Journal of Education and Practice
ISSN 2222-1735 (Paper) ISSN 2222-288X (Online)
Vol.8, No.19, 2017

THE EFFECTS OF THE 3N LEARNING MODEL AND PAIRED AND INDIVIDUAL READING SUMMARIZATION PRACTICES ON LEARNING LEVELS AND REMEMBERING

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Abstract

This study examined the effects of paired summarization and individual summarization practices and the 3N learning model on learning levels and remembering. An empirical research design with pre- and post-test control groups was applied in the study, and 68 fourth-grade students attending a science and technology course in a primary school located in Central Black Sea region comprised the sample. There were 23 students in the first and second experimental groups, and 22 students in the control group. The students in the control group received lessons given with traditional teaching methods; the students in the first experimental group received lessons given with paired summarization and the 3N learning model; and finally, those in the second experimental group received lessons given with individual summarization and the 3N learning model throughout 27 hour-long lessons. The data was collected both pre and post intervention through an achievement test. Data was analyzed with the Mann-Whitney U test and Kruskal-Wallis H test. The study findings suggested a meaningful difference in favor of the experimental group in terms of total learning and remembering, and comprehension and application stages of the cognitive domain. In light of the study results, additional activities can be included in teaching as well as the 3N learning model and paired summarization method, and the efficiency of such activities can be examined for different lessons.

Keywords: 3N Learning Model, Paired Summarization, Cooperative Learning, Constructivist Approach, Turkey.

Introduction

Compared to the past, today there are common efforts to organize and implement school training in a more professional manner. The answers to why school learning does not include essential information and skills which are appropriate for the necessities of the time are also under investigation. In this educational process, improving high-order thinking abilities as well as permanent learning and knowledge are accepted as investments in the future, which in turn results in an increase in the number of studies conducted within this field. Thus, the new learning-teaching approaches and practices have been popular topics. Contemporary developments and changes require the application of different learning models to ensure more effective, participative, and effective learning. The learning-teaching practices and changes aim to provide students with effective communication skills, high-level thinking abilities, the tendency to question the truth of given information, and complex problem-solving skills. The best method of achieving such goals is the constructivist approach, which is an approach commonly accepted by educators today (Demirel, 2009).

Constructivism has become the foundation of developments and practices in education since the beginning of 20th century. For example, John Dewey and William James criticized the "spectator theory of knowledge," and established their own constructivist notions (Açıkgöz, 2014a). To most scholars, constructivism serves as an umbrella term which covers very different opinions and theories, each of which generally places learners' activities at the center in education while constructing meaning (Demirel, 2009). The constructivist theories agree that learners should be active; they should have choice, and construct their knowledge as a whole through both individual and social activities. In this sense, it is imperative for educators to plan how to integrate students into their program. Just as participation in the learning and teaching processes is one of the preeminent variables predicting academic success and achievement, it is also the best indicator of high-quality teaching (Bloom, 1998; Özçelik, 2014).

In his assessments concerning constructivist approach practices both in Turkey and worldwide, Ergin

(2012) did not mention constructivism as a method that can be applied by the teacher alone, but it can be implemented with learning methods that are combined with various learning-teaching theories. The 3E, 4E, 5E, and 7E models are examples of these learning models. The constructivist approach is systematized for implementation. During this implementation process, it does not mean that every student will be motivated or will be able to think critically. The method ensures the construction and shaping of information, it facilitates interactions in the learning environment, and it directly incorporates students into physical and mental activities. For teachers, the method is facilitative and organizing, which provides a systematic learning environment. In his evaluations, Ergin (2012) states that the tricycle model is transformed into five stages, yet these stages will be incorporated together during implementation (Bıyıklı, 2013; Ergin, 2012; Öztürk, 2008). In the literature, it has been pointed out that the 3E model was extended with stages, but it was impossible to differentiate among these stages explicitly. For example, there is an evaluation process at each stage (Liu, Peng, Wu, & Ming-Sheng, 2009). As we stated above, the tricycle model was changed into five stages, and is generally accepted as five stages in the literature. Tosun and Polat (2013) emphasized that the 3E approach can be adopted rather than the 5E. The model is presented as the 3E scheme in the National Education Ministry 4th grade science program and teacher guidebooks. Since the age range of the study sample is in the concrete operational stage, the 3N learning model was preferred owing to its more generalized and concrete operational features.

