

OPTIMIZATION OF STUDENTS' LEARNING PROCESS THROUGH THE USE OF EFFECTIVE INFOGRAPHICS TOOLS

OTIMIZAÇÃO DO PROCESSO DE APRENDIZAGEM DOS ALUNOS ATRAVÉS DO USO DE FERRAMENTAS INFOGRÁFICAS EFICAZES

OPTIMIZACIÓN DEL PROCESO DE APRENDIZAJE DE LOS ESTUDIANTES MEDIANTE EL USO DE HERRAMIENTAS INFOGRÁFICAS EFICACES



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ABSTRACT: This article examines the use of infographics as a didactic resource for optimizing students' learning processes in higher education. Although visual tools are increasingly associated with digital learning environments, their pedagogical use still requires clearer articulation between theoretical assumptions, empirical data, and teaching practices. The study aimed to analyze how infographics are used by teachers and students and to discuss their contribution to the perception, organization, and assimilation of educational content. Methodologically, the research combined bibliographic analysis, observation of the educational process, preliminary interviews, and an online questionnaire answered by 648 undergraduate students at Admiral Makarov National University of Shipbuilding. The results indicate frequent student use of infographics in academic tasks and comparatively less systematic use by teachers during lectures. The findings suggest that infographics can support cognitive organization, reduce information overload, and improve access to complex content when intentionally integrated into pedagogical planning.

KEYWORDS: Infographics. Visualization. Genre features. Visual content. Data broadcasting.

RESUMO: O artigo apresenta uma análise abrangente das abordagens teóricas do conceito de infográficos, tal como aplicado na prática doméstica e em contextos científicos e pedagógicos. A infografia é uma tendência educativa moderna e uma ferramenta eficaz para melhorar a transformação verbal-visual e a assimilação de informações de aprendizagem em diferentes níveis educativos. O estudo reconstrói a evolução histórica dos materiais infográficos, desde imagens simples e protótipos cartográficos até visualizações dinâmicas contemporâneas. É dada especial atenção ao desenvolvimento tecnológico destinado a estruturar grandes conjuntos de dados, garantindo simultaneamente a acessibilidade e a eficiência da percepção. O artigo sistematiza os principais tipos e formas de infográficos, incluindo modelos estatísticos, cronológicos, comparativos, geográficos e dinâmicos, bem como as principais ferramentas de visualização. São descritos os requisitos formais de design. É proposto um esquema conceptual para a apresentação de materiais educativos, que serve de base para o desenvolvimento de recursos didáticos, juntamente com recomendações sobre recursos digitais e software profissional para conteúdos visuais de alta qualidade.

PALAVRAS-CHAVE: Infográficos. Visualização. Características do gênero. Conteúdo visual. Transmissão de dados.

RESUMEN: El artículo ofrece un análisis exhaustivo de los enfoques teóricos del concepto de infografía tal y como se aplica en la práctica doméstica y en contextos científicos y pedagógicos. La infografía es una tendencia educativa moderna y una herramienta eficaz para mejorar la transformación verbal-visual y la asimilación de la información de aprendizaje en diferentes niveles educativos. El estudio reconstruye la evolución histórica de los materiales infográficos, desde simples imágenes y prototipos cartográficos hasta visualizaciones dinámicas contemporáneas. Se presta especial atención al desarrollo tecnológico destinado a estructurar grandes conjuntos de datos, garantizando al mismo tiempo la accesibilidad y la eficiencia de la percepción. El artículo sistematiza los principales tipos y formas de infografía, incluidos los modelos estadísticos, cronológicos, comparativos, geográficos y dinámicos, así como las herramientas de visualización clave. Se describen los requisitos formales de diseño. Se propone un esquema conceptual para la presentación de materiales educativos, que sirve de base para el desarrollo de material didáctico, junto con recomendaciones sobre recursos digitales y software profesional para contenidos visuales de alta calidad.

PALABRAS CLAVE: Infografía. Visualización. Características del género. Contenido visual. Difusión de datos.

