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DEVELOPING DIGITAL COMPETENCIES IN WEB PAGE CREATION THROUGH THE INTEGRATION OF INTERACTIVE DIGITAL TEXTBOOKS IN HIGH SCHOOL EDUCATION

Speciality: 532.02 - School Didactics by Educational Stages and Subjects (Information and Communication Technology)

Summary of the Doctoral Thesis in Education Sciences

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CUPRINS

CONCEPTUAL FRAMEWORK OF THE RESEARCH

Relevance and Importance of the Topic. In the context of a society undergoing rapid technological evolution, digital skills have become indispensable for active participation and effective adaptation of individuals to the demands of social, educational, and professional life.

The development and enhancement of digital skills represent a global priority, supported through a series of strategies, programs, initiatives, and competency frameworks, developed both nationally and internationally, such as: (1) *Digital Education Action Plan (DEAP)* [10]; (2) *European Skills Agenda* [11]; (3) *Digital Decade 2030* [12]; (4) *"Education 2030"*, a national strategy of the Republic of Moldova [13]; (5) *Digital Transformation Strategy of the Republic of Moldova for 2023–2030* [14] etc.

The topic of this paper is timely in the context of the digitalization of education and the necessity to adapt teaching content and methods to the needs of the new generation of students, who are digital natives. The absence of a textbook for the ICT subject, tailored to the technical profile of the 12th-grade class in the Romanian educational system, highlights the need to develop modern, interactive educational resources aligned with current educational requirements. In this context, the topic has significant relevance as it aims to improve the educational process through the integration of modern digital resources, given that teaching materials suitable for the technical profile are currently insufficient or nonexistent.

The importance of the topic is further amplified by the positive impact of educational technologies on the learning process. These technologies facilitate both the acquisition of knowledge and the development of transversal skills, such as critical thinking, creativity, and problem-solving abilities. As Professor Lucian Ciolan emphasizes, digitalization significantly influences not only our thinking and behaviors but also human interactions, the way we perceive the world, and, in particular, educational experiences [19].

The epistemological framework of this research is grounded in the theoretical and practical perspectives presented in the works of several prominent authors such as: Antonesei L., Balmuş N., Best J., Bocoș M., Braicov A., Burlacu N., Ceobanu C., Cerghit I., Chiriac T., Chomsky N., Cojocariu V. M., Cojocaru V., Colman A., Cristea S., Cronk B., Cucoș C., Davies B., Dumitriu C., Făt S., Ferrari A., Gasser U. and many others.

The analysis of the educational realities concerning the development of high school students' digital competencies in the field of web page creation using HTML highlights the existence of several **contradictions** between:

– the requirements of the curriculum regarding the development of digital competencies and the insufficient teaching resources, particularly the lack of an ICT textbook for the 12th grade, adapted to the specific technical profile (technological high school);

– the extensive volume of content provided in the ICT curriculum and the limited instructional time allocated to the subject;

– students' strong interest in technology and the lack of interactive, engaging, and effective methods for teaching HTML;

– the educational potential of digital textbooks and their low level of integration into the current teaching-learning-assessment activities;

– students' need for autonomy and personalized learning and the rigid structure of traditional teacher-centered lessons.

These contradictions have generated **the research problem**, which consists of identifying innovative teaching solutions aimed at improving the development of high school students' digital competencies in web page creation using HTML.

The aim of the research (general objective) is to conceptualize and experimentally validate a teaching methodology for implementing a digital textbook integrated into a pedagogical model, intended to optimize the process of developing high school students' digital competencies in web page creation using HTML.

Research Objectives:

1. Analysis of theoretical concepts regarding digital competencies, web pages, HTML, and interactive digital textbooks;

2. Examination of the influence of digital technologies on the development of high school students' digital competencies;

3. Development of a pedagogical model that leverages an interactive digital textbook in the process of forming high school students' digital competencies in the field of web development;

4. Design of a teaching methodology for implementing the proposed model in a real educational environment (within ICT classes in a high school);

5. Experimental validation of the effectiveness of the proposed model and methodology.

The main hypothesis of the research assumes that the process of developing high school students' digital competencies in web page creation will become more effective if:

- a pedagogical model is developed that integrates an interactive digital textbook created using the *MDIR Constructor* educational software;

-   a teaching methodology is applied, specifically designed for implementing this model in ICT classes;

-   this methodology is experimentally validated in a real educational context, confirming its practical value.

Research Methodology. The scientific approach undertaken to achieve the research objectives was based on the application of various methods, selected and grouped according to their epistemological and practical specificity, as follows:

-   ***Theoretical methods:*** scientific documentation, analysis of specialized literature, synthesis, comparison, generalization, systematization, pedagogical design, and modeling;

-   ***Praxiological methods:*** observation, testing, pedagogical experiment, application of the teaching methodology within ICT classes;

-   ***Analytical methods***: processing and interpretation of collected data, quantitative and qualitative analysis, use of statistical methods for evaluating experimental results.

The scientific novelty and originality of this research lie in the development and experimental validation of a teaching methodology that leverages a textbook created by the author, transformed into an interactive digital textbook using the *MDIR Constructor* educational software, aimed at optimizing the teaching-learning process of HTML in high school education. The study proposes a contemporary pedagogical model focused on the development of students' digital competencies. The practical contribution of the research is manifested through the integration of an interactive digital resource into a teaching approach that is both applicable and relevant to the requirements of modern education.

Research Outcome. The results contribute to addressing an important scientific problem: identifying innovative teaching solutions designed to enhance high school students' digital competencies in web page creation using HTML. The research contribution to solving this problem lies in the development, application, and experimental validation of a pedagogical model and a teaching methodology that exploit the use of an interactive digital textbook within ICT classes.

Theoretical Significance. The research helps clarify the role of digital educational resources in the development of digital competencies and provides a relevant theoretical framework for assessing their effectiveness in the educational process.

Practical Value. The study provides a concrete pedagogical tool – a pedagogical model that includes an interactive digital textbook and its implementation methodology – which can be efficiently integrated into the teaching of HTML in high school education, contributing to the improvement of students' digital competencies.

Implementation of the Scientific Results. The results were implemented within the framework of a pedagogical experiment conducted with students from the Technological High School "Sf. Ioan de La Salle" in Romania, included in the experimental group, during ICT classes. The research findings were disseminated through participation in national and international scientific events, as well as through the publication of articles in specialized educational journals.

Approval of the Scientific Results: The research results were analyzed and validated at national and international scientific conferences, as well as through publication in specialized journals. Publications related to the dissertation topic comprise 12 scientific works: 4 articles published in specialized scientific journals (Category B) and 8 articles included in the proceedings of national and international conferences and symposia. These include: "*Validation of the Efficiency of Using Educational Software in the ICT Subject*", in the journal *Intellectus*, 2024; "*An Experimental Approach to Using Digital Textbooks in the Educational Process*", in the journal *Acta et Commentationes (Educational Sciences)*, 2024; "*New Directions in the Continuous Training of Teachers: Creating and Using Editable Digital Textbooks*", in the journal *Univers Pedagogic*, 2024; "*Modern Teaching Tools: The Digital Textbook*", in the journal *Didactica Pro…, Journal of Educational Theory and Practice*, 2023; "Using SPSS in Pedagogical Research", in the proceedings of the Annual Scientific Conference of Doctoral Students with International Participation "*Research, Innovation, Development*", 2024; "Integration of the Digital Textbook into the Teaching Process," in the proceedings of the International Scientific Conference "*Pedagogical Research: Contemporary Requirements and Development Perspectives*", 2023, Chișinău; "Transforming Education through Technology," in the proceedings of the National Virtual Education Conference *"CNIV"*, 2023; "Software Tools for Creating Digital Textbooks," in the proceedings of the International Scientific Conference "*Feminist Issues in the Socio-Economic Structure of the Contemporary World*", 2023, Iași; "Methods for Restricting Websites", in the proceedings of the International Scientific Conference "*Adapting the Educational System to New Approaches in Contemporary Society: Challenges and Solutions*", 2022, Chișinău; "Using Educational Software in Student Assessment," in the proceedings of the International Scientific Conference "*Genius, Talent, Creativity: A Socio-Cultural Perspective*", 2022, Iași; "Interpersonal Communication – A Fundamental Element of Human Existence" in the proceedings of the International Scientific Conference "*Interpersonal Communication: Cognitive and Praxiological Dimensions of Communication*", 2021, Iași; "Comparative Analysis of Digital Textbooks for Informatics and

ICT (Middle School Grades)", in the proceedings of the International Scientific Conference "*Current Issues in the Humanities*", 2021, Chişinău.

Additionally, a teaching aid (printed version) [15] was published, accompanied by a digital version [16], for which an AGEPI certificate was obtained (Appendix 23).

Structure of the Thesis: introduction, three chapters, general conclusions and recommendations, references (comprising 230 sources), 24 appendices, 135 pages of main text, 60 figures, and 25 tables.

CONTENT OF THE THESIS

The **Introduction** defines and justifies the relevance and importance of the research topic, specifies the research problem, establishes the aim, objectives, and main hypothesis, presents a synthesis of the methodology and the rationale for the applied methods, outlines the structure of the chapters, and records the approval of the obtained scientific results.

The thesis concludes with a set of general conclusions and recommendations, providing an integrative synthesis of the entire scientific endeavor, reflecting both the theoretical analysis and the experimental validation of the main hypothesis. These are aligned with the research topic, aim, and objectives, highlighting the extent to which they have been achieved. At the same time, the author's personal contributions are emphasized, with a focus on the theoretical and practical value of the results, their impact on educational practice, and the prospects for further research.

