METHODOLOGY OF USING SIMULATION TECHNOLOGIES IN PREPARING FUTURE TEACHERS FOR CORRECTIVE ACTIVITIES IN THE EDUCATIONAL PROCESS

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ABSTRACT

This article analyzes the methodology and effectiveness of simulation technologies (case studies, role plays, simulation exercises) in preparing future teachers for corrective activities in the educational process based on experimental results. The study was conducted with pedagogy students at Andijan State Institute of Foreign Languages. The experimental group (n=30) received a methodology based on simulation technologies, while the control group (n=30) continued with traditional teaching methods. Results were processed using Student's t-test, Cohen's d effect size, and ANOVA analysis. The experimental group demonstrated a statistically significant superiority in corrective competency over the control group ($t=6.12$; $p<0.001$; $d=1.58$).

Keywords: simulation technologies, case study, role play, corrective competency, future teachers, pedagogical correction, experiment, educational process.

INTRODUCTION

The modern educational paradigm requires teachers not only to impart knowledge but also to possess the competency to identify problems in the educational process in a timely manner and to eliminate them – that is, to carry out corrective activities. Corrective activity refers to the process of diagnosing deficiencies in student achievement, identifying their causes, and implementing appropriate pedagogical measures (Bloom, 1968; Black & Wiliam, 1998).

However, practice shows that young teachers face serious difficulties in corrective activities: even when they identify a problem, they lack the skills to provide an adequate pedagogical response (Darling-Hammond, 2006). The primary reason for this is that the process of preparing students for corrective activities in higher education institutions is predominantly theoretical in nature, with insufficient practical training.

Simulation technologies offer unique opportunities to address this problem. Simulation is a method of preparing students for practical activities by recreating real-world situations in an artificial environment, and it is widely used in medicine, aviation, and military training (Gaba, 2004). The main types of simulation technologies in pedagogical education are as follows:

Case study – a method of developing decision-making skills through the analysis of real or near-real pedagogical situations. Case studies teach students to analyze problems from multiple perspectives, consider various solution options, and select the most optimal strategy (Merseth, 1996).

Role play – students develop empathy, communication, and decision-making skills by assuming the roles of various participants (teacher, student, parent) in specific pedagogical situations (Van Ments, 1999).

Simulation exercises – by artificially creating a real classroom environment, students practice diagnostic, corrective, and assessment processes. This method also incorporates elements of microteaching (Bradley, 2006).

However, the integrative impact of these technologies specifically on the development of corrective competency has not been sufficiently studied. While existing research has primarily analyzed the effectiveness of individual technologies (Kilic, 2010; Remesh, 2013), their combined application and synergistic effect have been under-researched.

Research objective: to develop an integrative methodology based on simulation technologies (case studies, role plays, simulation exercises) for preparing future teachers for corrective activities in the educational process and to experimentally demonstrate its effectiveness.

Research tasks: 1) to develop and theoretically substantiate a methodology for preparing students for corrective activities based on simulation technologies; 2) to pilot the developed methodology through experimental testing; 3) to conduct a comparative analysis of corrective competency development in experimental and control groups; 4) to statistically substantiate the effectiveness of the methodology.

Research hypothesis: If an integrative methodology based on simulation technologies (case studies, role plays, simulation exercises) is applied in the process of preparing future teachers, their corrective competency level will be statistically significantly higher compared to students trained through traditional methods.

METHODS

Research Design

A quasi-experimental design (pretest-posttest control group) was employed in the study. The experiment was conducted at Andijan State Institute of Foreign Languages during the first and second semesters of the 2023–2024 academic year (32 weeks – 2 semesters). The longer duration was selected to enable the study of the full-cycle impact of simulation technologies.

Participants

Third and fourth-year students majoring in pedagogy participated in the study. Participants were assigned to two groups using convenience sampling: the experimental group (EG, n=30) and the control group (CG, n=30). A total of 60 students participated.

Table 1. Demographic characteristics of participants

Indicator	EG (n=30)	CG (n=30)
Mean age	21.2±1.4	20.9±1.3
Gender (male/female)	12/18	11/19
Mean GPA	3.72±0.38	3.68±0.41
Pretest mean score	38.7±9.4	37.2±10.1

The initial equivalence of the groups was verified using the Student's t-test on pretest scores ($t=0.61$; $p=0.54>0.05$), confirming that there was no statistically significant difference between the groups.

