich insights into their experiences with AI-supported visualization applications in the creative writing process. The data were analyzed using content analysis, and recurring patterns were coded and grouped under seven main themes.

Table 6
The effect of AI-supported visualization applications on students' creative writing experiences

Theme	*Category*	*Code*
Affective Experiences	Positive Emotions	Happiness*
		Excitement
	Anxiety and Concerns	Worry, difficulty
Transformation in Learning Process	Cognitive Development	Learning new vocabulary
		Permanent learning*
	Technological Adaptation	Initial difficulties
		Adaptation process
Collaborative Learning	Group Interaction	Positive evaluation*
	Intra-group Challenges	Intra-group disagreements
Writing Skills*	Content Enrichment	Elaboration with visuals
	Writing Motivation	Future use intention*
Technology Integration	Tool Usage Experience	Acquiring technology skills
	Technological Support	Tool usage guidance*
Productive Process	Creative Thinking	Drawing inspiration
	Process Management	Imagination
		Organization
Learning Outcomes*	Academic Achievements	Academic success*
	Individual Development	Increased self-confidence

Note. Codes marked with an asterisk (*) represent those with the highest frequency across participants.

Based on the data summarized in Table 6, the majority of students (n = 8) reported experiencing positive emotions throughout the process. Statements such as "writing my own story made me very happy" (S3) and "using my imagination excited me" (S7) illustrate that the process was generally enjoyable and engaging. These expressions suggest that the integration of AI-supported visualization tools contributed to increasing intrinsic motivation and fostering positive attitudes toward writing. Although some students (S5, S9) described experiencing initial difficulties and others (S4, S6) reported anxiety related to technology use, these concerns are considered natural and reflective of the initial adaptation challenges often encountered when introducing innovative educational technologies. These early anxieties appeared to diminish as students progressed, particularly when appropriate support mechanisms were provided.

Beyond affective experiences, students reported notable gains in their learning processes. A majority (n = 9) stated that the process supported their cognitive development. For instance, S3 explained, "I learned new words while writing stories," indicating gains in vocabulary and language development, while S6 shared, "it helped me remember what I learned in lessons," highlighting cognitive transfer and deeper retention. In addition to subject-specific learning, students also developed their ability to use technology effectively, which is a critical component of 21st-century skills. Their adaptation to using tools like DALL-E and Canva demonstrates growth in digital literacy, an essential competency in modern education.

Collaborative learning also emerged as a significant aspect of the experience. Most students (n = 7) evaluated group work positively, aligning with social constructivist learning principles. Working in groups appeared to support the development of writing skills through social interaction and peer feedback. However, a few students (S3, S5, S10) mentioned intra-group disagreements, reflecting the common challenges inherent in collaborative learning environments. These dynamics underscore the importance of group interactions in fostering both social and academic growth within AI-supported writing contexts.

Another important finding was the perceived value of visualization tools in enriching the creative writing process. Eight students expressed that the inclusion of visuals enhanced their written content, deepened their engagement, and facilitated more vivid storytelling. The students noted that visuals supported idea generation and narrative development, consistent with the

principles of multimodal learning. Notably, all students (n = 10) stated a desire to use similar visualization tools in future writing tasks, which points to the potential of such tools to serve as a sustainable source of motivation in writing education.

Students also shared reflections on the process of integrating technology into their writing. Their feedback indicates that technology helped make abstract concepts more concrete, increased engagement, and supported the organization of ideas. At the same time, their experiences highlighted the need for ongoing support, especially in managing technical challenges. These insights underscore the necessity of designing structured support mechanisms to ensure effective and inclusive technology integration.

In addition, the findings reveal that visualization tools significantly supported creative thinking. For instance, S7 commented, "using my imagination excited me; visuals helped new ideas form in my mind," and S6 noted, "thinking about visuals while writing gave me new ideas; the direction of my story changed." Such responses suggest that the tools served as cognitive stimulants, enabling students to generate and explore new ideas, thus contributing to the development of higher-order thinking skills. The process also fostered self-regulation and autonomy. For example, S2 explained, "I first imagined the visual, then started writing. This way, I could create my story more systematically," while S8 stated, "working with visuals made my writing process more organized; I could progress step by step." These experiences indicate that students developed more structured and strategic approaches to managing their writing tasks.

