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Effectiveness of Microteaching on Diagnosis and Error Correction Skills of Chinese Physical Education Majors: A Pilot Study

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Abstract
This pilot study aimed to evaluate the effects of microteaching on the diagnosis and error correction skills of Chinese university students majoring in physical education, using a Cluster Randomised Controlled Trial (CRCT) design. Yancheng Teachers University served as the experimental group (microteaching training), and Huaiyin Normal University was the control group (standard training), with 54 participants aged 20-22. Experts reviewed and approved the training procedures. Data analysis used Generalised Estimation Equations (GEE) and Bonferroni tests. Significant improvements in the skills were observed within both experimental and control groups over time. At the pre-test stage, no significant differences were found between the groups. but at the post-test stage, the experimental group showed statistically significant improvements in the skills compared to the control group (DECS: Cohen's d = 3.75, $p < 0.05$). These results suggest that microteaching is more effective than standard training in enhancing diagnosis and error correction skills in physical education majors, making it a superior method for teaching skills training.
Keywords: Microteaching, Diagnosis and Error Correction Skills, Physical Education Majors.

Introduction

Microteaching is distinguished by its key characteristics of timeliness, standardization, audio-visual presentation, and miniaturization. The concept of miniaturization specifically entails the focused training application of each micro-teaching session on relatively specialized topics and narrow content. This approach serves to alleviate student burden while enhancing their concentration on specific subjects (Chen, 2011). Standardization underscores the importance of mastering standardized teaching skills actions during the process of teaching skill training. Students are expected to cultivate a strong sense of standardization and procedural awareness in this training, thereby establishing professionalism and standardization consciousness for their future roles as educators (Chen, 2011). The utilization of audio-visual presentation primarily involves leveraging multimedia tools in teaching to comprehensively and vividly demonstrate the entire skill development process from various angles (Tong, 2001). Timeliness demands that professional teachers provide timely feedback on students' actual performance in teaching skills with professionalism and promptness. Based on specific student performance, corresponding opinions and suggestions should be provided to facilitate student progress (Tong, 2001). The name "micro-teaching" encapsulates these features: "micro" signifies dissecting various aspects and processes of traditional teaching for analysis one at a time; "teaching" represents format—referring to the standardization requirements for students to have a strong sense of standardization while learning teaching skills (Seidel, 2007).

Diagnosis and error correction skills in physical education are one of the essential skills for physical education teachers to conduct teaching activities. These skills involve observing students' movement practices in the classroom, promptly identifying incorrect movements, analyzing the causes of these errors, and using appropriate correction methods to rectify the students' mistakes (Williams, 1995; Souissi et al., 2020; Shi, 2014). These activities improve students' motor skills' standardisation, as reflected in a series of teaching practices (Nishizawa, 2017; Zhao, 2022; Xin, 2022).

Methodology

This study was implemented using a Cluster Randomised Controlled Trial (CRCT) approach, where groups, rather than individuals, served as the units of randomisation. The true experimental design included two groups: a control group receiving standard training (ST) and an experimental group undergoing microteaching training (MT). The study's measurement protocol received approval from the Ethics Committee of Yancheng City Hospital in Jiangsu Province (Approval number: 2023-K-100). Additionally, all participants provided informed consent before joining the study, ensuring they were given comprehensive details about the research to make a voluntary, informed, and rational decision to participate.

Participants

This study employed a microteaching intervention to train teaching skills, specifically focusing on diagnosis and error correction skills. Due to the research objectives and constraints related to available resources, Yancheng Normal University and Huaiyin Normal University were chosen to participate in a Cluster Randomised Controlled Trial (CRCT). The two universities were randomly assigned into two groups: Yancheng Teachers University was designated as the experimental group, while Huaiyin Normal University served as the control group. The experimental group underwent microteaching training, whereas the control group received standard training. The experiment included a total of 54 students, with 27 students allocated to each group.

Measurement of Variables

The present research employed a comprehensive set of validated instruments to measure the efficacy of microteaching training on specific teaching skills based on Shi (2013). It included:

1) *Microteaching Skills Assessment Scale*

Microteaching skills assessment scales are a standardised tool to rate individual teaching skills observed during microteaching sessions.

2) *Grading Ratio Statistical Scale*

This scale quantifies teaching performance based on a set grade ratio, allowing for objectively comparing skill proficiency levels.

3) *Matrix Calculation*

Matrix calculation is a systematic approach to calculating the overall teaching skills score, integrating scores from the microteaching skills assessment scale and grading ratio statistical scale to provide a holistic view of each participant's scores.

Each instrument was carefully chosen for its relevance to the research objectives, proven reliability and validity in prior studies, and ability to provide nuanced insights into the development of teaching skills among physical education students.