INTRODUCTION

Modern Ukrainian teacher education is in a state of transformation, which is determined not only by the European vector, but also by the challenges faced by Ukraine and the world: the pandemic and the war. These factors actualize the problem of modernizing the educational and methodological support of educational components. Special attention should be paid to the need to adapt the content to the cognitive characteristics of the generation whose worldview and ways of processing information are inextricably linked to the digital environment (Makarova & Makarov, 2018). Today's students are characterized by a high speed of information search, personal educational directions and trajectories, as well as the desire for continuous self-actualization. Given the predominance of the visual channel of perception among today's youth, the implementation of infographics in the educational process appears to be a strategically sound step. Infographics is viewed not only as an auxiliary didactic tool, but as a comprehensive methodology for structuring complex models that interact with each other and allow for the fulfillment of various functions, including:

- holistic formation of images and concepts through the systematization of large amounts of data in an understandable form;
- formation of interactive interaction (according to the concept of Nkosinkulu (2024); formally, the nature of infographics helps to stimulate active perception of information in the learning process, while integrating personal individual experience into a single cognitive repository).

In the context of the digitalization of education, the ability to perceive and assimilate complex data in a clear, meaningful, and aesthetically pleasing form is a mandatory competence of a teacher. A high degree of organization, technology, and ergonomics of infographic objects allows you to quickly optimize the cognitive load on a higher education student, while ensuring comfortable navigation within the educational material.

The impact of visualization goes far beyond the purely pedagogical plane, focusing on the economy of the global education sector. According to some studies (Bhat & Alyahya, 2024), the widespread use of infographics in the educational process helps to minimize costs while increasing academic productivity; improves learning outcomes and creates new segments in the labor market; optimizes marketing strategies and recruitment campaigns of educational institutions. According to many experts, the intensive development and widespread use of

infographics contributes to the formation of conditions for the development of the educational environment as a whole.

Despite the growing presence of infographics in educational environments, their use is often discussed mainly as a technological or design resource, without sufficient attention to the pedagogical conditions that make them effective in the learning process. In this sense, it is necessary to examine not only the formal characteristics of infographics, but also how teachers and students actually use them in higher education practices. This gap is particularly relevant in contexts marked by the expansion of digital learning, the acceleration of information flows, and the need to adapt educational materials to students' cognitive and communicative habits.

Therefore, the objective of this article is to analyze the role of infographics in optimizing students' learning processes, considering both theoretical approaches to visual communication and empirical data on their use by teachers and undergraduate students. More specifically, the study seeks to identify the frequency of infographic use in lectures and academic tasks, discuss the pedagogical functions attributed to these tools, and propose recommendations for their more effective integration into educational practice.

LITERATURE REVIEW

The use of infographics as a tool for achieving goals has been studied by scholars from different countries. In particular, Gottlieb et al. (2022) considered infographics to be a valuable tool for improving the perception of educational information. In their work, the researchers argue that there are ten strategies that contribute to the creation of high-quality educational infographics for any profession. They include:

- selection of appropriate information content, as well as determination of the target audience, presentation format, choice of software platform or software;
- use of pre-agreed fonts, styles, colors and schemes;
- Increasing the use of images that provide a consistent flow of ideas without the use of copyright, as well as the ability to get feedback from different ways of disseminating data.

Smiciklas (2012) describes the ways and possibilities of using the powerful and diverse ways of infographics, in particular through visual display, which can transform complex data

sets or concepts into intuitive formats that are easily and quickly perceived by humans. The author proves that infographics are useful for communication and will remain so even if current trends change the vector of development (Troianov, 2021). Smiciklas (2012) explores some classical types of graphic forms of work organization, as well as examines in detail the ways in which metaphors can be used to create infographics, and offers opportunities to organize information, ways to publish it, promote it, and get the most out of it.

Murray et al. (2017) and his team concluded in the course of their research that this particular tool can significantly improve the perception and assimilation of information through visualization.

Shemy (2022) investigates the impact of each style of infographics (static and dynamic) on the development of visual creativity and on reducing students' cognitive load. According to the author, dynamic infographics influence human thinking through visualization, especially at a young age, while reducing the cognitive load on the brain. At the current stage of education development, infographics is not only a visual tool, but also a transformational tool that shapes the way complex information is presented and assimilated.

