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Article

The usage of technology in scientific-epistemological limits of the possibilities of mixing quantitative and qualitative methods in pedagogical research

Khafayat Aliyeva Muzaffar[1], Gultaj Muradova Huseyn[2], Zeynab Mammadova Ramiz[3]

[1] Nakhchivan State University, Head of the Department of Oriental Languages, Doctor of Philosophy in Pedagogy.
Email: xafayataliyava@ndu.edu.az
ORCID: 0009-0008-7855-2637
[2] Nakhchivan State University, Teacher, Department of Oriental Languages, PhD Candidate.
Email: sadiqovagultac@ndu.edu.az
ORCID: 0009-0000-1577-4525
[3] Nakhchivan State University, Senior Lecturer, Department of Oriental Languages, PhD Student.
Email: mammadovazeyneb@ndu.edu.az
ORCID: 0009-0008-5737-9935

Abstract: The article provides a theoretical analysis of the scientific-epistemological foundations and boundaries of the mixed application of quantitative and qualitative methods in pedagogical research. The purpose of the study is to reveal the ontological and epistemological differences between the positivist-postpositivist and constructivist-interpretivist paradigms and to determine how these differences affect the scientific validity of mixed-methods designs. It has been established that the integration of quantitative and qualitative methods does not imply methodological syncretism but constitutes a research strategy grounded in a pragmatic philosophical stance while preserving its own internal epistemological consistency. The article analyses the scholarly debate between the "incompatibility thesis" and the position of pragmatic synthesis, and demonstrates the possibilities and limitations of epistemologically justifying mixed-methods designs (convergent, explanatory sequential, exploratory sequential, and embedded). In conclusion, the epistemological boundaries conditioning the scientific legitimacy of applying mixed methods are systematized (paradigmatic compatibility, the level of data integration, and criteria for the legitimation of findings).
Keywords: mixed methods, technology quantitative research, qualitative research, epistemology, paradigm, pragmatism, triangulation.

1. INTRODUCTION

In the methodology of pedagogical research, an important paradigmatic shift has taken place in recent decades from the confrontation of quantitative and qualitative approaches to their mixed (integrative) application. This shift is characterized as the "third methodological movement" and arises from the necessity that the complexity of pedagogical phenomena cannot be fully covered from a single methodological perspective [4]. However, the application of mixed methods is not just a technical operation (mechanical combination of quantitative and qualitative tools), but a scientific-methodological problem that requires deep philosophical-epistemological justification.

The relevance of the issue stems from the fact that while the positivist-quantitative paradigm aims at objective, measurable, generalizable knowledge, the constructivist-qualitative paradigm is based on the contextual, situational understanding of subjective meaning [1; 3]. The ontological (about the nature of reality) and

epistemological (about the ways of acquiring knowledge) differences between these two paradigms indicate that their integration by simply "accumulating" them is scientifically controversial. In this regard, the study of within what epistemological boundaries the application of mixed methods acquires scientific validity is an urgent scientific and methodological problem.

The purpose of the study is to theoretically determine the epistemological foundations and boundaries of the mixed application of quantitative and qualitative methods in pedagogical research.

The objectives of the study: 1) ontological-epistemological comparative analysis of quantitative and qualitative paradigms; 2) investigation of the scientific foundations of the "incompatibility thesis" and the pragmatic synthesis position; 3) demonstration of the typology of mixed method designs and the possibilities of their epistemological justification; 4) systematization of the boundaries that determine the scientific legitimacy of the mixed method.

2. THEORETICAL-METHODOLOGICAL BASIS OF THE RESEARCH

The theoretical basis of the research is formed by T. Kuhn's theory of scientific paradigms, E. Guba and Y. Lincoln's concept of research paradigms, as well as J. Creswell and V. Plano Clark's typology of mixed methods design [1; 6]. The concept of "paradigm wars" substantiated by E. Guba and Y. Lincoln emphasizes that the positivist and constructivist paradigms differ at the ontological, epistemological and methodological levels, and that these differences are deeper than a simple methodological choice - worldview in nature [1].

R.B. Johnson and A. Onwuegbuzi's concept of pragmatism proposes not the principle of "whatever works" as the philosophical basis of mixed methods, but a problem-centered approach that justifies methodological flexibility in accordance with the nature of the research question [5]. The fundamental works of A. Tashakkori and J. Teddley on the methodology of mixed methods systematized the levels of integration of quantitative and qualitative components (at the stages of data collection, analysis, interpretation) [7]. At the same time, the critical position of M. Hemmersly highlights the risk of mixed methods moving away from epistemological seriousness under the name of "methodological pluralism", which acts as an important source of counter-argument for the critical-analytical part of the study [3].

