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**METHODOLOGY FOR FORMING AND DEVELOPING HIGH-SCHOOL STUDENTS'
COMPETENCE IN CONDUCTING EXPERIMENTS IN THE HUMANITIES (WITHIN
THE ELECTIVE MODULES OF THE INFORMATICS COURSE)**

532.02. School Didactics (by Educational Levels and Subjects)

ABSTRACT

of the Doctoral Dissertation in Education Sciences

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The dissertation was elaborated within the **Doctoral School of Education Sciences at the Ion Creangă State Pedagogical University of Chişinău.**

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CONCEPTUAL FOUNDATIONS OF THE RESEARCH

Relevance and significance of the research problem: The rapid transformations of contemporary society, the accelerated development of information technologies, and the increasingly complex demands of the labor market require the continuous adaptation of the educational system to new realities. In this context, schools are expected to develop not only knowledge, but also competencies that enable students to actively integrate into a knowledge-based society characterized by civic participation and lifelong learning. The relevance of the topic is supported by the curriculum modernization process in the Republic of Moldova, reflected in strategic documents such as the Education Code, the “Education 2030” Strategy, and the Informatics Curriculum (2019), which promote the development of 21st-century key competencies. Within this reform, innovative elective modules have been introduced, including the module “Experimental Methods in the Humanities,” intended for high school students. The high level of novelty of this module generates the need to develop clear methodological guidelines regarding content selection, organization of the instructional process, and assessment of learning outcomes. At the same time, the module offers valuable opportunities for developing research, data analysis, and interpretation skills, fostering critical and creative thinking, as well as cultivating an investigative spirit and civic responsibility. The significance of the research lies in its contribution to the methodological foundation of the process of forming and developing high school students’ competence in conducting experiments in the humanities. This competence facilitates students’ engagement in investigating and solving community-related problems by capitalizing on digital tools and resources studied within the Informatics discipline. At the same time, the research supports the interdisciplinary integration of Informatics and the subject “Education for Society” providing a relevant educational framework for developing the competencies required of an active, responsible citizen adapted to the challenges of modern society.

Overview of the research context: An analysis of scientific publications indicates that the formation of high school students’ competence in carrying out experiments in the humanities within elective modules in Computer Science has not previously been the subject of doctoral research. At the same time, the competency-based approach, regarded as the foundation for the modernization of the national education system, has been extensively addressed in the scientific literature. The implementation of the 2019 Computer Science Curriculum in the Republic of Moldova was carried out in several stages. Beginning on 2 September 2019, the new curriculum was introduced in Grades 7 and 10, in accordance with Order No. 919 of the Ministry of Education, Culture and Research (19 July 2019), while the 2010 Computer Science Curriculum remained in force for the remaining grades [31]. During the 2020–2021 academic year, implementation continued in Grades 7–8 and 10–11, pursuant to Order No. 591 of the Ministry of Education, Culture and Research (26 June 2020) [32]. Since the 2021–2022 academic year, the 2019 Computer Science Curriculum has been fully implemented in all lower and upper secondary schools, in accordance with the Framework Plan approved by Order No. 200 of the Ministry of Education, Culture and Research (26 February 2021) [33]. The 2019 Computer Science Curriculum emphasizes the development of competencies required in a knowledge-based society, including problem-solving, modelling, data processing, and the application of information technologies in authentic learning contexts. A major innovation is the introduction of Specific Competence CS6, which focuses on the processing of experimental data from the natural sciences and the social sciences and humanities through the application of critical thinking and scientific rigor [18]. In this context, the Grade 12 curriculum includes the elective module Experimental Methods in the Humanities, an innovative module aimed at developing students’ research and data analysis competencies. The foundations of this approach can already be found in the Information and Communication Technologies elective curriculum (2013), which emphasized the importance of using digital tools for collecting, storing, and processing experimental data [17]. Only a limited

number of reference works on experimental research and statistical methods applied in education and the humanities are cited, including those by D. A. Novikov [34], P. Rateau [35], and other general methodological sources. However, no methodological guidelines, teaching materials, or educational resources specifically designed to support the implementation of the Experimental Methods in the Humanities module have been identified. From a theoretical perspective, the concept of competence has been extensively investigated by internationally recognized scholars such as J. Raven [36], Ph. Jonnaert [21], B. Rey, V. Garette, A. Defrance, and S. Kahn [30], G. Le Boterf [5], as well as by Romanian and Moldovan researchers including D. Potolea and S. Toma [19], V. Fluieraș [9], A. Ardelean and O. Mândruț [6], V. Guțu [15], V. Pâslaru [20], A. Gremalschi [11], V. Goraș-Postică [14], V. Cabac [23], I. Botgros and L. Franțuzan [13], and T. Cartaleanu and O. Cosovan [22]. The concepts of experimentation and experimental research have been addressed by authors such as F. Bacon [29], J. Siebel [10], C. Bernard [11], and A. M. Korikov [7]. In the field of the humanities, important contributions have been made by F. Depelteau [8] and S. Sanduleac [12]. Nevertheless, an analysis of documentary sources and scientific databases conducted using ScienceResearch, Google Scholar, You.com, and the National Bibliometric Instrument demonstrates that no studies have been identified that explicitly address the formation of high school students' competence in carrying out experiments in the humanities. As a result of the analysis of the theoretical foundations provided by educational policy documents [45], the literature on the methodology for forming and developing high school students' competence in carrying out experiments in the humanities (theoretical potential), and the practical needs related to teaching the elective module 5B. Experimental Methods in the Humanities, several discrepancies were identified. These discrepancies led to the formulation of the following **contradictions**:

- between the importance of developing students' competence in carrying out experiments in the humanities, as emphasized in educational policy documents, and the insufficient orientation of the general education system toward this competence;
- between the need to design the Computer Science curriculum with a focus on forming and developing students' competence in carrying out experiments in the humanities, and the limited research devoted to elaborating an appropriate methodology and identifying the pedagogical conditions under which this competence can be formed;
- between the existence of favorable conditions for developing high school students' competence in carrying out experiments in the humanities, created by the introduction of the elective module 5B. Experimental Methods in the Humanities into the 2019 Curriculum, and the insufficient use of this potential in educational practice.

These contradictions justify the relevance of the present research and give rise to the following **research problem**: *What methodological guidelines, supported by practical foundations, facilitate the formation and development of high school students' competence in carrying out experiments in the humanities through the study of elective modules?*

The object of the research is the process of forming and developing high school students' competence in carrying out experiments in the humanities through the content of the elective module 5B. Experimental Methods in the Humanities within the upper secondary Computer Science curriculum.

The aim of the research is to establish the theoretical foundations and praxiological guidelines for the development and experimental validation of a *Pedagogical Model and a Methodology for Forming and Developing High School Students' Competence in Carrying Out Experiments in the Humanities*.

Research hypothesis: High school students will effectively form and develop competence in carrying out experiments in the humanities if:

- the principles and conditions for designing and conducting experiments in the humanities are established;

- a Pedagogical Model and a Methodology for Forming and Developing High School Students' Competence in Carrying Out Experiments in the Humanities are developed;
- high school students are actively engaged in both classroom learning activities focused on the theoretical foundations of experimental research and in implementing community-based projects within their school and local community;
- the Methodology for Forming and Developing High School Students' Competence in Carrying Out Experiments in the Humanities, together with its constituent Pedagogical Model, is experimentally validated.

To achieve the research aim and test the research hypothesis, **the following objectives were established:**

1. To review, critically analyze, and systematize theoretical approaches and empirical studies in order to identify opportunities for forming and developing high school students' competence in carrying out experiments in the humanities.
2. To establish the theoretical framework and the pedagogical conditions for developing high school students' competence in carrying out experiments in the humanities.
3. To develop a Pedagogical Model for forming and developing high school students' competence in carrying out experiments in the humanities.
4. To design and describe a Methodology for Forming and Developing High School Students' Competence in Carrying Out Experiments in the Humanities.
5. To experimentally validate the proposed Pedagogical Model and the Methodology for Developing High School Students' Competence in Carrying Out Experiments.

The research on the formation of competence in carrying out experiments in the humanities was based on the following research **methods:**

- *Empirical research methods:* observation, description, interviews, online questionnaires, situational analysis, and the pedagogical experiment;
- *Theoretical research methods:* literature review, theoretical modelling of the pedagogical experiment, analysis, comparison and synthesis and systematization;
- *Data processing and analysis methods:* logical-graphical methods for structuring research content, statistical and mathematical data processing, and interpretation.

The scientific novelty and originality of the research are reflected in the determination of the theoretical foundations and praxiological guidelines for the development and experimental validation of a Pedagogical Model and a Methodology for forming and developing high school students' competence in carrying out experiments in the humanities. These contributions differ from existing models and methodologies through their strong focus on the learner as an active subject of the learning process. Within this model, students independently identify authentic and relevant problems from their own life context—whether within the school environment or the wider community—and critically analyze them. They propose concrete solutions through direct involvement in educational activities and projects, thereby developing critical thinking, initiative, civic responsibility, and collaboration skills, while actively engaging in problem-solving processes.

The results obtained, which contributed to the solution of the scientific problem, consist in the *identification of theoretical benchmarks regarding the formation and development of high school students' competence in carrying out experiments in the humanities, as well as in the experimental validation of the Pedagogical Model and the Methodology for forming and developing this competence.* These results were achieved through students' involvement in project-based activities, ensuring a higher level of engagement in researching and addressing community-related problems. This, in turn, contributes to the development of the targeted competence and fosters active citizenship.

The theoretical significance of the research lies in the description of the evolution of the concepts of *competence, experiment design and implementation, experiments in the*

humanities, and high school students' competence in carrying out experiments in the humanities. It also includes the formulation of scientific arguments regarding the importance of developing this competence among high school students in the context of fostering active citizenship, as well as the identification and refinement of assessment criteria.

The applicative value of the research consists in the potential use of the proposed Pedagogical Model and the Methodology for forming and developing high school students' competence in carrying out experiments in the humanities within general education.

The implementation of the scientific results was achieved, on the one hand, through the presentation and publication of research findings at national and international conferences and in specialized scientific journals, and, on the other hand, through the experimental application of the Pedagogical Model and the Methodology for forming and developing high school students' competence in carrying out experiments in the humanities in general education institutions (T. H. School "Văratice", Văratice village, T. H. School "E. Coșeriu", Mihăileni village, Rîșcani district), Moldova, during the years 2021–2023.