Researchers have studied in detail the twenty most popular ways of creating infographics to better understand what makes them effective, especially when it comes to training infographic designers (Dunlap & Lowenthal, 2016).

Klepar et al. (2021), studying the history of the emergence and development of infographics, made an attempt to formulate the essence of the concept of "infographics," studied the opportunities and problems of using them in the educational process, and substantiated the stages of creating a high-quality final product.

Vovk and Cheremsky (2017), studying the problem of effective use of infographics in terms of existing competencies, emphasize that with the help of well-created visualization tools (graphs, illustrations, design, animation, map schemes, electronic resources, videos, etc.), a person can easily perceive large amounts of information displayed by infographics. The researchers analyzed the existing types and classifications and identified the characteristic features and differences.

In the textbook *Data Visualization and Infographics* by Mulyar (2020), the author professionally and accessibly covers the theoretical foundations of data visualization and infographics. Based on existing cases, the author tried to prove the possibility of creating charts and graphs in Google Sheets; analyzed the features of working with the Google Analytics web analytics system; considered the web interface of the Google Tag Manager service.

The theoretical definition of the concept of “infographics” is detailed in the guidelines by Leshnivska and Dmytriv (2024). The manual analyzes the most common types of infographics, in particular, the sequence of creating visual infographic materials, collecting information and methods of communicating information to the consumer, including available web resources.

The purpose of the work is to highlight the unique functions of infographics that can be used as a way to study and memorize material in the context of the educational environment, systematizing and implementing the tools of modern technologies in the professional training of higher education students, based on existing research.

To ensure an objective approach, an integrated approach was applied, which includes the following research methods: theoretical and analytical analysis to study pedagogical, didactic and linguistic influence; generalization of theoretical concepts and design of an innovative methodological system for using various models for learning material in higher education; observation of the educational process and critical analysis of the structure and content of teaching and learning materials; interviews and questionnaires.

METHODOLOGY

This study is characterized as a bibliographic, descriptive, and exploratory research, combining theoretical analysis with empirical data collected in a higher education context. The bibliographic stage focused on studies concerning infographics, data visualization, visual literacy, cognitive load, and the pedagogical use of digital resources. The empirical stage was carried out at Admiral Makarov National University of Shipbuilding and involved undergraduate students from the first to the fifth year.

Data collection included an audit of teaching and methodological materials, observation of classroom practices, preliminary interviews with students, and an online questionnaire. The questionnaire was designed to identify the frequency with which infographics are used by teachers during lectures and by students in the preparation and presentation of academic tasks. A total of 648 students answered the questionnaire.

The data were analyzed through descriptive statistics and interpreted in dialogue with the theoretical framework on visualization, cognitive organization, and educational communication. The analysis sought not only to quantify the reported use of infographics, but

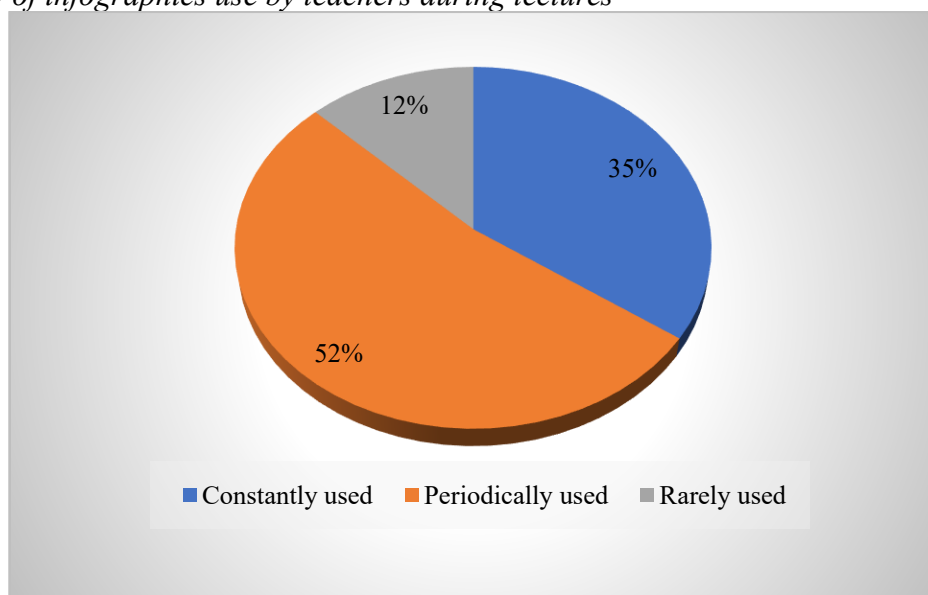
also to understand how these tools may contribute to the organization of complex information, the reduction of cognitive overload, and the improvement of students' learning experiences.

