

# Enhancing teacher training for infographic creation and evaluation

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**Abstract.** This study aims to develop an enhanced methodological framework for preparing pre-service teachers to create educational infographics and conduct expert evaluations of their effectiveness. Infographic creation is a complex multidisciplinary endeavor requiring both visual design skills and pedagogical knowledge. We present an updated training model built upon previous research (2015-2020) and enriched with recent advancements in digital competence frameworks, infographic design rubrics, and learning analytics. Our intervention consists of two complementary modules: “Infographics in Educational Activities” and “Expert Evaluation of E-tools’ Quality”. The experimental implementation involved 102 pre-service teachers, with quantitative results demonstrating significant improvements in infographic creation abilities and evaluation competencies in the experimental group across multiple measures. Key advancements include the integration of standards-based assessment frameworks, evolving technological tools for infographic creation, and alignment with digital competence frameworks for educators. This work contributes to the growing field of visual literacy in teacher education, addressing challenges in implementing complex visual representations within educational contexts while providing concrete methodological recommendations for teacher training programs.

**Keywords:** infographic design, teacher digital competence, visual literacy, expert evaluation, educational technology, data visualization

## 1. Introduction

The rapid evolution of digital technologies and the ubiquity of visual information in contemporary society have transformed educational environments, necessitating new approaches to teaching and learning. Modern students, accustomed to processing large volumes of information through multiple channels simultaneously, require educational materials that align with their perceptual preferences and cognitive styles. This transformation demands significant changes in the didactic tools used by teachers, which must be adaptable, responsive, and aligned with current pedagogical methodologies [7].

Infographics have emerged as particularly valuable educational tools, offering structured and systematic visualizations of processes and phenomena in both static and dynamic formats [13]. The educational value of infographics extends beyond mere visual appeal; they represent a powerful means of communication that can enhance comprehension, retention, and engagement with complex information. Recent research by Nuhoğlu-Kibar, Sullivan and Akkoyunlu [22] confirms that infographics enable collaborative knowledge construction and facilitate the sharing of condensed information in educational contexts.

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Several factors drive the growing adoption of infographics in educational settings. First, they represent a contemporary approach to data presentation that resonates with digital natives. Second, the proliferation of infographics in media, advertising, and textbooks necessitates that students develop competencies in interpreting and analyzing visual information. Third, the concise nature of infographics facilitates rapid engagement with content. Fourth, working with infographics fosters critical thinking and analytical skills essential for navigating information-rich environments. Additionally, creating infographics independently constitutes an effective learning strategy, requiring students to collect, select, and systematize information while developing digital literacy skills. These benefits align with emerging educational priorities focused on developing students' capacities for critical information evaluation and visual communication.

The integration of infographics into educational practices, however, requires teachers to possess specific competencies that extend beyond traditional pedagogical knowledge. Ozdamli and Ozdal [23] note that creating effective educational infographics demands both technical prowess and pedagogical insight, representing a complex undertaking that many educators find challenging. This complexity is further highlighted by Jaleniauskiene and Kasperuniene [11], who identify common difficulties faced by novice infographic creators, including challenges with text condensation, narrative structuring, and visual layout.

Within this context, our research addresses the critical need for comprehensive methodological frameworks to prepare pre-service teachers for infographic creation and evaluation. Building upon our previous work conducted between 2015 and 2020, we have developed an enhanced training model that incorporates recent advancements in infographic design rubrics [20], motion infographics [27], and digital competence frameworks for educators [2].

The objectives of this study are threefold: (1) to develop an enhanced methodological framework for preparing pre-service teachers to create and evaluate educational infographics; (2) to implement and evaluate this framework through experimental intervention; and (3) to analyze the effectiveness of the approach through quantitative and qualitative assessment methods.

## **2. Theoretical framework and recent developments**

### **2.1. Evolution of visual literacy in teacher education**

The theoretical foundations of using visual tools in education have evolved significantly over the past decade. The research by Bartlett [1], Bilousova and Zhyteneva [3], Davydov [6], and others established the fundamental understanding that visualization serves as a powerful means of reflecting the objective world in subjective cognition. More recently, scholars have expanded this foundation to consider how visualization can address the challenges of information overload in digital environments.