Approval of Scientific Results entitled "*Methodology for Forming and Developing High School Students' Competence in Carrying Out Experiments in the Humanities (within the study of elective modules in Computer Science)*" were presented in annual reports within the Doctoral School "Educational Sciences," an organizational and administrative structure of the State Pedagogical University "Ion Creangă" of Chișinău. During the period 2020–2025, numerous works were published addressing the theoretical, methodological, and applied aspects of forming high school students' competence in carrying out experiments in the humanities, including through the use of information technologies and project-based learning. The results were presented at international and national scientific conferences and published in peer-reviewed journals in the field of educational sciences. The main scientific contributions appeared in journals such as *Acta et Commentationes. Educational Sciences*, *Univers Pedagogic*, and *Didactica Pro*, as well as in conference proceedings organized by institutions such as Tiraspol State University and "Alecu Russo" State University of Bălți, among other higher education institutions. Examples of integrating digital applications (MS Excel, Google Forms, and other digital resources) into the elective module "Experimental Methods in the Humanities" were developed and presented. These examples are available on the page: https://padlet.com/adriana_cernei/CRESU.

CONTENTS OF THE THESIS

In the Introduction, the rationale for choosing the research topic "*Methodology for Forming and Developing High School Students' Competence in Carrying Out Experiments in the Humanities (within the study of elective modules in Computer Science)*" is presented. The relevance of the topic is also justified through an analysis of the degree of scientific investigation of the addressed problem. A brief overview of the current state of research in the field is provided, along with the formulated scientific problem that is addressed in the study. The scientific value, theoretical significance, and applicative relevance of the obtained results are also highlighted, together with information regarding their validation and implementation in educational practice.

Chapter 1, entitled "**Theoretical aspects regarding the notion of competence in carrying out experiments in the humanities**," consists of three independent yet interconnected subsections, which reflect the main conceptual, methodological, and axiological foundations of the investigated topic.

The first subsection, "*Analysis of specialized literature on the concepts of competence, experiment, experiments in the humanities, and competence in carrying out experiments in the humanities*," is devoted to the analysis and synthesis of existing theoretical approaches in the specialized literature concerning the fundamental concepts of the research. Definitions, characteristics, and components of the notions of competence, experiment, experiment in the humanities, and competence in carrying out experiments in the humanities are examined, highlighting the relationships among them and their relevance for the educational field. Within

this subsection, various approaches to the concept of competence are analyzed, identifying the main theoretical perspectives regarding competence as a set of resources and competence as a process of mobilizing resources in complex situations. Contributions of researchers from the European, Romanian, and national contexts are examined, allowing for the identification of the defining elements of competence. The evolution of the concept of experiment in scientific literature is also analyzed, highlighting its main characteristics as a research method and its role in the process of knowledge acquisition. Special attention is given to experiments in the field of the humanities, emphasizing their specific features and particularities.

Table 1. Concepts of competence in the European education system – analysis

Country	1. Knowledge	2. Skills	3. Attitudes
France	savoirs / theoretical competences	savoir faire – practical competences	savoir être – behavioral competences
Germany	fachkompetenz sachkompetenz	methodenkompetenz – metacompetences	personal kompetenz – personal competences
		Sozialkompetenz	
United Kingdom	knowledge / cognitive competences	skills or functional competences	competencies – social competences
Hungary	knowledge	application of knowledge	professional attitudes and behaviors
Portugal	cognitive competences	functional competences	cognitive competences

The second subsection, *“The issue of forming and developing high school students’ competence in carrying out experiments in the humanities,”* is dedicated to the pedagogical and methodological foundation of the process of developing the **competence in carrying out experiments in the humanities (CCCEHu)**. Within this subsection, the concepts of resource, situation, and family of situations are analyzed, highlighting their role in competence development within the context of modern curriculum-based approaches. As a result of the analysis of theoretical sources, the necessity of defining and clarifying the concept of **competence in carrying out experiments in the humanities** was substantiated. For this purpose, the structural components of this competence were identified, and a definition was formulated, which serves as the conceptual benchmark of the research. Based on a critical analysis of bibliographic sources and national curriculum documents, the concept of **competence in carrying out experiments in the humanities** was theoretically grounded, and an operational definition was developed, which is further used within the research. The proposed definition integrates the cognitive, operational, and attitudinal dimensions of competence and reflects the current requirements of competency-based education and the Computer Science curriculum. A definition of the competence in carrying out experiments in the humanities was proposed, taking into account the two “dimensions” of competence. From the perspective of “having competences,” and with reference to high school students, the competence in carrying out experiments in the humanities is understood as an open and evolving set of declarative and procedural knowledge from the fields of humanities, Computer Science, and experimental research methodology, as well as personal emotional-volitional attitudes and dispositions that enable students to conduct empirical investigations. From the perspective of “being competent,” the competence in carrying out experiments in the humanities refers to the student’s ability to identify and formulate a scientific problem in the field of humanities, generate hypotheses, plan and conduct experiments, collect and record data, process, analyze and interpret data, and formulate conclusions. A number of comments will be made regarding the above “dual” definition.

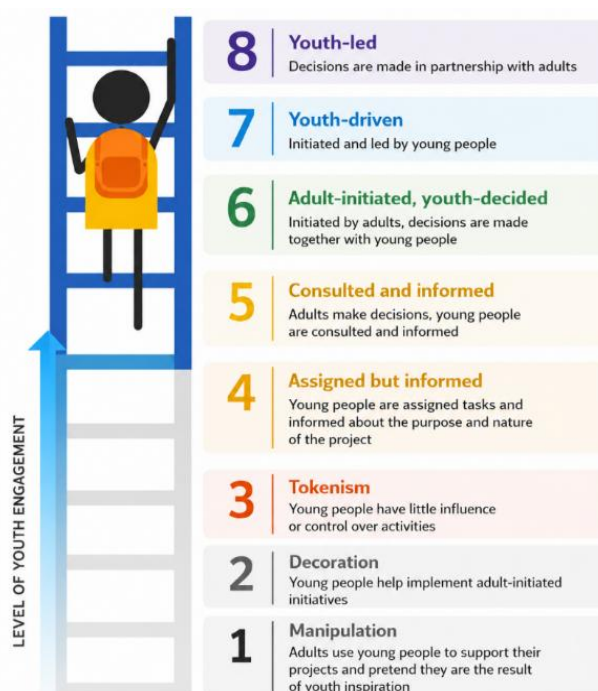


Fig. 1. The youth participation ladder, [OECD, 2019]

In Subchapter Three, “*Education through and for Democracy – a Value of the Competence of Conducting Experiments in the Humanistic Sciences*,” the relationship between education for democracy and the formation of the competence of conducting experiments in the humanistic sciences among high school students was analyzed. It was highlighted that contemporary social transformations, generated by globalization, digitalization, climate change, and demographic challenges, require the development of active, responsible citizens capable of participating in community life. The importance of civic spirit and active citizenship was emphasized, promoted both through the provisions of the Education Code of the Republic of Moldova, where, starting from 01.09.2023, Article 5 “Mission of Education” was supplemented with letter g) “the development of civic spirit and the promotion of active citizenship” [1], as well as through national and European strategic documents. In this context, the levels of youth participation in community life were analyzed, highlighting the need to move from formal and symbolic participation toward authentic and responsible involvement in decision-making processes and in solving community problems. The subchapter demonstrated that the optional module “Experimental Methods in the Humanistic Sciences,” the structure of which is presented in Table 2 and included in the curriculum of the subject Informatics for Grade XII, provides a favorable framework for the development of CCEHU.

Table 2. Structure of the elective module 5B “Experimental Methods in the Humanistic Sciences”, Grade XII, Humanities track, Informatics subject

Competence Units	Content Units
Defining variables in humanistic sciences	Experimental methodology of humanistic sciences. Concept of variable. Definition, notion of causality, correlation.
Defining control groups	Control groups and confounding variables: control group; synchronic and diachronic experiments; confounding variables.
Designing experimental plans, selecting subjects	Experimental designs and selection of subjects: unifactorial and multifactorial design; selection of participants.
Choosing measurement scales	Mathematical description of primary data in humanistic sciences: measurement scales and their graphical representations: nominal, ordinal, interval scales; choosing the measurement scale.

Numerical description of data used in the study of CREŞU	Summary and numerical description of data in humanistic sciences: measures of central tendency and dispersion for interval, ordinal, and nominal scales; selection of indicators depending on variables.
Sampling methods	Population and sample concepts: definitions, sampling methods.
Use of spreadsheet applications for data analysis	Use of spreadsheet applications for advanced data analysis in humanistic sciences: data collection, verification, organization, grouping; calculation of central tendency measures; creation of histograms; interpretation of results.
Use of software tools for social research	Use of software for social sciences: graphical interface, variable description, import; creation of contingency and association tables; creation of graphs.

Chapter Two, “Referentiality of the Formation and Development of High School Students’ Competence in Conducting Experiments in Humanistic Sciences within Elective Modules (in the School Informatics Course),” consists of three subchapters and is overall dedicated to the conceptual and methodological foundation of the process of forming and developing the competence of conducting experiments in humanistic sciences among high school students. Building on the theoretical frameworks analyzed in the first chapter, this chapter identifies and argues the pedagogical foundations underlying the development of the proposed competence formation model. The principles of the competence-based approach are examined, along with the triadic structure of competence (knowledge, skills, and attitudes), as well as the value of transdisciplinarity in the process of integrating knowledge from the fields of informatics, research methodology, statistics, and socio-human sciences.

Subchapter One of Chapter Two, “*The triadic structure of competence and transdisciplinarity – reference points in the elaboration of the Pedagogical Model for the formation and development of the competence of conducting experiments in humanistic sciences,*” highlights the essential role of transdisciplinarity and the triadic structure of competence in the development of the Pedagogical Model for forming and developing the competence of conducting experiments in humanistic sciences. The analysis of specialized literature reveals that current trends in educational modernization promote a constructivist approach to learning, the integration of content, the development of metacompetences, and an orientation toward transdisciplinary competencies. Transdisciplinarity is presented as a way of integrating knowledge from different fields, based on real problems and authentic life contexts. It facilitates knowledge transfer, the development of critical and creative thinking, as well as the active involvement of students in investigative and problem-solving processes. The study highlights the existence of systematic transdisciplinary practices in primary education and the need to extend them to the high school level, particularly within the elective module “Experimental Methods in Humanistic Sciences.” The analysis of documentary resources, the opinions of curriculum authors for “Informatics” (Grades X–XII) [18], as well as the author’s own experience, allowed the identification of the following components of the competence of conducting experiments in humanistic sciences (presented in Figure 2). Both the dynamic structure of competence and the transdisciplinary approach in the assimilation of the content of the module “Experimental Methods in Humanistic Sciences” are essential in the formation and development of the competence of conducting experiments in humanistic sciences among high school students. Starting from the dynamic structure of competence (PISA model), the components of the competence of conducting experiments in humanistic sciences selected from the Informatics curriculum, and the author’s experience, the resources of this competence are detailed in Figure 2.

