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The Effect of Dynamic Assessment Based Instruction on Children's Learning

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The purpose of this study is to demonstrate that dynamic assessment based instruction increases children's learning by using a quasi-experimental research design in Korea. In this study, dynamic assessment is defined as a measurement method of the zone of proximal development (ZPD) as well as the qualitative and quantitative diagnostic information for individual children. In addition, dynamic assessment based instruction is defined as a teaching method using the diagnostic information types in order to increase children's learning. In this study, 59 children between the ages of 4 and 5 participated. Three types of number concept achievement tests (pre-test, parallel test, and post-test) for each age group were developed and the content validity, face validity, and split-half reliability were examined. After conducting the pre-test, the children of each age group were divided into an experimental group and a control group. Dynamic assessment based instruction regarding number concepts was undertaken only with the experimental group for 4 weeks. Both groups took a post-test after completing the 4 weeks of classes. The ANCOVA technique wa`1s used for data analysis. The result of this study shows that dynamic assessment based instruction has a significant effect on children's learning of number concepts (in the case of 4-year-old children, $F = 12.34$, $p<0.01$; 5-year-old children, $F = 20.03$, $P<0.01$). Therefore, dynamic assessment based instruction should be used widely for children's cognitive learning.

Key Words: dynamic assessment, dynamic assessment based instruction, children's number concept

In order to improve the quality of early childhood education, the implementation of individualized instruction is very important. For its implementation, it is necessary to gather qualitative and quantitative diagnostic information about children's developmental characteristics, learning strategies, problem solving strategies, developmental level, etc. However, kindergartens in Korea have long used traditional or static assessment that focuses on what the child already knows and on what the child can do alone.

Bransford, Delcos, Vye, Burns, and Haselbring (1987) described three reasons for moving away from traditional assessment and moving toward dynamic assessment. First, traditional assessment is only concerned with the products rather than processes of learning. Second, it fails to address each child's responsiveness to instruction because it is based on the premise that prior learning adequately predicts future performance. Third, it does not provide prescriptive information for designing potentially effective instruction. In other words, traditional assessment focuses on the product rather than the process of learning. It also emphasizes the outcomes rather than the strategies for learning and offers no information on the child's responsiveness to teaching, learner's future learning potential, or pedagogical needs.

Jitendra and Kameenui (1993) argued that the failure of traditional assessment has prompted researchers to search for new assessment approaches designed to be more responsive to individual learner's potential strengths and weaknesses. The

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reason is traditional assessment is not designed to evaluate specific instructional strategies for remediation of learning deficits. It also does not recognize the learner's potential to succeed with adequate environmental support. To help alleviate this dissatisfaction with traditional assessment, many researchers have attempted to focus on dynamic assessment to provide more information about the individual's learning ability. Dynamic assessment has emerged from both theoretical conceptions about human cognitive plasticity and practical needs to find novel diagnostic measures for children, unable to reveal their capacities in traditional assessment.

Lunt (1993) stated that the intention of traditional assessment (static procedure) is to measure actual development, which is often subsequently confused with and used as measures of potential. Dynamic assessment procedures, on the other hand, involve a dynamic interactive exploration of the learner's learning and thinking processes, and aim to investigate a learner's strategies for learning and ways in which these strategies may be extended or enhanced. Since it offers individuals an opportunity to learn, dynamic assessment has the potential to show important information about individual strategies and processes of learning. Therefore dynamic assessment offers potentially useful suggestions about teaching. In sum, comparisons of static assessment versus dynamic assessment could be described as in Table 1.

In general, dynamic assessment is a general term used to describe a variety of evaluation approaches that emphasize both process and product. Jitendra and Kameenui (1993) summarized those approaches into five distinct dynamic assessment models: the test-train-test model, mediational assessment model, testing-the-limits model, graduated prompting model, and mediated and graduated prompting model.