Table 1
Instruments Used to Evaluate Teaching Skills

Term	**Instruments**
Diagnosis and Error Correction Skills	Diagnosis and Error Correction Skills Microtraining Evaluation Form (Shi, 2013)
Comprehensive scores of participants in individual teaching skills	1. Grading Ratio Statistical Scale 2. Matrix Calculation (Shi, 2013)

Data Analysis

This study's experimental data was analysed using Statistical Software for Social Sciences (SPSS) version 25. Descriptive approaches were used to check the data quality after the data entry. Data analysis by the researcher happened before data cleaning and hypothesis testing. The statistical significance was assessed by calculating two-tailed p-values at the alpha level of 0.05. Before evaluating the research hypotheses, certain assumptions, such as the normality test and homogeneity test of variance (Levene's test), were conducted. The effectiveness of intervention programs on dependent variables was assessed using the Generalised Estimating Equation (GEE) method since the study was conducted using a cluster design. GEE expands upon the logistic regression model and is a preferred method for conducting CRCT. CRCT studies employ GEE for analysis, as Barker et al. (2016) demonstrated. After the GEE analysis, a Bonferroni post hoc test was used to compare the means within and across groups.

Results

Test of Normality

Before conducting any statistical analyses, particularly inferential statistics, it is crucial to ensure that the study variables exhibit normality. Data that is normally distributed aligns with the shape of a normal distribution curve. To assess normality, the Kolmogorov-Smirnov and Shapiro-Wilk tests were applied. The findings indicated that most variables followed a normal distribution, as evidenced by p-values greater than 0.05.

Table 2
Normality Test of Variable at pre-test and post-test

	GR	Kolmogorov-Smirnova	p value	Shapiro-Wilk	p value
DECS.Pre	EG	0.192	0.006	0.837	<0.001
	CG	0.128	.200*	0.979	0.809
DECS.Post	EG	0.159	0.052	0.944	0.12
	CG	0.119	.200*	0.98	0.83

Homogeneity Test
The result of the homogeneity test on variable is presented in Table 3. The variable is accompanied by the Levene statistic, degrees of freedom (df1 and df2), and their respective p-values. The test evaluates the equality of variances between the groups being compared for research variable, diagnosis and error correction skills (DECS). The Levene statistic values quantify the extent of variation in variances among groups, with higher values indicating increased heterogeneity. The p-values associated with the observed differences establish the level of significance, where values over a specific threshold indicate no meaningful difference in variances between the groups. These results showed that the two groups have the same variance for all research variables ($p>0.05$).

Table 3
Test of Homogeneity of Variance (Leaven test) for all Research Variable

Variable	Levene Statistic	df1	df2	p-value
DECS	0.304	1	58	0.583

Comparison between Control and Intervention Groups at the Baseline
Prior to data analysis, it is advisable to evaluate the assumption of group homogeneity to ensure that the groups were equivalent in terms of the research outcome at baseline. Consequently, the homogeneity of research variables between the intervention and control groups was assessed as one of the preliminary assumptions. For variables that followed a normal distribution, an independent t-test was conducted, whereas for non-normally distributed variables, the Mann-Whitney U test was employed as a non-parametric alternative to compare the two groups. The comparison results (Table 4) revealed no significant differences between the control and intervention groups for the variable in question. Therefore, the pre-test score of this variable was included as a covariate in the analysis of the post-test scores.

Table 4
Comparison between Groups for all Research Variable at Baseline

Variable	Group		t/z value	p-value
	EG	CG		
DECS	66.275(3.49)	65.3(2.81)	0.599 b	0.549

Demographic Variables of Control and Intervention Groups
Descriptive data for the demographic factors within the Experimental Group (EG) and the Control Group (CG) are shown in Table 5. Descriptive statistics were used in independent analyses for each group to assess these demographic factors' homogeneity thoroughly. Then, using chi-square tests, a comparison evaluation between the EG and CG was carried out. Gender and age were the two main demographic factors included in the analysis. Regarding gender distribution, the data showed that 9 participants (30%) in the CG and 8 (26.7%) in the EG were classified as female. Accordingly, 21 (70%) and 22 (73.3%) male participants were in the CG and EG, respectively. When the observed differences were tested using a chi-square test, the p-value was 0.774, meaning there was no statistically significant difference between the gender compositions of the two groups ($\chi2$ = 0.082).

The participants were divided into three age groups based on their age distribution: 20 years, 21 years, and 22 years. Within the EG, the ages of 8 individuals (26.7%), 21 participants (70%), and one person (3.3%) were recorded as being in their 20s. By contrast, in the same age ranges, the CG consisted of nine participants (30%), 19 people (63.3%), and two participants (6.7%). After doing a chi-square test to assess the importance of age distribution discrepancies between the two groups, no statistically significant difference was found, as indicated by the p-value of 0.782 and $\chi2$ value of 0.492. It was confirmed that there were no statistically significant differences between the Experimental Group (EG) and the Control Group (CG) based on the study of demographic factors, specifically gender and age.

