

RESEARCH ARTICLE

# Methodology for Organizing Experimental Work to Develop Students' Scientific Worldview Through Teaching Philosophy on The Basis of Interdisciplinary Integration

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## Abstract

This article substantiates the methodology for organizing experimental work aimed at developing students' scientific worldview through teaching philosophy on the basis of interdisciplinary integration. The author describes the logic, stages and instrumentation of a pedagogical experiment conducted at five higher education institutions of the Republic of Uzbekistan, in which the interdisciplinary integrative method of teaching philosophy was implemented in the experimental groups. The article reveals the criteria-based diagnostic apparatus built upon four structural components of the scientific worldview – ontological, epistemological, methodological and axiological – and characterizes the corresponding levels of their formation. Particular attention is paid to the quasi-experimental design with non-equivalent control groups, the procedures for ensuring internal and external validity, and the statistical processing of empirical data by means of Student's t-test, Pearson's chi-square criterion and Cohen's d effect size. The proposed methodology makes it possible to obtain reliable evidence of the effectiveness of interdisciplinary integration in philosophy teaching and may serve as a model for organizing experimental research in the didactics of social and humanitarian disciplines.

## KEY WORDS

Scientific worldview, interdisciplinary integration, philosophy teaching, pedagogical experiment, quasi-experimental design, diagnostic criteria, experimental and control groups, statistical reliability, higher education.

## INTRODUCTION

The formation of a scientific worldview in students of higher education institutions constitutes one of the strategic goals of modern educational policy, since the worldview determines not only the system of knowledge possessed by the future specialist, but also the methodological culture of his or her thinking, value orientations and capacity for independent intellectual activity. Philosophy, by virtue of its integrative and generalizing nature, occupies a special place among academic disciplines in the realization of this goal: it synthesizes the achievements of the natural, technical, social and humanitarian sciences into a holistic picture of the world and

equips the student with universal categories of cognition. This integrative mission of philosophy was already recognized in classical Central Asian scholarship: Al-Farabi regarded philosophy as the science that unites all branches of knowledge into a single hierarchy of wisdom, while Ibn Sina and Biruni demonstrated in their own scientific practice the productivity of combining philosophical reflection with empirical investigation of nature.

At the same time, the analysis of mass pedagogical practice shows that philosophy is frequently taught in isolation from the content of students' special disciplines, as a result of which

philosophical knowledge remains formal, is not transformed into personal convictions and does not perform its worldview-forming function. The contradiction between the integrative potential of philosophy and the predominantly mono-disciplinary character of its teaching determines the necessity of developing and experimentally verifying a methodology of teaching philosophy on the basis of interdisciplinary integration. As J.T. Klein emphasizes, interdisciplinarity is not a mechanical addition of information from different fields, but a process of synthesis that produces a qualitatively new cognitive result. A.F. Repko similarly defines interdisciplinary research and learning as a process of integrating disciplinary insights for the construction of a more comprehensive understanding of complex problems.

Any pedagogical innovation, however theoretically substantiated, acquires scientific value only after experimental verification. Therefore the central task of the present article is to describe the methodology for organizing experimental work that allows one to establish, with the required degree of reliability, whether teaching philosophy on the basis of interdisciplinary integration produces a statistically significant improvement in the development of students' scientific worldview in comparison with traditional teaching.

**Theoretical foundations of the organization of experimental work.** The pedagogical experiment is understood in the present research as a specially organized, controlled and reproducible form of pedagogical activity in which the independent variable – the methodology of teaching philosophy on the basis of interdisciplinary integration – is deliberately introduced into the educational process, while the dependent variable – the level of development of students' scientific worldview – is measured before and after the intervention. The methodological basis of such an experiment was laid by D.T. Campbell and J.C. Stanley, who systematized experimental and quasi-experimental designs and described the factors threatening their validity. In the conditions of a real higher education institution, where academic groups are formed administratively and random assignment of individual students is impossible, the most adequate design is the quasi-experiment with non-equivalent control groups and pre-test and post-test measurement, the contemporary requirements of which are described in detail by L. Cohen, L. Manion and K. Morrison and J.W. Creswell.