In the literature, the constructivist approach is addressed in conjunction with cooperative learning (Saban, 2004). According to Vygotsky, knowledge is a social notion; in other words, knowledge is constructed through cooperative efforts to learn, understand knowledge, and solve a problem. Through cooperative efforts, group members share knowledge and ideas with each other, discover the weak points in each other’s logical bases, they correct each other, and they reconstruct their personal understanding considering others’ understandings. According to Açıkgöz (2014b), active learning is realized with cooperative learning techniques. Bayrakçeken, Doymuş, and Doğan (2013) emphasized that among the prominent approaches that maintain efficient and productive education, there are cooperative learning, problem-based learning, project-based learning, and questioning-based learning approaches. Among these learning models, the cooperative learning model is acknowledged as the most comprehensive model, because a number of scientific studies proved that cooperative learning improves the academic, social, and psychological domains, among others. Bell, Urhanne, Schanze, and Ploetzner (2010) suggested that the cooperative learning model commonly applied to today’s schools was found to motivate students to self-regulate, work in cooperation, and be a part of the group in terms of its interactive characteristics, and it was observed to activate students. Moreover, cooperative learning not only directs students to share and learn from each other in both the classroom environment and other surroundings by having heterogeneous groups work together towards a common goal, but also enhances students’ self-confidence, communication, problem solving, and critical thinking abilities, and guides students to actively participate in the learning-teaching process.

The paired summarization method is based on the cooperative learning model. A student takes initiative for both himself and his mate. This is an approach in which the pairs help each other in terms of reading comprehension. This method helps students possess equal chances for success, gain group support for learning, and develop individual responsibilities. In Doymuş, Bayrakçeken, and Doğan (2013), there is a list of cooperative learning methods in basic reading and writing practices, which includes composing two-agent teams and reading together, asking questions about what they read, summarization, guessing, and writing compositions about the subject matter. The team members help each other read, write, and correct mistakes. Their performance is assessed by checking the team members’ average.

From the beginning of primary education, students are expected to read and learn the information in published materials, such as course books and magazines, related to various lessons. During school, most students face problems regarding a lack of understanding of what they read. Although they read a text many times, they have problems expressing themselves when they are asked to repeat the text or its main idea. In recent years, specific techniques for reading and understanding have been developed to overcome such difficulties. One is the summarization technique. Görgen (1997) stated that summarization ability is of vital significance in understanding and remembering the text, and that it refers to a representative structure of the comprehensive and important statements in a text.

In the 3N learning model, paired and individual summarizations facilitate active engagement with the text, and summarization is represented as a mental activity. In order to make summaries and differentiate between important and unimportant information, analytical thinking, synthesizing, and understanding of the subject are prerequisites. In the literature, studies have proven that small group activities present opportunities to improve understanding of the reading material (Erden & Akman, 2004). By means of the 3N learning model, students can activate their innate curiosity, previous learning materials, as well as cognitive and affective schemes in the learning process; the model will help them realize what they will learn and be informed about their attainments; they can compare and make associations between previous and present learning themes; it can facilitate the application, maintenance, and transfer of knowledge; and students will have opportunities to get feedback about their own learning process. The model directly integrates students into the practice, and activates both students and teachers. The model consists of three stages.

Creating expectation: This is the introductory stage. The course starts with short activities, making students think about the subject through the presentation of materials and questions, reminding them of their previous learning and activating their natural learning curiosity. The teacher aims to have students realize their current knowledge and the association between their prior knowledge and the new knowledge. At this stage, students are informed about the goal of the course so that they can focus their minds on it. Thus, they gain opportunities to make connections between their previous and new learning materials (Nakipoğlu, Kaşmer, Gültekin, & Dönmez, 2010). The new concepts gain meaning when they are associated with the previously learnt ones, hence students can understand the subject through this association, which facilitates the learning process. At this point, students formulate their questions, so teachers are expected to ensure the process is complex enough to motivate students, especially through the combination of physical and mental inclusion in the activity.

Establishing knowledge: In this stage, the content is presented and the teacher delivers stimulus related to the topic. Open-ended questions are asked, which have been found to improve critical thinking abilities, such as questioning, discussing, reasoning, finding answers to questions, cooperative working, learning from each other, to ensure learning is constructive and active. Students search for their own thoughts. Teachers guide and give students time to complete summarizations and find answers to questions. Teachers also inform students and provide them with encouragement to describe what they are doing and make inferences from the process. It is a stage in which students offer solutions to questions. This can contribute not only to the improvements of students' ability to think, but also to search, summarize, analyze, and synthesize. This establishing knowledge stage in the 3N model refers to the process of establishing what students want to learn through their questioning of the learning material, as well as their sense of wonder. It is the stage of testing a hypothesis. The students who are in need of more explanations about a subject or any idea benefit from this model, and those who provide explanations to others are also able to strengthen their understanding of a given topic by explaining it. Group work also provides students with more varied experiences. They have more chances to express ideas and gain lifelong learning abilities (Saban, 2004). During this stage, teachers can ask questions about the basic concepts related to the theme or they can remind students about certain concepts, but answers are only given by students.