Table 5
Descriptive Statistics for Demographic Variables in Both Groups

Variable	Level	EG	CG	$\chi2$	P value
Gender	Female	8(26.7)	9(30)	0.082	0.774
	Male	22(73.3)	21(70)		
Age	20 years	8(26.7)	9(30)	0.492	0.782
	21 years	21(70)	19(63.3)		
	22 years	1(3.3)	2(6.7)		

Effectiveness of Microteaching Training Program on Diagnostic Error Correction Skills

The research objective of this study is "To evaluate the effect of microteaching training on diagnostic error correction skills of university students majoring in physical education in China." GEE was applied to assess the effectiveness of microteaching training programs on diagnostic error correction skills. Table 6 shows the descriptive statistics (Mean and standard error) for both groups at the pre-test and post-test.

Table 6
Descriptive (Mean and SD) Statistics of Diagnostic Error Correction Skills

Time	**Group**	**Mean**	**SE**
Pre-test	EG	65.475	0.420
	CG	65.405	0.401
Post-test	EG	86.540	0.297
	CG	81.070	0.232

The Generalized Estimating Equations (GEE) results, as presented in Table 7, concerning the total score of diagnostic error correction skills among students, revealed significant findings. Firstly, time significantly affected the total score of diagnostic error correction skills (χ2 = 3072.354, p < 0.001), indicating that diagnostic error correction skills exhibited notable changes over time, encompassing the pre-test and post-test assessments. Furthermore, the group's main effect was significant (χ^2 = 59.129, p < 0.001). Also, the interaction between time and group was not deemed significant (χ^2 = 66.407, p <0.001), indicating that the patterns observed in diagnostic error correction skills over time between the EG and CG were significantly different.

Table 7
Results of Generalised Estimating Equations (GEE) on Diagnostic Error Correction Skills

Source	**Wald Chi-Square**	**df**	**p-value**
Time	3072.354	1	<0.001
Groups	59.129	1	<0.001
Time * Group	66.407	1	<0.001

** significant at .05, a: baseline score was considered as covariate*

In order to evaluate the differences in the diagnostic error correction skills among participants across the time for both groups, the post-hoc test (Bonferroni) was applied (Table 8). Based on the result of the Bonferroni test, the difference in diagnostic error correction skills scores between pre-test and post-test EG and CG were statistically different (*p*<0.001). These findings highlight substantial improvements in diagnostic error correction skills scores from the pre-test to the post-test for both the EG and CG. Cohen's d values of d=10.58 for the EG and d=8.73 for the CG suggest large effect sizes, indicating significant practical significance in the improvements observed in diagnostic error correction abilities over time within both groups.

Table 8
Pairwise Comparison of Diagnostic Error Correction Skills Score across Time for Both Groups

Time	**Test**	**Mean Difference**	**SE**	***P* value**	**95%CI for Difference**		***Cohen d***
					LB	**UB**	
EG	Pre Vs post	-21.065	0.529	<0.001	-22.461	-19.669	10.58
CG	Pre Vs post	-15.665	0.399	<0.001	-16.620	-14.710	8.73

In order to evaluate the differences in diagnostic error correction skills scores between groups at both the pre-test and post-test stages, a pairwise comparison was performed.

Results (Table 9) showed that at the pre-test stage, no statistically significant difference was observed between the Experimental Group (EG) and the Control Group (CG) in diagnostic error correction skills scores ($p = 0.904$). The effect size (Cohen's d = 0.03) suggests a negligible effect, indicating minimal differences in diagnostic error correction abilities between the groups at the pre-test. However, at the post-test stage, a statistically significant difference was found between the EG and CG in diagnostic error correction skills scores ($p < 0.001$). The mean difference of 5.470 indicates a substantial increase in diagnostic error correction skills in the EG compared to the CG. Additionally, the large effect size (Cohen's d = 3.75) underscores the practical significance of this difference, indicating a substantial improvement in diagnostic error correction abilities in the EG compared to the CG at the post-test.

Table 9
Pairwise Comparison of Diagnostic Error Correction Skills Score between Groups at Pre and Post-test

Group	**Test**	**Mean Difference**	**SE**	**P value**	**95%CI for Difference**		**Cohen d**
					LB	**UB**	
Pre-test	EG vs CG	0.070	0.581	0.904	-1.068	1.208	0.03
Post-test	EG vs CG	5.4700b	0.376	0.000	4.626	6.314	3.75

Figure 1 illustrates the mean score of diagnostic error correction skills over time, revealing an increase at the post-test stage in both groups while it was more in the experimental group.