RESULTS

Based on the results of answering the second question about the independent development of visual content, it can be stated that students use visualization for their work much more often than teachers, in particular: 60% of respondents constantly add their own infographics to their answers as an accompaniment; 25% of respondents use it often; 10% visualize their work material periodically; only 5% of respondents do not use graphic methods in the learning process at all. It is worth noting that students prefer structural and logical classical diagrams, as well as tables and mind maps. Cartographic methods are the least common and narrative visualization formats are almost never used.

Figure 1.

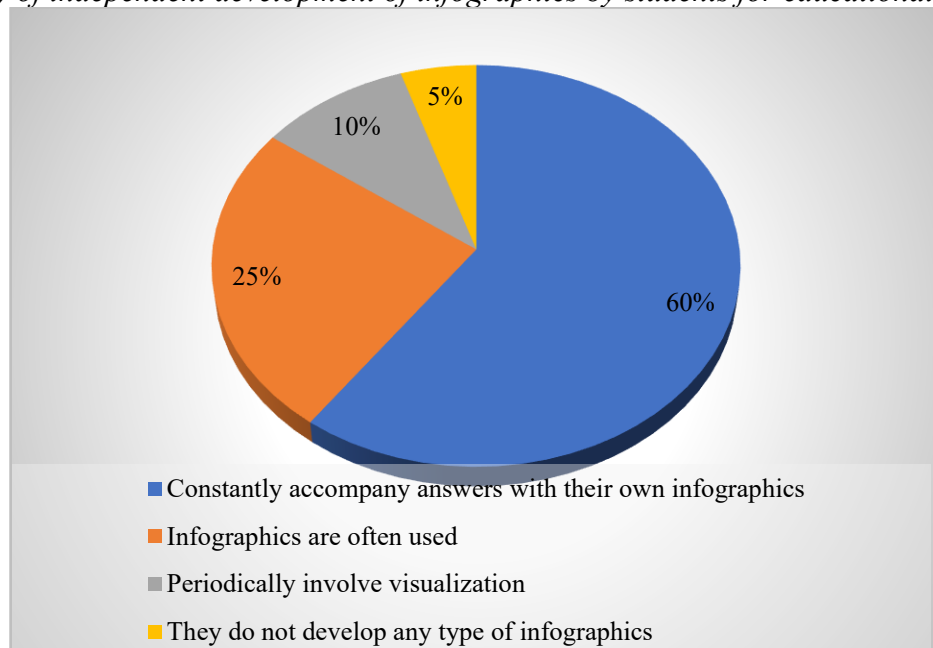
Frequency of infographics use by teachers during lectures



Note. The Authors.

Figure 2.

Frequency of independent development of infographics by students for educational purposes



Note. The Authors.

When asked about the benefits of introducing infographics into their work process, most students surveyed highlighted that of particular importance is the clarity of the display, conciseness, as well as convenience of graphics, even for working with large databases. The following content visualization functions were also mentioned:

1. The ability to display the interaction between different elements in dynamics.
2. A clear architecture that helps to organize complex theoretical constructs.
3. The ability to provide a clear exposition of data sets that require additional cognitive effort to analyze.
4. A pronounced preference for visual methods over traditional textual formats.

The results of the study confirm the hypothesis of a high level of visualization effectiveness in ensuring a comfortable perception of information by participants in the educational process.