Tzuriel (2001) defined dynamic assessment as an assessment of thinking, perception, learning, and problem solving by an active teaching process aimed at modifying cognitive functioning. In addition, Lidz (1987) defined dynamic assessment as an interaction between an examiner-as-intervener and a learner-as-active participant, which seeks to estimate the degree of modifiability of the learner and the means by which positive changes in cognitive functioning can be induced and maintained. In sum, dynamic assessment recognizes the need to develop assessment devices that provide direct measures of the child's potential for learning and developing, information on the processes that lead to the child's success or failure at cognitive tasks, and information on what might be done to facilitate the child's education and development (Minick, 1987).

Malowitzky (2001) claimed that dynamic assessment has some general characteristics. First, it is administered according to a test-intervention-retest format (Lidz, 1991). Second, the test-intervention-retest aspect of dynamic assessment is closely related to the learner's modification. Third, it generates information for developing interventions. Dynamic assessment uses teaching as part of the assessment; it supplies useful information for developing interventions. Lidz (1991) stated that by looking at the learning process, the examiner discovers how the child learns and how the child can best be instructed, and in this way, the results of dynamic assessment are relevant to the learning experience in the classroom.

Dynamic assessment procedures involve a dynamic interactive exploration of a learner's learning and thinking process and aim to investigate a learner's strategies for learning and ways in which these may be extended or enhanced. Since it offers individuals an opportunity to learn, dynamic assessment has the potential to show important information about individual strategies and processes of learning and, therefore, to offer potentially useful suggestions about teaching.

Stanley (1993) presented dynamic assessment procedures in a very concrete form. First, the examiner tests the learner

Table 1. *Comparisons of Static Assessment versus Dynamic Assessment*

Static Assessment	Dynamic Assessment
Examiner is an observer.	Examiner is a participant.
Examinee receives no mediation.	Examinee receives mediation.
Diagnosis ≠ Instruction	Diagnosis = Instruction
Focused on product.	Focused on both process and product.
Retrospective approach	Prospective approach
Decontextualized	Contextualized
Low transfer test ≠ Authentic task	High transfer test = Authentic task

working alone (static mode) to provide a measurement of skills on a task to establish a baseline. Second, the examiner provides a controlled protocol of assistance and instruction (dynamic mode) while the child works on a comparable task. Third, a post-test is given with an alternate form of the original measurement while the learner works alone (static mode) on the task. Fourth, the examiner compares the test and retest measurements to establish the learners zone of proximal development (ZPD, Vygotsky, 1978). Fifth, the examiner analyzes the learner's performance both quantitatively and qualitatively on both product and process.

To obtain information about responsiveness to instruction, dynamic assessments require the interaction between tester and student. When a student has difficulty in solving a problem or answering a question, the tester attempts to move the student from failure to success by modifying the format, providing additional examples or trials, modeling an appropriate strategy for success, or offering increasingly more direct cues or prompts.

Lidz (1991) provided the comprehensive guidelines for a curriculum-based dynamic assessment procedure. First, select tasks from the curriculum with which the child is experiencing difficulty. Second, during the pretest phase administer the first form of the task. Third, in the second phase, record detailed the child's responses. Fourth, compare pre- and post intervention performance and summarize the results.

Many researchers conducted several studies about differentiation and classification for various subjects (Berk & Winsler, 1995; Bodrova & Leong, 1996; Brown & Ferrara, 1985; Budoff, 1987; Campione, Brown, Ferrara, & Bryant, 1984). Tzuriel and Caspi (1992) examined dynamic assessment with special education children in order to show that it has more learning potential than static-conventional tests. Some researchers demonstrated the efficacy of a dynamic approach in differentiating normal children from those with language disorders (Penã et al., 1992), and in differentiating normal children from language learning deficiencies (Gillam et al., 1999). Also, dynamic assessment is a useful method for culturally different populations (Tzuriel & Kaufman, 1999), for persons with learning disabilities (Swanson, 1996), for children from non-mainstream backgrounds (Lidz & Penã, 1996), and for gifted-children (Stanley et al., 1995). However, we have to be careful about generalizing these results because there are some problems such as ceiling effects (Stanley et al., 1995), sample size or test questions that are too small (Haney & Evans, 1999; Lidz, 1991; Stanley et al., 1995), insufficient explanations of variables (Day & Cordón, 1993), the use of old tools (Tzuriel & Kaufman, 1999), and the rater problems (Ukrainetz et al., 2000).