Integrating the learning materials: Finally, the process comes down to shaping the answers, combining the experiences, composing novel concepts, and determining what students have learned. Students explain what they did and which answers they found, which provides an opportunity to correct any misunderstood information. Summarization activities and the process of finding answers can also help with memory. Students can expand, transfer, and re-organize their knowledge. Moreover, teachers can furnish formal explanations and scientific definitions, too. The record of the learned information is of vital significance for every age group, especially for young students. Revising what they learn, applying the knowledge, and deciding to transfer the information contribute to high-level thinking abilities and students' learning how to learn. This process can also be seen as a construction process. The transfer stage involves the generalization of skills and concepts (Bybee, 1997; Bıyıklı, 2013). It is a stage in which students can assess their own learning process. Assessment is included in every stage of the model. However, students can have the opportunity to truly realize their attainments in this stage (Bransford, Brown, & Cocking, 1999; Detterman & Sternberg; 1993; McKeough, Lupart, & Marini, 1995; Mayer, 1995; Phye, 1997; as cited in Özçelik, 2014). One of the essential goals of education is to increase permanency and transfer. The existence of these concepts means the existence of learning. Briefly, permanency (keeping in memory) requires students to remember what they learn. However, transfer requires students not only to remember what they learn, but also to make sense and use of it. In the literature, searching and finding in the mind are accepted as thinking; all these mental activities are assumed to contribute to cognitive awareness.

In the literature, the learning cycle model based on the constructivist approach is applied to various courses, such as English, geography, and artistic activities. However, it is predominantly applied to and studied in science-related fields. According to research results, the model had positive effects on academic achievement, permanency in learning, motivation, interest in learning, concept teaching, and cognitive processes (Bıyıklı, 1999; Coşkun, 2011; Kolomuc, Ozmen, Metin, & Acisli, 2012). However, there are very few studies examining the mentioned model with the summarization method. Summarization, which is a kind of meaning making strategy, has been proven to enhance understanding and permanency in learning. Especially in this study, the findings were based on knowledge comprehension and the application stages of the cognitive domain, which makes it different from the other studies in the literature. The aim of this study was to compare the effectiveness of the 3N model paired and individual summarization method with the traditional teaching method in terms of learning and remembering the attainments in the "Light and Sound" and "Our Planet Earth" units among primary school 4th grade students. The following hypotheses were tested:

Hypothesis 1: There will be statistically significant differences among the experimental group, in which paired summarization with the 3N model was applied (E1), the other experimental group, which used the individual summarization method (E2), and the group using the traditional teaching method (C) in a 4th grade primary school science course. The first experimental group will be more advanced in terms of the following variables: a) Total learning level, b) Information levels, c) Comprehension levels, and d) Application levels.

Hypothesis 2: There will be statistically significant differences among the experimental group, in which paired summarization with the 3N model was applied (E1), the other experimental group, which used the individual summarization method (E2), and the group using the traditional teaching method (C) in the 4th grade primary school science course. The first experimental group will be more advanced in terms of the following variables: a) Total remembering levels, b) Remembering levels in information, c) Remembering levels in comprehension, and d) Remembering levels in application.

Method

2.1. Research Model

This study used an experimental design with pre-test and post-test control groups, and aimed to examine the effects of the 3E (N) learning model paired and individual summarization methods on learning levels and remembering (Büyüköztürk, 2014). The research design is presented in Table 1.

Table 1: Research Design

Groups	Pre-test	Process	Post-test	Follow-up (Permanency)
EG1	PIF AT	Teaching using Paired Summarization with the 3N learning model	PIF AT	PIF AT
EG 2	PIF AT	Teaching using Individual Summarization with the 3N learning model	PIF AT	PIF AT
CG	PIF AT	Traditional Teaching	PIF AT	PIF AT

Note: EG: Experimental Group; CG: Control Group; PIF: Personal Information Form; AT: Achievement Test

As seen Table 1, the 4th grade students in the first experimental group used the paired summarization method with the 3N learning model; the ones in the second group employed the individual summarization method with the 3N learning model; and lastly, the students in the control group were taught with the traditional teaching method about the themes of "Sound and Light" and "Our Planet Earth." The experimental groups were conducted by the researcher, while the classroom teacher taught the students in the control group.