Chapter 1 **"Developing Digital Competencies in Web Page Creation: Conceptual Approaches and Analysis of the Current Situation"** provides a solid theoretical foundation for understanding the issues that form the basis of this research, namely the development of digital competencies with an emphasis on web page creation. This chapter explores the various dimensions of the concept of *competence* and how they are integrated into contemporary education. Both the theoretical definition of competence and its applicability in the educational context are analyzed, emphasizing the importance of digital competencies - particularly in the field of web page creation - as their practical expression.

Initially introduced in the specialized lexicon by the american linguist and philosopher Noam Chomsky to denote a person's knowledge of the grammatical rules of a language *(linguistic competence)*, the term "*competence*" later gained prominence, especially in the fields of education and personal development. It can also be used to mean the legal authority of a court

or another body to handle a certain matter (its original sense is juridical, meaning the right to judge) [6, p.151].

Le Boterf [18, p.15] argues that the definition "*competence is a sum of knowledge, skills, and attitudes*" remains valid over time, despite changes or other perspectives.

In December 2006, the European Parliament and the Council of the European Union adopted the *Recommendation on Key Competences for Lifelong Learning*, which was revised and updated on 22 May 2018. In this recommendation, member states were invited "*to develop the provision of key competences for all as part of their lifelong learning strategies, including strategies to achieve universal literacy*" and to use the *Key Competences for Lifelong Learning – A European Reference Framework*. Since its adoption, the recommendation has served as a reference document for the development of education, training, and competence-based learning [20, p.1].

In the field of education, *competence* refers to the desirable conduct that students/teachers should attain as a result of their integration into a training framework [8, p.86].

Digital competence is one of the eight key competences for lifelong learning. It is defined as involving "*the confident and critical use of all information and communication technologies for information, communication and problem-solving in all areas of life – work, leisure and communication*" [20, p.9].

In education, *digital competences* can be regarded as *a set of techno-pedagogical and communication skills* that enable teachers to carry out their activity effectively in the educational contexts generated by new technologies [2]. These skills are adaptable and need to be continuously updated, given the rapid evolution of technologies.

According to Calvani et al. [3], *digital competence* includes three dimensions, namely: *technical skills, cognitive skills* and *ethical knowledge*. As stated in the European Commission's report *"DigComp 2.0: The Digital Competence Framework for Citizens"*, the five main areas of digital competence are: (1) Information and digital literacy; (2) Digital communication and collaboration; (3) Digital content creation; (4) Online safety; (5) Problem-solving [21, p.8].

In recent years, Romania's population has faced a deficit of basic digital skills compared to EU member states [7], thus affecting the country's economic competitiveness and social inclusion. Possible causes may include: the COVID-19 pandemic, the lack of adequate educational resources, unequal access to technology and digital infrastructure, insufficient continuous training of teachers, socio-economic disparities, and the absence of consistent governmental initiatives to promote digital literacy etc.

The valorization of digital competences in the educational process involves not only familiarizing students with technology, but also their ability to actively and consciously understand, create, and control digital content. One of the most advanced applications of these competences is **web page creation** – a process that requires both an understanding of the structure and functioning of the Internet, and the use of specific languages that allow for structuring, organizing, and styling digital content in an accessible and interactive way.

HTML is the standard language used for creating and structuring the content of web pages. It allows users to describe the logical structure of a web document by using a series of **tags**, which indicate elements such as headings, paragraphs, lists, images, links etc.

Despite its apparent simplicity, HTML lies at the foundation of most digital interfaces we interact with on a daily basis. In high school education, HTML is not just a markup language, but also a valuable educational tool for developing essential digital competences in the information society.

Creating a web page means more than just writing code; it is a planned, step-by-step, and interactive process that combines analytical reasoning, innovation, and a wide range of digital skills.

Based on the aspects discussed above, we can define **digital competences in web page creation** *as a set of knowledge, skills, and attitudes that enable the user to design, structure, code, and publish web content in an efficient, ethical way, adapted to the needs of the target audience.*

In particular, **digital competences in creating web pages with the HTML language** *involve mastering the basic elements of a web page's structure, the ability to write and organize code correctly, the efficient use of HTML tags, the integration of multimedia content and links, as well as understanding how the page is rendered across different browsers and devices.*

The process of creating a web page is, essentially, a continuous problem-solving exercise. From planning the structure and design, to writing the code and, especially, debugging errors, students develop their algorithmic and logical thinking.

The development of digital competences in high school students, through the creation of web pages using HTML, requires more than the mere accumulation of technical knowledge. From the educator's perspective, this complex educational approach involves the integration of modern learning theories and the application of student-centered pedagogical principles, aiming to increase motivation, active engagement, and interest in the studied content. Through practical and interactive approaches, students not only learn to use languages such as HTML and CSS, but also develop logical thinking, creativity and autonomy in learning.

Chapter 2 "**Software Tools for the Development of Digital Textbooks: Implementation and Perspectives in Educational Practice**", explores the practical dimension of developing digital textbooks, focusing on modern educational tools, available software solutions, and the potential of integrating them into a pedagogical model applicable in high school education.

The theoretical approach begins with a conceptual delimitation of educational tools, tracing their evolution, functions, and associated pedagogical orientations. The transition is then made to the digital textbook as a modern learning tool, highlighting its defining characteristics and transformative potential in the educational process.

New technologies bring their own rules, generate new models and methods of instruction, digital educational resources, and forms of didactic communication that were impossible to anticipate just a few years ago.

As a result of scientific and technological progress, the modernization of educational tools has enabled the shift from static, intuitive materials to the use of computers. The successive evolution of these tools has significantly contributed to increasing the efficiency of the educational process. Contemporary schools thus benefit from a wider range of options and the possibility of using various tools simultaneously, including the computer [5, p.77].

A *school textbook* is an educational resource, printed or digital, designed to support students' formal and non-formal learning, as well as to facilitate the teaching activity carried out by teachers.

The **digital textbook** represents an alternative to traditional printed textbooks, being available in electronic format and designed to capitalize on digital technologies in education.

Essentially, *the digital textbook* is an electronic version of the printed textbook, but user interaction is limited to browsing the content.

The interactive digital textbook is designed to actively engage the user, integrating dynamic elements (tests with immediate feedback, animations, links to external resources, as well as the possibility to take notes, highlight, or answer questions). Through these features, it enables personalized learning and stimulates active learning, thus contributing to competence development through the student's direct involvement.

The creation of these educational resources involves the use of specialized software tools, which allow not only the development of content but also its customization to meet various pedagogical needs.

The educational software *MDIR Constructor* stands out among next-generation digital tools through the diversity of the features it offers. It attracts through the quality of its

presentation, provides the necessary information on a specific topic, facilitates interaction between computer and student or computer and teacher, and can adapt according to the user's needs.

Despite the significant advantages offered by the digital textbook, their integration into schools faces various obstacles. Among these obstacles, the following can be mentioned: (1) lack of access to technological resources; (2) resistance to change among some teachers [4, p.24]; (3) the need for continuous professional training.

The continuous professional development of teachers, with a special focus on the integration of technology in the educational process, is more than a necessity - it is an essential responsibility for the future of education, a deontological duty that many fulfill. The integration of technology into the educational process not only meets the requirements of a modern society but also offers students the opportunity to develop in a stimulating and innovative environment. By investing in teacher training, we are building not only a more efficient educational system but also a generation prepared for the challenges of the future.

A defining component of this chapter is **the pedagogical model** for teaching and learning the HTML language, which integrates an interactive digital textbook and proposes a practical approach tailored to the needs of high school students.

Pedagogical models, used to facilitate the educational process, are theoretical representations of teaching and learning processes and derive from learning theories. They are not mutually exclusive but can be complementary, being combined and adapted depending on the specific subject, the students' age, and the educational context.

The pedagogical model presented below (Fig. 2.33) proposes a modern methodology for teaching and learning the HTML language, using an *interactive digital textbook* created with the help of the educational software *MDIR Constructor*.

The model is based on principles from various learning theories in order to maximize the efficiency of the teaching and learning process.

The model's structure is organized into two complementary levels:

I. Theoretical – pedagogical foundations, represented by:

- *learning theories*: behaviorism, cognitivism, constructivism, connectivist learning theory, the Cognitive–Affective-Social Theory of Learning in Digital Environments (CASTLE), Self-Determination Theory (SDT) in digital contexts, the Cognitive Theory of Multimedia Learning (CTML);