In Subchapter Two, “*The pedagogical model for the formation and development of the competence of conducting experiments in humanistic sciences in the context of digitalization of instruction,*” the theoretical foundations of scientific research and the particularities of conducting experiments in humanistic sciences were analyzed, highlighting the differences and similarities between these and the natural sciences. The importance of the experiment as a method of

investigation and hypothesis testing was emphasized, as well as its role in developing students' scientific thinking and critical spirit. The concepts of observation, experience, and experiment were examined, highlighting that an experiment represents a controlled intervention on reality aimed at identifying and verifying causal relationships. At the same time, the particularities of experimentation in humanistic sciences were presented, determined by the complexity of social phenomena, the interaction between researcher and participants, and the difficulty of reproducing experimental conditions. Within the subchapter, the main models and stages of the experimental approach were analyzed, including the OIERIC model (O – Observation; I – Hypothesis; E – Experimentation; R – Results; I – Interpretation; C – Conclusions/Communication), as well as other established approaches in the literature. Based on these, a personal scheme for conducting experiments in humanistic sciences was developed, structured in the following stages: initiation of research, definition of the research object and problem, formulation of the research issue, data collection and processing, hypothesis testing, interpretation of results, formulation of conclusions, and reflection on the research process. The necessity of developing the competence of conducting experiments in humanistic sciences among high school students was also justified, based on the current requirements of the Informatics curriculum and national educational policy guidelines. In this context, the competence was defined as a dynamic integration of knowledge, skills, and attitudes that enables the investigation of social phenomena through experimental methods and digital tools. The main outcome of the subchapter is the theoretical and conceptual foundation of the Pedagogical Model for the formation and development of the competence of conducting experiments in humanistic sciences (MPFDECREȘU) (Figure 3), intended for implementation within the elective module “Conducting experiments in humanistic sciences” in the Informatics course for Grade XII. The proposed model valorizes the principles of scientific research, the specific nature of experimentation in humanistic sciences, and the opportunities offered by the digitalization of education, with the final aim of developing the competence of conducting experiments in humanistic sciences among high school students.

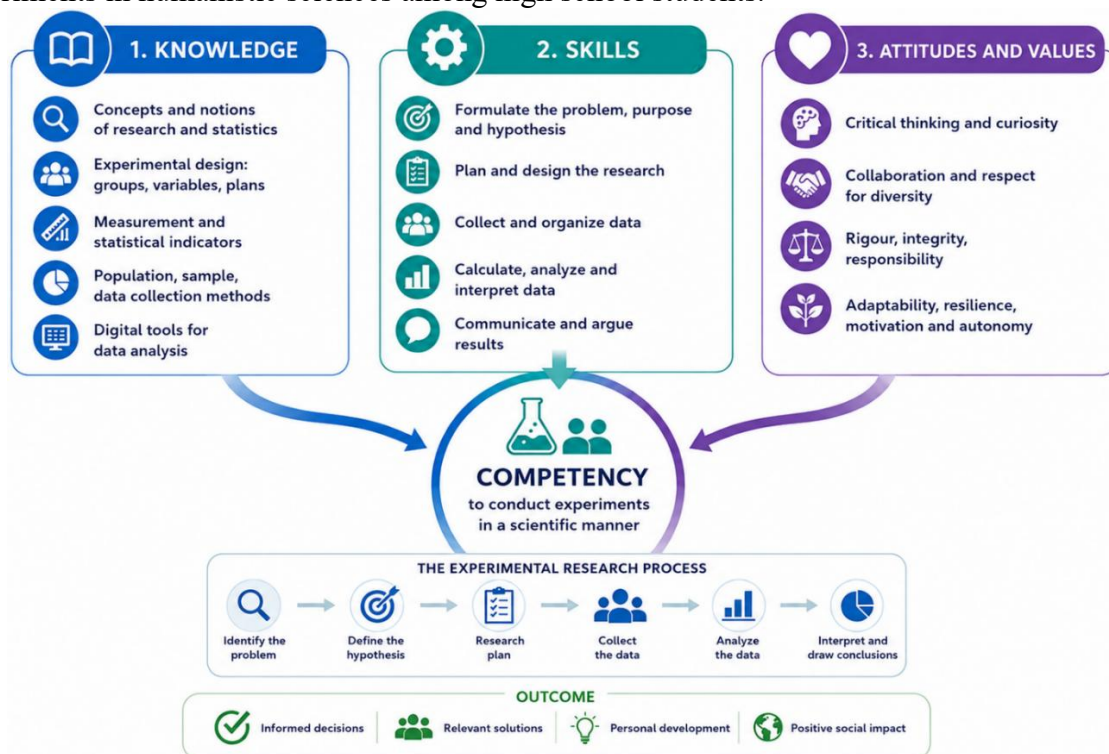


Fig. 2. Structure of CCEHU, proposed by the author, according to the PISA model
The proposed model, presented in Figure 3, establishes four correlational anchors:

1. **Updated conceptual principles** (co-evolution of nature and society, educational anthropocentrism, digital transformation, student-centered approach, individualization and differentiation, competence-based approach);
2. **Alignment with educational policy documents and the national Informatics curriculum**, with emphasis on specific competencies regarding data processing;
3. **An applied dimension aimed at ensuring the transfer from theory to practice** (functional knowledge in mathematics and informatics, analytical-synthetic skills, argumentation, teamwork, civic engagement);
4. **A structural mechanism of staged formation** (from awareness to automation), in which learning events are designed as investigative and social experiences.

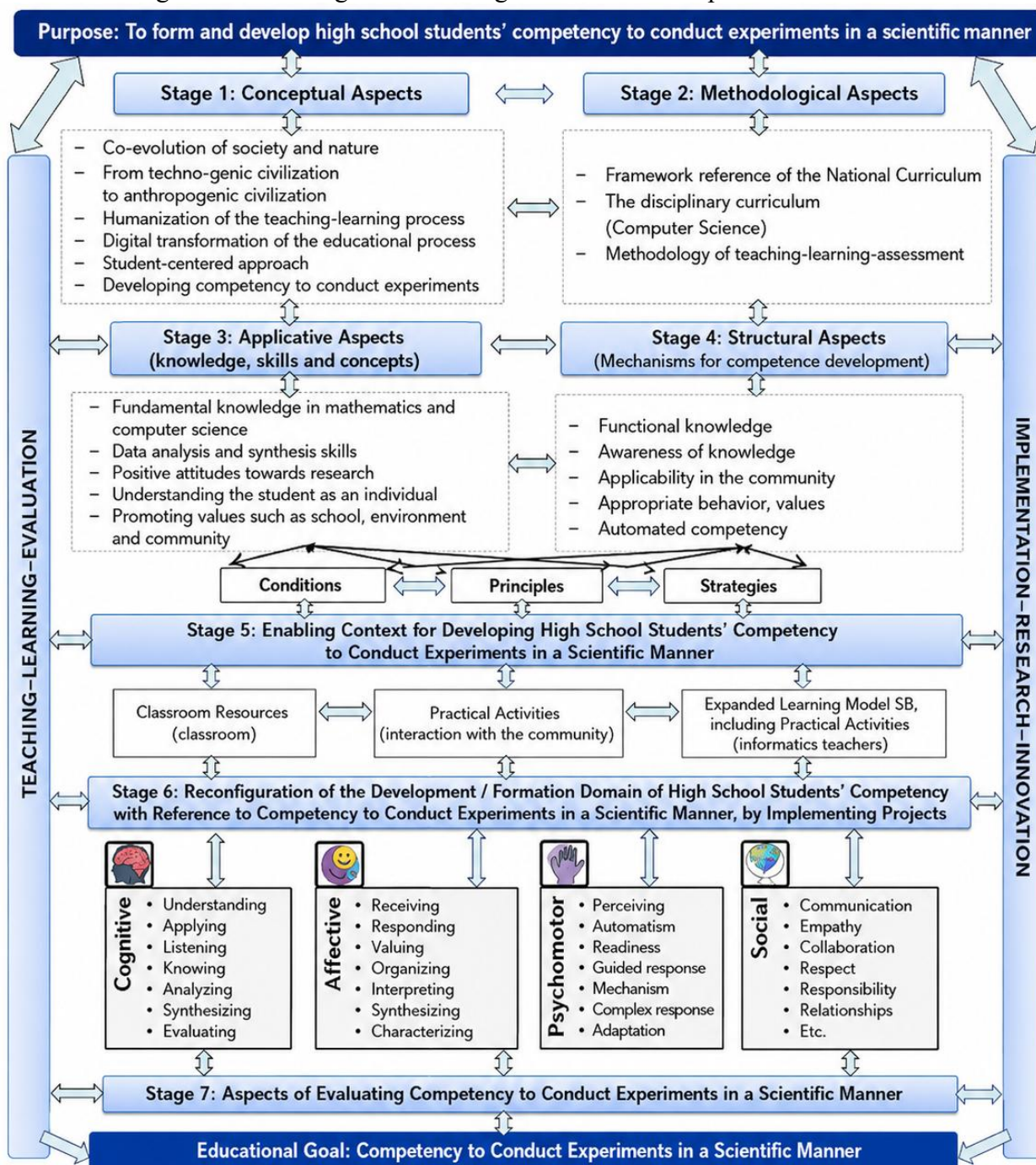


Fig. 3: PEDAGOGICAL MODEL for Forming and Developing High School Students' Competency to Conduct Experiments in a Scientific Manner

Subchapter Three, “*The methodology for the formation and development of high school students’ competence in conducting experiments,*” presents the methodology for forming and developing the competence of conducting experiments in humanistic sciences among high school students. The author proposes a research approach structured in seven stages: initiation of research, definition of the research object and problem, formulation of the research issue, data collection and processing, verification and interpretation of results, formulation of conclusions, and reflection on the research process. The role of the teacher is highlighted in motivating students for research activities and in guiding them in formulating research problems, objectives, and hypotheses. As an applied example, the investigation of the phenomenon of cheating in schools is analyzed, used to illustrate the stages of an experimental approach in the humanistic domain. The subchapter explains essential concepts such as the research problem, hypothesis, independent and dependent variables, sampling, and research methods. The particularities of quantitative, qualitative, and mixed methods are presented, as well as the main data collection tools, especially the questionnaire. The stages of data analysis and interpretation are also described, along with the process of validating or invalidating hypotheses and the importance of final reflection on the conducted activity. The proposed methodology aims to develop critical thinking, investigative competencies, and students’ responsibility, demonstrating that the experiment can also be effectively used in community-based research.