In Korea, there are some research studies regarding the relationship between ZPD and other factors such as intelligence, aptitude, achievement, etc. However, since those research studies have only focused on the measurement of ZPD or on its relationship with other variables, they have not provided enough information for improving children's learning. In order to improve children's learning, a dynamic assessment should be used for the gathering of qualitative and quantitative diagnostic information as well as each child's ZPD. In addition, the diagnostic information should be used properly in the classroom by teachers (Baek, 1999).

The goal of this study is to demonstrate that dynamic assessment based instruction increases children's learning by using a quasi-experimental research design in Korea. In this study, dynamic assessment is defined as a measurement method of the ZPD as well as the qualitative and quantitative diagnostic information for individual children. Dynamic assessment based instruction is also defined as a teaching method using the diagnostic information types in order to increase children's learning. The reason for selecting the achievement of number concept, as the dependent variable of study, is that numbers are not only the basic of math, but also the one of the critical tools for solving the learning problem.

Even though this research study was carried out under restricted conditions, it will contribute to clarifying the characteristics of dynamic assessment and to establish the usefulness of dynamic assessment based instruction.

Research Questions

It was hypothesized that there would be significant differences in the educational achievement between dynamic assessment based instruction and traditional assessment based instruction. In order to investigate the hypothesis, the following research question was proposed and investigated.

Does dynamic assessment based instruction increase children's learning?

Methodology

Subjects

The subjects of this research were 25 4-year-old children and 34 5-year-old children. Most of them belonged to middle income families. Their school district was fairly homogeneous with regard to demographics, specifically socioeconomic

Table 2. *Descriptive Statistics of Subjects (N=number)*

Children	Number of Classes	Experimental Group	Control Group	Total
4-year-old	2	13	12	25
5-year-old	2	17	17	34
Total	4	30	29	59

status. A pre-test was administered to all children. With their pre-test results, the children of each age group were divided into an experimental group and a control group (see Table 2).

Instruments

In this study, three types of number concept achievement tests (pre-test, parallel test, and post-test) were developed for each age group. Each test consists of 10 sub-areas with 20 items total (See Table 3).

To make these test items, the face and content validity and split-half reliability were examined. To establish the content and face validity, a series of interviews were conducted with a professor, 5 graduate level students majoring in educational measurement and evaluation, a kindergarten principal, and 3 kindergarten teachers who have more than 3 years of experiences. In addition, a pilot test for each test was conducted to check the appropriateness of hints, item difficulties, test validities, etc.

Table 3. *Instrument: Number Concept Achievement Test*

Sub-areas	Number of Items
Rote Counting	2
Rational Counting	2
Cardinal Number	1
Ordinal Number	2
Subitizing	2
One to One Correspondence	1
Inequality	2
Conservation of Number	2
Part-Whole	2
Addition / Subtraction	4
Total	20

Table 4. *Revised Split-Half Reliability of Tests*

Test	4-year-old Children	5-year-old Children
Pre-test	0.73	0.75
Parallel-test	0.82	0.63
Post-test	0.78	0.83

In order to test reliability, a revised split-half reliability was used. The revised split-half reliabilities are summarized in Table 4.

Pre-test

Two kinds of pre-test were developed. One was made for 4-year-old children; the other for 5-year-old children. By analysis of related studies such as Fischer (1988), test items were developed. The test consisted of 10 sub-areas with 20 items total. Total scores ranged between 0 and 20. 59 children were tested alone without any help (static mode) to provide a measurement of skills on a task to establish a baseline.

Parallel-test

Two kinds of parallel-test were developed. One was made for 4-year-old children; the other for 5-year-old children. For the experimental group, a parallel-test was used to measure each child's ZPD. To measure ZPD, the children in the experimental group were provided a controlled protocol of assistance and instruction about wrong pre-test items by a teacher. If the child did not know how to solve that item, the teacher helped the child solve the problem through hints. Through this method, the teacher measured each child's quantitative and qualitative diagnostic information as well as ZPD. The teacher was to analyze the child's performance on both product and process.