- *pedagogical principles*: student-centered learning, collaborative learning, interactive learning, active learning, learning through repetition and reward, observational learning (modeling), social interaction, and learning through connections.
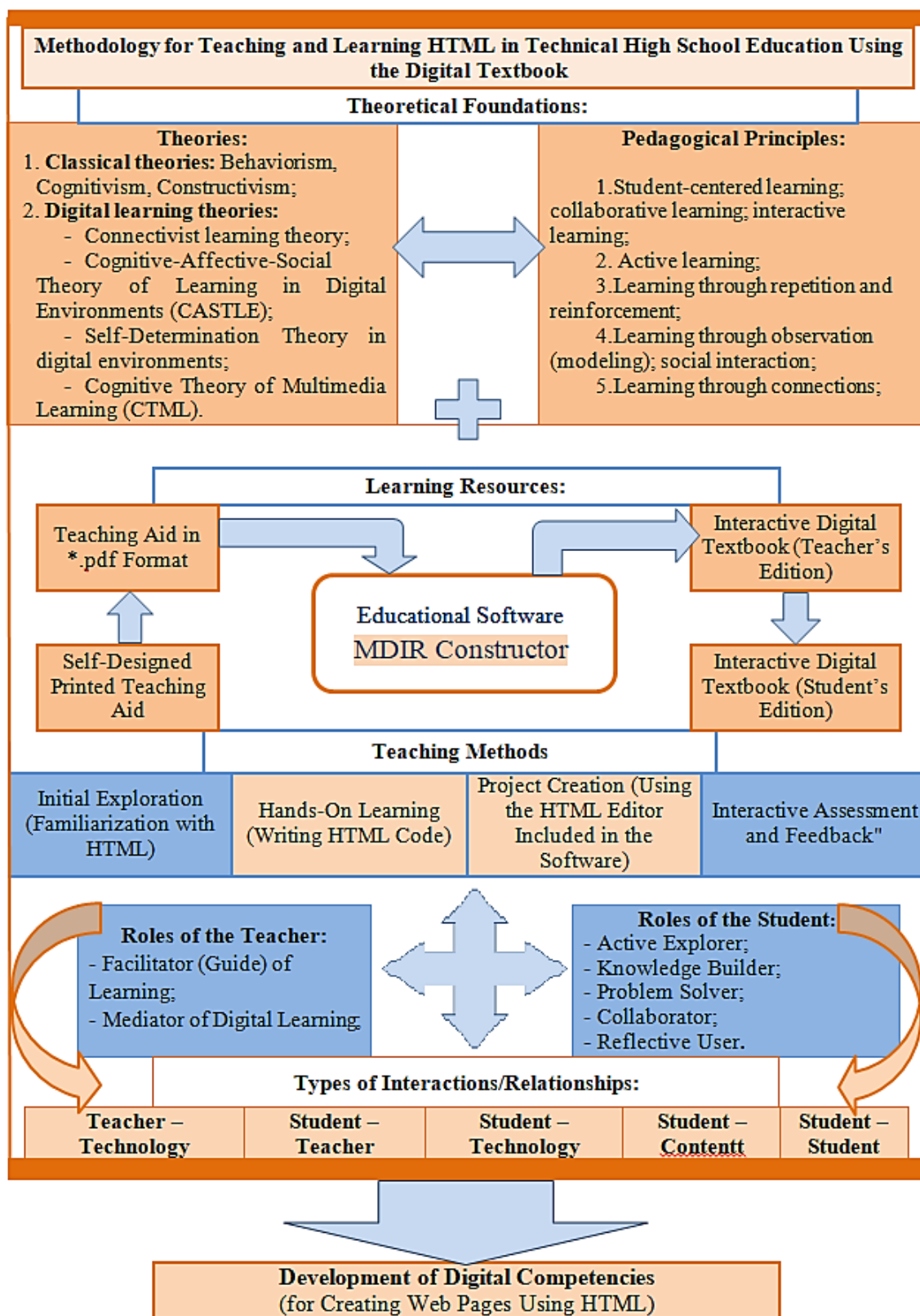
Methodology for Teaching and Learning HTML in Technical High School Education Using the Digital Textbook

Theoretical Foundations:

Theories:
1. **Classical theories:** Behaviorism, Cognitivism, Constructivism;
2. **Digital learning theories:**
   - Connectivist learning theory;
   - Cognitive-Affective-Social Theory of Learning in Digital Environments (CASTLE);
   - Self-Determination Theory in digital environments;
   - Cognitive Theory of Multimedia Learning (CTML).

Pedagogical Principles:

1. Student-centered learning; collaborative learning; interactive learning;
2. Active learning;
3. Learning through repetition and reinforcement;
4. Learning through observation (modeling); social interaction;
5. Learning through connections;

Learning Resources:

Teaching Aid in *.pdf Format

Interactive Digital Textbook (Teacher's Edition)

Educational Software MDIR Constructor

Self-Designed Printed Teaching Aid

Interactive Digital Textbook (Student's Edition)

Teaching Methods

Initial Exploration (Familiarization with HTML)

Hands-On Learning (Writing HTML Code)

Project Creation (Using the HTML Editor Included in the Software)

Interactive Assessment and Feedback"

Roles of the Teacher:
- Facilitator (Guide) of Learning;
- Mediator of Digital Learning;

Roles of the Student:
- Active Explorer;
- Knowledge Builder;
- Problem Solver;
- Collaborator;
- Reflective User.

Types of Interactions/Relationships:

Teacher – Technology	Student – Teacher	Student – Technology	Student – Contentt	Student – Student

Development of Digital Competencies
(for Creating Web Pages Using HTML)

Fig. 2.33. Pedagogical Model for Teaching and Learning HTML in High School Education

II. Methodological foundations, which address:

- *Resources used*: the educational software *MDIR Constructor*; *the interactive digital textbook* created with this software based on the teaching aid designed by the author; HTML editor; video tutorials; exercises and interactive tests integrated into the digital textbook;

- *Teaching methods and strategies*: discovery learning, collaborative learning, Problem-Based Learning (PBL), gamification etc.;

- *Assessment techniques*: interactive quizzes, formative/summative assessment tests; self-assessment, where students independently check their progress by solving exercises with the help of the HTML editor.

Chapter 3 "**Implementation and Analysis of the Pedagogical Experiment Results**", is dedicated to the organization and conduct of the pedagogical experiment, as well as the analysis of the results obtained. The stages undertaken are presented, followed by the presentation of results, statistical analysis of the data, and their interpretation. As a result of the research, the study's main hypothesis was confirmed, with an important contribution to its testing being the proposed pedagogical model, which included the use of an interactive digital textbook. Participants showed significant progress in using the HTML language, highlighting the effectiveness of the interactive approach adopted.

The overall research sample includes 167 students from "Sf. Ioan de La Salle" Technological High School, Neamț County, Romania, from grades 9 and 12, in different specializations. Of these, 83 students from the "Construction, Installations, and Public Works" profile formed the *experimental group*, while 84 students from the "Electronics and Automation" profile formed the *control group*.

Sampling was unistage, using the parallel sample technique. Commonly encountered in educational research, the parallel sample technique is a method in which two groups equivalent in terms of knowledge level are subjected to different treatments in order to observe the effects of the independent variable on the dependent variable.

In the experiment conducted in our research, the *independent variables* are: the *interactive digital textbook* (derived from the printed textbook designed by the author [15]), created with the help of the educational software *MDIR Constructor* [1] and assessment tests. *The dependent variables* are: the process of developing digital competences specific to web page creation, academic performance (measured by the grades obtained from the tests) and school achievement.

The data required for the research were obtained through the use of a docimological test as a research instrument and the data analysis was carried out using SPSS software, commonly used for statistical analyses.

The analysis of quantitative data required the use of specific statistical tests, as follows: the *t-test* (parametric test), used for comparing means in independent samples when certain distribution conditions are met, particularly normal distribution; the *Mann–Whitney U test* (non-parametric test), applied for comparisons between groups when the data do not follow a normal distribution. The applicability of parametric and non-parametric tests was determined based on the results of other statistical tests, such as: the *Shapiro–Wilk test*, for verifying the normality of a distribution; the *Kolmogorov–Smirnov test*, for assessing the conformity of data to a theoretical distribution; the *Levene test*, for checking the homogeneity of variances.

The main distinct stages of the psycho-pedagogical experiment conducted with parallel samples are:

a) *Pre-experimental stage*, with a descriptive nature, in which a comparison is made from the perspective of the equivalence of the two subject samples, establishing the existing level at the beginning of the psycho-pedagogical experiment;

b) *Experimental stage*, with a formative nature, in which the experimental samples are exposed to the independent variable;

c) *Post-experimental stage*, with a control and data comparison purpose.

The pre-experimental stage aims to establish the level of students' ICT preparedness at the start of the pedagogical experiment, both for the experimental groups and the control groups.

In this context, it is essential to respect a fundamental condition, namely: ensuring the *equivalence of the participating samples* (experimental - EE and control - EC), with approximately equal levels, so that they can initially be considered comparable in all respects.

Although the composition of the samples was random, to ensure that they are similar in terms of academic performance, and therefore learning capacity, an *initial test* was applied to assess the level of digital competencies, followed by the calculation of the average for each sample and the determination of the statistical significance of the difference between the means [9, p.155].

The statement and results of the initial test are presented in Appendixes 1, 2, 3, 4, while the sample means and their difference are shown in Table 3.1 and Figure 3.2.

It can be observed from Table 3.1 that *the control samples* had a slight initial advantage, which did not exceed 5.81%.