Visual literacy – the ability to interpret, evaluate, and create visual materials – has been recognized as a core competency for educators in the digital age. Makhachashvili, Kovpik and Bakhtina [15] emphasize that visual literacy enables teachers to communicate complex ideas effectively and engage students through multiple modalities. This perspective is further developed by Nkosinkulu [19], who positions infographics as a dynamic visual tool that transcends generational boundaries and establishes a universal language of comprehension.

The development of modern visualization tools has catalyzed innovation in both teaching methodologies and pedagogical technologies. Manko [16] conceptualizes visualization as the foundation for a qualitatively new stage in the development of the fundamental principle of learning – the principle of clarity. This transformation

has significant implications for teacher education, as highlighted by Bilousova and Zhyteneva [3], who emphasize the need for early preparation of teachers in visual literacy.

## **2.2. Infographic Design Models and Assessment Frameworks**

Recent advances in infographic design theory have provided structured approaches to creating and evaluating visual representations. The Infographic Design Model (IDM) and Infographic Design Rubric (IDR) developed by Nuhuğlu Kibar and Akkoyunlu [20] offer a criteria-based framework for creating and assessing infographics. Their model comprises three main components: content generation, visual design generation, and digital design. This framework provides a systematic approach to infographic creation that can be taught to pre-service teachers and incorporated into educational practice.

Building on this foundation, Nuhuğlu Kibar and Akkoyunlu [21] developed a comprehensive process model for infographic generation as a learning strategy. Their educational design research employed iterative cycles of analysis, design, and evaluation to refine the process. The resulting model includes steps such as content acquisition, infographic design information, content preparation, content generation, visual design generation, draft generation, and digital design. This structured approach aligns with educational design principles and provides a clear pathway for teaching infographic creation to educators.

Assessment frameworks for evaluating infographic quality have also evolved substantially. Fragou and Papadopoulou [9] proposed a modular evaluation framework for assessing infographics in higher education contexts, focusing on aspects such as content generation, information visualization, and data representation. Similarly, Caccamo [4] developed an approach to evaluate the accessibility of infographics using the System Usability Scale (SUS), highlighting the importance of considering user experience and accessibility in infographic design.

These frameworks provide essential structures for teaching infographic creation and evaluation to pre-service teachers, enabling them to develop both technical skills and critical assessment capabilities.

## **2.3. Digital competence frameworks for educators**

The concept of digital competence has become increasingly central to teacher professional development. Several frameworks have emerged to define and structure the digital competencies required by educators in contemporary educational environments. The European Framework for the Digital Competence of Educators (DigCompEdu), as described by Kullaslahti, Ruhalahti and Brauer [14], outlines essential digital skills for educators, emphasizing the integration of digital technologies into teaching and learning processes. This framework identifies key areas including digital content creation, communication and collaboration, and empowering learners.

More recently, Tondeur et al. [26] developed the Higher Education Digital Competence (HeDiCom) framework, which includes four dimensions of teachers' digital competencies: teaching practice, empowering students for a digital society, teachers' digital literacy, and teachers' professional development. This framework specifically addresses the needs of higher education contexts but offers valuable insights for teacher education more broadly.

McGarr [17] provides a critical analysis of digital competence frameworks, arguing that while they offer helpful guidance for policy makers and teacher educators, they may inadvertently constrain teachers' professional autonomy if applied mechanistically. This perspective highlights the importance of integrating digital competence frameworks into teacher education in ways that foster critical engagement rather than mere compliance.

The creation and evaluation of infographics represent concrete applications of digital competence, requiring teachers to demonstrate skills in digital content creation, information literacy, and critical assessment. By aligning infographic training with established digital competence frameworks, teacher education programs can situate specific technical skills within broader professional development contexts.

#### **2.4. Technological advancements in infographic creation**

The landscape of tools and technologies for creating infographics has evolved significantly in recent years. Traditional software for infographic creation required substantial technical expertise, limiting accessibility for many educators. However, contemporary web-based tools have democratized the process, making infographic creation more accessible to users with varying levels of technical proficiency.

