The influence of localization and materialization of mathematics activities on the indigenous first grade students' learning effects: Two assessment results

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Abstract

This research aimed to discuss the indigenous students' learning effects of mathematics which was based on the self-designed localization and materialization of mathematics activities and had proceeded for one year. The quasi-experimental method was used in this research. There were 58 indigenous first grade students which were divided into three experimental groups (A, B, C) and one control group (D). Experimental instruments embodied written tests and manipulative tests which were designed by researchers according to the indicators proclaimed by Ministry of Education. The main findings were as followed: (1) The influence of localization and materialization of mathematics activities on the indigenous first grade students' learning effects was limited. (2) According to the result of Paired T-test of the written and manipulative tests, most of scores of manipulative tests were higher written tests.

Research Motivation and Goals

Due to the low socioeconomic status, deficient in family culture, and the inappropriate education strategies of indigenous students who live in remote tribes, many researches showed that indigenous students' academic grades tended to be inferior. Tan (1997, p.37) found out that many researches indicated that the education of indigenous people tended to be low and the ratio of schooling and drop-out of junior high school was higher, therefore, they were in disadvantage to move upward status (e.g., Wang, 1992; Li and Chien, 1992; Li and Hsu, 1984; Tsui, 1983; Tan, 1996). Indigenous students' inferior academic grades and learning difficulty in mathematics were often mentioned in many researches as well (Chen, 1998; Chuan, 2000; Chih, 2001). These descriptions of indigenous students' inferior academic grade and mathematics performance were the spurs for researcher's motivation.

Tan (2002) pointed out that according to the relative researches in indigenous students' learning they prefer dynamic and concrete manipulation of learning (e.g. Liu, 1987; Chu, 1991; Kuo & He 1997; Chih, 1988; Lin, 1998; Kuo, 2001). For the mathematics education in different culture, Bishop and Zaslavsky emphasized to combine learner's cultural background and made mathematics activities useful and successful (Bishop, 1992; Zaslavsky, 1988). Bishop (1992) mentioned that there were different peoples who were frustrated by mathematics or estranged them from mathematics. Chih (2001) in a two-year and half research in indigenous mathematics activity, the greatest contribution was to take cultural context into consideration to students' difficulty in learning. The outcome of the research confirmed the importance of integration of materialization and the understanding of local culture with activities.

Besides, in relative researches, indigenous students preferred materialization and concrete manipulative activities. The learning activities had better to do with living experience and community culture. The mathematics activities which we designed were proceeded in class teaching. Paiwan first grade students in Taitung area were main subjects in this research. The effect of which was compared to the ones of experimental groups and control group.

Research Methodology

Research Design

This research divided subjects into four groups which were A (n=14), B (n=16), C (n=17) and D (n=11). Group A, B and C were experimental groups. Group D was control group. Group mathematics manipulative teaching (10 times * 2 sessions * 40minute = 800 minutes) in the semester and/or five-day summer and winter camp (5 day * 4 session * 40 minute = 800 minutes) were proceeded in experimental groups. There were no treatment for the control group D. 10 mathematics manipulative teaching activities and summer and winter camp were proceeded in experimental group A. 10 mathematics manipulative teaching activities were proceeded in experimental group B. Summer and winter camp were proceeded in experimental group C. There were no teaching activities, summer and winter camp for the control group D. The experiment treatment in this research was based on the result of action research in previous year. We designed "Localization and Materialization of Mathematics Activity" for indigenous first grade students in Paiwan tribe in Taitung, Taiwan. We mainly focused on materialization manipulation in the first semester. Culture was taken into mathematics activities design for second semester.

Research Instruments

According to ability indicators of first grade mathematics in elementary school, researcher edited five written tests (one pretest and four posttests) with similar levels. The researchers read the items to the students in group with one to one narration. Each correct answer of question gained one point. There were 32 points for total. Item difficulty of the written test was $p = .42$, the index of discrimination $D = 49.23$, Cronbach $\alpha = .908$.

Researcher deleted four questions of calculation in above-mentioned written test and turned the above-mentioned written test into manipulation test with concrete items. The researcher worked with one student in the manipulation test. There were 28 points for total. Item difficulty of the written test was $p = .53$, the index of discrimination $D = 52.24$, Cronbach $\alpha = .875$.

Research Result and Discussion

Performance of Mathematics Written Test

For the discussion on students' score in experimental groups (A, B, C) and control group (D) , we could reveal that the mean score (standard deviation) of pretest which was given in the beginning of the first semester in the first year were 12.57(6.86), 12.81(6.94), 13.23(6.66), and 12.09(7.38). The first post-test was given at the end of first semester and the score were 21.27(5.64), 20.12(7.22), 21.62(6.49), and 1.72(6.49). The second post-test was given at the beginning of second semester and the score were 25.28(4.51), 23.75(7.10), 23.41(5.29), and 24.90(7.03). The third post-test was given at the end of second semester and the score were 30.00(2.21), 28.43(4.73), 27.64(4.27), and 28.63(5.98). The fourth post-test was given at the beginning of second year and the score were 27.57(4.81), 26.87(5.80), 26.82(4.53), and 28.91(3.59).