Chapter Three, entitled “Experimental argumentation of the formation and development of high school students’ competence in conducting experiments in humanistic sciences,” is structured into three subchapters that are in a logical and sequential relationship. The first subchapter, “*The design of the pedagogical experiment regarding the formation and development of high school students’ competence in conducting experiments in humanistic sciences through involvement in projects,*” presents the design of the pedagogical experiment (Fig. 4), establishing the methodological framework of the research, the participants, stages, and instruments used. Within the module running parallel to the instructional-educational process in Informatics, students were assigned the task of conducting a micro-research study and a community analysis in order to identify pressing issues. This activity was carried out using a questionnaire available on Google Forms [189]. Continuing the micro-research initiated through the online questionnaire, the design of the formative sequence and the assessment framework was guided by two methodological imperatives: ensuring constructive alignment between objectives, activities, and assessment; and respecting the requirements of experimental control under the specific conditions of humanistic sciences.

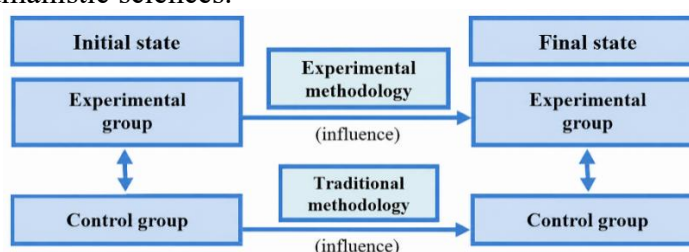


Fig. 4. Design-ul experimentului pedagogic

In these conditions, a quasi-experimental design (Fig. 5) was adopted, using a pretest–posttest structure with a control group, implemented on cohorts of Grade XII students from two high schools (experimental sample and control sample), following the same curricular content framework and the same implementation schedule. The major difference consisted in the presence/absence of the designed pedagogical intervention (experimental methodology vs. traditional methodology). The construction of variables and control procedures follows the framework presented in the chapter (dependent variables – level of competence development; independent variable – complex tasks from Module 5B; and controlled variables – initial level, content, teaching method, technical environment, and assessment method). The target competence – “conducting experiments in humanistic sciences” – was operationalized into four observable

dimensions, aligned with the triad “knowing – knowing how to do – knowing how to be/becoming”: (D1) conceptual-declarative (notions, concepts, causal relationships); (D2) procedural-technical-experimental design, sampling, data collection; (D3) analytical-interpretive (statistical analysis appropriate to the type of scale, evidence-based argumentation); (D4) civic-ethical and collaborative (research ethics, teamwork, communication of results to the community). These dimensions explicitly reflect the content of Module 5B: “Experimental Methods in Humanistic Sciences” (variables, experimental designs, scales, numerical descriptions, sampling groups), which allows an integrated, continuous, and summative assessment of progress.

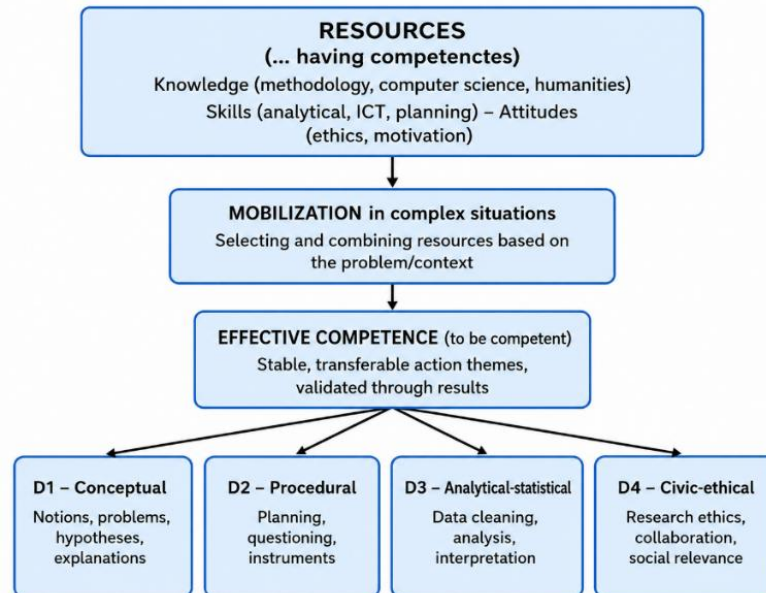


Figure 5. Transition from resources (knowledge, skills, attitudes) to their mobilization in complex situations and to actual competence, structured along dimensions D1–D4

Based on this operationalization, the measurement instruments and procedures are:

a. Standardized questionnaires (pretest and posttest): The student questionnaire (initial and final version) uses Likert-scale items (1–5), grouped into dimensions consistent with the architecture of the competence.

TIMELINE			
T0 (Pretest)	Intervention (Module 5B / projects)	T1 (Posttest)	T2 (Follow-up)
EXPERIMENTAL GROUP (EG) — n EG = 48			
T0: Pretest [M1, M2]	Intervention Complex topics, projects, work with real data	T1: Posttest [M1, M2]	T2: Follow-up [M1 select]
CONTROL GROUP (CG) — n CG = 46			
T0: Pretest [M1, M2]	No intervention (regular curriculum)	T1: Posttest [M1, M2]	T2: Follow-up [M1 select]
LEGEND AND METHODOLOGICAL NOTES			
Design type: quasi-experimental (non-random allocation; matching on key variables). VI (independent variable): exposure to the intervention – Module 5B + projects / complex research topics in higher education. VD (dependent variable): level of competence in conducting experiments in higher education (composite score / performance rubric / applied test). VC (controlled variables): initial level, core curriculum content, ICT infrastructure, assessment schedule, instruments, and common criteria, teacher (where possible). Measures: M1 – standardized test/rubric; M2 – questionnaire/scale (efficacy). Time points: T0 = pretest; T1 = posttest; T2 = follow-up (retention). Analysis: $\Delta = (T1 - T0)$ EG vs $(T1 - T0)$ CG; (optional) retention: $(T2 - T1)$.			

Figure 6. Quasi-experimental design (pretest–intervention–posttest)

b. Analytical rubric for the project product To capture “in-action” performance, an analytical rubric was developed: (R1) formulation of the research problem and research questions; (R2) experimental design (variables, sample, control of factors); (R3) data quality (validation,

cleaning, coding); (R4) adequacy of statistical analyses to the type of data (nominal/ordinal/interval/ratio); (R5) interpretation and evidence-based argumentation; (R6) ethical dimension and data protection; (R7) quality of communication (report/poster/pitch); (R8) civic relevance/impact of the proposal for the community.

c. Observation sheet of research behaviors: Systematic observation (within teams, at key stages) captures indicators such as initiative, team roles, perseverance, methodological autonomy, responsibility for data quality, and adherence to research ethics.

Sampling was purposive at the school level (LT Văratice; LT “Eugen Coșeriu”), with students distributed into two conditions: an experimental group (receiving the designed intervention) and a control group (traditional methodology). In the absence of strict randomization at the student/class level (a constraint of the school context), comparability was strengthened through: pretesting using the same instruments; approximate matching based on initial characteristics (academic averages, gender); identical content delivery (Module 5B), schedule, and logistical conditions; identical final assessment procedures (tests, indicators, criteria).

- **T0 (week 0):** Pretest + collection of minimal demographic and academic data;
- **T1–T2 (weeks 1–4):** Planning and collection of community data (including the online questionnaire with items on pressing issues; instruments adapted to the rural context);
- **T3 (weeks 5–7):** Data analysis and interpretation; report writing;
- **T4 (weeks 8–9):** Posttest (same questionnaire) + assessment + public presentation.

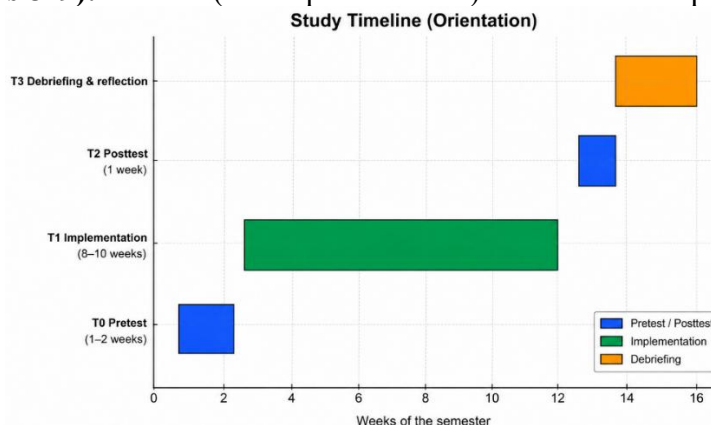


Figure 7. Study timeline (indicative schedule)

To synthesize the theory of the intervention and the coherence between resources, implementation steps, and expected effects, the logical chain of the approach is presented (Fig. 8). The following subchapter, “*Valorization of the Pedagogical Model and of the Methodology for the formation and development of high school students’ competence in conducting experiments in humanistic sciences within elective modules in the school Informatics course,*” describes the process of implementation and application of the Pedagogical Model and Methodology in teaching practice, highlighting the concrete ways in which the investigated competence is formed. The valorization of the Pedagogical Model, based on the relationship between resources–mobilization–competence, was carried out within the optional module “Experimental Methods in Humanistic Sciences,” 8–10 weeks.