Jaleniauskiene and Kasperuniene [10] categorized the current ecosystem of infographic creation tools into three groups: (1) tools primarily designed for infographic creation, (2) platforms offering a wider range of visualization forms with semi-automated processes requiring minimal training, and (3) universal graphic editing tools that demand prior knowledge for creating visual materials. This diversity of tools offers multiple entry points for teachers with different skill levels and technical backgrounds.

A particularly significant advancement has been the development of motion infographic systems, as described by Tsai, Huang and Chang [27]. These systems combine continuous images with simplified information, addressing limitations of static images and potentially enhancing information retention. Research indicates that motion infographics can be particularly effective for students with learning challenges, demonstrating improved academic achievement and comprehension of visual content compared to traditional static visualizations.

Another emerging trend is the application of artificial intelligence and natural language processing to infographic creation. Neema and Purohit [18] described an automatic infographic builder that generates visualizations from natural language statements, using deep neural networks to dynamically select appropriate graphics and images. This approach significantly reduces the technical barriers to infographic creation, potentially making the process more accessible to educators with limited design experience.

These technological advancements have important implications for teacher education, suggesting the need for flexible training approaches that account for rapidly evolving tools while emphasizing fundamental principles of visual communication that transcend specific technologies.

### **3. Methodology**

#### **3.1. Research design**

This study employed a quasi-experimental design with control and experimental groups to evaluate the effectiveness of our enhanced training model for developing pre-service teachers' competencies in creating and evaluating educational infographics. The research was conducted over a six-month period (September 2022 - February 2023) at H. S. Skovoroda Kharkiv National Pedagogical University, building upon our previous work conducted between 2015 and 2020.

The study incorporated both quantitative and qualitative methods to provide a comprehensive understanding of the training's effectiveness. Quantitative data were collected through pre- and post-intervention assessments, while qualitative data were gathered through observations, interviews, and analysis of participants' infographic artifacts.

### 3.2. Participants

The study involved 102 pre-service teachers enrolled in undergraduate and master's programs in education. Participants were divided into experimental ( $n=60$ ) and control ( $n=42$ ) groups. The assignment to groups was based on existing academic groupings, with proportional representation of students across different specializations and academic years.

To ensure comparability between groups, a preliminary assessment was conducted to measure participants' baseline knowledge and skills related to infographic creation and evaluation. This assessment included a survey on prior experience with infographics, knowledge of digital tools, and self-efficacy in creating visual educational materials. Statistical analysis using Pearson's criterion confirmed no significant differences between the control and experimental groups at baseline.

### 3.3. Enhanced training modules

Building on our earlier framework, we developed an enhanced training program consisting of two integrated modules: "Infographics in Educational Activities" and "Expert Evaluation of E-tools' Quality". The content and structure of these modules were updated to incorporate recent advances in infographic design models, digital competence frameworks, and technological tools, as described in table 1.

The modules were implemented through a combination of lectures, workshops, practical sessions, and independent project work. The experimental group received the enhanced training program, while the control group participated in the original training modules developed during our 2015-2020 research. Both groups completed the same assignments and assessments, enabling direct comparison of outcomes.

### 3.4. Data collection and analysis

Data were collected through multiple instruments:

1. Pre- and post-intervention surveys assessing knowledge, skills, and attitudes related to infographic creation and evaluation.
2. Practical assessments of participants' ability to create infographics for specific educational purposes.
3. Expert evaluation tasks requiring participants to assess the quality of sample infographics.
4. Observation protocols documenting participants' engagement and challenges during training activities.
5. Semi-structured interviews with a subset of participants to gather qualitative insights.
6. Analysis of infographic artifacts created by participants using the IDR framework.

Quantitative data were analyzed using both descriptive and inferential statistical methods. For comparing pre- and post-intervention measures, paired t-tests were employed. Differences between experimental and control groups were assessed using independent samples t-tests and Pearson's criterion. Qualitative data were analyzed through thematic content analysis, identifying patterns, challenges, and insights related to participants' experiences with the training program.

## 4. Results

### 4.1. Development of infographic creation skills

The analysis of pre- and post-intervention assessments revealed significant improvements in participants' ability to create educational infographics, with the experimental group demonstrating greater gains compared to the control group. Table 2 presents

**Table 1**

Enhanced modules for infographic training.