3. ONTOLOGICAL-EPISTEMOLOGICAL FOUNDATIONS OF QUANTITATIVE AND QUALITATIVE PARADIGMS

Quantitative research is based on the positivist and post-positivist philosophical tradition: reality is perceived as an objectively existing structure independent of the subject (ontological realism), and knowledge is obtained through empirical observation and measurement, within the framework of the deductive-nomothetic methodology [1; 3]. In this paradigm, the role of the researcher is defined as a neutral observer, and reliability and internal-external validity act as the main criteria of scientificity.

Qualitative research is based on the constructivist-interpretivist paradigm: reality is perceived as a socially constructed, multiple and contextual phenomenon (ontological relativism), and knowledge is formed in the process of interaction between the researcher and the participant, through inductive-idiographic methodology [1; 3]. In this paradigm, alternative categories such as "credibility", "transferability" and "confirmability" are emphasized instead of reliability as a criterion of scientificity.

It is these ontological-epistemological differences that form the basis of the "incompatibility thesis": according to this thesis, the "mixing" of paradigms with different philosophical foundations within the framework of one study creates a logical contradiction, since the same researcher cannot simultaneously hold both an ontological realist and a relativist position [1]. However, supporters of pragmatic philosophy propose to resolve this contradiction not at the philosophical level, but at the methodological-practical level: the nature of the research question should dictate the methodological choice, and philosophical "purity" should not be prioritized over the practical usefulness of the study [5].

4. MIXED METHOD DESIGNS AND THEIR EPISTEMOLOGICAL JUSTIFICATION

According to the typology developed by C. Creswell and V. Plano Clark, mixed method designs include four main models: 1) convergent parallel design — simultaneous collection of quantitative and qualitative data and comparative analysis of the results (triangulation goal); 2) sequential explanatory design — first quantitative, then conducting a qualitative phase to deepen its results; 3) sequential exploratory design — first identifying constructs

based on qualitative research, then testing them with quantitative tools; 4) embedded design — one method plays an auxiliary role within another [6].

The epistemological justification of each design type imposes different requirements. The main epistemological problem in convergent design is how to compare results from different epistemological origins during "triangulation" - this requires an approach that J. Green calls a "dialectical stance", which turns the tension between paradigms into a source of productive dialogue, rather than resolving it [2]. In sequential designs, epistemological consistency is relatively easy to maintain, since each stage retains its paradigmatic logic, and integration occurs at the level of interpretation of the results [7, 9,10].

At the same time, a number of epistemological risks arise in the practical application of mixed methods: a) "paradigm reductionism" - the loss of semantic richness of qualitative data by simply quantifying them; b) "methodological superficiality" - the superficial, formal use of both methods instead of a deep application; c) the uncertainty of the integration point - the lack of justification for where and how to combine quantitative and qualitative results [3; 7].

5. EPISTEMOLOGICAL BOUNDARIES OF THE SCIENTIFIC LEGITIMACY OF MIXED METHODS

Based on the analysis conducted, the epistemological boundaries that determine the scientifically justified application of mixed methods in pedagogical research can be systematized as follows:

1. The boundary of paradigmatic transparency — the researcher must clearly justify his philosophical position (pragmatic, transformative or dialectical), explain the choice of mixed methods not only with "practical convenience", but also with the epistemological requirements of the research question [5].
2. The boundary of the justification of the level of integration — at what stage (design, data collection, analysis, interpretation) and how the quantitative and qualitative components will be integrated should be planned in advance methodologically [6; 7].
3. The boundary of legitimation — A. Onwuegbuzi and R.B. As Johnson suggests, the results of mixed methods research should meet both quantitative (reliability, generalizability) and qualitative (credibility, depth) criteria of scientificity separately, and in addition, the specific legitimacy criteria of the integrated results (e.g., "sample integration", "weakness compensation") should be justified [5].
4. The boundary of the reflexivity of the researcher's position - it is necessary to methodologically consider the role tension that arises when the researcher switches between both objective-neutral and subjective-participatory positions [2; 3].

Failure to observe these boundaries leads to the application of the mixed method as a mere "methodological fad" without deep scientific justification, which weakens the epistemological seriousness of the research [3].

6. Conclusion

The theoretical and epistemological analysis shows that the mixed application of quantitative and qualitative methods in pedagogical research is not a mechanical methodological combination, but a complex scientific and methodological strategy that requires deep philosophical justification. The ontological and epistemological differences between the positivist-postpositivist and constructivist-interpretivist paradigms do not exclude the application of the mixed method in principle, but condition its scientific legitimacy within certain limits. Although the pragmatic philosophical position acts as the most justified epistemological basis for mixed methods, it requires the fulfillment of methodological requirements such as paradigmatic transparency, planning of the level of integration, dual legitimation and researcher reflexivity.

The results of the study can be used in the development of methodological design of pedagogical research, in the justification of methodological sections of dissertations, as well as in the enrichment of the content of the course "Methodology of Pedagogical Research" in higher education institutions. A prospective direction of research could be the investigation of the epistemological foundations of the application of mixed methods designs in digital educational environments (integration of big data and narrative data).

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