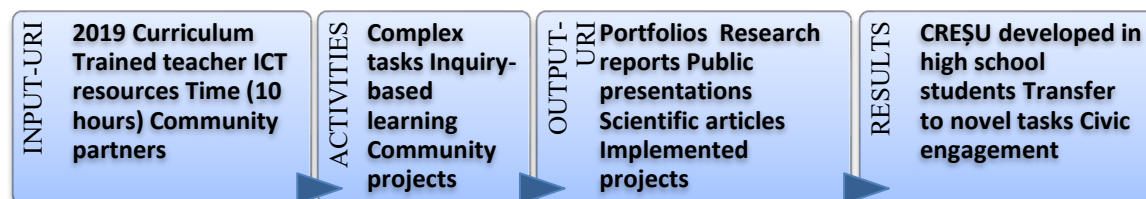


Figure 8. Logical framework of the educational intervention, developed by the author

In the experimental group, the instructional process was organized according to the principles of **constructive alignment**, integrating authentic research- and project-based tasks

explicitly aligned with the intended learning outcomes and assessment instruments. In the control group, the same curricular content and instructional conditions were maintained; however, teaching and assessment were conducted using traditional instructional methods. The educational intervention aimed to foster the progressive development of the four dimensions of competence: **conceptual understanding (D1), procedural competence (D2), data analysis and interpretation (D3), and civic and ethical responsibility (D4).**

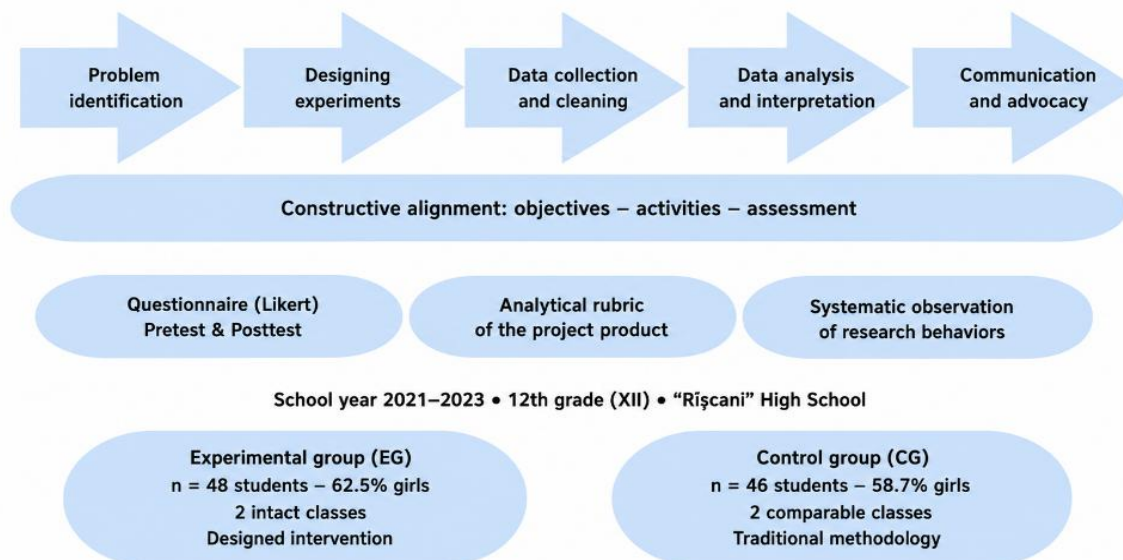


Figure 9. Framework for the implementation of the Model and the Methodology

The learning process was supported through the use of integrated learning artifacts, including project matrices, research protocols, databases, research reports, and academic posters. Assessment relied primarily on analytical rubrics, self-assessment, and continuous reflective practice. Implementation fidelity was ensured through common lesson guides, standardized administration procedures, evaluator calibration sessions, and systematic monitoring of all instructional stages. Outcome evaluation was based on the **triangulation of evidence** obtained from standardized questionnaires, analytical rubrics, and structured observation protocols, providing a comprehensive picture of students' learning progress. Data management followed standardized procedures for data collection, coding, validation, and secure storage, in accordance with the ethical principles of educational research.

Instrument reliability was examined by estimating **internal consistency (Cronbach's α)** for both the overall scale and individual subscales. Content validity was established by aligning each instrument with the targeted learning outcomes corresponding to dimensions D1–D4, while structural equivalence between the pre-test and post-test was maintained through identical instructions, administration conditions, and testing time. Each assessment item was mapped **one-to-one** to the competencies specified in **Module 5B** of the curriculum, including variables, control groups, experimental designs, measurement scales, descriptive statistics, and sampling procedures. **Psychometric indicators are presented below.**

- **Cronbach α — total:** 0,86 (T0) → 0,91 (T4) in EG; 0,85 (T0) → 0,88 (T4) in CG.
- **Subscales:** D1: 0,80→0,87; D2: 0,78→0,86; D3: 0,77→0,84; D4: 0,74→0,82 (EG).

The findings indicated that the implementation of the **Pedagogical Model** facilitated a shift from knowledge reproduction toward **inquiry-based learning**, argumentation, and the solution of authentic community problems. Students developed research, analytical, and communication competencies while demonstrating responsibility for data quality, adherence to ethical standards, and civic engagement. Several student teams further capitalized on the acquired experience by designing and implementing projects funded through the **Youth Fund Program of Rîșcani District**. Overall, the intervention demonstrated the potential of the Pedagogical Model to support

the development of competencies related to **experimental research in the humanities** through the coherent integration of project-based learning, authentic assessment, and students' active participation in community life.

To ensure the rigor and quality of the intervention, the following quality assurance mechanisms were implemented:

1. **Implementation fidelity:** the use of a common lesson guide hosted on **Padlet**, together with the maintenance of constant instructional resources (ICT laboratory and allocated instructional time) across all classes, controlling contextual variables.
2. **Equity:** equal access to digital tools; acceptance of multiple product formats (e.g., posters and presentations) to accommodate diverse learning preferences; and additional support for students experiencing learning difficulties through mini-tutorials and consultation sessions.
3. **Transparency:** explicit assessment criteria communicated from the outset through analytical rubrics; formative feedback provided after each learning activity; and anonymization of student data in all research reports.

To document the implementation and effectiveness of the **Methodology**, participation and learning indicators were monitored throughout the intervention:

- **Participation in project-based activities (EG):** mean attendance rate of **95.8%** across instructional sessions; submission rate of intermediate project **93.7%**.
- **Out-of-class learning time (EG):** median of **2.0 hours per student per week**;
- **Data quality:** following data cleaning, missing data accounted for **less than 3%** of team datasets; **inter-rater agreement** for coding procedures reached **0.83**.
- **Formative perceptions** (selected items, 5-point Likert scale):
 - *"I can distinguish between causation and correlation."* **2.7 (T0) → 4.1 (T4)** in the EG; **2.6 → 3.1** in the CG.
 - *"I know how to select an appropriate measurement scale."* **2.5 → 3.9** in the EG; **2.4 → 3.0** in the CG.
 - *"I can design a simple experimental plan."* **2.3 → 3.8** in EG; **2.3 → 3.0** in CG.

Examples of indicators for 3 competencies that can be developed in computer science.

Competency	Indicators (brief)	Examples
Critical thinking	Analyzes and evaluates information, arguments, and reasoning.	Evaluates the credibility of information sources; applies evaluation criteria; draws logical conclusions; synthesizes information; demonstrates ethical responsibility.
Information management	Searches for, organizes, evaluates, and uses information effectively.	Identifies information from multiple sources; summarizes and organizes data; verifies the authenticity of information; respects copyright and appropriate information-use practices.
CREŞU	Plans, conducts, analyzes, and reports research.	Formulates research questions and hypotheses; selects appropriate research methods and instruments; analyzes data; presents evidence-based conclusions.

Within the implementation framework, formative performance thresholds were established for each dimension (Figure 10): **D1:** $\geq 80\%$ of students correctly identify the type of measurement scale and an appropriate descriptive statistic for each item. **D2:** $\geq 75\%$ of students develop a coherent experimental design, including clearly defined variables and justified sampling procedures. **D3:** $\geq 70\%$ of students correctly select and interpret an appropriate statistical test (χ^2 or t -test) using their team's dataset. **D4:** $\geq 85\%$ of students adhere to ethical standards and effectively communicate their findings through a clear and readable scientific poster.

Table 3. Operational timeline and implementation mechanisms for Module 5B

Stage & timeline	Target learning outcomes (D1–D4)	Learning activities & tasks	Instruments used	Evidence / Assessment
A. Initiation and establishment of standards (Weeks 0–1)	Reinforcement of D1 (terminology; causal and correlational relationships); Introduction to D4 (research ethics; data protection); Clarification of assessment criteria (R1–R8).	Local case study ("Street lighting" / "Green spaces"); Concept map on <i>variables–indicators–measurement scales</i> ; Rubric calibration workshop using sample student products.	Initial questionnaire (Appendix 2); Analytical rubric (criteria R1–R8).	Baseline assessment (T0); diagnostic task: identification of variables and appropriate measurement scales.
B. Planning and experimental design (Weeks 1–3)	D2 (sampling; single- and multifactor experimental designs); D1 (control group; extraneous variables).	Identification of a local problem (based on the Google Forms survey); Formulation of hypotheses; Variables–indicators–measurement scales matrix; Data collection plan (roles and timeline).	Project templates; Experimental design guide; Analytical rubric (R1, R2, R6).	Formative feedback on the research design based on the analytical rubric.
C. Data collection and quality assurance (Weeks 3–5)	D2 (data collection techniques; error prevention); D4 (informed consent; data anonymization).	Administration of research instruments (including the local online questionnaire); Data entry into the database; Data cleaning: missing values, outliers, and coding procedures.	Local questionnaire; Research database; Data quality checklist.	Data quality checklist completed; inter-rater agreement for coding > 0.80.
D. Data analysis and interpretation (Weeks 5–7)	D3 (descriptive statistics; contingency tables; selection of statistical tests); D1 (accurate interpretation of statistical indicators).	Calculation of descriptive statistics according to measurement scale; Data visualization (bar charts, boxplots, heat maps); Mini-seminar: <i>Median vs. Mean; Chi-square vs. Independent Samples t-test</i> .	Statistical worksheet; Spreadsheet software; Interpretation guide.	Practical assessment: justified selection of the appropriate statistical test and interpretation of the results.
E. Communication and advocacy (Weeks 7–9)	D4 (public communication; civic relevance); Integration of D1–D3.	Team research report; Scientific poster; Presentation to local stakeholders (teachers, local public authorities, student council).	Report templates; Presentation checklist; Final questionnaire (Appendix 3).	Comprehensive analytical rubric (R1–R8); Post-test (T4); public feedback and student self-reflection.

Source: Developed by the author based on the intervention scenario and the assessment framework designed for Module 5B (Grade 12, 2021–2023).