In terms of academic outcomes, nine students indicated that the intervention supported their overall achievement. S3's reflection—"I learned new words while writing stories and these words became more permanent in my mind"—shows improvement in vocabulary retention, while S6's comment—"thinking about the story I wrote helped me remember what I learned in lessons"—demonstrates evidence of cross-curricular learning and knowledge transfer. These academic developments were accompanied by gains in personal growth. Students reported improved self-confidence, increased motivation, and stronger self-expression skills. For instance, S1 shared, "creating my own story increased my self-confidence; now I can express my ideas more easily," and S8 noted, "after this study, I am more willing to write; I think I can express myself better." These findings suggest that AI-supported visualization applications contributed not only to cognitive and academic development but also to emotional and social aspects of learning, offering a holistic and enriching educational experience.

The qualitative findings demonstrate that AI-supported visualization applications provided multidimensional contributions to the creative writing process. While some students experienced initial challenges and expressed a need for technological support, these issues highlight important considerations for the design and implementation of such educational technologies. Importantly, the findings reveal a notable transformation in students' approaches to writing. The integration of AI-supported visualization tools fostered a more engaging, structured, and student-centered learning environment, as evidenced by several key outcomes:

- Enhanced Creative Expression
  - Students demonstrated increased ability to generate and develop ideas
  - Visual supports facilitated more detailed and imaginative writing
  - Greater confidence in expressing creative thoughts
- Improved Process Management
  - More systematic approach to writing tasks
  - Better organization of ideas and content
  - Enhanced ability to plan and execute writing projects
- Technological Competence:
  - Development of digital literacy skills
  - Increased comfort with educational technology
  - Integration of technological tools in creative processes
- Social Learning Benefits:

- Enhanced peer collaboration
- Productive group interactions
- Shared learning experiences

- Metacognitive Development
  - Improved self-reflection abilities
  - Better awareness of writing processes
  - Enhanced self-assessment capabilities

The qualitative data further revealed a clear progression in student engagement with the AI-supported tools. Initial hesitation and uncertainty gradually gave way to confidence and creative exploration, suggesting a positive adaptation trajectory. This pattern provides valuable insights for future implementations of AI-enhanced educational interventions.

Taken together, the intersection of quantitative and qualitative findings offers a comprehensive perspective on how AI-supported visualization applications influence students' writing disposition and creative engagement. The complementary nature of the two data sets strengthens the overall conclusions and adds depth to our understanding of the educational impact of such technologies.

These findings collectively suggest that the use of AI-supported visualization applications in creative writing education holds significant promise. The observed impacts—ranging from cognitive development and technological competence to enhanced creativity and social interaction—demonstrate the potential of these tools to meaningfully enhance students' learning experiences in the digital age. As such, the integration of AI-based visualization tools may serve as a valuable innovation in writing instruction, contributing to both academic achievement and holistic student development.

4. Discussion and Conclusion

This study examined the effect of AI-supported visualization applications on students' writing dispositions using a mixed methods research design. The findings revealed that these applications contributed positively to students' writing dispositions across multiple dimensions. During the intervention, students in the experimental group who engaged with AI-supported visualization tools demonstrated significant improvements in the dimensions of confidence, continuity, and passion, whereas students in the control group—who received traditional instruction—showed notable declines in confidence and passion. These findings are consistent with the results of Zawacki-Richter et al. (2019), whose systematic review concluded that AI-supported learning environments are generally more effective than traditional pedagogical approaches. Similarly, Bernard et al. (2018), through their meta-analyses, emphasized the importance of adopting systematic approaches to effectively integrate technology in educational settings.