Table 3.1. Initial Test – Means

School Year	Grade	Sample	Number of Students (*N*)	Mean (*m*)	Difference of Means	Difference of Means (%)
2022 - 2023	a IX-a	EE	21	6,90	0,35	5,07%
		EC	22	7,25		
	a XII-a	EE	19	6,62	0,32	4,83%
		EC	25	6,94		
2023 - 2024	a IX-a	EE	25	6,46	0,19	2,94%
		EC	17	6,65		
	a XII-a	EE	18	6,71	0,39	5,81%
		EC	20	7,10		
Total			167			
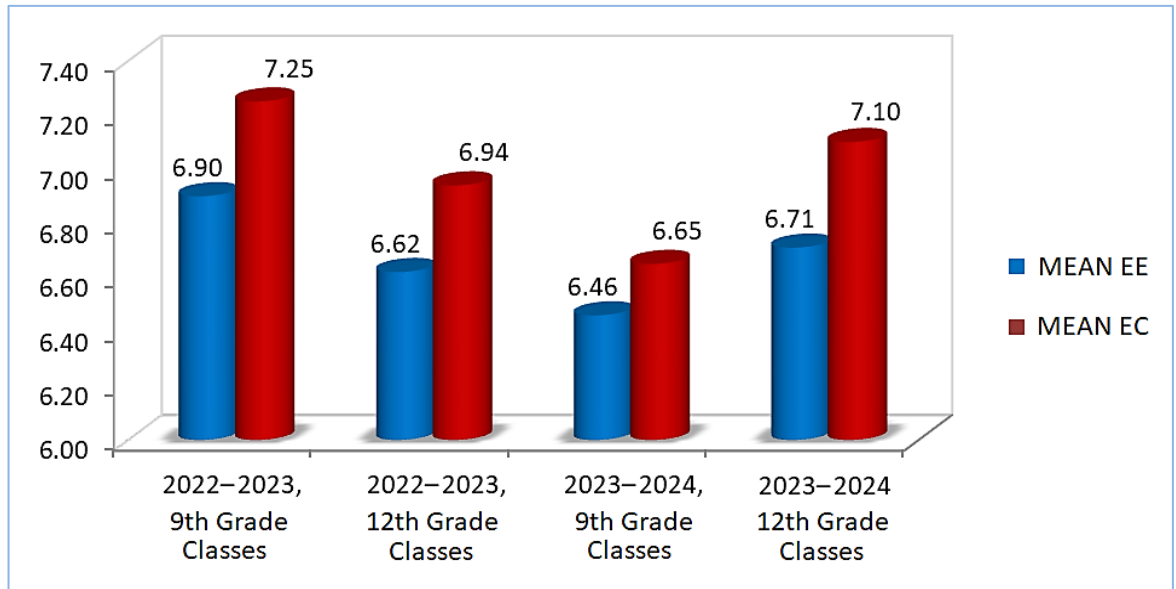
Fig. 3.2. Initial Test – Analysis of Mean Scores

We will further verify the *equivalence of the participating samples*. For this purpose, we will consider two independent samples (9th-grade classes, school year 2023-2024), for which N_1= 25 (*EE*) and N_2= 17 (*EC*), with the test means being $m_1 = 6,46$ and $m_2 = 6,65$. We will examine whether the difference between the initial test means of the two classes is statistically significant. If the difference between the means is not statistically significant, it indicates that the two samples are equivalent. We formulate the *statistical hypotheses*:

H_0(*null hypothesis*) : $m_1 = m_2$, ($m_1 - m_2 = 0$) there is no significant difference between the two means m_1 și m_2;

H_1(*alternative hypothesis*): $m_1 \neq m_2$, ($m_1 - m_2 \neq 0$) there is a significant difference between the means).

We will proceed to test the statistical hypotheses using the *independent-samples t-test* via the SPSS software.

**Table 3.2. Output of the *Independent-Samples t-Test*
(*Group Statistics* și *Independent Samples Test*)**

Group Statistics

	GRUP	N	Mean	Std. Deviation	Std. Error Mean
NOTA	EE	25	6.4600	1.06966	.21393
	EC	17	6.6471	.93148	.22592

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
NOTA	Equal variances assumed	.095	.759	-.585	40	.562	-.18706	.31959	-.83298	.45886
	Equal variances not assumed			-.601	37.473	.551	-.18706	.31113	-.81721	.44309

The test results (*Output*) are presented in Table 3.2, in the form of two subtables.

The *Group Statistics* table included in Table 3.2 contains the number of participants in the experiment $N_1=25$, $N_2=17$), the mean of each sample (*Mean*), the standard deviation of the means (*Standard Deviation*) and the standard error of each mean (*Standard Error Mean*).

The *Independent Samples Test* in the same table (Table 3.2) actually presents the results of two tests: *Levene's test* for equality of variances and the *t-test* for two independent samples.

After interpreting the data from the two tables, it can be concluded that *the difference between the means is not statistically significant*, indicating that *the two samples are equivalent*.

Using the same SPSS software to avoid complex calculations, the procedure is applied similarly for the other pairs of samples participating in the experiment. The *t-test* results are presented in Table 3.3 and Table 3.4.

Table 3.3. *t-test* Results – Group Statistics

Group Statistics					
	GRUP	N	Mean	Std. Deviation	Std. Error Mean
School Year 2022 – 2023, 9th Grade Classes					
NOTA	EE	21	6,9048	1,57812	0,34437
	EC	22	7,2500	1,38659	0,29562
School Year 2022 – 2023, 12th Grade Classes					
NOTA	EE	19	6,6184	1,45385	0,33354
	EC	25	6,9400	1,59635	0,31927
School Year 2023 – 2024, 12th Grade Classes					
NOTA	EE	18	6,7083	1,13192	0,26680
	EC	20	7,1000	1,66504	0,37231

Tabelul 3.4. Rezultatele *testului t* – Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference		
									Lower	Upper	
An școlar 2022 – 2023, Clasele a IX-a											
NOTA	Equal variances assumed	0,721	0,401	-0,763	41	0,450	-0,34524	0,45247	-1,25901	0,56854	
	Equal variances **not** assumed			-0,761	39,769	0,451	-0,34524	0,45386	-1,26268	0,57221	
An școlar 2022 – 2023, Clasele a XII-a											
NOTA	Equal variances assumed	0,177	0,676	-0,687	42	0,496	-0,32158	0,46776	-1,26556	0,62240	
	Equal variances **not** assumed			-0,696	40,559	0,490	-0,32158	0,46171	-1,25434	0,61118	
An școlar 2023 – 2024, Clasele a XII-a											
NOTA	Equal variances assumed	3,515	0,069	-0,838	36	0,407	-0,39167	0,46724	-1,33927	0,55594	
	Equal variances **not** assumed			-0,855	33,616	0,399	-0,39167	0,45804	-1,32290	0,53957	

We have demonstrated that the pairs of samples (*EE, EC*) participating in the experiment are *equivalent* in terms of academic performance and learning abilities, with no significant differences between them.

Next, we will perform a *statistical analysis* of the results obtained from the initial test.

Table 3.9. Tests of Normality

School Year	Grade Class / Sample	Mean	Skewness	Kurtosis	Significance level (*Sig., p value*)		Distribution
					K-S	S-W	
2022 - 2023	a IX-a (EE)	6,90	0,120	0,892	0,200	0,509	normal
	a IX-a (EC)	7,25	-0,531	0,283	0,136	0,269	normal
	a XII-a (EE)	6,62	-0,114	-1,083	0,041	0,269	approximately normal
	a XII-a (EC)	6,94	-0,373	-1,168	0,042	0,054	approximately normal
2023 - 2024	a IX-a (EE)	6,46	0,279	0,707	0,173	0,200	normal
	a IX-a (EC)	6,65	-0,684	0,104	0,187	0,217	normal
	a XII-a (EE)	6,71	-0,336	-0,781	0,200	0,618	normal
	a XII-a (EC)	7,10	-0,176	-0,997	0,200	0,522	normal

For this purpose, we will use the same software, SPSS, with which we will assess the *normality of the score distribution*.

According to the data in Table 3.9, the score distributions obtained in the initial test are generally normal, with slight deviations observed in the 12th-grade classes, school year 2022-2023, where the *Kolmogorov-Smirnov test* results suggest an approximate normality ($p = 0,041 < 0,05$, $p = 0,042 < 0,05$); however, the *skewness* and *kurtosis* coefficients remain within acceptable limits.

Thus, the results indicate a *normal distribution* and a balanced allocation of scores, suggesting that the test was well designed, allowing a clear differentiation of students' performance levels.

The experimental stage aims to introduce the independent variable - *the interactive digital textbook* - as a new mode of instruction, through its intervention in the teaching and educational activities of the experimental group, while the activities of the control group proceed without being influenced by the introduced variable. In this way, the experimental stage operationalizes *the proposed pedagogical model*, transforming it from a theoretical framework into a practical action setting, in which the interactive digital textbook becomes the central tool for assessing the impact of the new methods on the teaching-learning process.

During the experimental stage, the effectiveness of using the integrated HTML editor within the interactive digital textbook was also evaluated, revealing a positive effect on students' performance in using the HTML language.

The post-experimental stage is the phase in which the post-test is administered, aiming to monitor the comparative academic progress of students in the experimental and control groups, in order to confirm or refute the experimental hypothesis.

Table 3.17. Post-Test Mean Scores

School Year	Grade Class	Sample	Number of Students (n)	Post-Test Mean (m)	Difference of Means	Difference of Means (%)
2022-2023	a IX-a	EE	21	8,32	0,71	8,53%
		EC	22	7,61		
	a XII-a	EE	19	8,18	0,84	10,27%
		EC	25	7,34		
2023-2024	a IX-a	EE	25	8,35	0,88	10,54%
		EC	17	7,47		
	a XII-a	EE	18	8,17	0,99	12,12%
		EC	20	7,18		

The statement and results of the final test are presented in Appendixes 8, 9, 10, 11, the class means are shown in Table 3.17, and a comparative graphical representation of the initial and final test means is provided in Figure 3.12.

Analyzing the mean scores obtained in the final test (Table 3.17, Figure 3.12), it can be observed that the experimental samples achieved higher values than the control samples, reflecting *a superior level of digital competencies in using the HTML language* in favor of the experimental samples.