2.2. Participants

Participants consisted of 4th grade primary school students attending a primary school in the Central Black Sea Region during the 2015–2016 academic year. Three classes with similar characteristics, including students' genders, teachers' length of service, literacy, mathematics, and life sciences courses achievements, were randomly selected. Two of the classes were designated as the experimental groups while one class was appointed as the control group. There were 22 students (11 girls, 11 boys) in the control group, while there were 23 students (11 girls, 12 boys) in the first experimental group, and 23 students (11 girls, 12 boys) in the second experimental group.

2.3. Measures

Personal Information Form: A form was supplied to the participants to obtain information about their gender and age.

Achievement Test: This test was developed by the researcher in order to measure students' achievement level in information, comprehension, and application in the “Sound and Light” and “Our Planet Earth” units.

Development of the Achievement Test: A comprehensive literature review was conducted, and the theoretical structure was examined to develop the test and to determine the properties to measure. Fourth grade science and technology course books, source books, teacher guide books, and the curriculum developed by the Turkish National Education Ministry, Education Board were analyzed in order to determine the questions for the test. In the second stage, the analysis of “Light and Sound” and “Our Planet Earth” units, which were within the scope of the study and would be taught to students in the second term, was conducted. The whole process was based on the attainments in the 4th grade Science and Technology Teacher Guide Book which was selected as the course book for the following five education years by the Turkish National Education Ministry, Board of Education under stipulation number 244, on December 26th, 2014. This course book started to be used during the 2013–2014 academic year. The cognitive dimensions of the educational attainments in these units were determined on the basis of the analytical approach and expert opinion. The table of specifications was prepared in such a way that the contents could be exemplified with test items. This table of specifications was also the test plan and allowed for content validity. By means of this table, the levels of the attainments and the significance of these levels were described (Özçelik, 2013). Thus, more than one test item for each attainment was prepared. If the only aim is to determine the learning level, it is not a must for an assessment instrument to cover all the behavioral characteristics; sufficient and critical samples of the target behavioral features are adequate (Atılgan, 2013; Özçelik, 2013). In preparing the test questions, specific features of designing an ideal test question were taken into consideration to ensure proper representation of each attainment; that the test items were ordered from hardest to easiest and in terms of the domains they reflected; that they were of precondition relations; that similar items were grouped together; and that the items’ statements, type size, and spaces between the items were arranged in accordance with participants’ age and levels. Considering such properties of an optimal test and its items, the best form was used for the test in the study. The draft achievement test, which consisted of 60 items chosen from the question pool, was re-examined in terms of various psychometric properties, such as homogeneity, being scientific, and appropriate to students’ development levels (Atılgan, 2013). Following the revisions, the test items were examined by four program developers, as well as three science and technology experts. In the pilot study, the science and technology teachers and 4th grade classroom teachers were interviewed, and their opinions were acquired. These 60 questions were found to possess content validity, but it was decided to apply them to students in 30+30 questions, which were in the form of A and B and assessed the same behaviors, due to the students’ age group. The trial groups were chosen from 5th grade students who had learnt these themes the previous year. And the trial application was conducted with 114 students.

The final 26 test items had a general validity of .40. However, one item with .29 validity was included in the test so as not to disturb the content validity. The statistical values of the final form of the test were measured. The reliability of the A group test items was .80, and it was .81 for the B group test items. Four different types of scores can be acquired from the test: Knowledge, Comprehension, Application, and Total levels. The knowledge subtest scores consisted of the total of the items related to knowledge; the comprehension subtest scores consisted of the total item scores related to comprehension; the application subtest scores consisted of the total item scores related to application; and lastly, the total score for the test consisted of the total right answers given to all the questions on the test. In scoring the test, each right answer was given 1 point, while wrong, incomplete, or unclear answers were given a score of 0.

2.4. Intervention

The intervention with the students in the experimental groups lasted a total of six hours during nine weeks in which three courses were taught on two different days. The members of the control group continued the normal course program with their teacher. The courses were planned considering the educational attainments in the units. However, the courses were delivered with paired and individual summarization methods in the 3N learning model for the experimental groups. In addition to extra activities from the model, the activities in the course book were included in the process, in an attempt to make the courses more interactive and less monotonous. The researcher planned the entire course process, guidance, materials, and preparatory exercises. The pre-tests were administered one week before the implementation while the post-tests were given right after the implementation, and the remembering tests were conducted one month after the implementation.