Post-test

Two kinds of post-test were developed. One was made for 4-year-old children; the other for 5-year-old children. After conducting the 8^{th} instruction session, the post-test was administered to 59 students to measure the children's achievement. The test consisted of 10 sub-areas with 20 items total. The post-test was made with more difficult items than pre-test including such as pattern, classification, symbol, comparison, ordering.

Data Collection and Procedure

In order to demonstrate that dynamic assessment based

Table 5. *Research Design for Each Age Group*

Weeks	Experimental Group	Control Group	Period
April 1st	Pre-test Dynamic assessment	Pre-test	1 week
April 2nd ~ May 1st	Dynamic assessment Based instruction	General instruction	4 weeks (30 minutes x 8 times)
May 2nd	Post-test	Post-test	1 week

Table 6. *Acquired Quantitative and Qualitative Information by Dynamic Assessment*

Quantitative Information	Qualitative Information
·ZPD score	Degree of concentration
Pass / Fail	Learning strategies
Pre-test, parallel-test score	Problem-solving strategies
Number of hints	Error or misconception types
Level of math concept	Child's developmental characteristics

instruction increases children's learning, a quasi-experimental research design was performed. The research procedure is summarized as follows (See Table 5).

The details of the quasi-experimental research design procedure are as follows (See Figure 1).

Conducting the pre-test

59 children between the ages of 4 and 5 participated. All children took the pre-test to measure each child's actual development level. It took about 10～15 minutes for each child. The test was executed in a quiet room, individually.

Dividing into the two groups (experimental & control group)

After conducting the pre-test, the children of each age group were divided into an experimental group and a control group by considering the pre-test results (See Table 2). Therefore, 4-year-old experimental group consisted of 13 children and the control group consisted of 12 children. And