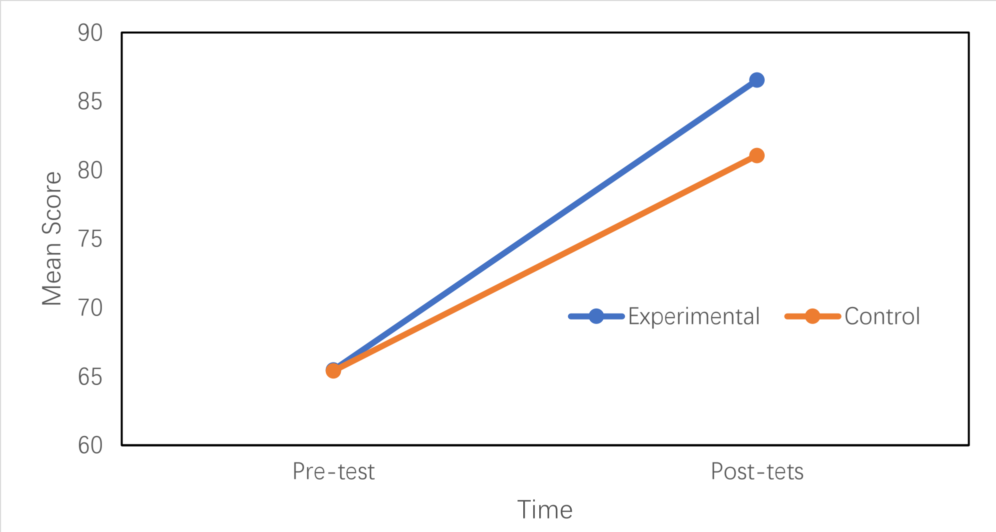

Figure 1: Mean Score of Diagnostic Error Correction Skills of Experimental and Control Groups across the Time

Discussion

The GEE results evidenced a significant effect of time on the total score of diagnostic error correction skills ($p < 0.001$), indicating that diagnostic error correction skills exhibited notable changes over time, encompassing the pre-test and post-test assessments. Based on the Bonferroni test results, these findings highlighted substantial improvements in diagnostic error correction skills scores from the pre-test to the post-test for both EG and CG. Pairwise comparison showed that in the pre-test, there was no significant difference in the two groups' diagnosis and error correction skill scores ($p>0.05$). After the 12-week training period, there was a significant difference between the two groups ($p < 0.001$). EG showed higher diagnostic and error correction skill scores compared to CG. Due to this finding, the hypothesis that microteaching training can significantly improve physical education college students' diagnostic and error correction skill levels was proven. These findings showed that both microteaching training and standard training methods improved students' diagnosis and error correction skills, but the effect of microteaching training was more significant than standard training.

In applying microteaching to train students' diagnosis and error correction teaching skills, teaching students can discover their problems through recorded teaching videos, focusing on training in discovery and identification, error attribution, and error correction organisation (Deneme, 2020; Sana, 2007; Gupta et al., 2016). Discovery and identification include the timeliness of error discovery and accuracy of error judgment. Error attribution includes comprehensiveness of cause analysis and accuracy of cause judgment. Error correction organisation includes the rationality of error correction timing and pertinence of error correction methods (means), the effectiveness of error correction methods (means), the diversity of error correction methods, and the rationality of combination with other skills (means) (Kpanja, 2001; Esteban et al., 2016). By training the above indicators, teachers can improve their error correction skills and ability to comprehensively apply teaching skills (Reddy, 2019; Abendroth et al., 2011).

When standard teaching methods are used to train students' teaching skills, teachers or peers point out most of the problems that arise. For students practising, these problems are "abstract" rather than "concrete," which leads to students' inability to face the issues that arise during practice (Remesh, 2013).

Conclusions and Future Research

The training used in microteaching is a sub-skill training to make teaching skills more perfect. Both microteaching and standard teaching improve the teaching skills of physical education majors, but the training effect of microteaching is better than standard teaching. The groups' diagnostic and error correction skills have significantly improved. However, there is a significant difference in comprehensive teaching skills scores between the two groups, and the effect of microteaching training is better than standard teaching.

Future Research

Based on the findings, several recommendations for future research are listed.

(1) This study only verified the effect of microteaching training on movement explanation skills and movement demonstration skills in physical education. Future studies need to verify the effect of microteaching training on other teaching skills in physical education, such as introduction, questioning, body language, and lesson-closing skills. The current research results do not indicate whether microteaching will affect introduction, questioning, body language, or lesson-closing skills. This focus may be an aspect that needs to be supplemented in future research.

(2) This study did not explain the effect of students' personality characteristics on the formation of physical education teaching skills. As every student has personality characteristics, future research should focus on developing teaching skills training methods based on students' personality characteristics to optimise students' physical education teaching skills.

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