2.5. Statistical Analyses

All the statistical analyses were conducted using SPSS 15. Since there were 8 inclusive students in the selected classes, these students were not included in the analysis, and the analysis was performed with 60 students. The Kruskal-Wallis H Test was administered to examine if there were meaningful differences between knowledge, comprehension, and application total pre-test and post-test scores among the groups. Post hoc Mann-Whitney U Test was conducted to investigate which groups had meaningful differences in their scores. During the Mann-Whitney U Test, Bonferroni adjustment was applied to control for Type I error rate efficiently. The analysis was reported with effect size estimates. The effect size used in the Mann-Whitney U Test was the correlation coefficient (r) (Howell, 2013). In the interpretation of the correlation coefficient, the effect size classification suggested by Cohen (1992) was used. According to Cohen (1992), .29 and lower correlation values were low; values between .30 and .49 were medium; and values .50 and over indicated high-level effects. In all statistical analyses, the significance level was accepted as .05.

Results

The pre-test, post-test, and follow-up mean ranks based on the total, information, comprehension, and application scores are presented in Table 2.

Table 2: The Pre-test, Post-test, and Follow-up Mean Ranks

Variable	Pre-test	Post-test	Follow-up
	M.R	M.R	M.R
Experimental Group 1 (*n*=20)			
Total	32.78	38.73	38.95
Information	31.70	33.05	34.45
Comprehension	30.75	40.65	40.88
Application	32.60	37.80	39.70
Experimental Group 2 (*n*=20)			
Total	29.05	29.40	29.48
Information	30.90	31.05	30.55
Comprehension	29.75	29.18	29.60
Application	28.63	28.00	24.95
Control Group (*n*=20)			
Total	29.68	23.38	23.08
Information	28.90	27.45	26.50
Comprehension	31.00	21.68	21.03
Application	30.28	25.70	26.85

Note: M.R: Mean Rank.

Table 3: The Kruskal Wallis H Test Results Related to Pre-test Scores

Pre-test	χ^2	*Df*	*P*
Total	.55	2	.760
Knowledge	.36	2	.835
Comprehension	.07	2	.966
Application	.65	2	.723

Kruskal Wallis H Tests were conducted to determine whether there was a statistically meaningful difference in pre-test total scores and information, comprehension, and application level mean ranks among the first and second experimental groups and the control group. The results of the test are presented in Table 3.

As seen in Table 3, the pre-test scores of the students in the experimental and control groups were not statistically different in terms of the total ($\chi^2(2)= .55$, $p>.05$), knowledge ($\chi^2(2)= .36$, $p>.05$), comprehension ($\chi^2(2)= .07$, $p>.05$), and application ($\chi^2(2)= .65$, $p>.05$) scores. Kruskal Wallis H Tests were performed to analyze the post-test scores of the students in both the experimental and control groups. The results of the tests are presented in Table 4.

Table 4: Kruskal Wallis H Test Results Related to Post-test Scores

Post-test	χ^2	*Df*	*P*
Total	7.951	2	.019
Knowledge	1.14	2	.567
Comprehension	12.54	2	.002
Application	7.38	2	.025

As seen in Table 4, the agents in the experimental and control groups showed certain differences in terms of the total ($\chi^2(2)= 7.95$, $p<.05$), comprehension ($\chi^2(2)= 12.54$, $p<.01$), and application ($\chi^2(2)= 7.38$, $p<.01$) scores. However, there was no significant difference in knowledge level ($\chi^2(2)= 1.14$, $p>.05$). The Bonferroni correction was administered and Mann-Whitney U Tests were performed to determine the source of the differences in the total, comprehension, and application scores (The significance level was set at .017.). Mann-Whitney U Test results showed that there was no statistically meaningful difference between the first (*M.R:*38.73) and second (*M.R:*29.40) experimental groups (U=137.50, $p>.05$, z= -1.71, r= -.27); or between the second experimental group (*M.R:*29.40) and control group (*M.R:*23.38) (U=159.50, $p>.05$, z= -1.10, r= -.17) in terms of total achievement test scores. However, the total achievement test scores of the first experimental group (*M.R:*38.73) were significantly higher than those in the control group (*M.R:*23.38) (U=98.00, $p<.01$, z= -2.78, r= -.34).