<b>Module component</b>	<b>Original content (2015-2020)</b>	<b>Enhancements (2022-2023)</b>
<b>Module 1: Infographics in educational activities</b>		
Theoretical foundations	Basic concepts of infographics and visualization	Integration of IDM framework [20] and alignment with DigCompEdu competence areas [14]
Typology	Static infographics categorization	Expanded to include motion infographics [27] and interactive visualizations [25]
Design principles	General visual design principles	Structured approach based on IDR criteria [20] with emphasis on accessibility [5]
Tool mastery	Basic software introduction	Expanded toolkit including web-based, AI-assisted, and motion infographic tools [10]
Practical application	Creation of simple infographics	Team-based collaborative infographic creation [22] with peer feedback processes
<b>Module 2: Expert evaluation of e-tools' quality</b>		
Evaluation frameworks	Basic quality criteria	Integration of IDR [20] and modular evaluation frameworks [9]
Assessment methods	Simple rating scales	Multi-criteria assessment incorporating weighting factors and expert consensus methods [24]
Data analytics	Basic statistical analysis	Integration of learning analytics principles for data-informed evaluation [12]
User experience	Limited consideration	Expanded focus on accessibility, usability, and user experience evaluation [5]
Improvement strategies	General recommendations	Structured improvement framework based on assessment results and data storytelling principles [8]

the percentage of participants in each group who achieved different competency levels across key skill dimensions.

As shown in table 2, the experimental group demonstrated markedly higher percentages of participants achieving sufficient and high competency levels across all skill dimensions. Particularly notable improvements were observed in participants' awareness of infographics as a didactic tool, ability to use expert evaluation methods, and ability to assess compliance with requirements for educational materials.

Statistical analysis using Pearson's criterion confirmed that these differences were significant, with  $\chi^2$  values ranging from 9.3 to 27.8 (all exceeding the critical value), indicating the effectiveness of the enhanced training program.

#### **4.2. Expert evaluation competencies**

A key aspect of our enhanced training program was the development of participants' ability to conduct expert evaluations of educational infographics. As part of this

**Table 2**

Comparison of infographic creation skills by group (percentage of participants).

<b>Skill dimension</b>	<b>Group</b>	<b>Low level</b>	<b>Medium level</b>	<b>Sufficient level</b>	<b>High level</b>
Awareness of infographics as a didactic tool	C	42.9	28.6	16.7	11.9
	E	5.0	20.0	35.0	40.0
Ability to structure educational material	C	26.2	31.0	23.8	19.0
	E	10.0	15.0	45.0	30.0
Ability to use tools for creating infographics	C	23.8	35.7	23.8	16.7
	E	8.3	16.7	43.3	31.7
Knowledge of quality requirements	C	19.0	42.9	26.2	11.9
	E	6.7	26.7	38.3	28.3
Ability to use expert evaluation methods	C	42.9	33.3	23.8	0.0
	E	10.0	16.7	33.3	40.0
Ability to assess compliance with requirements	C	19.0	28.6	42.9	9.5
	E	3.3	6.7	48.3	41.7

process, participants in both groups were asked to identify and rank criteria for evaluating infographics, then apply these criteria to sample materials.

Table 3 presents the weighting factors assigned to different evaluation criteria by participants in the experimental group, based on the expert consensus method.

**Table 3**

Weighting factors for evaluation criteria in experimental group.

<b>Evaluation criterion</b>	<b>Rank</b>	<b>Inverse rank sum</b>	<b>Weighting factor</b>
Correlation with curriculum content	1	0.45	0.35
Structural clarity and conciseness	2	0.40	0.31
Adherence to pedagogical principles	3	0.24	0.19
Adherence to ergonomic demands	4	0.19	0.15

The concordance coefficient for these rankings was  $W = 0.57$ , indicating a moderate degree of consensus among participants. This finding is significant as it demonstrates that participants in the experimental group developed not only individual evaluation skills but also a shared understanding of quality standards for educational infographics.

When applying these criteria to sample infographics, participants in the experimental group demonstrated significantly greater consensus and analytical sophistication compared to the control group. They were more likely to identify specific strengths and weaknesses in the materials and to propose targeted improvements based on objective criteria rather than subjective preferences.