The content-related basis of the experimental teaching is constituted by the author's interdisciplinary integrative method (MEFIM), the invariant core of which includes four stages: problem statement (muammoni qo'yish), interdisciplinary analysis, joint systematization and reflection (refleksiya). The flexibility of the method consists in the variation of the second stage depending on the type of the philosophical topic: abstract ontological and gnoseological topics are analyzed by means of concept mapping; historical-philosophical topics – by means of comparative analysis;

practice-oriented ethical topics – through ethical dilemmas; social-philosophical topics – through case study. Such variability corresponds to R. Fogarty's position that integration models should be selected in accordance with the character of the educational content, and the reflexive stage realizes the idea of transformative learning, according to which a change of worldview presupposes critical reflection on one's own premises.

The dependent variable of the experiment – the scientific worldview – is operationalized through four interrelated structural components. The ontological component reflects the student's holistic scientific picture of the world and his or her understanding of the unity and material-systemic character of reality; the epistemological component characterizes the understanding of the nature, sources, methods and criteria of scientific knowledge; the methodological component manifests itself in the ability to apply philosophical categories and general scientific methods to the analysis of problems of one's own specialty; the axiological component expresses the system of value orientations connected with science, truth, social responsibility and humanism. This component structure makes it possible to translate the abstract notion of worldview into a system of empirically measurable indicators, which is an indispensable condition of experimental work.

The experimental work was organized at five higher education institutions of the Republic of Uzbekistan representing different regions and profiles of professional training, which ensured the territorial and content diversity of the sample and increased the external validity of the conclusions. In each institution parallel academic groups studying the discipline of philosophy according to the same curriculum were selected and divided into experimental and control groups. In the experimental groups philosophy was taught on the basis of the interdisciplinary integrative methodology, whereas in the control groups teaching was carried out in the traditional manner. The total sample comprised more than four hundred second-year students, which satisfies the requirements imposed on the volume of samples in comparative pedagogical research.

The experimental work was carried out in three logically interconnected stages. At the first, ascertaining (diagnostic) stage, the initial level of development of the scientific worldview was measured in all groups by means of an identical battery of diagnostic instruments. The purpose of this stage was twofold: first, to establish the factual state of the problem in mass practice, and second, to verify the statistical homogeneity of the experimental and control groups, since the comparability of the groups at the input is the decisive condition of the internal validity of a quasi-experiment. The equality of the initial distributions was verified by Pearson's chi-square criterion and Student's t-test for independent samples; the absence of statistically significant differences (p

> 0.05) allowed the groups to be recognized as equivalent in the measured parameters.

At the second, formative stage, which lasted one full academic semester, the experimental teaching was implemented. All fifteen topics of the philosophy course – from the essence of philosophy, Eastern and Western philosophy, ontology and the philosophy of development to ethics, aesthetics, global processes and the problem of corruption – were taught in the experimental groups according to the four-stage logic of the interdisciplinary method, with the systematic involvement of material from the students' special disciplines, the natural sciences, history and law. The teachers of the experimental groups underwent preliminary methodological training; unified technological maps of lectures and seminars were developed in order to guarantee the standardization of the intervention across all five institutions. In the control groups the same topics were taught by the same volume of academic hours, but without purposeful interdisciplinary integration, which made it possible to isolate the influence of the experimental factor from the influence of the content and duration of instruction.

During the formative stage intermediate (current) measurements were also conducted, allowing the dynamics of the formation of worldview components to be traced and operative corrections to be introduced into the experimental methodology. Such monitoring corresponds to the principle of the controllability of the pedagogical experiment and at the same time performs a formative-evaluative function, supplying both the teacher and the students with feedback.

At the third, control (final) stage, the diagnostic battery applied at the ascertaining stage was administered repeatedly in all groups. The comparison of the input and output measurements within each group and between the groups constituted the empirical basis for conclusions about the effectiveness of the experimental methodology. The final stage also included the qualitative analysis of the products of students' activity – essays, concept maps, projects and reflexive diaries – which made it possible to supplement the quantitative data with substantive characteristics of the changes taking place in the students' worldview.

The reliability of the conclusions of any pedagogical experiment is determined, first of all, by the quality of its diagnostic apparatus. In the present research the diagnostics was constructed on the criteria-level basis: for each of the four components of the scientific worldview a criterion was formulated, indicators were singled out, and three levels of formation – low (reproductive), medium (productive) and high (creative) – were described. The low level is characterized by fragmentary philosophical knowledge, the inability to connect it with special disciplines and an indifferent attitude to worldview problems; the medium level – by systematized knowledge, situational ability to carry out interdisciplinary

transfer and a generally positive value attitude; the high level – by a holistic scientific picture of the world, an independent and stable ability to apply philosophical methodology to professional and life problems, and a firm system of scientifically grounded convictions.