DISCUSSION

The results of the study indicate that infographics are already present in the educational practices analyzed, although their use is not equally distributed between teachers and students.

According to the survey, 33% of respondents reported that university teachers use infographics regularly during lectures, 50% indicated periodic use, and 12% stated that such resources are rarely used. These data suggest that, although infographics have been incorporated into teaching practices, their use still appears to be occasional or insufficiently systematic for a significant part of the educational experience.

This finding is relevant because it shows that the pedagogical potential of infographics depends not only on their availability as digital or visual tools, but also on the intentionality with which they are integrated into the organization of educational content. The predominance of periodic use suggests that infographics may still be treated as complementary resources, used to support specific topics or moments of instruction, rather than as part of a broader methodological strategy for structuring learning.

The students' responses point to another important aspect: they seem to use infographics more frequently in their own academic activities than teachers use them during lectures. According to the survey, 60% of respondents constantly accompany their answers with their own infographics, 25% often use them, 10% periodically involve visualization, and only 5% do not develop any type of infographic for educational purposes. These data suggest that students recognize the value of visual organization in the presentation of knowledge and that they may already be incorporating visual literacy practices into their learning routines.

This contrast between teacher use and student use is one of the central findings of the study. It indicates that students' learning practices are already strongly influenced by visual forms of communication, while institutional teaching practices may not yet fully integrate these resources into pedagogical planning. Therefore, the use of infographics in higher education should not be understood only as a matter of technological modernization, but as a didactic issue related to how knowledge is selected, organized, represented, and interpreted in the classroom.

These results dialogue with the theoretical perspective according to which infographics can contribute to the structuring of complex information and to the reduction of cognitive overload. Visualization is defined as a systematic graphical display of information and empirical data (Tufte, 1998). In this sense, the students' frequent use of infographics in their own academic tasks corroborates the idea that visual resources can facilitate the organization of information, especially when learners need to synthesize content, establish relations between concepts, or present large amounts of data in a concise form.

According to Okunkova (2022), the design of infographics should prioritize the graphic component without eliminating the conceptual accuracy of the information presented. This principle is particularly relevant to the data collected in the present study, since students reported valuing clarity, conciseness, convenience in dealing with large databases, and the possibility of displaying dynamic interactions between different elements. These responses indicate that students do not perceive infographics merely as decorative resources, but as tools that help them manage information and construct meaning.

Dunlap and Lowenthal (2016) also argue that the effectiveness of infographics lies in their capacity to concentrate relevant content in a limited visual space while preserving clarity and accuracy. The findings of this study support this argument, but also indicate that the effectiveness of infographics cannot be understood as an automatic consequence of visualization itself. The mere use of images, diagrams, charts, or maps does not guarantee better learning. Infographics become pedagogically effective when they are designed according to the learning objective, the characteristics of the content, and the cognitive needs of students.