The observed *level difference* between the samples (*EE, EC*) can be statistically tested using the non-parametric *Mann–Whitney U test*, which will indicate whether this difference is significant ($p < 0,05$).
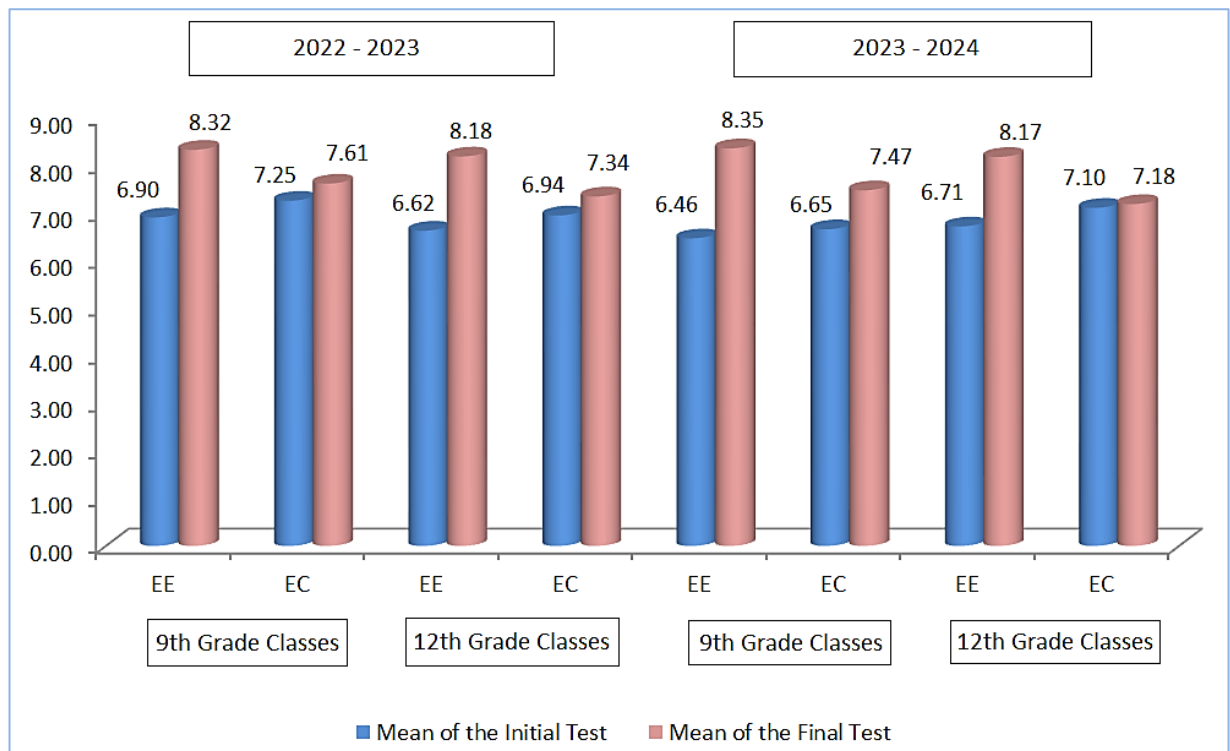
Fig. 3.12. Comparative Graphical Representation of Initial and Final Test Means

We will consider two independent samples: 12th-grade classes, school year 2023-2024, with $n_1=18$ (*EE*), $n_2=20$ (*EC*), for which we will apply the *Mann–Whitney U test* using SPSS software. We formulate the statistical hypotheses:

H_0 (*null hypothesis*): there are no statistically significant differences between the *EE* and *EC* scores in the final test;

H_1 (*alternative hypothesis*): there are statistically significant differences between the *EE* and *EC* scores in the final test.

The test results (*Output*) are illustrated in Fig. 3.13. Additionally, the software provides the outcome of the hypothesis testing, as well as a graphical representation of the score frequencies (Fig. 3.14).
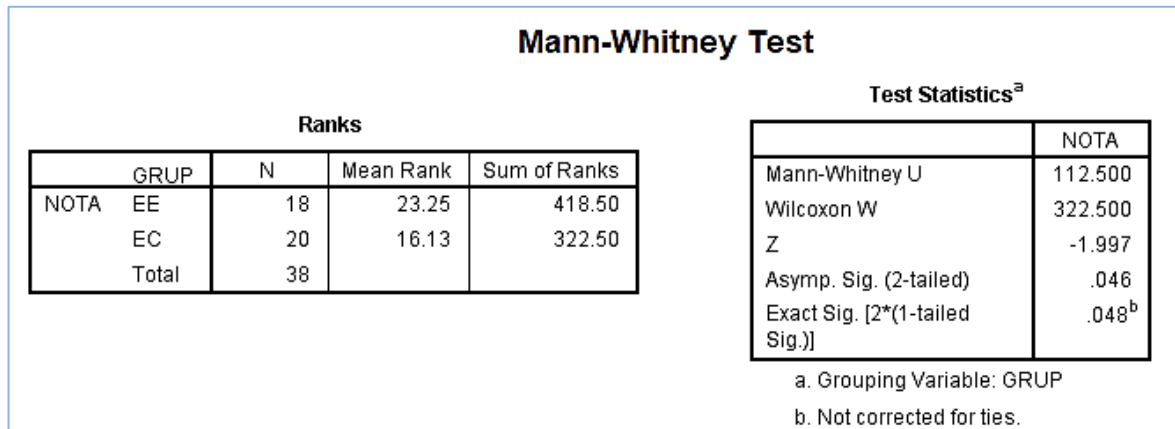

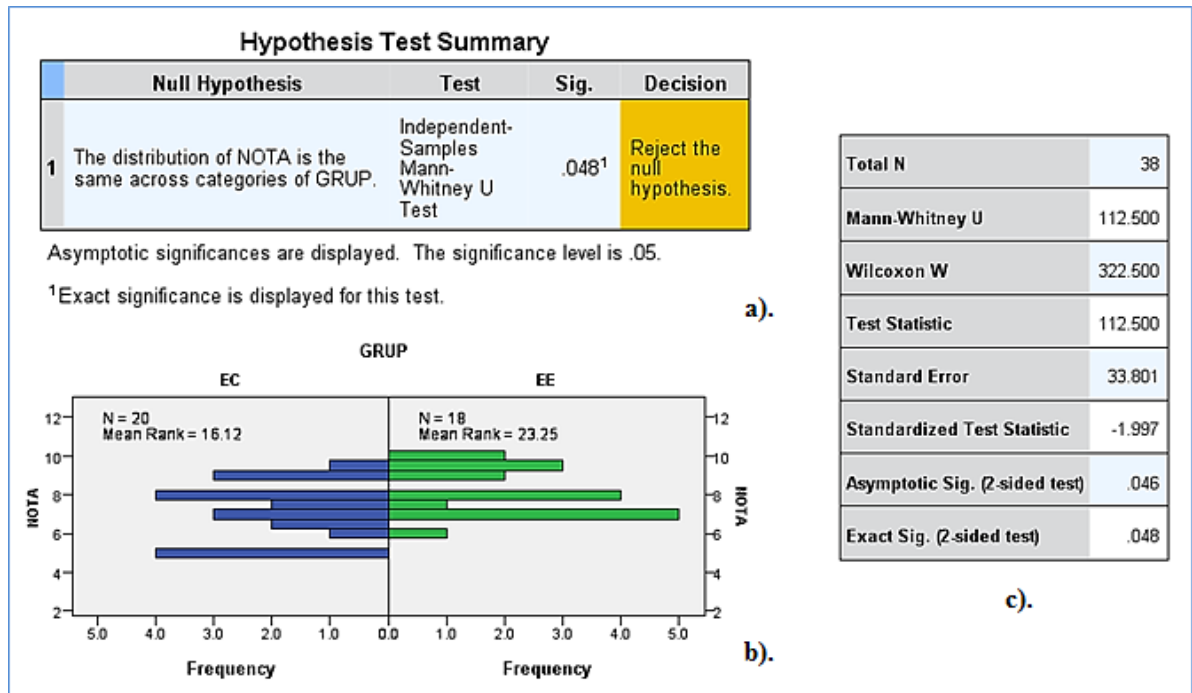**Fig. 3.13.** *Mann–Whitney U Test* **Results:** *Ranks* **and** *Test Statistics* **Tables**

Fig. 3.14. *Mann-Whitney U* **Test Results for Two Independent Samples:**
a) Hypothesis Testing; b). Score Distribution; c). Statistical Indicators.

The *Ranks* and *Test Statistics* tables in Fig. 3.13 include values such as the *sum of ranks* for each sample (418,50 and 322,50), the Mann–Whitney U test *z-score* (−1,973), the Mann–Whitney U test *statistic value* (112,50) etc.

It can be observed that, $p = 0,048 < 0,05$, *the null hypothesis* (H_0) *is rejected* (Fig. 3.14,a) and *the alternative hypothesis* (H_1) *is accepted*. In other words, *there are statistically significant differences between the EE and EC scores in the final test.*

For the other pairs of samples involved in the experiment, we will proceed in a similar manner, obtaining the following results:

✓ 12th-grade classes, school year 2022-2023;

Mann-Whitney Test

Ranks

	GRUP	N	Mean Rank	Sum of Ranks
NOTA	EE	19	27.05	514.00
	EC	25	19.04	476.00
	Total	44		