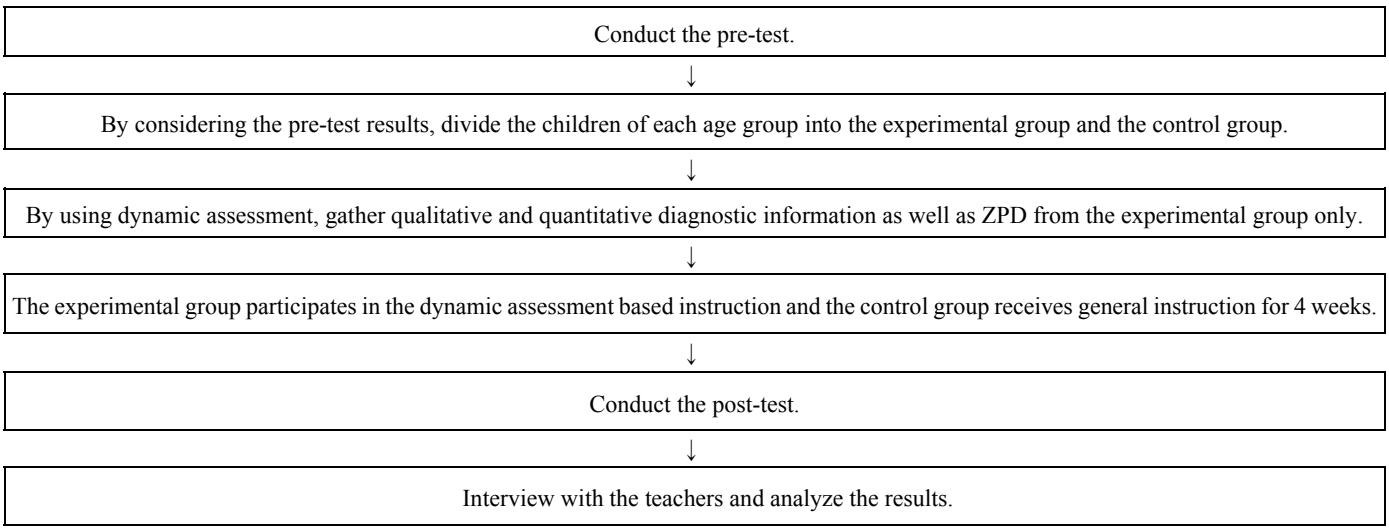

Figure 1. *Quasi-Experimental Research Design Procedure*

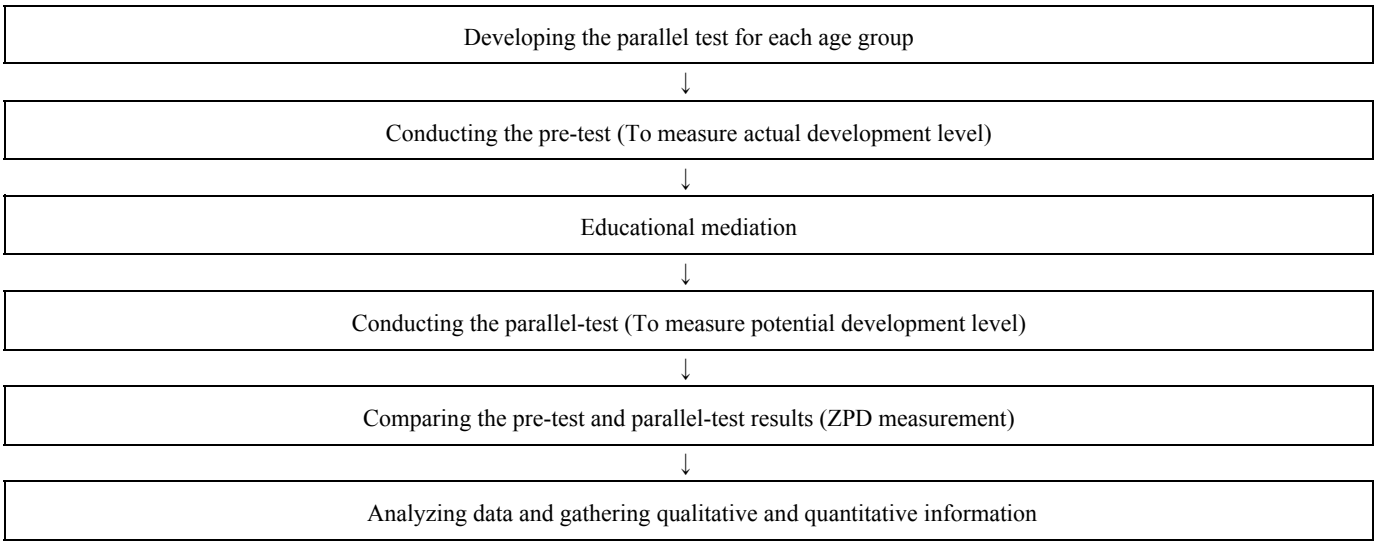

Figure 2. *Dynamic Assessment Procedure*

5-year-old experimental group consisted of 17 children and the control group consisted of 17 children.

Conducting the dynamic assessment to the experimental group

The experimental group children were the only ones to participate in the dynamic assessment. The procedure of dynamic assessment is presented in Figure 2. Using dynamic assessment (test - meditation or intervention - retest), the teacher compared the pre-test and parallel-test results to measure the children's ZPD (the score difference between pre-test and parallel-test score or each child). The teacher analyzed the children's performance quantitatively and qualitatively on both product and process. Through dynamic assessment, the teacher acquired the ZPD as well as the qualitative and quantitative diagnostic information for each child. The collected quantitative and qualitative information is summarized in Table 6. There were several problem-solving strategies used, such as using fingers, mental calculation, thinking aloud, etc. In addition, there were big differences in the ZPD scores (4-year-old children's range was from 0 to 9; 5-year-old children's range was from 0 to 7).

Dynamic assessment based instruction

Only the experimental group participated in the dynamic assessment based instruction about number concept for 4 weeks (8 times x 30 minutes). The control group received traditional instruction for the number concept without dynamic assessment for 4 weeks (8 times x 30 minutes). The instruction sessions were conducted in the following order (See Table 7). For the experimental group, the teacher used individual children's diagnostic information. For example, the teacher gave individually proper instruction to the child with number misconceptions. The teacher also gave step-by-step, concrete explanations to the children with low pre-test scores.

Conducting the post-test

In order to measure the children's achievement, all 59 children were administered a post-test after the completion of 4 weeks of classes.