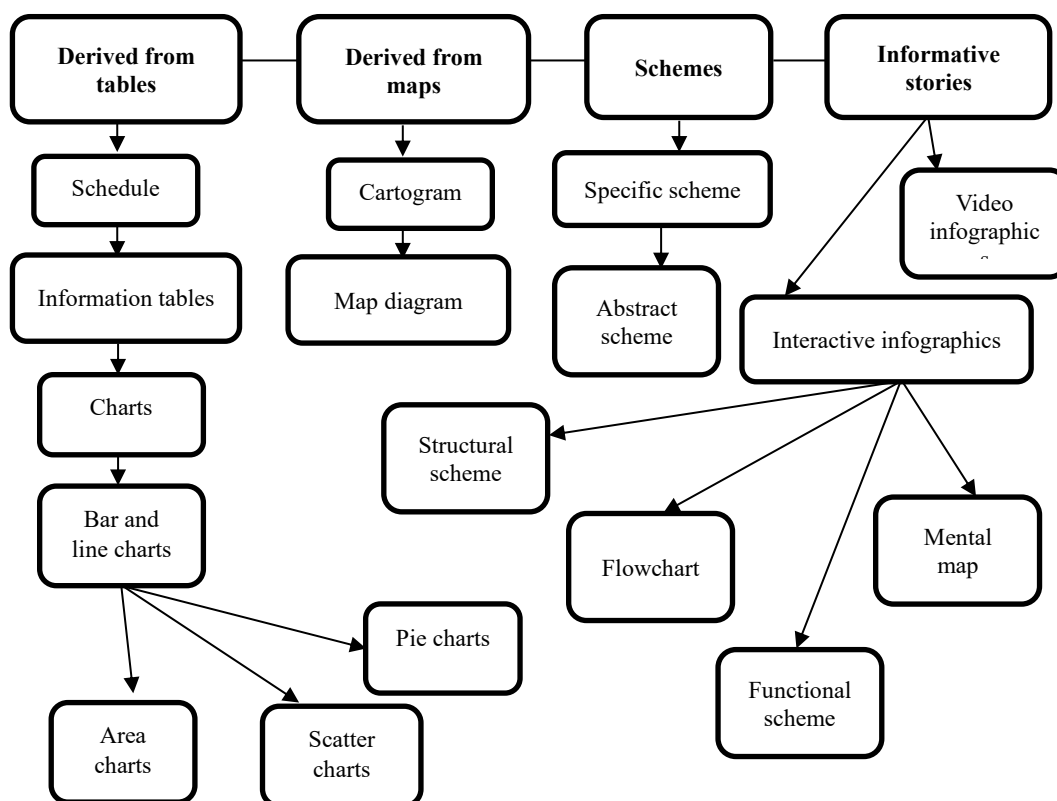
In this sense, the data partially corroborate the theoretical literature on the pedagogical value of visualization, but they also expand the discussion by showing the need for teacher mediation. If students already use infographics frequently in their academic activities, teachers can play an important role in helping them produce and interpret these materials critically. This includes discussing criteria such as clarity, hierarchy of information, accuracy of data, visual coherence, readability, and correspondence between form and content.

Therefore, infographics should be understood not only as visual products, but also as pedagogical processes. Their educational value is not restricted to the final image or diagram, but also involves the stages of selecting information, establishing hierarchies, identifying conceptual relations, and translating verbal or numerical data into visual structures. When these stages are incorporated into teaching and learning activities, infographics can contribute to the development of students' analytical, communicative, and digital competences.

The historical development of data visualization, from statistical charts associated with W. Playfair to the visual communication principles later systematized by authors such as Tufte (1998), shows that infographics have long been connected to the need to make complex information intelligible. However, in the context of the present study, this historical background is relevant mainly because it reinforces the idea that visual representation requires methodological criteria. Educational infographics should not only attract attention, but also organize knowledge, guide interpretation, and support the learner's cognitive activity.

Considering that students reported frequent use of infographics in their own academic tasks, it becomes necessary to provide methodological guidance on the types of visual resources that may be used in educational contexts. Figure 3 systematizes possible approaches to presenting material through infographics, while Table 1 presents digital tools that may support their production.

Figure 3.
Approaches to presenting material in infographics



Note. The Authors.

Table 1.
Online resources for creating infographics

	Easel.ly – is an editor with a limited number of free templates (10 diagrams, 25 photos, and 10 infographic fonts for infographics). The service's interface is simple and easy to use, so it is a good first step in creating an infographic, but it's not useful for users who want to create complex information graphics. Advantages: a set of free templates, the ability to edit (a paid subscription will expand the possibilities for creating information graphics).
	Canva – is a service for creating high-quality infographics, such as informational stories, charts, tables, diagrams, etc., which can be developed using free templates; it is possible to edit templates, upload photos, remove and add elements. The online resource allows working in a group in real time, and a premium subscription gives more options when creating infographics. Advantages: user-friendly interface, a large number of free templates and graphics, and the ability to save in video, PDF, and JPG formats.