The results further suggest that AI-supported visualization applications can act as tools of pedagogical transformation. This aligns with the findings of Zhai et al. (2021), who highlighted the transformative potential of AI in educational contexts. Graham et al. (2018) also underscored the importance of a balanced approach in literacy education, noting that technology-enhanced practices can transform writing from a mechanical task into a creative and reflective process. The observed outcomes in this study support Wu and Chen's (2020) findings, which revealed that digital storytelling tools stimulate creative thinking and help students explore ideas more deeply.

The study also found that collaborative learning experiences were positively influenced by the integration of technology. Students in the experimental group reported increased peer interaction and collaboration, which mirrors the findings of Bikowski and Vithanage (2016) regarding web-based collaborative writing environments. Sung et al. (2017), in their meta-analysis of mobile-supported collaborative learning, similarly found that technology-enhanced collaborative environments improve both student achievement and motivation.

While the benefits were evident, the research also identified challenges associated with the use of AI-supported applications. Some students expressed initial anxiety or difficulty using the

technology, a finding that aligns with Kim et al.'s (2018) emphasis on the importance of support mechanisms in technology-rich learning environments. Mei et al. (2018) also noted the critical role of teacher preparedness and ongoing support for successful technology integration. Li et al. (2022) reinforced that AI-based educational tools require carefully designed support structures to be effective.

The observed growth in students' self-efficacy and self-expression echoes earlier findings by Zawacki-Richter et al. (2019), who emphasized the role of AI in fostering autonomy and self-regulation. Likewise, Graham et al. (2018) found that technology-supported writing instruction enhances students' motivation and belief in their writing abilities. Zhai et al. (2021) also highlighted the role of AI as a catalyst for developing higher-order thinking skills.

Overall, the findings emphasize the need to integrate technology with strong pedagogical foundations. Wu and Chen (2020) argue that technology alone cannot guarantee success; it must be grounded in well-defined pedagogical strategies. Similarly, Bernard et al. (2018) and Sung et al. (2017) stress that the effectiveness of educational technologies depends on their alignment with instructional goals and the thoughtful planning of implementation processes.

In conclusion, the study provides evidence that AI-supported visualization applications can contribute meaningfully to writing education by supporting multiple dimensions of student learning. However, as Kim et al. (2018) highlight, realizing this potential requires a systematic, well-supported approach. Li et al. (2022) further note that the sustainability of AI's educational impact depends on the careful design, planning, and evaluation of its implementation. As such, the present research offers practical implications for the design of future educational technology initiatives, particularly in writing instruction.

The integration of quantitative and qualitative findings offers a holistic understanding of the effects of AI-supported visualization tools. While the quantitative results showed statistically significant improvements in writing dispositions, the qualitative data revealed the mechanisms driving those improvements. For instance, the increase in the confidence dimension (d = 0.89) was reflected in statements like S1's "creating my own story increased my self-confidence" and S8's "now I can express my ideas more easily." The improvement in the passion dimension (d = 0.98) was supported by emotional reflections such as S3's "writing my own story made me very happy" and S7's "using my imagination excited me." Similarly, the enhancement in the continuity dimension (d = 1.20) was exemplified by comments like S2's "I first imagined the visual, then started writing" and S8's "working with visuals made my writing process more organized." The qualitative analysis also uncovered additional benefits not captured in quantitative measures, including gains in cognitive development, collaborative learning, and digital literacy. This complementarity between data sets enriches the study's conclusions and provides robust insights for educators and researchers.

Despite these promising results, it is important to recognize the potential challenges and limitations associated with the use of AI in educational settings. Researchers such as Zawacki-Richter et al. (2019) have raised concerns about over-reliance on AI technologies and emphasize the need for a balanced integration with traditional pedagogical approaches. Holstein et al. (2019) stress that AI should complement rather than replace human instruction, advocating for teacher-AI collaboration. Ethical considerations, questions of digital equity, and access to AI technologies are also important factors that must be addressed (Pedro et al., 2019). Holmes et al. (2019) argue for a systematic framework that both leverages the opportunities of AI and addresses its limitations to ensure that technology enhances rather than impedes effective teaching and learning.