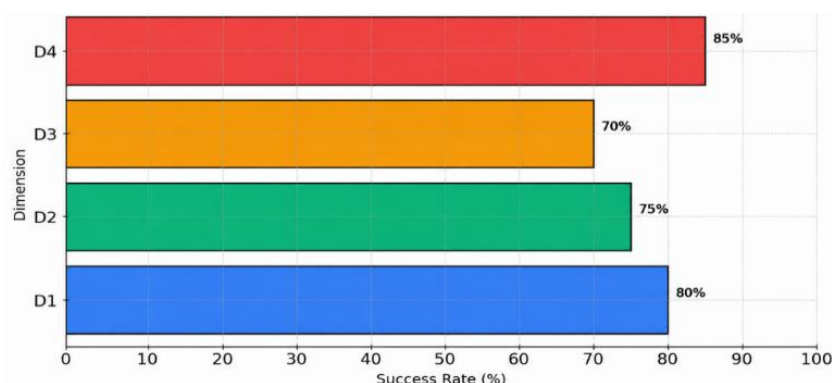


Fig. 10. Formative Benchmarks Across the D1–D4 Dimensions of CCEHU

The final subsection of Chapter Three, entitled “*Experimental Validation of the Pedagogical Model and Methodology for Forming and Developing High School Students’ Competence in Conducting Experiments in the Humanities within Elective Modules of the School Informatics Course,*” presents the experimental and control groups and provides a detailed description of the design and procedures of the pedagogical experiment. The study was conducted between **2021 and 2023** in two high schools in the **Rîșcani District** (Republic of Moldova) and involved **94 twelfth-grade students**: the experimental group (**n = 48**) and the control group (**n = 46**). The **independent variable** was the pedagogical intervention based on **Elective Module 5B**, while the **dependent variable** was the level of students’ competence in conducting experiments in the humanities. Data were collected through **questionnaires, assessment rubrics, and observation sheets**, all aligned with the intended learning outcomes of the module. Ethical principles, including **voluntary participation, confidentiality, and secure data management**, were strictly observed throughout the research process. To ensure implementation fidelity, common instructional guidelines, standardized assessment criteria, and comparable conditions were applied to both groups.

Table 4. Psychometric Synopsis and Quality Indicators

Evaluated Component	Summary of Results	Methodological Notes
Reliability – Cronbach's α (EG)	Overall: 0.86 (T0) → 0.91 (T4) ; Subscales: D1: 0.80→0.87; D2: 0.78→0.86; D3: 0.77→0.84; D4: 0.74→0.82.	High internal consistency; improvements observed across all dimensions in the EG.
Reliability – Cronbach's α (CG)	Overall: 0.85 (T0) → 0.88 (T4).	Good stability in the CG without the planned pedagogical intervention.
Content Validity	Questionnaire items aligned with the CCEHU framework	Expert review confirmed agreement regarding content coverage.
Structural Validity	The structure was confirmed through exploratory factor analysis (EFA).	Verified at the sample level; structural consistency maintained from T0 - T4.
Data Quality – Completeness	< 3% missing values after data cleaning across the datasets.	Data-cleaning procedures included double verification, coding rules.
Data Quality – Inter-rater Agreement	Inter-rater agreement: 0.83 (coding).	Behavioural anchors and evaluator–observer calibration sessions.

Within the experimental validation, the **reliability, validity, and effectiveness** of the pedagogical intervention were evaluated. The results demonstrated **high internal consistency** of the questionnaires, with **Cronbach's α coefficients ranging from 0.74 to 0.91**, confirming the stability and coherence of the research instruments. Their validity was ensured through alignment with the objectives and content of **Elective Module 5B**, expert review, and verification of the underlying factor structure. Statistical analyses revealed significant progress in both groups, although the improvement was substantially greater in the **experimental group (EG)**. The composite competence score increased from **2.58 to 3.96** in the EG, compared with an increase from **2.55 to 3.10** in the **control group (CG)**. The differences between the groups were statistically significant and associated with a **large effect size**, as further confirmed by **analysis of covariance**

(ANCOVA). These findings provide strong evidence for the effectiveness of the proposed **Pedagogical Model** and **Methodology** in developing high school students' competence in conducting experiments in the humanities. Across all four competence dimensions, the **experimental group consistently outperformed the control group**, with statistically significant differences and **large effect sizes (Cohen's $d \approx 0.82\text{--}0.95$)**. This performance profile indicates that the intervention not only promoted measurable progress but also generated **consistent and robust learning outcomes** across all evaluated domains: **knowledge acquisition, practical application, analytical thinking, and socio-civic competencies**. Improvements observed in the individual subscales were consistent with students' formative self-reports on representative items, such as “*I understand the difference between causality and correlation*,” “*I know how to select an appropriate measurement scale*,” “*I can design an experimental plan*,” and “*I have developed teamwork competence*.” In all cases, the gains were considerably greater in the experimental group than in the control group (Section 3.2).

The findings confirm that the **pedagogy of integration**—defined as the coordinated mobilization of **cognitive, affective, and action-oriented resources** to address complex, context-based situations involving community engagement, ethics, and civic responsibility—produces significantly greater gains in students' competence in conducting experiments in the humanities than the traditional instructional approach. The learning scenarios functioned as **formative drivers**, requiring students to complete the entire scientific inquiry cycle: **problem identification** → **research design** → **data collection** → **data analysis** → **communication of findings**.

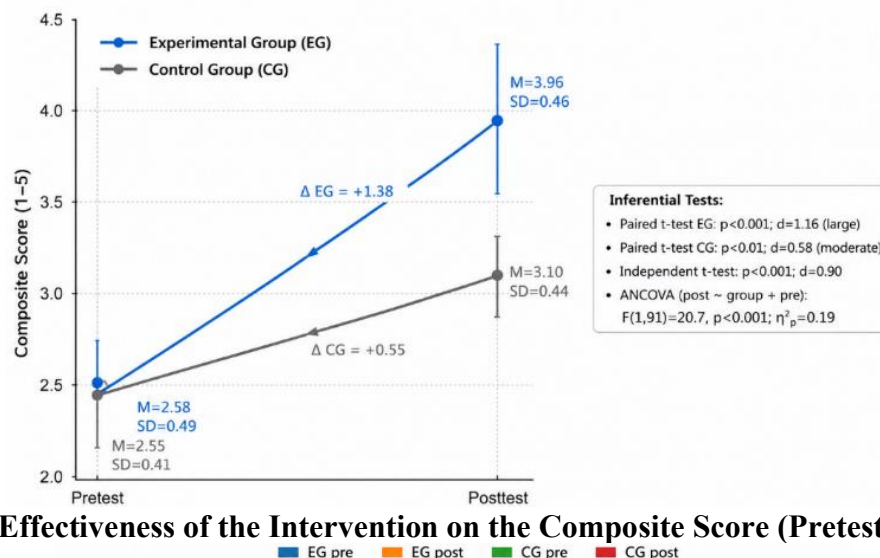


Fig. 11. Effectiveness of the Intervention on the Composite Score (Pretest–Posttest)

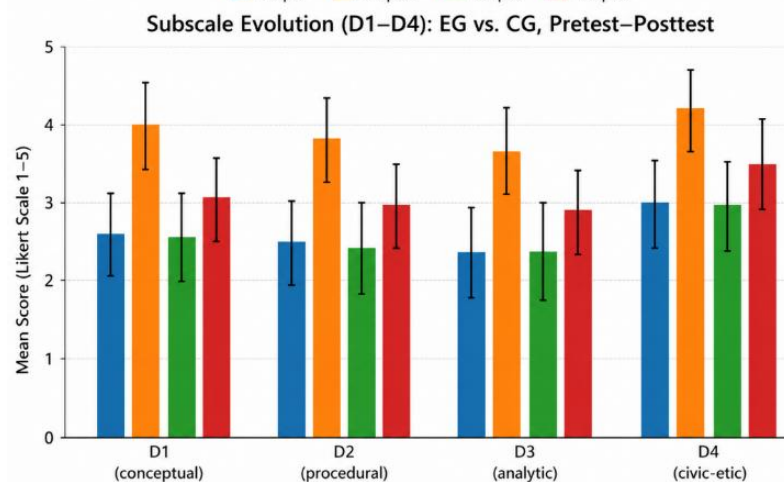


Fig. 12. Evolution of the Subscales (D1–D4): EG vs. CG, Pretest–Posttest

Note: The bars represent the mean scores on the 1–5 Likert scale, while the error bars indicate standard deviations. EG = Experimental Group; CG = Control Group. Statistical summary: All gain differences (Δ) between the EG and CG across D1–D4 were statistically significant (t-test on Δ , $p < 0.001$), with Cohen's d effect sizes ranging from approximately 0.82 to 0.95. This “**chain of valorisation**” explains why the educational outcomes are both **robust and transferable**, as evidenced by students' concrete proposals submitted to local public authorities (LPAs) regarding the development of green spaces, public lighting, waste sorting, and pedestrian safety. These projects are presented in **Appendices 5 and 6** of the dissertation.

The findings confirm the central research hypothesis that **high school students significantly develop their competence in CCEHU when:** a) **Clear principles and conditions** are established for the design and implementation of experiments; b) **A pedagogical model** centred on complex learning tasks is developed and implemented, supported by an explicit **methodology** for conducting the learning process (8–10 weeks) and based on the principle of **constructive alignment**; c) **Standardised and authentic assessment instruments** (questionnaires, assessment rubrics, and observation protocols) are employed within a **quasi-experimental research design** that controls the major variables; d) The instructional process is grounded in the **pedagogy of integration** and in **authentic, complex community-based situations** that require the simultaneous mobilisation of students' **knowledge, skills, and attitudes**.

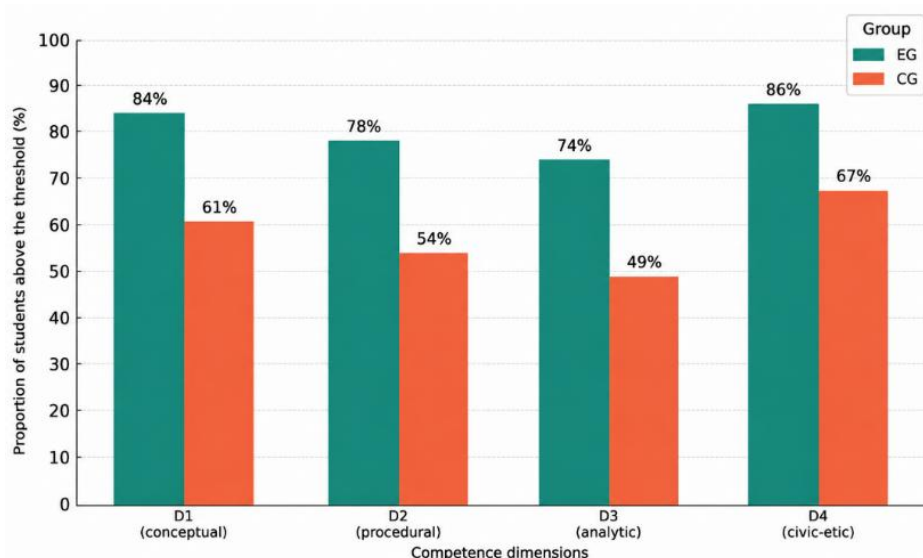


Fig. 13. Attainment of Formative Thresholds Across Dimensions D1–D4: Comparison Between the Experimental and Control Groups

On this basis, the proposed **Pedagogical Model and Methodology** may be recommended—subject to the limitations identified in this study—for implementation in other high schools and for integration into the portfolio of **elective modules** within the **Grade 12 Informatics curriculum**. The pedagogical experiment validated the effectiveness of the proposed **Pedagogical Model and instructional methodology**, demonstrating their positive impact on the formation and development of **high school students' competence in conducting experiments in the humanities** within **general secondary education**, specifically in the **Grade 12 Informatics course**.

