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INNOVATIVE TEACHING METHODS FOR CADETS IN MILITARY DISCIPLINES: A PROPOSED PEDAGOGICAL EXPERIMENT

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Abstract
This article examines the pedagogical potential of innovative teaching methods for cadets studying military disciplines. The relevance of the study is determined by the need to improve the professional training of future officers, develop independent thinking and practical skills, and enhance their ability to apply theoretical knowledge when solving educational and professional tasks.

Keywords: Military education, cadets, innovative teaching methods, pedagogical experiment, simulation-based learning, problem-based learning, digital educational technologies, professional competencies.

Introduction

The modern system of higher military education is oriented towards training specialists who possess not only the necessary body of theoretical knowledge but also well-developed practical skills, analytical thinking, independence, and the ability to make sound decisions when addressing professional tasks. Accordingly, the improvement of teaching methods for cadets has become an important area of development in military pedagogy.

Traditional teaching methods remain important for the systematic acquisition of theoretical knowledge. However, an approach focused primarily on explanation, memorisation, and reproduction of information may limit opportunities for independently applying knowledge in new learning situations. This creates a need to integrate traditional and innovative teaching methods.

J.J.Vogel-Walcutt, L.Fiorella, and N.Malone emphasise that the development of military training simulators and virtual learning systems should be accompanied by a carefully considered selection of instructional strategies [1, 2]. Thus, technological provision alone does not guarantee improved learning outcomes. The structure of

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learning tasks, feedback, the sequencing of exercises, and assessment criteria are also of considerable importance.

Another area of development involves the use of extended reality technologies. J. Garcia and colleagues investigated an educational programme incorporating XR in higher military education and highlighted its potential to engage learners in discussions of complex issues [3]. Nevertheless, the application of these technologies requires consideration of financial costs, technical conditions, and the alignment of virtual scenarios with educational objectives.

Problem-based learning, case analysis, small-group work, and blended learning also play an important role. These approaches create conditions for active knowledge acquisition, reasoned argumentation, independent problem-solving, and reflection. The effectiveness of such approaches should be assessed on the basis of learners' performance in educational tasks rather than solely on their subjective perceptions of the technologies employed.

Despite the existence of studies addressing individual innovative teaching methods, there remains a need to develop a comprehensive methodology for evaluating them in the specific context of a military educational institution. Such a methodology should account for cadets' initial levels of preparedness, the content of the discipline, teaching conditions, instructors' qualifications, and the objectivity of assessment procedures [4].

The aim of the study is to develop a proposed methodology for a pedagogical experiment to evaluate the impact of the integrated application of innovative teaching methods on the quality of cadets' training in military disciplines.

To achieve this aim, the following objectives have been established:

1. To systematise innovative teaching methods applicable to the teaching of military disciplines.
2. To identify criteria and indicators for assessing cadets' learning outcomes.
3. To develop the structure of the pedagogical experiment and specify the procedure for its implementation.
4. To propose methods for data analysis and testing the research hypothesis.
5. To identify the organisational and methodological conditions necessary for the reproducibility of the study.

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Research hypothesis: It is hypothesised that the integrated application of simulation-based, problem-based, interactive, and digital learning may lead to greater improvements in measurable learning outcomes than an approach based predominantly on traditional teaching methods, provided that the instructional content, duration of training, and final assessment criteria are comparable.
This hypothesis is a proposition that requires empirical verification.

2. Methods

2.1. Research Design

A pedagogical experiment using a quasi-experimental design is proposed. The design includes an experimental group and a control group, baseline assessment, and final assessment.
The experimental group will be taught using the proposed integrated set of innovative methods. The control group will study the same instructional material in accordance with the educational practices adopted by the institution. Both groups should have comparable learning objectives, instructional content, lesson duration, and conditions for final assessment.
Where feasible, cadets should be randomly assigned to the groups. If organisational constraints make random assignment impossible, groups with comparable baseline characteristics should be selected, and any differences should be taken into account when interpreting the results.
The required sample size will be determined after calculating the statistical power needed for the study. Selecting an arbitrary number of cadets without a prior sample-size calculation would be methodologically inappropriate.

2.2. Stages of the Pedagogical Experiment.

The proposed methodology comprises three main stages.
Stage 1: Baseline assessment. Initial assessments of theoretical knowledge, practical skills, and the ability to solve educational tasks will be conducted. Learning conditions will be clarified, and assessment materials, standardised instructions, and common assessment criteria will be prepared.

Stage 2: Intervention. The proposed teaching methodology will be implemented in the experimental group. It will involve preliminary study of theoretical material,

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practical or simulation-based exercises, problem-solving activities, group discussions, and feedback. The control group will continue its training in accordance with the agreed traditional teaching methodology.

Stage 3: Final assessment. Final assessments will be conducted using the same criteria as those applied at baseline. Where organisationally feasible, a delayed assessment will also be administered to evaluate the retention of knowledge and skills. The duration of the intervention will be determined by the curriculum and the complexity of the selected discipline. It must be specified in the research protocol before the study begins.