To integrate the above statistics, according to the figure 1, after students in experimental groups accepted the localized and materialized activities, experimental group A had great progress among three experimental groups. The second one is experimental group B. Experimental group C had the least progress. To compare with control group, it had greater progress than experimental B and C after the second post-test. After the summer vacation, the three experimental groups reduced but the control group had progress.

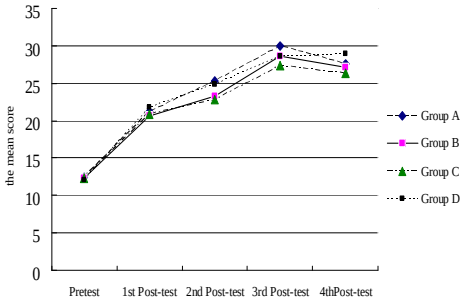

Figure 1. Mean scores of written tests

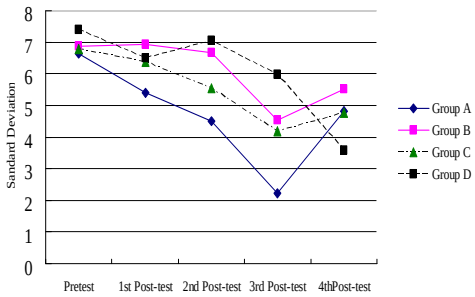

Figure 2. SD of written tests

Table 1
Analysis of Covariance (ANCOVA) of Written Tests

ANCOVA for 1st Post-test	SS	df	MS	F	Sig.
Covariate (Pretest)	659.559	1	659.559	24.371	.000
Between	38.441	3	12.814	.473	.702
Within (error)	1326.092	49	27.063		
ANCOVA for 2nd Post-test					
Covariate (Pretest)	669.980	1	669.980	27.799	.000
Between	53.278	3	17.759	.737	.535
Within (error)	1277.363	53	24.101		
ANCOVA for 3rd Post-test					
Covariate (Pretest)	101.220	1	101.220	5.682	.021
Between	48.367	3	16.122	.905	.445
Within (error)	944.068	53	17.813		
ANCOVA for 4th Post-test					
Covariate (Pretest)	155.490	1	155.490	7.490	.008
Between	44.339	3	14.780	.712	.549
Within (error)	1100.240	53	20.759		

*P<.05

For the discussion on the standard deviation of the four groups, the standard deviation of experimental groups and control group reduced gradually. According to figure 2, experimental group A had lowest standard deviation, and control group had highest one after the third post-test. However, the fourth post-test showed the three experimental groups raised and the control group reduced on SD.

Used the ANCOVA to control the pretest score, according to the table 1, the result showed there were no significant differences between the four groups. The influence of the localized and materialized activities had limitation. One of the main interferences to the whole research process was the control group gave courses review in the two weeks before the second year. From the interview, the control group spent more time on mathematics activities than other groups was another interference.

Performance of Mathematics Manipulative Tests

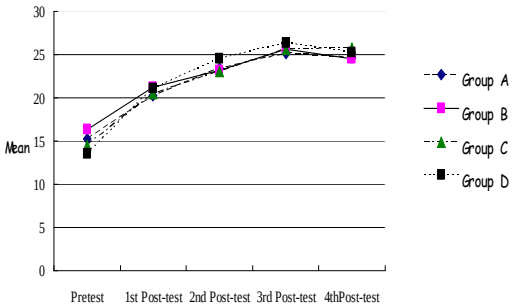

Figure 3. Mean scores of manipulative tests

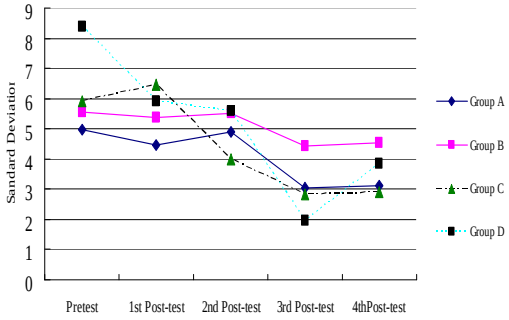

Figure 4. SD of manipulative tests

Table 2

Analysis of Covariance (ANCOVA) for Manipulative Tests

ANCOVA for 1st Post-test	SS	df	MS	F	Sig.
Covariate (Pretest)	595.549	1	595.549	37.195	.000
Between	17.224	3	5.741	.359	.783
Within (error)	784.560	49	16.011		
ANCOVA for 2nd Post-test					
Covariate (Pretest)	467.911	1	467.911	29.191	.000
Between	48.890	3	16.297	1.017	.393
Within (error)	849.544	53	16.029		
ANCOVA for 3rd Post-test					
Covariate (Pretest)	108.507	1	108.507	11.994	.001
Between	19.411	3	6.470	.715	.547
Within (error)	479.479	53	9.047		
ANCOVA for 4th Post-test					
Covariate (Pretest)	129.176	1	129.176	12.603	.001
Between	28.442	3	9.481	.925	.435
Within (error)	543.226	53	10.250		

* P<.05.