GENERAL CONCLUSIONS AND RECOMMENDATIONS

The formation and development of upper secondary school students' competence in conducting experiments in the humanities is a relevant issue in contemporary education, as schools are expected to develop not only individuals capable of reproducing information, but also individuals who can investigate reality, interpret data, justify decisions, and participate responsibly in addressing problems within their communities. In this context, the research sought to establish

the theoretical and praxiological foundations for developing this competence through elective modules in the Grade 12 Computer Science course and to test experimentally the effectiveness of the proposed pedagogical guidelines. The relevance of the research stems from the need to bridge the gap between **school knowledge and social reality**, between digital competencies and research capability, and between subject learning and students' engagement with authentic societal problems. A review of the relevant literature, the curricular and regulatory framework, and educational practice made it possible to formulate an integrated perspective on the issue (1.1–1.3). From this perspective, the research was structured like a puzzle comprising three interdependent components: **identifying the contradictions and the research problem, establishing the foundations of the pedagogical solution, and developing and testing that solution in school practice**. The overall outcome of the research is the substantiation and validation of a pedagogical approach that guides students from acquiring cognitive and procedural resources towards **mobilising these resources in authentic situations**, while embracing the analytical, interpretative, ethical, and collaborative dimensions.

The research led to the following conclusions:

1. Competence in conducting experiments in the humanities is a multidimensional competence rather than the mere application of research techniques. The research clarified the content of this competence by relating cognitive, procedural, and attitudinal resources to the authentic situations in which they are mobilised (1.2). The distinctive nature of experimentation in the humanities gives this competence a specific configuration: inquiry involves not only obtaining data, but also formulating a relevant problem, choosing appropriate methods for collecting and interpreting information, recognising the limitations of conclusions, and assuming responsibility towards the individuals and communities involved. Accordingly, competence in conducting experiments in the humanities (CREȘU, the Romanian acronym) was operationalised through four complementary dimensions: **D1 – conceptual-declarative, D2 – procedural-technical, D3 – analytical-interpretative, and D4 – civic-ethical/collaborative**. This structure makes it possible to trace the progression from what students know to what they can accomplish and how they use research findings responsibly.

2. Developing CREȘU requires an educational context in which research, digitalisation, and education for democracy converge. The theoretical findings indicate that this competence can develop when students investigate issues that are meaningful to themselves and their communities, and when digital tools support the research process rather than constitute an end in themselves (1.2; 1.3; 2.1). Within this configuration, Computer Science provides the infrastructure needed to collect, organise, process, and represent data, while the humanities provide the subject matter and interpretative context.

3. The MPFDECREȘU pedagogical model provides a solution for translating this conception into a coherent instructional framework. The value of the model lies in aligning educational aims, content, activities, and assessment within a learning pathway focused on mobilising competence (2.1; 2.2). The model integrates the principles of the pedagogy of integration and constructivist pedagogy, organising students' development around the axes of **information – research – engagement**. The importance of this structure lies in its ability to bridge the separation between theoretical knowledge acquired in Computer Science and its application in conducting experiments, with findings used in relation to the original problem and the context in which it arises.

4. The methodology developed makes it possible to operationalise the model in school practice. The principal methodological outcome is the organisation of students' activities into a flexible pathway that begins with problem formulation and culminates in reflection on both the findings and the research process (2.2; 2.3). This organisation changes students' roles: they are no longer merely recipients of a problem formulated by the teacher, but participate in identifying the problem, selecting information, designing the investigation, processing data, and drawing

conclusions. At the same time, the methodology introduces competence assessment as a complex process in which declarative knowledge is considered alongside practical performance and research behaviour. Triangulating questionnaires, the analytic rubric, and observation makes it possible to assess the development of CREŞU from complementary perspectives (2.3; Appendices 2, 3, 7, and 8).

5. Experimental validation demonstrates that the outcomes of the model and methodology extend beyond declarative knowledge and are reflected in concrete research performance. The educational experiment, conducted under actual school conditions, revealed greater progress among students in the experimental group than among those in the control group, both in overall competence and across dimensions D1–D4 (3.1; 3.3). The significance of this finding lies not only in the difference between the groups' final outcomes, but also in the coherent nature of the progress: students involved in the pedagogical intervention advanced from understanding concepts and procedures to conducting investigations, analysing and interpreting data, and communicating findings. The outputs of projects and experimental activities confirm this transition towards authentic performance, as students used the data they obtained to formulate conclusions addressing specific problems (3.2; 3.3; Appendices 4–8).

The experimental findings therefore support a broader interpretation: **the effectiveness of the intervention is linked to the sequential integration of problem formulation, research design, investigation, analysis, interpretation, and communication**, rather than to the isolated use of a particular method or digital tool. This finding reinforces the pedagogical value of the model and explains why competence development requires the simultaneous acquisition of knowledge, procedural experience, and appropriate research practices. With regard to the research hypothesis, the findings confirm that the formation and development of CREŞU are supported when the foundations and pedagogical conditions of experimentation in the humanities are clearly defined; a coherent model for organising competence development is provided; the methodology enables students to engage in authentic investigations and projects; and outcomes are assessed using instruments that capture knowledge, performance, and research behaviour alike (2.1–2.3).

Therefore, **the scientific problem addressed by the research was resolved** by identifying and substantiating methodological guidelines supported by practical foundations for the formation and development of CREŞU within the elective modules of the Computer Science course. **The research aim was achieved** through the development and validation of the pedagogical model and its corresponding methodology, while the stated objectives were accomplished in a logical sequence: establishing the conceptual foundations (1.1–1.3), determining the pedagogical conditions (2.1), developing the model (2.2), designing the methodology (2.3), and conducting experimental validation (3.1–3.3).

The research also clarified several contradictions that define the scope of the problem investigated: **between the need to develop active, participatory learners and the predominance of learning situations in which students primarily reproduce knowledge; between the development of digital competencies and their limited use in investigating social and humanities-related problems; and between the transdisciplinary nature of the competencies targeted by the curriculum and the predominantly subject-based organisation of learning** (1.2; 1.3; 2.1). The proposed model and methodology address these contradictions by creating a context in which digital tools, school-based research, and civic engagement reinforce one another.

The **theoretical significance** of the research lies in conceptualising CREŞU as a multidimensional structure and substantiating the relationship between competence-related resources, authentic research situations, and the civic-ethical dimension of experimental activity (1.1–1.3). Its **practical significance** lies in the availability of a pedagogical model, a methodology, and a set of instruments that can be used within Module 5B, “Experimental Methods in the Humanities,” and, with the necessary adaptations, in other curricular contexts (2.2; 2.3;

Appendices 2–12). At the same time, the findings must be interpreted in light of the study's limitations. The quasi-experimental design did not allow for the full randomisation of participants, the sample consisted of students from specific institutions, and the duration of the research did not permit a comprehensive assessment of the long-term stability of the competence (3.1; 3.3). These limitations indicate the need for further research involving larger samples, diverse institutional and curricular contexts, and longitudinal monitoring.

The author's personal contributions are reflected in the development of the integrative conceptual framework and the operationalisation of the concept of competence in conducting experiments in the humanities (Chapter I, § 1.1); the development of the pedagogical model and methodology (Chapter II, §§ 2.2, 2.3); the design and implementation of the educational experiment (Chapter III, § 3.2); and the construction and validation of the assessment instruments (Chapter III, § 3.3). The findings must be interpreted in the context of the following limitations: the absence of full randomisation of the sample; the relatively small size of the group studied, drawn from two upper secondary schools in the northern Republic of Moldova; and dependence on institutional conditions, including ICT resources and organisational culture.

The resolution of the research problem and the achievement of the stated objectives are confirmed by **the findings published in works** [24, 38 – 41, 43 – 69, 72 – 77, 79] and [80]. These achievements open up opportunities to extend and adapt the pedagogical model to diverse educational contexts, contributing to the strengthening of a research culture—specifically, conducting experiments in the humanities—within schools, the development of students' inquiry and innovation competencies, and the establishment of teaching practices focused on authentic learning, active participation, and students' responsible engagement in community life.

In light of the findings and conclusions of the research, we consider it necessary to put forward the following **recommendations for the development of educational theory and practice**:

- Given the effectiveness of the pedagogical model and the methodology developed, their explicit integration into curricular and methodological documents is recommended, together with their use in implementing the Computer Science curriculum.
- Continuing professional development programmes for teachers should be developed and expanded, with an emphasis on educational research design, data analysis, research ethics, and the use of digital tools.
- Open educational resources, including small-scale projects, should be created and continuously updated to facilitate the transfer and adaptation of good practices across different school contexts.
- Interdisciplinary and transdisciplinary approaches should be strengthened by integrating research activities in collaboration with other subjects and by developing authentic contexts for inquiry.
- Practical inquiry-based teaching, learning, and assessment activities should be expanded, using the findings and instruments validated within this research.
- Adequate institutional and technological conditions should be ensured to support students' research activities and the public dissemination and use of their findings.
- Research into the development of students' research competencies should continue through the application of the model in diverse educational contexts, in other subjects, and at other levels of schooling.

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ADNOTARE
Andriana CERNEI
METODOLOGIA FORMĂRII ȘI DEZVOLTĂRII LA ELEVII LICEENI A COMPETENȚEI
DE REALIZARE A EXPERIMENTELOR ÎN ȘTIINȚELE UMANISTICE (ÎN CADRUL
STUDIERII MODULELOR LA ALEGERE ÎN CURSUL DE INFORMATICĂ)
CHIȘINĂU, 2026

Structura tezei: Adnotări în limbile română, rusă, engleză, introducere, trei capitole, concluzii generale și recomandări, bibliografie 232 surs), 6 anexe; 149 pagini text de bază; 29 figuri, 11 tabele.

Cuvinte-cheie: competență, experiment (științe umanistice), informatică, învățare bazată pe cercetare, proiect, transdisciplinaritate, model pedagogic, metodologie, situații complexe de problemă.

Domeniul de studiu: Didactica școlară.

Scopul cercetării: Fundamentarea, elaborarea și valorificarea experimentală a unui model pedagogic și a unei metodologii pentru formarea/dezvoltarea competenței de realizare a experimentelor în științele umanistice la liceeni (modulul opțional 5B – Informatică).