Table 7. *Contents of the Instruction for Each Age Group*

Weeks	Experimental Group	Control Group
1st	Comparison, Counting-Graph	
2nd	Symbol, Ordering	
3rd	One to one correspondence	
4th	Classification	
5th	Pattern	
6th	Cardinal number, Ordinal number	
7th	Addition / Subtraction, Inequality	
8th	Conservation of number, Part-whole	

Table 8. *Descriptive Statistics for 4-year-old Children (N=25)*

Group	N	Mean	SD
Experimental group	13	11.46	2.73
Control group	12	10.33	2.02
Experimental group	13	15.23	3.83
Control group	12	12.00	2.43

Table 9. *ANCOVA results of 4-year-old Children*

	Sum of Squares	df	Mean Square	F
Covariate (Pre-test)	99.26	1	99.26	15.38**
Experimental Variable (Dynamic Assessment)	79.60	1	79.60	12.34**
Error	141.97	22	6.45	
Total	376	24		

(**p<. 01)

Data Analysis

To verify the hypothesis, an ANCOVA analysis for each age group was undertaken.

Results

The dynamic assessment based instruction has a significant effect on 4-year-old children's number concept learning achievement (F=12.34, p<0.01). The results of 4 –year-old children are summarized in Table 8 and Table 9. The pre-test mean score of the 4-year-old experimental group was 11.46 (SD= 2.73) and the post-test mean score was 15.23 (SD=3.83). The pre-test mean score of the 4-year-old control group was also 10.33 (SD=2.02) and the post-test mean score was 12.00 (SD=2.43). The results are showed graphically (see Figure 3).

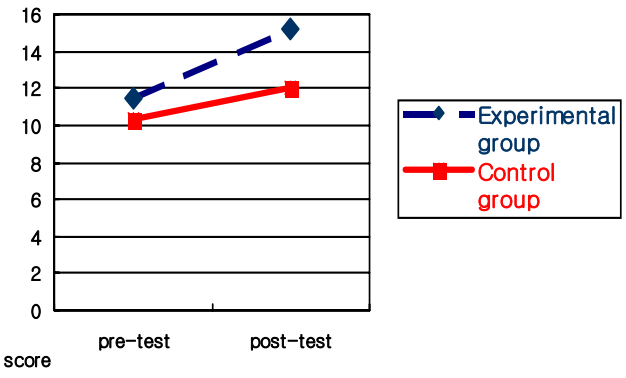

Figure 3. *Differences of Test Results of 4-year-old Children*

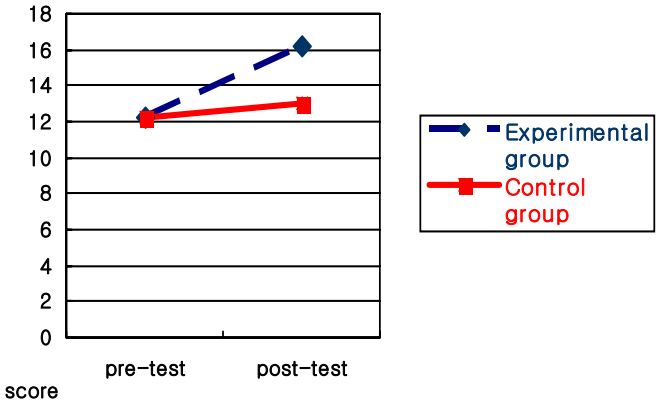

Figure 4. *Difference of Test Results of 5-year-old Children*

Table 10. *Descriptive Statistics for 5-year-old Children (N=34)*

	Group	N	Mean	SD
Pre-test	Experimental group	17	12.24	2.31
	Control group	17	12.24	3.87
Post-test	Experimental group	17	16.17	2.43
	Control group	17	13.00	3.27

Table 11. *ANCOVA results of 5-year-old Children*

	Sum of Squares	df	Mean Square	F
Covariate (Pre-test)	201.71	1	201.71	47.10**
Experimental Variable (Dynamic Assessment)	85.76	1	85.76	20.03**
Error	132.76	31	4.28	
Total	420.24	33		

(**p<. 01)

The dynamic assessment based instruction has a significant effect on 5-year-old children's number concept learning achievement ($F = 20.03$, $p<0.01$). The results of 5–year-old children are summarized in Table 10 and Table 11.

