

THE STRUCTURAL DIMENSIONS OF DIGITAL COMMUNICATION COMPETENCE IN PRIMARY SCHOOL STUDENTS

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Abstract. This article examines digital communication in primary education as a key component of contemporary pedagogy that supports the development of twenty-first-century competencies and learners' adaptability. Drawing on the theories of multimedia learning and cognitive load, it highlights how the integration of text, images, animations, and sound enhances comprehension and optimizes cognitive processing. A case study on fourth-grade geography demonstrates the educational value of interactive maps, 3D visualizations, and simulations in promoting inquiry-based learning and spatial reasoning. The findings emphasize that the successful integration of digital communication depends on effective instructional design, continuous teacher professional development, and a balanced combination of traditional and digital teaching methods.

Key words: digital communication, digital communication competence, pedagogical approach, multimedia learning, digital literacy, constructive dimensions.

DIMENSIUNILE STRUCTURALE ALE COMPETENȚEI DE COMUNICARE DIGITALĂ LA ELEVII DIN ÎNVĂȚĂMÂNTUL PRIMAR

Rezumat. Articolul examinează comunicarea digitală în învățământul primar ca o componentă esențială a pedagogiei contemporane, care sprijină dezvoltarea competențelor secolului XXI și adaptabilitatea elevilor. Fundamentat pe teoriile învățării multimedia și ale încărcării cognitive, studiul evidențiază modul în care integrarea textului, imaginilor, animațiilor și sunetului optimizează procesarea informațiilor și facilitează înțelegerea profundă. Un studiu de caz privind predarea geografiei în clasa a IV-a demonstrează valoarea educațională a hărților interactive, vizualizărilor 3D și simulărilor în dezvoltarea învățării prin investigație și a raționamentului spațial. Concluziile subliniază că eficiența comunicării digitale depinde de un design didactic riguros, de formarea continuă a cadrelor didactice și de îmbinarea echilibrată a metodelor tradiționale și digitale.

Cuvinte-cheie: comunicare digitală, competența de comunicare digitală, demers pedagogic, învățare multimedia, alfabetizare digitală, dimensiuni constructive.

Argumentation of the topic

Contemporary education has introduced digitalization as a new element, an aspect that has changed the way information is accessed and placed special emphasis on the development of digital competence. In the education system, pupils and students communicate, for the most part, within the digital environment, so that digitalization represents an essential component through which the teacher conducts their educational approach and facilitates active learning [6].

Digital communication stems from the need to develop this competence and becomes one of the essential tools that supports the development of communication skills and critical thinking. Currently, the integration of technology in school activities should not be viewed merely as content, but as „a way that facilitates the interactive teaching of different subjects” [5].

For pupils in primary education, developing digital communication competence is essential for adapting to the requirements of the current curriculum. This need is reflected in learning contexts that leverage technology in a structured and pedagogical manner [4].

The school has the role of integrating digital communication in a balanced and formative way. Through the European digital education action plan 2021 to 2027 [3], emphasis is placed on developing digital competences from an early age, specifying that the use of digital content and digital tools supports teaching and learning. The primary level is an authentic framework in which pupils develop essential digital competences and in which communication adapted to the digital context is cultivated. Thus, digital communication aligns as one of the objectives of contemporary education, evoking the idea that „Education” as Plato states, is „the art of forming good habits”. In this sense, in our view, developing digital communication competence refers to pupils' readiness to efficiently and responsibly use various digital tools and media to communicate, collaborate, and share information. The role of digital communication in primary classes is to build a flexible and responsible mindset, essential in a social context characterized by constant change. Digital communication competence can be approached from three dimensions: technological, epistemological, and methodological.

The technological dimension, addresses aspects related to the relevance of using digital media as a support for didactic innovation and competence development. Digital communication is manifested at the primary cycle through the use of digital school platforms, interactive applications, and collaboration in virtual spaces. Currently, pupils use various forms of technology mediated interaction, so that digital communication has become a fundamental component of early literacy [1]. In the text „*Digital Pedagogy*” by S. Făt [5], it is demonstrated that „today's pupils have different expectations from school”, given that some of them have been consciously exposed to technology by their families, making it an authentic solution for keeping them engaged and disciplined. Thus, the integration of digital technologies becomes „a solution to the justified expectations of pupils”, being a learning environment that shapes behaviours, relationships, and cognitive processes.