Test Statistics^a

	NOTA
Mann-Whitney U	151.000
Wilcoxon W	476.000
Z	-2.068
Asymp. Sig. (2-tailed)	.039

a. Grouping Variable: GRUP

Fig. 3.15. *Mann–Whitney U Test* **Results:** *Ranks* **and** *Test Statistics* **Tables (12th-Grade Classes, 2022–2023)**
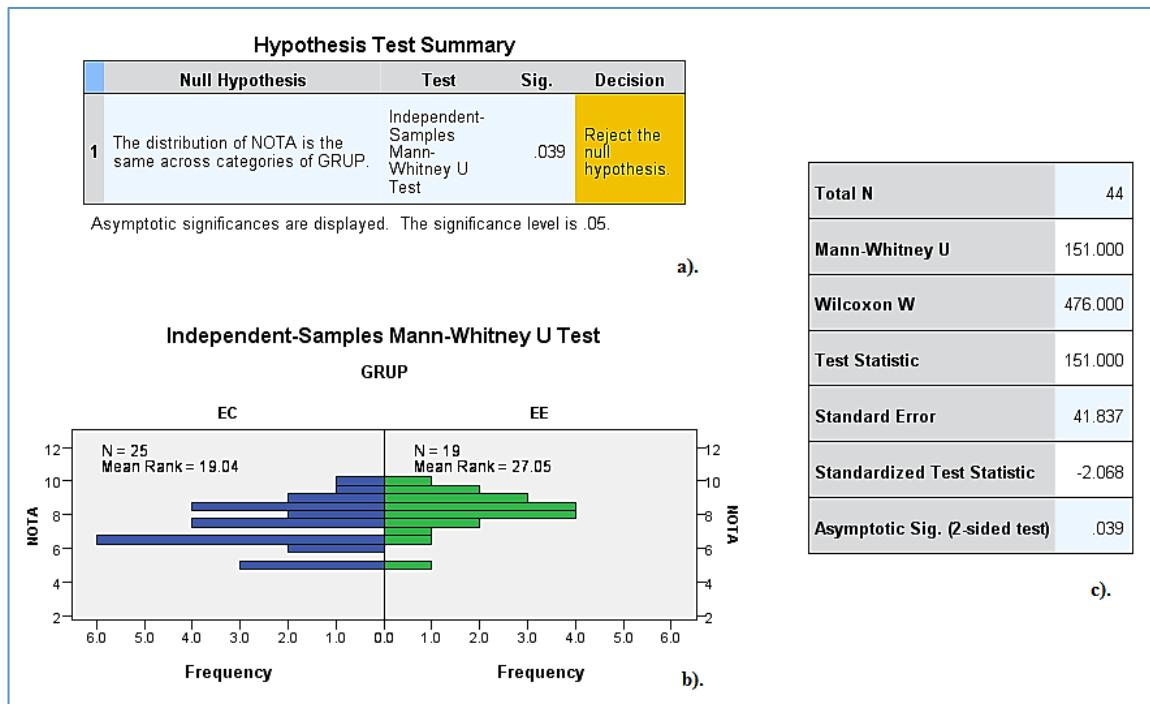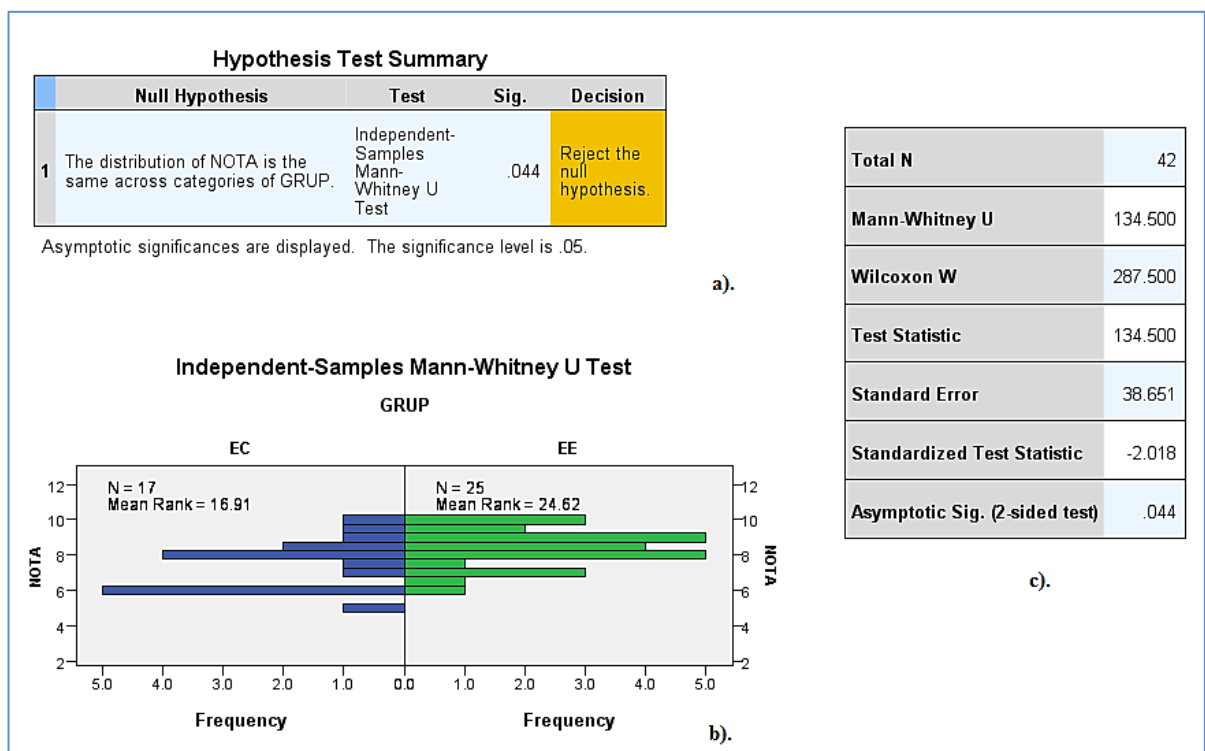

Fig. 3.16. *Mann–Whitney U Test* **Results for Two Independent Samples (12th-Grade Classes, 2022–2023): a). Hypothesis Testing; b). Score Distribution; c). Statistical Indicators.**

The *Ranks* and *Test Statistics* tables in Fig. 3.15 display the *sum of ranks* for each sample (514,00 and 476,00), the Mann–Whitney U test *z-score* (−2,068), the Mann–Whitney U test *statistic value* (151,000) and so on.

It can be observed that, $p = 0,039 < 0,05$, *the null hypothesis (H₀) is rejected* (Fig. 3.16,a), and *the alternative hypothesis (H₁) is accepted*. In other words, *there are statistically significant differences between the EE and EC scores in the final test*.

✓ 9th-grade classes, school year 2023 - 2024;

Mann-Whitney Test

Ranks

	GRUP	N	Mean Rank	Sum of Ranks
NOTA	EE	25	24.62	615.50
	EC	17	16.91	287.50
	Total	42		

Test Statistics[a]

	NOTA
Mann-Whitney U	134.500
Wilcoxon W	287.500
Z	-2.018
Asymp. Sig. (2-tailed)	.044

a. Grouping Variable: GRUP

Fig. 3.17. *Mann–Whitney U Test* **Results:** *Ranks* **and** *Test Statistics* **Tables (9th-Grade Classes, 2023–2024)**

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of NOTA is the same across categories of GRUP.	Independent-Samples Mann-Whitney U Test	.044	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

a).

Independent-Samples Mann-Whitney U Test

GRUP

b).

Total N	42
Mann-Whitney U	134.500
Wilcoxon W	287.500
Test Statistic	134.500
Standard Error	38.651
Standardized Test Statistic	-2.018
Asymptotic Sig. (2-sided test)	.044

c).

Fig. 3.18. *Mann–Whitney U Test* **Results for Two Independent Samples (9th-Grade Classes, 2023–2024): a). Hypothesis Testing; b). Score Distribution; c). Statistical Indicators.**

The *Ranks* and *Test Statistics* tables in Fig. 3.17 display the following: the *sum of ranks* for each sample (615,50 and 287,50), the Mann–Whitney U test *z-score* (−2,018), the Mann–Whitney U *test statistic value* (134,500) and so on.

It can be observed that, $p = 0,044 < 0,05$, *the null hypothesis (H_0) is rejected* (Fig. 3.18, a) and *the alternative hypothesis (H_1) is accepted*. In other words, *there are statistically significant differences between the EE and EC scores in the final test.*

✓ 9th-grade classes, school year 2022–2023;

Fig. 3.19. *Mann–Whitney U Test* **Results:** *Ranks* **and** *Test Statistics* **Tables (9th-Grade Classes, 2022–2023)**

The *Ranks* and *Test Statistics* tables in Fig. 3.19 display the following: the *sum of ranks* for each sample (545,50 and 400,50), the Mann–Whitney U test *z-score* (−2,048), the Mann–Whitney U test *statistic value* (147,500) and so on.
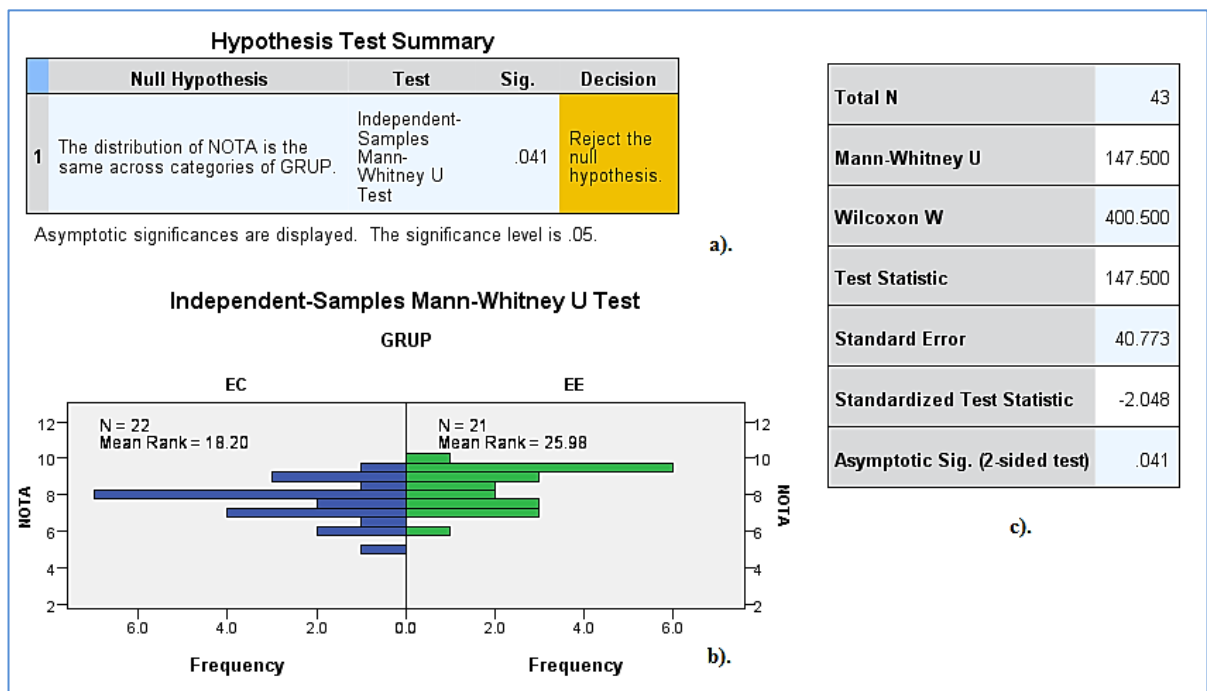

Fig. 3.20. *Mann–Whitney U Test* **Results for Two Independent Samples (9th-Grade Classes, 2022–2023):**
a). Hypothesis Testing; b). Score Distribution; c). Statistical Indicators.