2.3. Content of the Innovative Teaching Methodology.

The proposed approach comprises four interrelated components.

Simulation-based component. This component involves completing standardised learning tasks using simulators, models, educational software, or safe training scenarios. Each scenario must have a predefined objective, a specified sequence of actions, and criteria for successful performance.

Problem-based component. This component involves analysing a learning problem, identifying its essential conditions, comparing possible solutions, and providing a rationale for the selected option. The content of the tasks will be determined by the curriculum of the relevant discipline.

Interactive component. This component includes small-group activities, discussion of results, peer assessment against established criteria, and collective reflection. The instructor facilitates interaction and ensures that feedback is appropriate and constructive.

Digital component. This component involves the use of electronic learning materials, tests, video demonstrations, interactive models, or virtual reality tools where these are available and pedagogically justified. Digital tools are used to achieve specific learning objectives rather than merely to introduce technological novelty [5].

After each practical task, a structured debriefing will be conducted to examine the objectives set, the decisions made, the criteria met, and the aspects requiring

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improvement during subsequent attempts. This analysis helps connect practical experience with a deeper understanding of the learning material.

2.4. Assessment Criteria and Indicators.

Four criteria are proposed for testing the research hypothesis, as presented in Table 1.

Table 1 Assessment Criteria, Indicators, and Instruments

Criterion	Indicators	Assessment instrument
Theoretical knowledge	Accuracy of answers, understanding of key concepts, and application of knowledge	Standardised test
Practical skills	Sequence of actions, accuracy of performance, and compliance with established requirements	Observation checklist
Analytical thinking	Identification of essential conditions, soundness of decisions, and quality of argumentation	Analytical rubric
Independence	Planning task completion, use of feedback, and ability to identify errors	Observation form and analysis of completed work

A performance scale describing different levels of achievement will be developed for each criterion. For example, practical skills may be assessed according to the completeness of required actions, the correctness of their sequence, and the number of significant errors.

The criteria and threshold values must be approved before the experiment begins. Ideally, the assessments should be conducted by two trained evaluators who are unaware of the group to which each cadet belongs. Inter-rater agreement should be assessed using an appropriate statistical measure.

The learning tasks must correspond to the content of the relevant discipline and be of equivalent difficulty for both groups. If different test versions are used, their difficulty levels must be shown to be comparable.

2.5. Data Analysis

The first stage will involve descriptive statistical analysis. Means and standard deviations or medians and interquartile ranges will be calculated, depending on the distribution of the data.

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To assess changes within each group, baseline and final results will be compared. Between-group differences should preferably be evaluated by analysing final outcomes while accounting for baseline scores, for example, through analysis of covariance (ANCOVA), provided that the relevant assumptions are satisfied. Where repeated measurements are obtained, an appropriate repeated-measures model may be used.

In addition to p-values, effect sizes and confidence intervals should be reported. Appropriate methods of frequency analysis will be used for categorical data. The specific statistical test will be selected after examining the data structure, checking the assumptions of the model, and considering the research design.

The data-analysis protocol, criteria for excluding observations, and primary outcome measure should be specified in advance to reduce the risk of selective interpretation of the results.

2.6. Ethical and Organisational Considerations.

The study will be conducted with the approval of the relevant educational institution and in accordance with applicable ethical requirements. Participants will be informed about the aims and procedures of the study. If the results are intended for scientific publication, the confidentiality of personal data and the voluntary nature of participation in research procedures must be ensured in accordance with applicable regulations.

Participation in the study must not result in unjustified advantages or disadvantages for cadets in their regular academic assessment. Where necessary, data anonymisation and independent assessment of results will be employed.

Training scenarios and practical tasks must comply with the approved curriculum and applicable safety requirements. Information subject to access restrictions must not be disclosed in the publication.

3. Results

As the present study focuses on the development of a methodology for a pedagogical experiment, its outcome is a research model rather than an empirical determination of the effectiveness of innovative teaching.

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The design process resulted in the identification of the stages of the experiment, the proposed set of teaching methods, the development of an assessment framework, and the establishment of a general procedure for statistical analysis.

The first outcome is the organisation of the innovative teaching methodology into four components: simulation-based, problem-based, interactive, and digital learning. Their integration makes it possible to structure the learning process as a sequence progressing from the study of instructional material to task performance, analysis of the results, and further practice.

The second outcome is an assessment framework covering theoretical knowledge, practical skills, analytical thinking, and independence. The use of several complementary indicators helps avoid situations in which teaching effectiveness is assessed exclusively on the basis of test scores or cadets' subjective satisfaction.

The third outcome is a proposed framework for comparing the experimental and control groups. Baseline testing makes it possible to assess initial differences, while final assessment enables the examination of changes following the intervention. When implemented through an appropriate research design, this approach provides a basis for a more robust assessment of the contribution of the proposed methodology to learning outcomes.