Experimental Procedure: Simulation Technologies Methodology

The experimental group received a three-stage integrative methodology based on simulation technologies. A specific type of simulation served as the primary tool at each stage:

Stage I. Developing corrective thinking through case studies (Weeks 1–10). During this stage, students were presented with 20 cases drawn from real pedagogical practice. Each case had the following structure: situation description (the student's problem, classroom environment, teacher's actions); diagnostic data (test results, observation protocol, parent's letter of concern); analysis task (identify the problem, analyze the causes, develop a corrective plan). Students worked in small groups of 4–5 members, with 90 minutes allocated for each case. Following group presentations, the "best corrective solution" was selected and discussed collectively.

Stage II. Developing corrective communication skills through role plays (Weeks 11–20). During this stage, students assumed the roles of various participants – teacher, student, parent, and school psychologist – in different pedagogical situations. Each role play session was conducted in the following sequence: introduction to the situation and role assignment (10 minutes); conducting the role play (20–25 minutes); viewing and analyzing the video recording (15 minutes); group reflection and re-enactment (20 minutes). A total of 15 different pedagogical situations were developed, including: individual conversation with an underperforming student; discussion of a corrective plan with a parent; resolving a problematic situation as a class advisor; designing differentiated assignments for a gifted student; and resolving conflicts among students.

Stage III. Consolidating integrative corrective competency through full simulation exercises (Weeks 21–32). In this final stage, the knowledge and skills developed in the previous two stages were integrated. Students participated in full pedagogical simulations: modeling a real classroom environment (15–20 "students" with varying levels of achievement); conducting a full 45-minute lesson; applying diagnostic tools during the lesson (formative assessment, rapid tests, observation); making corrective decisions and developing individual plans at the end of the lesson;

video analysis and reflective journal writing. Each student completed a minimum of 4 full simulation exercises.

The control group continued with traditional teaching methods (lectures, seminars, practical exercises, pedagogical practicum). Both groups received identical theoretical content; the difference lay solely in the practical training methodology.

Measurement Instrument

A specially developed "Corrective Competency Test" (CCT) was used to assess the level of corrective competency. The test encompasses five components:

Table 2. Structure of the Corrective Competency Test

No.	Component	Points	Assessment method
1	Problem identification	20	Situational test items
2	Cause analysis	20	Case analysis tasks
3	Corrective plan development	20	Practical task (plan project)
4	Corrective communication	20	Role play assessment rubric
5	Reflection and self-assessment	20	Reflective essay and journal
	Total	**100**	

The content validity of the test was evaluated by 9 experts (professors, associate professors, and experienced school teachers). The Content Validity Index

was CVI=0.89. Reliability was determined using Cronbach's alpha coefficient: α=0.91 (very high internal consistency).

Statistical Analysis Methods

Data were processed using SPSS 26.0 and R 4.3.0 software. The following statistical methods were employed: descriptive statistics (mean, standard deviation, median, mode); Shapiro-Wilk normality test; independent and paired samples Student's t-test; one-way analysis of variance (one-way ANOVA); Cohen's d effect size; eta-squared (η^2) effect size; post-hoc analysis with Bonferroni correction.

RESULTS

Pretest Results

The pre-experimental corrective competency levels were low in both groups. The mean score in the EG was 38.7±9.4, and in the CG it was 37.2±10.1. Independent samples t-test results showed no statistically significant difference between the groups (t=0.61; df=58; p=0.54), confirming the initial equivalence of the experiment.

Posttest Results

After the 32-week experiment, corrective competency levels increased in both groups; however, the increase in the experimental group was significantly higher.

Table 3. Comparative analysis of pretest and posttest results

Group	Pretest (M±SD)	Posttest (M±SD)	t	p	d
EG (n=30)	38.7±9.4	79.3±8.1	18.36	<0.001	4.63
CG (n=30)	37.2±10.1	54.8±11.6	6.42	<0.001	1.62

Note: M – mean, SD – standard deviation, d – Cohen's d (within-group)

As shown in Table 3, the mean score in the experimental group increased from 38.7 to 79.3 (gain: 40.6 points), while in the control group it increased from 37.2 to 54.8 (gain: 17.6 points). The gain in the experimental group was 2.3 times higher than that in the control group.