It can be observed that, $p = 0,041 < 0,05$, *the null hypothesis (H₀) is rejected* (Fig. 3.20, a) and *the alternative hypothesis (H₁) is accepted*. In other words, *there are statistically significant differences between the EE and EC scores in the final test.*

Table 3.19 presents the results of the Mann–Whitney U test for all pairs of samples participating in the experiment.

Table 3.19. *Mann–Whitney U Test* **Results**

School Year	Grade Class	Sample	Number of Students	Mean Rank	Sum of Ranks	U	z	p	Hypothesis Confirmed
2022-2023	a IX-a	EE	21	25,98	545	147,5	−2,048	0,041	H₁
		EC	22	18,20	400,4				
	a XII-a	EE	19	27,05	514	151	−2,068	0,039	H₁
		EC	25	19,04	476				
2023-2024	a IX-a	EE	25	24,62	615,5	134,5	−2,018	0,044	H₁
		EC	17	16,91	287,5				
	a XII-a	EE	18	23,25	418,5	112,5	−1,997	0,048	H₁
		EC	20	16,12	322,5				

The results of the Mann–Whitney U test (Table 3.19) indicate the existence of statistically significant differences between the scores obtained by the *EE* and those of the *EC*, highlighting a higher level of digital competencies in using the HTML language in favor of the experimental group. This means that it is highly unlikely that the observed differences are due to chance; rather, they reflect a real effect of the independent variable, namely the use of the interactive digital textbook and the applied methodology.

While statistical tests inform us about the statistical significance of certain results, *the effect size (r)* is relevant in the context of the practical significance of the results. For nonparametric tests, such as the *Mann–Whitney U*, *the effect size* (*r*) is calculated using formula (3.15) [17, p.83], where $n = n_1 + n_2$

$$r = \sqrt{\frac{z^2}{n}} = \frac{|z|}{\sqrt{n}}$$
(3.15)

The effect size (*r*) was calculated for all pairs of samples and is summarized in Table 3.20.

Table 3.20. Effect Size

School Year	Grade Class	Sample	Effect Size (*r*)	Measured Effect
2022-2023	a IX-a A, B	EE, EC	0,3123	*moderate* to *strong*
	a XII-a A, B	EE, EC	0,3118	*moderate* to *strong*
2023-2024	a IX-a A, B	EE, EC	0,3114	*moderate* to *strong*
	a XII-a A, B	EE, EC	0,3239	*moderate* to *strong*

In order to illustrate the progress achieved by students following the pedagogical intervention, the results obtained in *the final test* were compared with those from *the initial test*.

This comparative analysis makes it possible to identify changes in the level of the assessed competencies and to evaluate *the effectiveness of the applied pedagogical model*.

Table 3.21 highlights the percentage increase in the means for each sample, based on the results of the initial and final tests, providing a clear picture of the impact of the intervention and reflecting the students' clear progress in using the HTML language.

Although *the control samples* initially had a slight advantage (up to 5,81%; Table 3.1), students in *the experimental samples* recorded significantly greater progress, consistently surpassing *the control samples* in the final test (up to 12,12%; Table 3.17). The higher percentage increases in *the experimental samples* (up to 29,41%; Table 3.21), compared to the stagnation observed in the control samples (up to 12,33%), confirm the positive impact of the method applied in the experiment.

Table 3.21. Percentage Evolution of Means by Sample

School Year	Grade Class	Sample	Initial Test Mean	Final Test Mean	Percentage Increase (%)
2022-2023	a IX- a	EE	6,90	8,32	20,58%
		EC	7,25	7,61	4,97%
	a XII- a	EE	6,62	8,18	23,56%
		EC	6,94	7,34	5,76%
2023-2024	a IX- a	EE	6,46	8,35	29,26%
		EC	6,65	7,47	12,33%
	a XII- a	EE	6,71	8,17	21,76%
		EC	7,10	7,18	1,13%

The success rate, defined as the percentage of students who achieved at least the minimum passing grade in the applied tests (in this case, grade 7), contributes to demonstrating the effectiveness of the educational intervention. For *the experimental samples*, in the 2022–2023 school year, grade IX *(EE)* recorded an absolute percentage increase of 42,86 points (from 52,38% to 95,24%), while grade XII (*EE*) increased by 42,10 points (from 47,37% to 89,47%). In the 2023–2024 school year, the progress was even more substantial in certain cases, such as grade IX *(EE)*, which achieved a 56-point increase (from 36% to 92%), and grade XII *(EE)*, which increased by 44,44 points (from 50% to 94,44%). For *the control samples*, the analysis reveals more modest progress. For instance, grade IX *(EC)* in the 2023–2024 school year recorded an increase of only 17,65 points (from 47,06% to 64,71%). This value represents the maximum observed in the control group and is significantly lower compared to the results obtained for the experimental samples. Overall, the data indicate a significant improvement in

student performance, confirming that the applied method promoted an increase in the number of students reaching the minimum success threshold, especially within the experimental group.

Since the two types of samples did not show significant differences at the beginning of the experiment and were considered equivalent (according to the independent-samples *t-test*, Table 3.4), it can be concluded that the differences observed at the end of the study are attributable to the independent variable introduced during the formative stage. This variable consisted of *the interactive digital textbook*, developed using the educational software *MDIR Constructor*, and the applied methodology.

Therefore, the results obtained validate the effectiveness of the pedagogical model for teaching and learning HTML through the use of the interactive digital textbook in secondary education.

GENERAL CONCLUSIONS AND RECOMMENDATIONS

The analysis of the theoretical and practical dimensions addressed in this research led to the formulation of the following conclusions:

– the pedagogical model, which includes the interactive digital textbook developed using the educational software *MDIR Constructor*, proposed in this study, has proven to be effective;

– the results obtained in the post-experimental stage highlight the following key aspects:

✓ there are statistically significant differences between the experimental and control samples regarding the mean scores on the final test, with differences favoring the experimental samples (Chapter 3, 3.2.3);

✓ Although the control samples initially had a slight advantage (up to 5,81%; Table 3.1), students in the experimental samples made significantly greater progress, consistently surpassing the control samples in the final test (up to 12,12%; Table 3.17);

✓ the high percentage increases in the experimental samples (up to 29,41%; Table 3.21), compared to the near-stagnation observed in the control samples (up to 12,33%), confirm the positive impact of the method applied in the experiment (Chapter 3, 3.2);

✓ the success rate in tests increased in the experimental samples by up to 56 percentage points (from 36% to 92%), compared to an increase of up to 17,65% (from 47,06% to 64,71%) in the control samples (Chapter 3, 3.2);

✓ *the effect size* (*r*), calculated for the non-parametric tests (*Mann–Whitney U*), indicates a *medium* to *strong impact* of the pedagogical intervention (Chapter 3, 3.2.3);

✓ the progress of students in the experimental group is attributed to the application of the proposed model;

✓ the scores obtained in the applied tests reflect a significant progression in the development of the digital competencies of students in the experimental samples, thus confirming the effectiveness of the educational model (Chapter 3, 3.2).

– the personal contributions of the research are reflected in:

✓ the development of an innovative digital educational resource – the interactive digital textbook – tailored to the needs of high school students (Appendix 22, Appendix 23);

✓ the elaboration of a pedagogical model applicable to teaching HTML, as well as a methodology for implementing it in real educational contexts (Chapter 2, 2.6);

✓ the experimental validation of the proposed model and methodology, by demonstrating a positive impact on the development of students' digital competencies (Chapter 3).

– the practical value of the study lies in the possibility of extending the proposed model to other educational contexts, as well as in the effective use of the developed digital resource in regular teaching activities.

Throughout the three chapters of the study, **all the proposed research objectives** were systematically achieved, contributing **to the confirmation of the main hypothesis** and, implicitly, to addressing **the scientific problem under investigation**. This problem focused on *identifying innovative teaching solutions aimed at supporting the improvement of high school students' digital competencies in creating web pages using the HTML language.*

The results obtained, published in the works mentioned at the beginning, highlight the effectiveness of the solution proposed in the study.

Research Limitations

The results of the experiment confirmed the main hypothesis of the study, showing that the proposed pedagogical model and the developed methodology are effective. However, the research presents the following **limitations**:

- *sample size*: the overall sample was adequate for the study; however, a larger sample would have allowed for a more rigorous statistical analysis, thereby increasing the precision and robustness of the results;

- *duration of the intervention*: the period during which the pedagogical model was applied was relatively short, limiting the observation of long-term effects;

- *teacher/human factor influence*: the involvement and teaching style of the instructor may affect the outcomes achieved by the students;

- *model updates*: the developed pedagogical model will require periodic revisions to remain aligned with technological advancements and current educational needs.