The fourth outcome is the development of data-analysis principles that account for baseline preparedness, require the reporting of effect sizes and confidence intervals, and provide for the prior specification of the primary outcome measure.

Table 2 Planned Indicators for the Pedagogical Experiment

Indicator	Baseline measurement	Final measurement	Proposed method of analysis
Theoretical knowledge	Pre-training test	Comparable post-training test	Comparison adjusted for baseline scores
Practical skills	Assessment using an observation checklist	Repeat assessment using the same checklist	Comparison of changes and effect sizes
Analytical thinking	Completion of a learning task	Completion of a comparable task	Analysis of scores using an analytical rubric
Independence	Observation using an approved scale	Repeat observation	Comparison of indicators, taking the characteristics of the scale into account
Retention of learning outcomes	Not used as a primary measure	Delayed assessment	Analysis of knowledge and skill retention

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Note: The table presents a measurement plan. No numerical results are available because the experiment has not yet been conducted.

The proposed model provides a basis for testing the hypothesis that the integrated application of innovative teaching methods may offer advantages. Nevertheless, before the experiment is conducted, it cannot be claimed that the experimental group will necessarily achieve better results, nor can projected percentages of improvement be presented as established findings.

4. Discussion

The proposed methodology is designed to move beyond general assertions about the advantages of innovative teaching towards a testable research procedure. This is particularly important in military education, where professional training encompasses different types of learning activities and cannot be adequately assessed using a single universal indicator.

Published research indicates that simulation-based training can contribute to improvements in specific practical skills. In the study by R. J. Scalese and colleagues, a statistically significant improvement was reported in the performance of a specific first-aid skill [2]. However, the nature of the task, the instruments used, and the training conditions limit the extent to which these findings can be directly generalised to other disciplines.

The study by J. Garcia Estrada and colleagues demonstrates the potential of extended reality (XR) in higher military education, particularly for engaging learners with complex content and stimulating discussion [3]. This example shows that the evaluation of digital technologies should consider not only technical characteristics but also the nature of the learning task, participant interaction, and the quality of pedagogical support.

A systematic approach to the design of instructional technologies is also emphasised in the work of J. J. Vogel-Walcutt and colleagues [1]. The authors highlight the need to integrate pedagogically grounded strategies into training systems. In the proposed methodology, this principle is reflected in the use of predefined objectives, common assessment criteria, feedback, and repeated performance of learning tasks.

The comparability of the experimental and control groups is a crucial element of the study. If the experimental group receives more instructional time, additional equipment, or more intensive instructor support, the observed differences cannot be

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attributed unambiguously to the innovative teaching methods alone. Therefore, training conditions should be made as comparable as possible, and any differences should be described in detail.

Another important issue concerns the quality of the assessment instruments. Tests should measure knowledge relevant to the discipline, while practical checklists should record observable actions. The use of vague judgements, such as "thinks well" or "demonstrates a high level of readiness", without operational criteria makes the study more difficult to reproduce.

The proposed framework provides for the assessment not only of immediate learning outcomes but also, where resources permit, of the retention of knowledge and skills. Delayed measurement makes it possible to determine whether improvements persist over a specified period. However, it requires additional planning and consideration of any further training that may occur between assessments.

A limitation of the present study is its design-oriented nature. No participants have been recruited, no empirical data have been collected, and the hypothesis has not been tested statistically. Furthermore, the methodology has been developed in a general form and requires adaptation to the specific discipline, curriculum, and organisational conditions of the military educational institution.

Thus, the practical value of the proposed approach lies in providing a reproducible foundation for empirical research. Following the implementation of the experiment, the resulting data will make it possible to clarify which components of innovative teaching are associated with changes in learning outcomes and under what conditions the methodology may be recommended for implementation.

5. Conclusion

This article presents a proposed methodology for a pedagogical experiment aimed at evaluating the effectiveness of innovative teaching methods for cadets studying military disciplines.

An integrated framework combining simulation-based, problem-based, interactive, and digital learning has been developed. The stages of the experiment, the assessment criteria for theoretical knowledge, practical skills, analytical thinking, and independence, as well as the principal approaches to statistical data analysis, have been established.

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The importance of ensuring comparability between experimental and control groups, applying common assessment criteria, specifying outcome measures in advance, and reporting effect sizes alongside statistical significance has been substantiated. Particular attention has also been paid to research ethics, data protection, and compliance with safety requirements.

The proposed methodology provides a foundation for testing the hypothesis that the integrated application of innovative educational technologies may offer advantages. However, its effectiveness can be established only after the pedagogical experiment has been conducted and the resulting empirical data have been analysed.

Future research should focus on piloting the methodology at a specific military educational institution, calculating the required sample size, evaluating the quality of the assessment instruments, and publishing the findings with actual quantitative results.

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