Between-Group Comparative Analysis

Table 4. Between-group comparative analysis of posttest results

EG (M±SD)	CG (M±SD)	t	df	p	Cohen's d
79.3±8.1	54.8±11.6	6.12	58	<0.001	1.58 (large)

The difference between groups on the posttest was highly statistically significant ($t=6.12$; $df=58$; $p<0.001$). Cohen's d effect size was 1.58, indicating a "large" effect ($d>0.8$). ANOVA analysis also confirmed this difference ($F(1,58)=37.45$; $p<0.001$; $\eta^2=0.39$).

Component-Level Analysis

A detailed analysis of the posttest results across the five components of corrective competency is presented below:

Table 5. Posttest results by corrective competency components

Component (max. 20)	EG (M±SD)	CG (M±SD)	t	p	d
Problem identification	16.4±2.1	12.8±2.9	5.52	<0.001	1.42
Cause analysis	15.8±2.3	11.4±3.1	6.27	<0.001	1.61

Corrective plan development	16.1±2.0	10.6±3.4	7.68	<0.001	1.97
Corrective communication	15.6±2.4	10.2±3.2	7.42	<0.001	1.91
Reflection	15.4±2.5	9.8±3.5	7.21	<0.001	1.84

As shown in Table 5, the experimental group demonstrated statistically significant superiority across all five components ($p<0.001$). The largest effect sizes were observed in the "Corrective plan development" ($d=1.97$) and "Corrective communication" ($d=1.91$) components. This result indicates the particularly high effectiveness of simulation technologies in developing practical corrective skills.

Stage-by-Stage Progress Analysis

Interim assessments were conducted in the experimental group at the conclusion of each stage (case studies, role plays, full simulation):

Table 6. Stage-by-stage corrective competency dynamics in the experimental group

Stage	Week	M±SD	Gain (points)	Gain (%)
Pretest	0	38.7±9.4	–	–
I – Case studies	10	52.4±8.7	+13.7	+35.4%
II – Role plays	20	66.8±7.9	+14.4	+27.5%
III – Simulation	32	79.3±8.1	+12.5	+18.7%

Table 6 shows that consistent growth was observed at each stage. The greatest increase occurred during Stage I (case studies, +35.4%), which is explained by students mastering the fundamentals of corrective thinking. In Stages II and III, the percentage growth decreased; however, the absolute point gains remained stable, demonstrating a "resistance to ceiling effect."

Distribution by Corrective Competency Levels

Table 7. Corrective competency levels based on posttest results

Level	Score range	EG (n)	EG (%)	CG (n)	CG (%)	χ^2
High	76–100	19	63.3%	4	13.3%	
Medium	51–75	10	33.3%	14	46.7%	
Low	0–50	1	3.3%	12	40.0%	
						18.74*

*$p<0.001$

In the experimental group, 63.3% of students achieved the high level, while in the control group this indicator was only 13.3%. In the control group, 40% of students remained at the low level, whereas in the experimental group this figure decreased to 3.3%. The chi-square test confirmed that the distributional difference between groups was statistically significant ($\chi^2=18.74$; $p<0.001$).

DISCUSSION

The research results demonstrated the high effectiveness of simulation technologies in preparing future teachers for corrective activities. The obtained results provide grounds for discussing several important aspects.

First, the large effect size for overall corrective competency (d=1.58) confirms the significant superiority of simulation technologies over traditional methods. This finding is consistent with Gaba's (2004) conclusions that simulation technologies are among the most effective methods for developing practical skills. At the same time, our study differs from research in the medical and military fields in that it demonstrates the impact of simulations specifically on pedagogical corrective competency.

Second, the component analysis revealed that the greatest impact was observed in the "Corrective plan development" (d=1.97) and "Corrective communication" (d=1.91) components. This is a logically grounded finding, as students practiced plan development skills through case studies and communication skills through role plays. Merseth's (1996) conclusion that the case study method improves the quality of pedagogical decision-making provides theoretical support for our results.

Third, the stage-by-stage progress analysis demonstrated the advantages of an integrative approach. The highest percentage growth was observed during the case study stage (+35.4%), indicating that the application of theoretical knowledge to practical situations is most effectively mastered in the initial stage. The role play and full simulation stages served the function of consolidating and deepening this knowledge.

Fourth, the distribution by levels showed that the proportion of students achieving the high level in the experimental group (63.3%) was 4.8 times greater than in the control group (13.3%). This finding has practical significance: simulation technologies not only improve average indicators but also significantly increase the number of highly qualified specialists.