The pre-test mean score of the 5-year-old experimental group was 12.24 (SD= 2.31) and the post-test mean score was 16.17 (SD=2.43). The pre-test mean score of the 5-year-old control group was also 12.24 (SD=3.87) but the post-test mean score was 13.00 (SD=3.27). The results are showed graphically (see Figure 4).

In sum, the results show that there are statistically significant differences between the experimental group and the control group in the levels of children's number concept achievement. In other words, dynamic assessment based instruction is a more effective influence on children's learning than static assessment based instruction.

Table 12. *Correlation between ZPD and Hints*

Children		M	SD	r
4-year-old	ZPD	3.85	2.44	-0.61*
	Hints	2.55	.62	
5-year-old	ZPD	3.59	1.62	-0.35*
	Hints	2.07	.47	

(*p< .05)

Table 13. *Correlation between ZPD and Improvement*

Children		M	SD	r
4-year-old	ZPD	3.85	2.44	
	Improvement	3.77	2.95	
5-year-old	ZPD	3.59	1.62	
	Improvement	3.94	1.89	

(**p< .01)

Discussion and Conclusion

In this study, dynamic assessment is defined as a measurement method of ZPD as well as the qualitative and quantitative diagnostic information for each child's individualized instruction. In addition, dynamic assessment based instruction is defined as a teaching method using the diagnostic information types in order to increase children's learning.

In this study, three types of number concept achievement tests (pre-test, parallel test, and post-test) for each age group were developed. The content validity, face validity, and split-half reliability were examined. 59 children between the ages of 4 and 5 participated. After conducting the pre-test, the children of each age group were divided into an experimental group and a control group. Only the experimental group participated in the dynamic assessment based instruction

related to number concepts for 4 weeks. The control group received general instruction related to number concepts without dynamic assessment for 4 weeks. Both groups took a post-test after the completion of 4 weeks of classes. The ANCOVA technique was used for data analysis.

The result of this study is that the dynamic assessment based instruction has a significant effect on children's learning (in the case of 4-year-old children, $F = 12.34$, $p<0.01$; 5-year-old children, $F = 20.03$, $P<0.01$). The pre-test mean score of the 4-year-old experimental group ($N_{11}=13$) was 11.46 (SD=2.73) and the post-test mean score was 15.23 (SD=3.83). The pre-test mean score of 4-year-old control group ($N_{12}=12$) was 10.33 (SD=2.02) and the post-test mean score was 12.00 (SD=2.43). The pre-test mean score of the 5-year-old experimental group ($N_{21}=17$) was 12.24 (SD= 2.31) and the post-test mean score was 16.17 (SD=2.43). The pre-test mean score of the 5-year-old control group ($N_{22}=17$) was also 12.24 (SD=3.87) but the post-test mean score was 13.00 (SD=3.27).

With the main research results, there are two extra findings of this study. One is that there is a negative correlation between the ZPD and hints, which given by the teachers in order to help each child's problem solving (in the case of 4-year-old children's Pearson's r is -0.61; 5-year-old children's Pearson's r is -0.35) (See Table 12). The results show that a learner who has a wide ZPD needed fewer hints to solve the problems. The other is that there is a positive correlation between ZPD and improvement, which was calculated as a gain score between post-test and pre-test for each child (in the case of 4-year-old children's Pearson's r is 0.72; 5-year-old children's Pearson's r is 0.63) (See Table 13). Results show that the learner who has a wide ZPD will improve much more than others. In order to generalize these extra findings of this study, a further study needs to be conducted to reconfirm these results.

In sum, it is confirmed that dynamic assessment based instruction is a more effective and more powerful influence upon children's learning than static assessment based instruction. However, there are many restrictions when generalizing the results because of the short period of the study, restricted learning areas, etc. To overcome these restrictions, many teachers should apply themselves to research studies of this kind over a more extended period of time. Even though this study has some limitations, it exemplifies that dynamic assessment based instruction has a great effect on children's learning. Therefore, dynamic assessment based instruction should be used widely for children's cognitive learning.

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