Regarding comprehension test scores, no meaningful difference was found between the second experimental group (*M.R:*29.18) and control group (*M.R:*21.68) (U=140.50, $p>.01$, z= -1.64, r= -.26). However, there were differences between the first experimental group and second experimental group (U=114.00, $p<.017$, z= -2.41, r= -.38), and between the first experimental group and control group (U=83.00, $p<.001$, z= -3.25, r= -.51). As seen in Table 2, the comprehension scores of the participants in the first experimental group (*M.R:*40.65) were significantly higher than those in the second experimental group (*M.R:*29.18) or control group (*M.R:*21.68).

The Mann-Whitney U Test results related to application scores revealed that there was no statistically meaningful difference between the first experimental group and second experimental group (U=130.00, $p>.017$, z= -2.33, r= -.37); or between the second experimental group and control group (U=180.00, $p>.017$, z= -.60, r= -.10). However, there was a difference between the first experimental group and the control group (U=124.00, $p<.017$, z= -2.49, r= -.39). As seen in Table 2, the participants' application scores in the first experimental group (*M.R:*37.80) were significantly higher than those in the control group (*M.R:*25.70).

Lastly, Kruskal Wallis H Tests were performed to examine if the changes in the experimental groups persisted in the one-month follow-up. The analysis results are shown in Table 5. There were differences among groups' follow-up study scores for the total ($\chi^2(2)= 8.47$, $p<.05$), comprehension ($\chi^2(2)= 13.46$, $p<.001$), and application ($\chi^2(2)= 10.20$, $p<.01$) scores. However, there was no meaningful difference in knowledge scores of the groups ($\chi^2(2)= 2.16$, $p>.05$). A series of Mann-Whitney U Tests and Bonferroni corrections were administered to reveal the source of the differences in the total, comprehension, and application scores among the groups (The significance level was set at .017.). Mann-Whitney U Test results suggested that no statistically meaningful difference was found between the first experimental group (*M.R:*38.95) and second experimental group (*M.R:*29.48) (U=136.50, $p>.05$, z= -1.73, r= -.27); or between the second experimental group (*M.R:*29.48) and the control group (*M.R:*23.08) (U=157.00, $p>.05$, z= -1.17, r= -.19) in terms of total achievement scores.

Table 5: Kruskal Wallis H Test Results Related to Remembering Scores

Post-test	χ^2	*df*	*P*
Total	8.47	2	.015
Knowledge	2.16	2	.340
Comprehension	13.46	2	.001
Application	10.20	2	.006

However, the achievement test total scores of the participants in the first experimental group (*M.R:*38.95) were significantly higher than those in the control group (*M.R:*23.08) (U=94.50, p<.01, z= -2.88, r= -.46).

Considering the comprehension test scores, no meaningful difference was found between the second experimental group (*M.R:*29.60) and the control group (*M.R:*21.03) (U=141.00, p>.05, z= -1.62, r= -.26). Additionally, there was no difference between the first experimental group (*M.R:*40.88) and the second (*M.R:*29.60) (U=123.00, p<.017, z= -2.16, r= -.34). However, a meaningful difference was found between the first experimental group and the control group (U=69.50, p<.001, z= -3.59, r= -.57). As seen in Table 2, the comprehension scores of the participants in the first experimental group (*M.R:*40.88) were higher than those in the control group (*M.R:*21.03).

According to Mann-Whitney U Test results related to the application scores, there was no statistically meaningful difference between the second experimental group (*M.R:*24.95) and the control group (*M.R:*26.85) (U=191.00, p>.05, z= -.26, r= -.04). However, there were meaningful differences between the first (*M.R:*39.70) and second experimental groups (U=98.00, p<.01, z= -3.11, r= -.50), and between the first experimental group and the control group (U=118.00, p<.01, z= -2.57, r= -.41). As seen in Table 2, the application scores of the participants in the first experimental group (*M.R:*39.70) were significantly higher than those in the control group (*M.R:*26.85) and the second experimental group (*M.R:*24.95).

Teachers' and Students' Feedback During the Experimental Process

Since the researcher conducted the courses and educational practices planned within the scope of the study, she had the opportunity to observe the variety of positive feedback, such as that the model directly incorporated the students into the process, it had various activities, the students wanted to participate in the process voluntarily, etc. Considering the teachers' and students' statements during the interviews, it can be concluded that the learning by living approach in the study positively influenced the learning process. The study findings also corroborated this. The feedback from the students and teachers is given below:

Students:

"We learned and had fun!"

"We don't get bored during the course."

"We find the answers to the questions quickly, since we cooperate with friends."

"We drill the information into our brains."

"We learn easily. It's not a difficult task anymore."

"We love these courses."

"We aren't afraid of asking questions."