	Freepik – is a resource that focuses on design, photography and illustrations suitable for infographics. With Freepik, one can find various elements and templates for information graphics. Advantages: access to over three million elements for infographics.
	Visme – a platform that provides a set of free templates for creating static infographics, has limitations when editing, some elements of the template cannot be deleted, but one can upload own images, add tables and diagrams. Advantages: convenient tools for infographics, fast interface.
	Animaker – a tool for creating dynamic infographics. The service uses simplified elements, including animated objects; saves previous versions of video infographics that can be viewed and edited; and allows to download information graphics or use a link. Advantages: the ability to quickly create video infographics.

Note. The Authors.

Each of the analyzed services is characterized by a specific set of advantages and functional limitations. The range of software solutions varies from intuitive platforms to more complex systems requiring advanced digital literacy. However, the data analyzed in this study show that the central issue is not only access to tools, but also the pedagogical and methodological orientation of their use. Since students already report frequent use of infographics, educational practice should include guidance on how to select information, organize visual hierarchies, represent data accurately, and adapt visual formats to specific learning objectives.

Thus, the contribution of the empirical data is to show that infographics occupy a double position in the educational process. On the one hand, they facilitate access to complex content, reduce cognitive effort, and support the organization of knowledge. On the other hand, they require critical mediation so that their use does not remain superficial or merely aesthetic. The findings therefore reinforce the relevance of infographics in contemporary education, but also indicate that their effectiveness depends on the articulation between visual design, didactic intentionality, and students' active engagement with information.

FINAL CONSIDERATIONS

The objective of this study was to analyze the role of infographics in optimizing students' learning processes, considering both theoretical approaches to visualization and empirical data on their use in higher education. The results indicate that infographics are recognized by students as useful tools for organizing, synthesizing, and presenting educational content. The data also show that students use visual resources frequently in their own academic activities, while the use of infographics by teachers during lectures appears to be less systematic.

The survey showed that 33% of respondents reported regular teacher use of infographics during lectures, 50% indicated periodic use, and 12% stated that such resources are rarely used. In contrast, students reported more frequent use of infographics in their own academic tasks: 60% constantly accompany their answers with visual resources, 25% use them often, 10% use them periodically, and only 5% do not develop any type of infographic for educational purposes. This contrast suggests that students may be more actively incorporating visual organization into their learning practices than teachers are incorporating it into lecture planning.

These findings allow us to conclude that infographics can contribute to the learning process when they are integrated into pedagogical planning and used with clear methodological purposes. Their main contribution lies in their ability to organize complex information, reduce cognitive overload, represent relations between concepts, and make educational content more accessible. In this sense, the empirical data corroborate the theoretical perspectives that define infographics as resources capable of combining verbal, numerical, and visual information in a coherent and cognitively efficient way.

At the same time, the study shows that the educational effectiveness of infographics should not be understood as an inherent property of the tool itself. The mere presence of visual resources does not guarantee better learning. Infographics become pedagogically effective when they are designed and used according to criteria such as clarity, accuracy, visual hierarchy, adequacy to the content, and correspondence with the intended learning objectives. Therefore, teacher mediation remains essential, both in the use of infographics as teaching materials and in the guidance of students who produce their own visual representations.

The study also highlights the need to strengthen visual literacy in higher education. Since students already demonstrate frequent use of infographics in academic tasks, educational institutions and teachers should create opportunities for the critical development of this competence. This includes not only encouraging the use of digital platforms and graphic tools, but also teaching students how to select information, establish conceptual relations, avoid distortions, and communicate data responsibly.

The research has some limitations. First, the empirical data were collected in a single higher education institution, which limits the generalization of the results to other educational contexts. Second, the analysis is based mainly on descriptive data and students' self-reported perceptions, without directly measuring learning outcomes before and after the use of infographics. Third, the study combines a broad theoretical review with a limited empirical survey, which suggests the need for future research with more detailed methodological designs.

Future studies may deepen this investigation by comparing different courses, disciplines, and educational levels, as well as by analyzing the quality of the infographics produced by students and teachers. Experimental or longitudinal studies could also examine more precisely the effects of infographics on comprehension, retention of information, cognitive load, and academic performance. Despite these limitations, the present study reinforces the relevance of infographics as pedagogical resources and argues that their most effective use depends on the articulation between visual design, didactic intentionality, and critical engagement with information.

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