### 4.3. Qualitative findings

Qualitative data collected through observations and interviews revealed several important insights about participants' experiences with the enhanced training program.

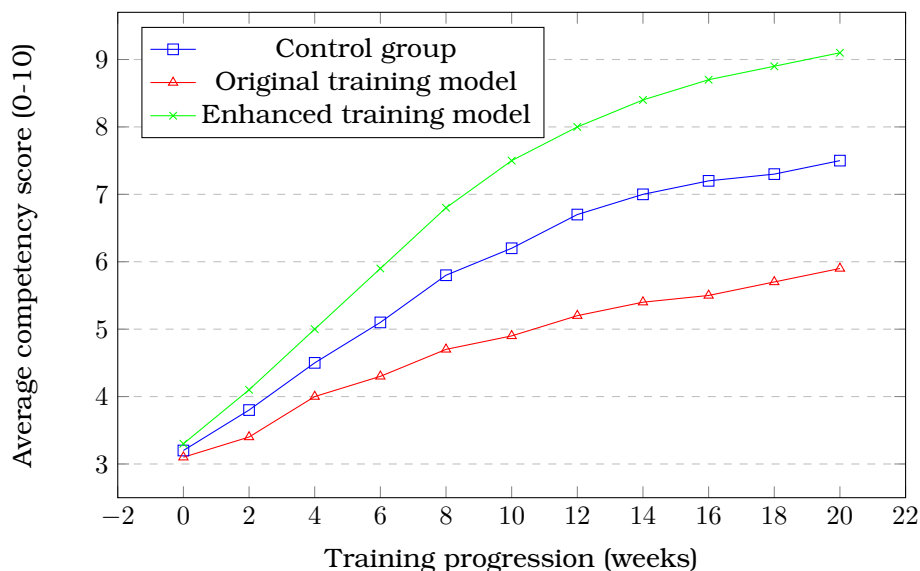
First, participants in the experimental group reported initially feeling overwhelmed by the complexity of creating high-quality infographics, particularly when attempting to balance visual appeal with pedagogical effectiveness. However, as they progressed through the structured modules, many described experiencing "breakthrough moments" where concepts and techniques suddenly cohered into a unified approach.

Second, the integration of recent frameworks and models, particularly the IDM and IDR, was cited by many participants as especially valuable. One participant noted: “Having clear criteria for what makes an effective infographic helped me move beyond simply making something that looks good to creating something that actually teaches effectively”.

Third, the collaborative aspects of the enhanced program were highlighted as particularly beneficial. Team-based projects enabled participants to leverage diverse skills within groups and learn from peers with different strengths. This collaborative dimension aligns with findings from Nuhoglu-Kibar, Sullivan and Akkoyunlu [22], who emphasized the value of cooperative approaches to infographic creation.

Finally, participants appreciated the explicit connections drawn between infographic creation skills and broader digital competence frameworks. Several noted that understanding how these specific skills fit within their overall professional development as educators gave the training greater relevance and applicability.

Figure 1 illustrates the progression of average competency scores across the training period, comparing the control group, participants receiving the original training model, and those receiving the enhanced training model. The data show a clear advantage for the enhanced training approach, with a steeper learning curve and higher ultimate achievement levels.



**Figure 1:** Progression of average competency scores over training period.

## 5. Discussion

### 5.1. Key findings and theoretical implications

Our findings demonstrate that the enhanced training program significantly improved pre-service teachers’ abilities to create and evaluate educational infographics across multiple dimensions. The integration of structured frameworks such as IDM and IDR, alignment with digital competence standards, and incorporation of collaborative approaches contributed to these positive outcomes.

These results align with and extend previous research in several important ways. First, they support assertion by Nuhoglu-Kibar, Sullivan and Akkoyunlu [22] that infographic creation can function effectively as a collaborative learning strategy when supported by appropriate scaffolding. Our enhanced program provided this scaffolding through structured activities, clear criteria, and opportunities for peer feedback.