Fifth, the ANOVA result (η^2=0.39) indicates that 39% of the variance in corrective competency is attributable to the application of simulation technologies. This is a very high indicator for pedagogical research (Cohen, 1988).

Unique Contribution of Each Simulation Type

Case studies primarily developed analytical thinking and multi-faceted problem analysis skills. Through the analysis of real situations, students mastered the theoretical foundations of corrective decision-making.

Role plays developed empathy, communication, and interpersonal interaction skills. By assuming the roles of students and parents, students gained a deeper understanding of the socio-psychological aspects of the corrective process.

Full simulation exercises enabled the integration and application of knowledge and skills developed in previous stages in an environment closely resembling real conditions. This stage provided the most practical experience and fostered professional self-confidence.

Limitations

The study has several limitations. First, the sample size was moderate (n=60), which limits the broad generalizability of the results. Second, since a quasi-experimental design was employed, random assignment was not performed. Third, the long-term effects (follow-up) of simulation technologies were not examined. Fourth, it was difficult to isolate the individual impact of each simulation type, as an integrative methodology was employed. Future studies are recommended to employ larger sample sizes, randomization, longitudinal designs, and dismantling designs (isolating the individual impact of each component).

Practical Recommendations

Based on the research findings, the following practical recommendations are offered. It is advisable to implement simulation technologies in a phased manner

within the “Pedagogical Diagnostics and Correction” course at higher education institutions: beginning with case studies, followed by role plays, and finally full simulation exercises. Mandatory inclusion of video recording and reflective analysis in each simulation session is recommended. It is essential to incorporate a minimum of 20 cases, 15 role play situations, and 4 full simulation exercises into the curriculum. Involving experienced school teachers as experts in simulation sessions will enhance quality.

CONCLUSION

The research results allow the following key conclusions to be drawn:

The integrative methodology based on simulation technologies (case studies, role plays, simulation exercises) develops the corrective competency of future teachers significantly more effectively than traditional methods ($t=6.12$; $p<0.001$; $d=1.58$). The methodology demonstrated the greatest effectiveness in the “Corrective plan development” ($d=1.97$) and “Corrective communication” ($d=1.91$) components, confirming the role of simulation technologies in developing practical corrective skills.

The phased integrative approach (case studies → role plays → full simulation) ensures stable and consistent competency growth. In the experimental group, 63.3% of students achieved the high corrective competency level, which is 4.8 times higher than the 13.3% observed in the control group.

Accordingly, the broad implementation of simulation technologies as an effective tool for preparing future teachers for corrective activities in the educational process is recommended for pedagogical practice.

REFERENCES

1. Allen, D.W., & Ryan, K.A. (1969). Microteaching. Addison-Wesley Publishing Company.

2. Black, P., & Wiliam, D. (1998). Assessment and classroom learning. Assessment in Education: Principles, Policy & Practice, 5(1), 7–74.

3. Bloom, B.S. (1968). Learning for mastery. Evaluation Comment, 1(2), 1–12.

4. Bradley, P. (2006). The history of simulation in medical education and possible future directions. Medical Education, 40(3), 254–262.

5. Cohen, J. (1988). Statistical power analysis for the behavioral sciences (2nd ed.). Lawrence Erlbaum Associates.

6. Darling-Hammond, L. (2006). Constructing 21st-century teacher education. Journal of Teacher Education, 57(3), 300–314.

7. Gaba, D.M. (2004). The future vision of simulation in health care. Quality and Safety in Health Care, 13(suppl 1), i2–i10.

8. Kilic, A. (2010). Learner-centered micro teaching in teacher education. International Journal of Instruction, 3(1), 77–99.

9. Merseth, K.K. (1996). Cases and case methods in teacher education. Handbook of Research on Teacher Education, 2, 722–744.

10. Popham, W.J. (2014). Classroom assessment: What teachers need to know (7th ed.). Pearson.

11. Remesh, A. (2013). Microteaching, an efficient technique for learning effective teaching. Journal of Research in Medical Sciences, 18(2), 158–163.

12. Teshaboyev, A.Yu. (2024). Methodology for preparing future teachers for diagnostic and corrective activities in the educational process. Doctoral dissertation project.

13. Van Ments, M. (1999). The effective use of role-play: Practical techniques for improving learning (2nd ed.). Kogan Page.