Learning as a process in the early grades is concentrated in the intuitive concrete zone (working with objects, colour, size, sounds); therefore, digital communication at this stage will gradually drive the development of multimodal expression skills: *text, image, sound, symbols*. Recent studies show that the use of technology in communication supports the

development of message reception and production skills, contributing to the formation of flexible and adaptive thinking. This digital learning process comes with rules of digital behaviour and digital conduct reflected in: netiquette, personal data protection, managing emotions in the online environment, and responsibility toward the digital community. The European DigComp standards have been included in Romania in recent curricular documents. The study conducted by M. Paiu and R. Muruz highlights the necessity of developing "communication competence in primary school pupils in the context of digital education" [11], emphasizing that digital pupils need structured pedagogical contexts to use technology efficiently and responsibly.

The epistemological dimension, addresses theories that support increasing motivation for learning. From a psychological standpoint, distributing information between the visual and verbal channels reduces overloading of working memory and allows the allocation of cognitive resources toward higher order cognitive processes (analysis, comparison, argumentation). Thus, animations and interactive maps are not merely „visual aids”, but didactic devices that reconfigure the architecture of the learning task. Contemporary learning models [9] emphasize that pupils process information more efficiently when it is presented multimodally: combining visual and auditory analyzers in interactive contexts for formative effectiveness. In the geography subject, this can be represented through: animations about the water cycle, interactive digital maps, and graphical representations of terrain.

J. Bruner draws a fundamental distinction between iconic and symbolic representation, emphasizing that the transition from manipulating images to operating with abstract concepts is a gradual process, dependent on cognitive maturation [2]. At the age of 10 to 11, pupils' mental functioning is structured through images, visual models, animated sequences, and concrete spatial representations. This predominance of iconic thinking is not a limitation, but an essential reference point for didactic design, as it indicates the need for systematic use of visual and digital resources as support for forming geographical concepts. Images, animations, and maps are not simple auxiliary materials, but epistemic tools that facilitate the organization of information, the construction of spatial relationships, and the emergence of coherent mental structures [15]. Through them, pupils can observe the dynamics of terrain, follow climatic changes, or interpret spatial distributions in a manner that goes beyond what verbal discourse or traditional graphic symbols can offer.

The Cognitive Load Theory, developed by J.Sweller, provides a solid explanatory framework for how human cognitive architecture responds to informational complexity in the learning environment [16]. According to this theory, the strategic distribution of information between the visual and verbal channels optimizes the functioning of working

memory, reducing unnecessary cognitive pressure and allowing the allocation of mental resources toward processes of conceptual elaboration, integration, and transfer.

Digital communication makes a considerable contribution to pupil engagement and the increase of their motivation level in the learning process. By using digital applications, pupils can access educational resources that offer them a varied learning perspective. The cognitive level undergoes accelerated development, meaning that a primary school pupil will process cognitive reasoning much faster and with greater creativity. Each cognitive journey is transposed through one's own mental map, resulting in an authentic and personally representative product. The article published by L. Uleia highlights that „the rapid evolution of technology has radically transformed the way we learn and interact”, and the digital environment „has created new opportunities for pupils, teachers, and educational institutions” [17].

Pupils' interest in the online environment means that the use of digital technologies in the classroom favours the exponential growth of interactivity, experience exchange, communication, and collaboration. At the same time, online assessments provide rapid feedback, which helps maintain the pupil's attention on the learning task and facilitates the remediation of difficulties encountered.

The variety of information searched for and then selected by pupils from the online environment leads to equally diversified products. Digital communication has added value because it promotes collaborative learning. Peer feedback given reciprocally stimulates motivation to work more and more diversely. The term „diversified” refers both to content and to the adoption of learning at one's own personal pace [18]. Pupils become content creators, meaning they analyze the information found, study it, select it, personalize it in their own context, and present their product in a responsible way. For them, digital communication is not just a technical skill, but a complex competence that combines language, critical thinking, collaboration, and responsibility. In this sense, it becomes a pillar of modern education, contributing to the formation of autonomous, creative pupils capable of navigating digital environments with discernment. The development of these competences cannot, however, be separated from the way technology is integrated into the educational process. As C. Redecker emphasizes, the integration of technology is not a technical endeavour, but a deeply pedagogical one, requiring learning design skills, critical selection of resources, and ethical use of digital tools [12].

This approach is fully in line with R. Mayer's theories [9] on multimedia learning, which highlight the fact that the effectiveness of digital resources depends on how they are structured to support pupils' cognitive processes. In the same vein, M. Spitzer's research [14] on cognitive load in digital environments draws attention to the risk of cognitive overload when instructional design is not rigorous and adapted to the pupil's level of development. Developing digital communication competences in primary cycle pupils is

closely linked to the quality of pedagogical design and to teachers' capacity to create balanced learning contexts that harness the potential of technology without affecting fundamental cognitive processes.