"We also remember what we learnt in the past."

"We are happy when we find the answers to the questions.''

"We learn about topics we are interested in.''

Teachers:

"The students are brave."

"They are happy.''

"They have established positive friendships with each other.''

"They've started to comment during courses.''

"They've started to question more."

"They are content with the process."

"That students know something about the subjects and are able to find the answers to the questions really motivates and encourages them."

"They find every answer as if they were in a competition. They yell out 'I found it!' or 'We found it!'"

Discussion

The effects of the paired and individual summarization methods with the 3N learning model in a science course on 4th grade students' learning levels and remembering were investigated in this study. The study results displayed no meaningful difference between the experimental and control groups' pre-test scores, while there were statistically significant differences in favor of the experimental groups' post-test scores regarding total learning, comprehension, and application levels. Among the experimental groups, there were meaningful differences in favor of the first and second experimental groups. Considering these findings, it can be concluded that 3N learning models based on the constructivist approach are more effective than traditional teaching models. The evidence in the literature generally suggests that learning cycle models increase students' participation, which in turn enhances academic success. Accumulating evidence also suggests that summarization, which is a *making meaning* strategy, provides a code, and enhances comprehension and permanency. The meaningful difference between the groups in which paired summarization with the 3N model was applied (E1) and the other group, which used the individual summarization method (E2), can be interpreted to be a result of the positive effects of cooperative learning. In this context, the group that worked in cooperation was more successful than the other. That the cooperative learning model is inherent in the constructivist approach and that it contributes to academic success is commonly mentioned in the literature. However, there were significant differences among the groups in which paired summarization with the 3N model was applied (E1), the other group which used the individual summarization method (E2), and the group being taught with the traditional teaching method (C) in terms of students' knowledge levels. More specifically, the students' knowledge levels were higher in the first and second experimental groups.

The educational situations, which were planned based on the current program, can be said to have positive effects on information level. The difference was observed in the comprehension and application stages. The results of a study by Campell (2006) revealed an increase in students' ability to comprehend the subject matter during the study. In assessment research about the cooperative learning model, Denise and Kuan-Chou (2010) pointed out that working cooperatively towards a common goal brings academic success, but they also emphasized the importance that each individual should take responsibility for his own success. Stahl, Rinehart, and Ericson (1986; as cited in Görgen, 1997) revealed that the comprehension and remembering levels of students in regards to what they read increased significantly following the summarization teaching method. Fazelian, Ebrahim, and Soraghi (2010) found that the teaching process based on the learning cycle model meaningfully increased learning and permanence in science courses. In their studies with 4th and 6th grade students in a science course, Bıyıklı (2013) and Öztürk (2013) found that learning levels increased in the post-test, and that there were meaningful differences between experimental and control groups' post-test score averages (Aslan, 2006; Öztürk, 2013). Yi and LuXi (2012) stated that cooperative learning actively motivates students, which in turn contributes to present and future attainments. Similarly, Hsısung (2012) reported that if cooperative working conditions are observed and improved, working cooperatively will be more effective than individual work, and added that it will give motivation even to students who have little interest, and will support their social skills. The summarization, which is a *meaning making* strategy in the model, is also influential in transferring information to long-term memory (Görgen, 1997; Erden & Akman, 2004).

According to the researcher's observations during the implementation, even in course books and source books, which were designed with various activities, the summarization strategy significantly contributes to the determination of the main theme of the subject. Although the amount of research that evaluates the cognitive processes directly is limited in the literature, the available findings suggest that learning cycle model practices based on the constructivist approach enhance understanding and comprehension. As stated before, most of the studies used the 5E learning cycle, so the available findings are generally dependent on the model's expanded 5E cycle form. In his study based on the 5E model, Özsevenç (2006) asserted that participation in a course, including being responsible for one's own learning and cooperative peer learning, facilitate understanding.

Post-test comprehension level findings show that there were apparent differences in comprehension levels among the E1, E2, and C groups' students, and these differences were in favor of the experimental groups. In terms of application level, there were statistically meaningful differences in favor of the experimental groups.

More specifically, the first experimental groups' scores were higher than those for the second group. These findings likely stem from the fact that the students actively participated in the process and experienced it interactively.

The findings related to remembering level revealed that there were significant differences among the groups in which paired summarization with the 3N model was used (E1), the other group which employed the individual summarization method (E2), and the group being taught with the traditional teaching method (C) in terms of students' total remembering levels. The outcomes were in favor of the experimental groups; specifically, the total remembering levels of the students in the first experimental group were higher than those in the second experimental group. However, there were no differences in their knowledge retention. Traditional teaching maintained the permanency in knowledge level attainments. On the other hand, there were meaningful differences in comprehension and application level remembering in favor of the experimental groups. In this sense, the related hypothesis was supported.