We could reveal that the mean score (standard deviation) of pretest and post-test of mathematics manipulative test to the four groups (A, B, C, D) were 15.28(5.16), 16.31(5.65), 14.47(5.93), and 13.54(8.38); the score of first post-test were 20.27(4.67), 21.18(5.44), 20.50(5.01), and 21.09(5.92); the score of second post-test were 23.42(4.89), 23.18(5.76), 23.00(3.75), and 24.54(5.59); the score of third post-test were 25.14(3.03), 25.56(4.60), 25.64(2.76), and 26.36(1.96); the score of fourth post-test were 24.64(3.12), 24.71(4.55), 25.28(2.88), and 25.27(3.84).

From the above statistics, it showed that both students in experimental groups and control group had progress in the manipulative test. According to figure 3, the performance of students in control group was much better than the one of students in experimental groups. Moreover, according to figure 4, the standard deviation of control group tended to be lower. It was different from the result of written test before the third post-test. The scores of the four groups were regressed in the fourth post-test.

If we regarded the pretest score of manipulative test as covariance, and analyzed four

post-test scores by analysis of covariance, it showed that there were no significant differences of manipulative test between students in experimental groups and control group (as table 2). Therefore, localization and materialization of mathematics activities had limited effects on the mathematical learning.

Comparison between the Performances of Written Tests and Manipulative Tests

The researcher analyzed the data of students' pretest and post-test in written and manipulative test by Paired T-test. According to table 3 and 4, it showed that there were significant differences between written and manipulative test in pretest (T=-5.92, p=.000). For the discussion on the average number of correctness, the number of correctness in manipulative test was higher than the ones in written test. The first and second post-test showed the same results. However, the result showed differently in third post-test. There were no significant differences already (T=-.79, p=.434). The possible reason for this situation might be most of the children had acquired the mathematics concepts for they had learned it for one year. Therefore, there were no significant differences between written test and manipulative test. The interest thing was that there were significant differences between written and manipulative test in fourth post-test (T=-2.60, p=.012). So, the students had better performance in manipulative test with concrete material than the abstract written test.

Table 3

The Average Number of Correctness for Written Test and Manipulative Test

Type of test	Pretest *Mean* *(SD)* n	1st Post-test *Mean* *(SD)* n	2nd Post-test *Mean* *(SD)* n	3rd Post-test *Mean* *(SD)* n	4th Post-test *Mean* *(SD)* n
Written Tests	11.63 (5.65) 58	18.12 (5.24) 54	20.84 (5.06) 58	25.12 (3.81) 58	24.02 (4.30) 58
Manipulative Tests	15.01 (6.14) 58	20.77 (5.13) 54	23.44 (4.89) 58	25.63 (3.26) 58	25.05 (3.51) 58

Table 4

Paired T-test of Written Tests and Manipulative Tests and Deferred tests of Students.

	Paired Variance Deviation				
	M	*SD*	*t*	*df*	Sig.
Pretest Written Test – Manipulative Test	-3.36	4.33	-5.92	57	.000*
1st Post-test Written Test – Manipulative Test	-2.65	3.02	-6.45	53	.000*
2nd Post-test Written Test – Manipulative Test	-2.60	6.56	-3.02	57	.004*
3rd Post-test Written Test – Manipulative Test	-.52	5.00	-.79	57	.434
4th Post-test Written Test – Manipulative Test	-1.05	3.09	-2.60	57	.012*

Conclusion and Suggestion

There were no significant differences in statistics according to the quantitative data of teaching effects of localization and materialization of mathematics activities. We could just know that the effects of localized and materialized teaching were limited according to the written tests and manipulative tests which were not similar with the other studies. The studies which pointed out combined indigenous culture and live experiences into the teaching activities (You, 2000; Tan, 2002; Tan & Lin, 2002; Bishop, 1992; Zaslavsky, 1988) and manipulative teaching activities to indigenous students (Lin, 2000; Chih, 2001; Tan, 2002) could promote indigenous students' learning effect. The researchers needed to check the research process and extraneous variables and internal validity and find out the possible reasons.

However, according to result of comparison between written tests and manipulative tests, the score of manipulative test was higher than the one written test. We sincerely suggested that teachers used concrete teaching materials much more to help indigenous first grade students' learning of mathematics concepts. In addition, most of activities and teaching materials based on mainstream culture, and that were different from students' living environment and experience very much. Therefore, teachers should endeavor to integrate localization ingredient with activities. The regressive performance which happened after a summer vacation was worth to mindful and make an effort to it.

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