Recommendations for Future Research

- adapting the pedagogical model to other areas of ICT or subjects that require digital competencies;

- investigating the long-term impact of using digital resources on students' skills development, with a focus on critical thinking, creativity, and problem-solving;

- leveraging the replicable framework provided by this study in other initiatives for integrating digital resources into pre-university education;

- exploring the use of the *MDIR Constructor* educational software in diverse educational contexts, considering its formative potential;

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1. IFRIM, C.-C., Validarea eficienţei utilizării softurilor educaţionale la disciplina Tehnologia Informaţiei şi a Comunicaţiilor. În: *Intellectus.* (Categoria B) 2024, nr. 2, pp. 201-209. ISSN 1810-7079.ISSNe 1810-7087, CZU: 004.9:37. DOI : 10.56329/1810-7087.24.2.19, https://ibn.idsi.md/en/vizualizare_articol/218669.

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6. IFRIM C.-C., Instrumente software pentru elaborarea manualelor digitale. În: *Conferința Științifică Internațională „Problematica feministă în structura social-economică a lumii contemporane”, Ediția a XIV-a, 26 mai, 2023*, *Iași.* organizatori: Academia Română, Filiala Iași, Institutul de Cercetări Economice și Sociale „Gh. Zane”, Departamentul de Psihologie și Științele educației, pp.158-165. ISBN 978-630-328-001-1.

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Patents and Other Intellectual Property Objects (IPO):

1. IFRIM C.-C., BALMUS N., CHIRIAC T., „*e-HTML: Auxiliar digital interactive pentru studierea limbajului HTML”*. ADEVERINȚĂ (AGEPI) privind înscrierea obiectelor dreptului de autor și ale drepturilor conexe, Seria PC Nr. 8190 din 20.05.2025.

Other Works:

1. IFRIM, C.-C. *Limbajul HTML: auxiliar didactic pentru clasa a XII-a,* Iași: PIM, 2023, 94 p. ISBN 978-606-13-8073-2.

2. IFRIM C.-C., BALMUȘ N., CHIRIAC T., *Limbajul HTML: auxiliar didactic pentru clasa a 12-a*, Chișinău: [S. n.], 2025 (CEP UPSC), 95 p. ISBN 978-9975-48-242-4 (PDF), 004.434:37.091.

ANNOTATION
IFRIM Constantin-Cătălin
FORMAREA COMPETENȚELOR DIGITALE ÎN CREAREA PAGINILOR WEB PRIN INTEGRAREA MANUALELOR DIGITALE INTERACTIVE ÎN ÎNVĂȚĂMÂNTUL LICEAL
Teză de doctor în științe ale educației, Chișinău, 2025

Structura tezei: introducere, trei capitole, concluzii generale și recomandări, bibliografie din 230 de titluri, 24 anexe, 136 de pagini text de bază, 60 figuri, 25 tabele.

Publicații la tema tezei: 12 lucrări științifice.

Cuvinte-cheie: competență, competențe digitale, pagină web, limbajul HTML, resurse, software educațional, manual digital, formare, experiment pedagogic.

Scopul lucrării este de a conceptualizare și valida experimental o metodologie didactică de implementare a unui manual digital interactiv integrat într-un model pedagogic, care să contribuie la optimizarea procesului de formare a competențelor digitale ale elevilor de liceu în crearea paginilor web utilizând limbajul HTML.

Obiectivele cercetării: (1) analiza conceptelor teoretice privind competențele digitale, paginile web, limbajul HTML, manualele digitale interactive; (2) examinarea influenței tehnologiilor digitale asupra formării și dezvoltării competențelor digitale ale elevilor din învățământul liceal; (3) elaborarea unui model pedagogic care valorifică un manual digital interactiv în procesul de formare a competențelor digitale ale elevilor de liceu, în domeniul dezvoltării web; (4) proiectarea unei metodologii didactice de implementare a modelului propus într-un mediu educațional real (în cadrul orelor de TIC-Tehnologia Informației și a Comunicațiilor dintr-o instituție de învățământ liceal); (5) validarea experimentală a eficienței modelului și a metodologiei propuse.

Noutatea și originalitatea științifică constau în elaborarea și validarea experimentală a unei metodologii didactice care valorifică un manual realizat de autor, transformat într-un manual digital interactiv cu ajutorul softului educațional *MDIR Constructor*, destinat optimizării procesului de predare-învățare a limbajului HTML în învățământul liceal. Lucrarea propune un model pedagogic actual, axat pe formarea și dezvoltarea competențelor digitale ale elevilor. Contribuția practică a cercetării se concretizează în integrarea unei resurse digitale interactive într-un demers didactic aplicabil și pertinent în raport cu cerințele educației moderne.

Rezultatul obținut contribuie la rezolvarea unei probleme științifice importante, respectiv identificarea unor soluții didactice inovatoare menite să îmbunătățească formarea competențelor digitale ale elevilor de liceu în crearea paginilor web, utilizând limbajul HTML. Contribuția cercetării la rezolvarea problemei constă în elaborarea, aplicarea și validarea experimentală a unui model pedagogic și a unei metodologii didactice care valorifică utilizarea unui manual digital interactiv în cadrul orelor de TIC.

Semnificația teoretică: cercetarea contribuie la clarificarea rolului resurselor educaționale digitale în formarea competențelor digitale și oferă un cadru teoretic relevant pentru evaluarea eficienței acestora în procesul educativ.

Valoarea aplicativă: cercetarea oferă un instrument pedagogic concret – un model pedagogic care include un manual digital interactiv și metodologia de implementare – ce poate fi integrat eficient în procesul de predare a limbajului HTML în învățământul liceal, contribuind la îmbunătățirea formării competențelor digitale ale elevilor.

Implementarea rezultatelor științifice: a fost realizată în cadrul experimentului pedagogic desfășurat cu elevi ai Liceului Tehnologic „Sf. Ioan de La Salle" din România, incluși în lotul experimental, în cadrul orelor de TIC. Rezultatele cercetării au fost diseminate prin participări la manifestări științifice de specialitate, atât naționale, cât și internaționale, precum și prin publicarea unor articole în reviste de profil educațional.

ANNOTATION

IFRIM Constantin-Cătălin
DEVELOPING DIGITAL COMPETENCIES IN WEB PAGE CREATION THROUGH THE INTEGRATION OF INTERACTIVE DIGITAL TEXTBOOKS IN HIGH SCHOOL EDUCATION
Doctoral thesis in educational sciences, Chişinău, 2025

Structure of the thesis: introduction, three chapters, general conclusions and recommendations, bibliography of 230 titles, 24 Appendixes, 136 pages of basic text, 60 figures, 25 tables.

Publications on the topic of the thesis: 12 scientific papers.

Keywords: competence, digital competences, web page, HTML language, resources, educational software, digital manual, training, pedagogical experiment.

The purpose of the thesis is to conceptualize and experimentally validate a didactic methodology for the implementation of a interactive digital textbook integrated into a pedagogical model, designed to contribute to optimizing the process of developing high school students' digital competencies in creating web pages using the HTML language.

Research objectives: (1) analysis of theoretical concepts regarding digital competences, web pages, HTML language, digital textbooks; (2) examination of the influence of digital technologies on the training and development of digital skills of high school students; (3) development of a pedagogical model that utilizes an interactive digital textbook in the process of training digital skills of high school students, in the field of web development; (4) design of a didactic methodology for implementing the proposed model in a real educational environment (within ICT - Information and Communications Technology classes in a high school educational institution); (5) experimental validation of the effectiveness of the proposed model and methodology.

Scientific novelty and originality consist in the development and experimental validation of a teaching methodology that utilizes a textbook created by the author, transformed into an interactive digital textbook with the help of the educational software *MDIR Constructor*, intended to optimize the teaching-learning process of the HTML language in high school education. The paper proposes a current pedagogical model, focused on the training and development of students' digital skills. The practical contribution of the research is embodied in the integration of an interactive digital resource into an applicable and pertinent didactic approach in relation to the requirements of modern education.

The result obtained contributes to solving an important scientific problem, namely the identification of innovative teaching solutions aimed at improving the formation of digital skills of high school students in creating web pages, using the HTML language. The contribution of the research to solving the problem consists in the development, application and experimental validation of a teaching methodology that capitalizes on an interactive digital textbook within ICT classes.

Theoretical significance: the research contributes to clarifying the role of digital educational resources in the formation of digital skills and provides a relevant theoretical framework for evaluating their efficiency in the educational process.

Applicative value: the research offers a concrete pedagogical tool - a pedagogical model that includes an interactive digital textbook and an implementation methodology - which can be effectively integrated into the process of teaching HTML language in high school education, contributing to improving the formation of students' digital competencies.

Implementation of scientific results: it was carried out within the pedagogical experiment carried out with students of the Technological High School „Sf. Ioan de La Salle" in România, included in the experimental group, within ICT classes. The research results were disseminated through participation in specialized scientific events, both national and international, as well as through the publication of articles in educational journals.

IFRIM, CONSTANTIN-CĂTĂLIN

DEVELOPING DIGITAL COMPETENCIES IN WEB PAGE CREATION THROUGH THE INTEGRATION OF INTERACTIVE DIGITAL TEXTBOOKS IN HIGH SCHOOL EDUCATION

Speciality: 532.02 - School Didactics by Educational Stages and Subjects (Information and Communication Technology)

Summary of the Doctoral Thesis in Education Sciences