The findings show that the method enhanced comprehension level remembering when compared to the traditional teaching method, and these findings were consistent with the post-test results. The methods used in the aforementioned implementations were also seen to be effective in comprehension level remembering. Çiğdemoğlu (2012) asserted that the learning cycle model stimulates understanding and success. Other researchers (Bülbül, 2010; Tuna, 2011; Önder, 2011; Sunar, 2013; Karaman, 2013) underlined the statistically meaningful and positive differences in the effects of the model on academic success and permanency. The most significant effect was seen in the groups working cooperatively. The current study's findings are likely the result of the fact that the students actively participated in their education and experienced it interactively. Additionally, it can be inferred that the summarization method generally had a positive effect. Summarization is not only an indication of understanding, but it is also a type of creation. During summarization, students make associations between old and new information, which facilitates the meaning making process and storage in long-term memory. The information stored in long-term memory is more permanent, and can be recalled when necessary (Weinstein & Mayer, 1986, as cited in Görgen, 1997).

Since the constructivist approach based on the 3E (N) model inherently provides students with opportunities to acquire information through learning by experience, it also affected the post-test remembering scores in the levels of application and practice. According to the researcher's personal observations, the model integrated both students and teachers in the activity. However, developing an understanding of the systematic nature of the model is of critical importance in terms of avoiding becoming monotonous. The results for the groups in which paired and individual summarization methods with the 3N learning model were applied suggest that the model led students to cognitive attainments in comprehension and application levels beyond just the knowledge level and provided permanency in learning. Working cooperatively and the summarization applications within the scope of the model can be said to increase the effectiveness of learning. These findings and results are consistent with the literature. However, the present study assessed the learning levels in terms of the cognitive processes dimension, which brought a different perspective when compared to other studies in the literature.

In the study, knowledge level was not found to be different from that in the traditional teaching method. However, the experimental process was influential: first on comprehension, and then on application levels. The follow-up (remembering) test results were similar to the post-test results, which was the evidence for permanency. The findings in the literature also supported the results. Tekin (2007) specified that cognitive level learning is the basis of affective and psycho-motor learning. The results suggest that the students learn by doing and the combination of physical and mental functioning contribute to cognitive development, both of which enhance students' academic success and facilitate remembering. Students establish their own knowledge by practicing, using material, questioning, and comparing.

The qualitative data results showed that students were motivated to learn and had fun during the courses, and that they identified their work with that of scientists. The researcher's observations during the experimental practice included that the students were relaxed, paired groups in particular were trying to find the answers to the questions as if they were competing with each other, they seemed excited and were smiling, the individuals in the paired group were expressing their opinions in a more courageous manner, all of which can be thought to be the positive reflections of the model.

Since the curriculum after 2005 has been based on the constructivist approach, the information in the course books and teachers' guidebooks was given with more visual forms and activities. The summarization method in the 3N model is thought to be functional in terms of the fact that students can pick the main ideas behind the subjects as well as the activities.

The findings in the literature suggest that students who work cooperatively can solve their problems by discussing and sharing opinions with their peers without asking the teacher. There were various studies indicating that the learning cycle model should be applied cooperatively and with alternative activities.

This study has some limitations. First, it examined the effects of paired summarization and individual summarization practices with the 3N learning model on learning levels and remembering among the 4th grade students in science and technology courses. So, the effects of the model on other class levels and courses are unknown. Second, the follow-up study was relatively short term. Although the one-month follow-up study revealed the continuance of the positive effects, the exact permanency duration of this effect is not known. Despite these limitations, the study results support the theory that in combining cooperative learning with the summarization method, the 3N learning model had positive effects on cognitive skills, comprehension, and application levels beyond just the knowledge level. The combination of physical and mental activity in paired and individual summarization methods of the 3N learning model contributed to functionality and permanent learning, which in turn is thought to provide educators with a more effective learning environment. In light of these study results, the effectiveness of the model can be examined by integrating additional activities into the process. Additionally, the functionality of the 3N learning model can be examined in terms of class levels and various courses established with the constructivist approach.

Acknowledgement

The research reported here based on first author's doctoral thesis conducted under the supervision of Prof.Dr. Mehmet Arslan. Early drafts of this article presented in International Conference on Social and Human Sciences in Berlin between the 18-21 May 2017.

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