Second, the findings demonstrate the value of integrating formal assessment frameworks into infographic training, as suggested by Fragou and Papadopoulou [9] and Caccamo [5]. The experimental group's ability to apply consistent evaluation criteria and achieve greater consensus in quality assessments indicates that structured approaches to evaluation enhance analytical capabilities.

Third, the results suggest that explicitly connecting specific technical skills (such as infographic creation) to broader professional competence frameworks enhances perceived relevance and application. This supports emphasis of Tondeur et al. [26] on integrating digital skills within comprehensive competence models rather than teaching them as isolated capabilities.

From a theoretical perspective, our findings contribute to understanding how visual literacy development intersects with broader digital competence frameworks in teacher education. They suggest that specific visual communication skills develop most effectively when situated within comprehensive professional development frameworks that address both technical and pedagogical dimensions.

## 5.2. Practical implications for teacher education

Our research has several practical implications for teacher education programs seeking to develop pre-service teachers' visual literacy and infographic creation skills:

1. Structured frameworks enhance skill development and assessment. The integration of models such as IDM and IDR provided clear pathways for both learning and evaluation, suggesting that similar frameworks should be incorporated into visual literacy training.
2. Collaborative approaches yield superior results. The team-based projects in our enhanced program fostered peer learning and enabled participants to leverage diverse skills, indicating that infographic creation should be taught as a collaborative rather than purely individual endeavor.
3. Explicit connections to professional standards increase relevance. By aligning infographic training with established digital competence frameworks, we enhanced participants' understanding of how these skills contribute to their broader professional development.
4. Technological diversity should be embraced. Our enhanced program incorporated a range of tools, from basic to advanced, acknowledging that teachers will work in diverse technological environments. This approach prepares educators to adapt their skills across contexts rather than being dependent on specific tools.
5. Assessment competencies require deliberate development. The significant improvements in evaluation abilities among the experimental group highlight the importance of explicitly teaching assessment approaches rather than assuming these skills will develop naturally alongside creation capabilities.

These implications suggest that teacher education programs should adopt comprehensive approaches to visual literacy development that integrate structured frameworks, collaborative methodologies, and explicit connections to professional standards.

## 5.3. Challenges and limitations

Despite the positive outcomes observed in our study, several challenges and limitations merit consideration. First, creating effective educational infographics requires a diverse skill set that includes both technical abilities and pedagogical knowledge. Many participants struggled to balance these dimensions, confirming findings from Jaleniauskiene and Kasperiuoniene [11] regarding common challenges faced by novice infographic creators.

Second, the rapid evolution of technological tools presents ongoing challenges for teacher education programs. Tools that are current today may become obsolete relatively quickly, suggesting the need for approaches that emphasize fundamental principles and adaptable skills rather than proficiency with specific applications.

Third, our study was conducted in a specific institutional context with pre-service teachers, potentially limiting generalizability to other settings or to in-service teacher professional development. The effectiveness of similar training approaches in different contexts requires further investigation.

Fourth, while our study demonstrated improvements in infographic creation and evaluation skills, it did not directly assess the impact of these skills on teaching effectiveness or student learning outcomes. Longitudinal research examining how teachers apply these competencies in classroom settings would provide valuable insights into the ultimate educational value of infographic training.

Finally, our enhanced program required significant time and resource investments, which may present implementation challenges in resource-constrained educational settings. Developing more efficient delivery models while maintaining effectiveness represents an important direction for future work.

## 6. Conclusion

This study developed and evaluated an enhanced training program for preparing pre-service teachers to create and evaluate educational infographics. By integrating recent advances in infographic design models, digital competence frameworks, and assessment approaches, the program significantly improved participants' visual literacy skills across multiple dimensions.

The research contributes to the field by demonstrating the effectiveness of structured, collaborative approaches to visual literacy development in teacher education. It provides empirical evidence supporting the integration of formal frameworks such as IDM and IDR into teacher training and highlights the value of explicitly connecting specific technical skills to broader professional competence models.

Future research should extend these findings by examining the long-term impact of such training on teaching practices, investigating applications in diverse educational contexts, and exploring more efficient delivery models. Additionally, studies examining how teachers adapt infographic creation skills to emerging technologies would provide valuable insights into the sustainability of visual literacy training in rapidly evolving digital environments.

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