Obiectivele cercetării: Analiza cadrului conceptual (competență/experiment/transdisciplinaritate); stabilirea principiilor și condițiilor de proiectare a experimentelor; proiectarea Modelului și a Metodologiei; operaționalizarea instrumentarului (chestionare inițial/final, rubrică, fișe de observație, instrumentul Padlet, cu materialele utilizate la realizarea experimentului pedagogic); implementarea cvasi-experimentală (pretest–posttest, grup de control); validarea rezultatelor și formularea recomandărilor post-cercetare.

Noutatea și originalitatea științifică: conceptualizarea integrată resurse–mobilizare–competență pe patru dimensiuni (D1–D4), articulată cu pedagogia integrării și cu învățarea prin proiect; design cvasi-experimental implementat în contexte reale de școală; dispozitiv evaluativ triangulat (scala Likert + rubrică + observație) cu indicatori psihometrici buni (α total GE 0,86→0,91).

Problema științifică soluționată: Demonstrarea, în condiții școlare obișnuite, că un demers integrat (învățare prin cercetare și proiect, aliniere constructivă, controlul variabilelor majore) produce creșteri semnificativ superioare, stabile și educațional relevante ale nivelului competenței de realizare a experimentelor în științele umanistice față de metodologia tradițională.

Rezultatele științifice principale: Studiul a implicat două cohorte de clasa a XII-a din două licee, organizate în grup experimental și grup de control. Elevii din grupul experimental au înregistrat progrese vizibile mai mari decât cei din grupul de control, atât pe scorul compozit al competenței (sinteză a dimensiunilor D1–D4), cât și pe performanța „în acțiune” evaluată prin rubrică. Diferențele sunt semnificative statistic și relevante educațional, confirmând efectul intervenției proiectate. Pragurile formative stabilite pe fiecare dimensiune au fost atinse de majoritatea elevilor din grupul experimental, iar coerența rezultatelor a fost susținută de analizele de validitate și fiabilitate ale instrumentelor.

Semnificația teoretică: Lucrarea clarifică raportul dintre resursele elevului, procesele de mobilizare și competența propriu-zisă, oferind criterii și indicatori expliți pentru evaluarea nivelului de dezvoltare a competenței de realizare a experimentelor în științele umanistice. Modelul pedagogic este ancorat teoretic în transdisciplinaritate și în educația pentru cetățenie democratică, iar validarea sa se face printr-o schemă operațională care probează competența în „familii de situații” autentice.

Valoarea aplicativă: Cercetarea pune la dispoziție un ghid de proiectare pe unități de învățare, care aliniază obiectivele, activitățile și evaluarea, împreună cu un set de instrumente reaplicabile – chestionare pe scală Likert, rubrică analitică R1–R8 și fișe de lucru – susținute de o cronogramă și protocoale de asigurare a calității datelor. Modelul este transferabil către alte module și discipline, iar pragurile formative stabilite pe dimensiunile D1–D4 pot fi folosite pentru monitorizarea curentă a progresului.

Implementarea rezultatelor științifice: s-a pilotat în IPLT Văratice și IPLT „Eugen Coșeriu” (r. Rîșcani) în cadrul modulului 5B, clasa a XII-a; instrumentarul învățării a fost utilizat în pretest/posttest și în evaluarea produselor de proiect, cu diseminare prin activități metodice și comunicări științifice; structurarea capitolului III reflectă explicit proiectarea, valorificarea și validarea experimentală.

АННОТАЦИЯ
Андриана ЧЕРНЕЙ
МЕТОДОЛОГИЯ ФОРМИРОВАНИЯ И РАЗВИТИЯ У СТАРШЕКЛАСНИКОВ
КОМПЕТЕНТНОСТИ ПО РЕАЛИЗАЦИИ ЭКСПЕРИМЕНТОВ В ГУМАНИТАРНЫХ
НАУКАХ (В РАМКАХ ИЗУЧЕНИЯ МОДУЛЕЙ ПО ВЫБОРУ В КУРСЕ
ИНФОРМАТИКИ)
КИШИНЁВ, 2026

Структура диссертации: аннотации на румынском, русском, английском, введение, три главы, общие выводы и рекомендации, библиография 232 источника, 6 приложений; 149 страниц основного текста; 29 рисунков и 11 таблиц.

Ключевые слова: компетентность, эксперимент (гуманитарные науки), информатика, обучение на основе исследования, проект, трансдисциплинарность, педагогическая модель и методология.

Область исследования: дидактики в школьном образовании

Цель исследования: теоретическое обоснование, разработка и экспериментальная валидация педагогической модели и методологии формирования/развития у старшеклассников компетентности реализации экспериментов в гуманитарных науках (модуль по выбору 5B по информатике).

Задачи исследования: провести анализ понятийного поля (компетентность — эксперимент — трансдисциплинарность); определить принципы и условия проектирования экспериментальных действий; сконструировать педагогическую модель и методологию; операционализировать инструментарий (анкеты до/после, аналитическая рубрика, листы наблюдений); реализовать квази-эксперимент (предтест–посттест с контрольной группой); валидировать результаты и сформулировать куррикулярные рекомендации.

Научная новизна и оригинальность заключается в интегральной концептуализации «ресурсы – мобилизация – компетентность» в четырёх измерениях (D1–D4), сопряжённой с педагогикой интеграции и проектным обучением; в разработке квази-экспериментального дизайна, реализованного в реальных школьных условиях; в создании триангулированного оценочного инструментария (шкала Лайкерта + аналитическая рубрика + наблюдение) с подтверждёнными психометрическими свойствами (напр., α Кронбаха в ЭГ: 0,86→0,91)..

Научная проблема, решаемая в исследовании, носит теоретико-прикладной характер и состоит в доказательстве того, что интегрированный подход (обучение на основе исследования и проекта, конструктивное выравнивание, контроль ключевых переменных) при обычных школьных условиях обеспечивает значимые, устойчивые и педагогически релевантные приросты уровня компетентности по сравнению с традиционной методикой.

Теоретическая значимость исследования состоит в уточнении соотношения «ресурсы обучающегося – процессы мобилизации – проявление компетентности», в выведении критериев и индикаторов оценки уровня компетентности реализации экспериментов в гуманитарных науках, а также в теоретическом обосновании модели в русле трансдисциплинарности и воспитания демократического гражданства.

Практическая значимость исследования состоит в предоставлении воспроизводимого пакета: руководства по поэтапному проектированию (выравнивание целей, деятельности и оценивания), набора инструментов (анкеты по шкале Лайкерта, аналитическая рубрика R1–R8, листы наблюдения), календарного плана и протоколов качества данных; модель переносима на другие модули и учебные предметы, а пороговые ориентиры по D1–D4 пригодны для мониторинга прогресса.

Внедрение научных результатов. Модель и методология апробированы в Теоретическом лицее Вэратик и Теоретическом лицее «Еуджен Кошерю» (р-н Рышканы) в рамках модуля 5B (11–12 классы); инструментарий использован в предтесте/посттесте и при оценке проектных продуктов; результаты распространены через методические мероприятия и научные сообщения; структура третьей главы отражает проектирование, внедрение и экспериментальную валидацию.

ANNOTATION
Andriana CERNEI

**METHODOLOGY FOR FORMING AND DEVELOPING HIGH-SCHOOL STUDENTS’
COMPETENCE IN CONDUCTING EXPERIMENTS IN THE HUMANITIES (WITHIN
THE ELECTIVE MODULES OF THE INFORMATICS COURSE)
CHIȘINĂU, 2026**

Thesis structure: annotations in Romanian, Russian, English; introduction; three chapters; general conclusions and recommendations; bibliography 232 sources; 6 appendices; 149 pages of main text; 29 figures and 11 tables.

Keywords: competence; experiment (humanities); informatics; research-based learning; project; transdisciplinarity; pedagogical model and methodology.

The field of study: Didactics of school education.

The purpose of the research: To substantiate theoretically, design, and experimentally validate a pedagogical model and methodology for forming/developing high-school students’ competence to conduct experiments in the humanities (Informatics elective module 5B).

Research objectives: Analyze the conceptual framework(competence/experiment/transdisciplinarity); determine principles and conditions for designing experimental activities; design the model and methodology; operationalize the toolkit (initial/final questionnaires, analytic rubric, observation sheets); implement a quasi-experimental design (pretest–posttest with control group); validate results and formulate curricular recommendations.

The scientific novelty and originality: an integrated conceptualization of resources–mobilization–competence across four dimensions (D1–D4), articulated with the pedagogy of integration and project-based learning; a quasi-experimental design implemented in real school settings; a triangulated assessment device (Likert questionnaires + analytic rubric + observation) with solid psychometric indicators (e.g., Cronbach’s α in the experimental group 0.86→0.91).

The main scientific results: The study involved two cohorts of 12th-grade students from two high schools, organized into an experimental and a control group. Students in the experimental group achieved markedly greater gains than those in the control group, both on the composite competence score (synthesizing D1–D4) and on “in-action” performance assessed via rubric. Differences are statistically significant and educationally meaningful, confirming the effect of the designed intervention. Formative benchmarks set for each dimension were reached by the majority of students in the experimental group, and consistency of results was supported by validity and reliability analyses of the instruments.

The theoretical importance of the research: The thesis clarifies the relationship between students’ resources, mobilization processes, and demonstrated competence, offering explicit criteria and indicators for evaluating the conduct of experiments in the humanities. The model is theoretically anchored in transdisciplinarity and education for democratic citizenship, and is validated through an operational scheme that tests competence in authentic “families of situations.”

Applicative value: The research provides a sequence-based design guide aligning objectives, activities, and assessment, together with a replicable toolkit—Likert-scale questionnaires, analytic rubric R1–R8, and working sheets—supported by a timeline and data-quality protocols. The model is transferable to other modules and subjects, and the formative benchmarks on D1–D4 can be used for ongoing progress monitoring.

The implementation of the scientific results: The model and methodology were piloted at IPLT Vărativ and IPLT “Eugen Coșeriu” (Rîșcani district) within module 5B (12th grade). The toolkit was used for pretest/posttest and for evaluating project products, with dissemination through methodological activities and scholarly communications. The structure of Chapter III explicitly reflects design, implementation, and experimental validation.

Andriana CERNEI

**METHODOLOGY FOR FORMING AND DEVELOPING HIGH-SCHOOL STUDENTS'
COMPETENCE IN CONDUCTING EXPERIMENTS IN THE HUMANITIES (WITHIN
THE ELECTIVE MODULES OF THE INFORMATICS COURSE)**

532.02. School Didactics (by Educational Levels and Subjects)

ABSTRACT
of the Doctoral Dissertation in Education Sciences

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