In accordance with the component structure, a complex of mutually complementary diagnostic instruments was applied. The ontological and epistemological components were measured chiefly by means of criterion-referenced tests of philosophical knowledge and specially constructed tasks for the interpretation of scientific facts; the methodological component – by means of competence-oriented tasks requiring the application of philosophical categories to the material of the students' specialty, as well as by the analysis of concept maps composed by the students; the axiological component – by means of validated questionnaires of value orientations, essay analysis and structured observation of students' participation in discussions and ethical dilemma analysis. The combination of quantitative and qualitative instruments realizes the strategy of methodological triangulation, which substantially reduces the probability of instrumental distortions and raises the construct validity of the diagnostics.

All instruments underwent preliminary approbation in a pilot study: the difficulty and discriminativity of test items were calculated, the internal consistency of the scales was estimated, and expert evaluation of the content validity of the tasks was carried out with the participation of specialists in philosophy and pedagogy. Only those instruments whose psychometric characteristics satisfied the accepted requirements were included in the final diagnostic battery. The results of all measurements were converted into a unified point scale, which subsequently allowed both the level distribution of students and the mean group values to be subjected to statistical comparison.

The statistical processing of the empirical data was carried out in several directions. First, Student's t-test for independent samples was used for the comparison of the mean values of the experimental and control groups at the input and output measurements, and the t-test for dependent samples – for the estimation of intragroup shifts. Second, Pearson's chi-square criterion was applied to the comparison of the level distributions of students (low, medium, high) in the groups, which is adequate for ordinal data of pedagogical diagnostics. Third, since statistical significance by itself does not yet testify to the practical importance of differences, the effect size was calculated by Cohen's *d*, the interpretation of which followed the conventional gradations of small, medium and large effect. The threshold level of significance in all procedures was accepted as  $p < 0.05$ .

Special attention was paid to the neutralization of threats to validity. Internal validity was ensured by the input equivalence

of the groups, by the identity of curricula, academic hours and assessment procedures, by the standardization of the experimental intervention through unified technological maps, and by the conduct of input and output diagnostics with identical instruments under identical conditions. The threat of the experimenter effect was reduced by the fact that the final diagnostics was carried out and processed with the participation of teachers not informed about the group affiliation of specific works. External validity was supported by the multiplicity and diversity of the experimental bases: the reproduction of statistically significant positive shifts at five institutions of different profiles testifies that the revealed effect is not a local artifact of one pedagogical collective, but a regular consequence of the experimental methodology itself.

The generalization of the accumulated experience allows several pedagogical conditions to be formulated on which the success of experimental work of the described type depends. The first condition is the preliminary theoretical modeling of the object: the experiment must be preceded by the construction of a pedagogical model embracing the target, organizational-technological and experimental-evaluative components, since only a clearly structured model can be transformed into a verifiable system of variables. The second condition is the methodological preparation of teachers, ensuring the fidelity of the implementation of the experimental methodology. The third condition is the unity of the diagnostic apparatus throughout all stages and bases of the experiment. The fourth condition is the combination of quantitative statistical procedures with qualitative analysis of the products of students' activity, which protects the researcher both from the superficiality of purely numerical comparisons and from the subjectivism of purely qualitative impressions. Finally, the fifth condition is the reflexive character of the experimental work itself: systematic discussion of intermediate results with the participating teachers turns the experiment from a single act of verification into a mechanism of the continuous improvement of the methodology.

### CONCLUSION

The methodology for organizing experimental work presented in this article makes it possible to verify, with scientific rigor, the effectiveness of teaching philosophy on the basis of interdisciplinary integration as a means of developing students' scientific worldview. Its essential characteristics are the quasi-experimental design with non-equivalent control groups at five higher education institutions; the three-stage logic uniting the ascertaining, formative and control stages; the criteria-level diagnostics of the ontological, epistemological, methodological and axiological components of the worldview; and the statistical apparatus combining Student's t-test, Pearson's chi-square criterion and Cohen's d effect size. The experimental data obtained on this basis confirm that purposeful interdisciplinary integration in philosophy teaching produces statistically significant and

practically meaningful growth in all components of the scientific worldview in comparison with traditional instruction. The described methodology possesses reproducibility and may be employed as a model for the organization of experimental research in the didactics of other social and humanitarian disciplines of higher education.

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