The methodological dimension, highlights the role of digital resources in diversifying didactic strategies and in consolidating pupils' intellectual autonomy in order to develop digital communication competence. The integration of digital maps from educational GIS platforms to applications such as Google Earth or interactive maps together with animations dedicated to landforms and atmospheric phenomena, reconfigures the teaching of geography into a genuine process of exploration. These tools not only extend pupils' access to dynamic visual representations, but transform the act of learning into an investigative experience, in which geographical space is analysed, modelled, and reinterpreted in real time. The research of J. Kerski [7] and E-K Shin [13] converges in highlighting that the systematic construction of digital maps leads to the formation of more accurate mental representations, the development of advanced spatial analysis skills, and the intensification of intrinsic motivation, generated by the exploratory and interactive nature of the tasks. The results presented by X. Lu et al. [8] convincingly indicate that the use of dynamic visualizations has a substantial impact on pupils' motivation, as these resources facilitate the decoding of abstract concepts and generate a learning framework with a strong integrative character. For fourth grade pupils, information processing is more efficient when content is anchored in dynamic visual stimuli, which allow the observation of transformations, the identification of spatial relationships, and the construction of coherent mental models. Pupils respond positively to tasks involving exploration, digital manipulation, and collaboration, because these forms of interaction reduce the gap between their perceptual experience and the geographical concepts they need to assimilate.

Geography is one of the subjects that offers pupils the opportunity to understand the world around them. Familiarizing pupils with landforms, climate types, and human settlements contributes to understanding the complex relationship between humans and the environment. It is an exploratory subject that encourages the pupil to observe, understand, and relate. One of the effective directions of modern learning is the application of digital technology in the teaching of geography. It is one of the pathways that modern didactics applies to improve the learning process and the modelling of pupils' knowledge. Currently, pupils no longer learn geography by assimilating information and orienting themselves on classic maps; they become explorers of a varied library of digital resources, becoming creative and autonomous participants. The use of digital technology in fourth grade geography produces major effects on both the teaching and learning processes. The use of interactive digital applications or merely presenting content in 3D/4D during lessons brings a much deeper sensory stimulation and cognitive engagement of pupils. Through the use

of digital technology, concentration, and understanding of abstract concepts increase. Compared to traditional frontal explanation, these environments create a multisensory learning context in which the pupil becomes a co constructor of the meaning of learning.

In teaching geography in primary classes at the contemporary stage, the integration of digital maps, animations regarding the morphology of terrain or the dynamics of atmospheric phenomena, reconfigures the status of the lesson, advancing from a predominantly descriptive exposition toward an exploratory and interactive approach. These visual and digital resources facilitate the construction of precise, flexible, and transferable mental representations, as they allow pupils to observe accurately, identify spatial relationships, and interpret phenomena in a manner much closer to how they manifest in reality.

Synthesis research on the use of visual media in active learning highlights the fact that such tools amplify intrinsic motivation, not only through their technological appeal, but especially through their capacity to confer on the content a greater degree of relevance, accessibility, and anchoring in pupils' everyday experience. In this sense, technology does not function as a simple didactic support, but as a catalyst for higher order cognitive processes: exploration, analysis, modelling, and anticipation.

Through the use of interactive digital resources, pupils become active participants in the construction of geographical knowledge, developing skills of investigation, interpretation, and argumentation. Thus, a framework is shaped in which pupils take on the role of explorers of geographical space, capable of transferring concepts to new situations, formulating hypotheses, and understanding the complexity of the contemporary world approached through a critical lens. The systematic integration of digital tools in the teaching of geography at the fourth-grade level emerges, in light of the theoretical and empirical arguments analysed, as an indispensable pedagogical direction for developing the competences specific to the 21st century.

Visual, interactive, and collaborative resources not only facilitate pupils' access to correct mental representations and understanding of geographical processes, but configure a learning environment in which exploration and conceptual modelling become central processes. By harnessing the natural cognitive functioning of young school age pupils, educational technology contributes to the development of intrinsic motivation, the stimulation of active participation, and the consolidation of intellectual autonomy. The results converge on the idea that the digitalization of geography teaching does not represent a circumstantial option, but an essential condition for the development of spatial thinking, for cultivating transversal competences, and for preparing pupils for a critical understanding of the contemporary world.

In conclusion, the effectiveness of developing digital communication competence in primary school pupils depends on rigorous didactic design and the continuous professional

development of teachers, maintaining a dynamic balance between traditional and digital methods. From the perspective of the technological dimension, the integration of digital resources facilitates access to interactive and collaborative digital tools that support pupils' active engagement. On an epistemological level, these resources contribute to the construction of knowledge by relating to valid conceptual structures and by stimulating learning processes. And from a methodological standpoint, they aim at adapting digital technologies to pupils' cognitive particularities, stimulating intrinsic motivation and intellectual autonomy. Thus, digital communication competence no longer appears as a circumstantial option, but as an essential condition for developing the transversal competences necessary for pupils' social integration.

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