Therefore, while AI-supported visualization tools show great promise in enhancing writing instruction, their implementation should be approached with critical awareness. Educators must consider these tools as part of a broader pedagogical ecosystem, not as stand-alone solutions. The findings from this research contribute to the growing body of literature on AI in education and offer valuable guidance for designing balanced, effective, and student-centered learning environments in the digital age.

5. Future Implications

Based on the findings of this study examining the effect of AI-supported visualization applications on students' writing dispositions, several recommendations are proposed to inform educational practice and future implementations.

Given the significant improvements observed in all dimensions of writing disposition (confidence, continuity, and passion) among students in the experimental group, and the declines identified in the control group, it is recommended that AI-supported visualization applications be integrated alongside traditional instructional methods in writing education. The systematic use of visualization tools can support and sustain students' engagement and development in writing, particularly by enhancing their affective and cognitive involvement.

To address the initial difficulties and technology-related anxieties reported in the qualitative findings, orientation sessions focused on technology use should be provided at the outset of implementation. These sessions should be tailored to students' prior experiences and technological readiness. A graduated integration model, which introduces AI-supported tools progressively, is also recommended to accommodate individual differences and to promote sustainable positive emotional engagement.

The study revealed that the connection between visual thinking and written expression deepens students' creative writing processes. Therefore, it is recommended to incorporate visualization tools into writing instruction to stimulate creative thinking. Additionally, writing curricula should include activities aimed at developing students' visual thinking strategies, enabling them to conceptualize and organize their ideas more effectively.

In light of the positive dynamics observed in collaborative writing environments, group work should be intentionally integrated with AI-supported visualization applications. However, to prevent the intra-group conflicts identified in some cases, collaborative processes should be carefully structured, and group dynamics should be regularly monitored. Teachers should facilitate group cohesion and provide strategies for managing conflicts constructively.

To reinforce the development noted in students' self-efficacy and self-expression, AI-supported applications should include opportunities that promote student autonomy. This includes allowing students to make choices about writing topics, visualization formats, and project timelines. To further support the development of higher-order thinking skills, students should be encouraged to take greater responsibility in managing and reflecting on their own learning processes.

Given the support needs that emerged during the technology integration phase, it is crucial for teachers to provide continuous guidance throughout the implementation process. Establishing technical support mechanisms, particularly during the early stages, will facilitate students' adaptation to AI-supported tools and minimize disruptions to learning.

Finally, the research demonstrated that AI-supported visualization applications offer rich multimodal learning opportunities that enhance the writing experience. To capitalize on this potential, educators are encouraged to integrate a variety of visual thinking strategies into writing instruction. This includes utilizing diverse visualization tools that promote the simultaneous development of visual and written expression skills, thereby supporting students' overall literacy and communication competencies in the digital age.

6. Limitations

Several limitations should be taken into account when interpreting the findings of this study. First, the relatively small sample size (N = 29) and unequal group distribution (experimental group = 12; control group = 17) may constrain the generalizability of the quantitative results. Second, the study was conducted in a single primary school in Türkiye, which may limit the applicability of the findings to other educational contexts and cultural settings.

Third, the implementation period was limited to three weeks, and as such, the research did not assess the long-term effects of AI-supported visualization applications on students' writing

dispositions. Future studies are needed to explore whether the observed improvements are sustained over time.

In terms of qualitative data, while the mixed methods design enabled a deeper exploration of students' experiences, interviews were conducted with only 10 participants from the experimental group. This limited scope may not fully capture the diversity of experiences across the broader student population.

Given these limitations, future research could expand on this study by implementing larger-scale interventions across diverse educational environments, conducting longitudinal studies to assess lasting impacts, and incorporating more comprehensive qualitative analyses that include participants from both experimental and control groups. Such efforts would enhance the robustness, applicability, and depth of understanding regarding the role of AI-supported visualization tools in writing education.

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