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Effect of semantic encoding strategy instruction on transfer of learning in e-learning environments

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Highlights

- We study effects of semantic encoding strategy instruction on transfer of learning
- Recalling performance was included in the study as a control variable
- Two experimental and a control group were used in the study
- Analyses suggest that semantic encoding strategies should be integrated into the content when designing e-learning environments.

Article Info: Research Article

Keywords: *Transfer of learning, Semantic encoding, Strategy instruction, Near transfer, Far transfer*

Abstract

This research aims to examine the effect of semantic encoding strategy instruction on students' near and far transfer performances in e-learning environments. The research was performed by experimental design. Dependent variables of the research were near and far transfer performances. Independent variable was strategy instruction on encoding. Also recalling performance was included in the research as a control variable. Research data were gathered with a transfer test containing 18 multiple-choice items. The experimental study was performed with 67 students with a medium level of recalling performance. The students were randomly assigned to experimental group I (strategy instruction+integrated content), experimental group II (strategy intruction+non-integrated content), and control group (non-integrated content). The results of this research indicated that encoding strategy instruction is essential for the transfer of learning in e-learning environments. However, it is more effective when e-learning design is integrated with encoding strategies. Therefore, it is suggested that semantic encoding strategies should be integrated into the content when designing e-learning environments.

1. Introduction

The main assumption of education is successfully recalling information, skills and manners learned in a platform and using them in different platforms in the future (Halpern & Hakel, 2003). Many educators claim that formal education aims to transfer information from one context to another (Halpern, 1998). Transfer is about how previous learning actions affect learning today and in the future and how the learning of the past and today are adapted to similar and new situations (Haskell, 2000). The transfer of learning should occur to receive the information and to use it in different platforms in the future. According to Skinner (1953), the transfer includes the generalization of reactions between two distinguishing effects. After the cognitive revolution, the mental symbolic presentation concept was used instead of similar qualities (Lobato, 2006). Schunk (2009) emphasized that transfer is a critical element for learning, generally including complex cognitive operations. Cognitive concepts covered in learning emphasize the

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complexity of transfer operations (Phye, 2001). Although superficial-level skills can be transferred automatically, many transfers require high-level cognitive skills. The transfer is a fundamental concept in learning regarding both the process and the result. It helps to learn by making information receiving, storage, processing, and preservation stages easier. It is not only the basis of future learning but also plays a crucial role in other cognitive activities such as thinking, questioning, deciding, metacognition, and problem-solving (Assiter, 1995; Cargill, 2004; Halpern & Hakel, 2003; Lister, 2003; Thompson et al., 2003). Although it has been proven that school life provides individuals with some basic knowledge and skills and increases their intelligence through different methods such as writing, reading, and questioning, it is emphasized that it is insufficient in transfer support. Standardized tests on transfer show that learning transfer is difficult (NSF, 2002). This enabled researchers to examine the transfer process (Cheng & Hamspon, 2007). For this reason, it is thought that it is important to determine the effect of cognitive processes such as semantic encoding on the transfer of learning.

2. Literature

The nature, formation, and development of transfer of learning have been the subject of many experimental and theoretical scientific studies over the last century. Experimental studies on transfer were started at the beginning of the 20th century (Judd, 1908; Thorndike & Woodworth, 1901). Thorndike supported that transfer occurs in identical situations. According to Barnett and Ceci (2002), two reasons cause transfer subjects to attract the attention of researchers, one in theory and one in practice. When considered theoretically, Singley and Anderson (1989) emphasized that transfer constitutes an important trial source in learning and performance modeling. They supported this emphasis on the fact that the definition and evaluation of performance modeling were made generally on the persistency of learned behaviors and applicability in new contexts. With the transfer of studies for the development of the learning-teaching process into this area with the increasing information about human cognition, the analysis of the transfer of learning in light of cognitive data has become necessary. Gick and Holyoak (1980) stated that transfer occurs when the students match a new situation they come across with schemes coded before and find suitable solutions. So transfer depends entirely on information recorded and encoded before.

Encoding is used for different operations in which information becomes memory presentation. All memory forms start with encoding. The things learned are encoded by associating with present information. According to Baddeley (2001), information is semantically encoded to be stored in long-term memory. The possibility of a piece of information activating other pieces of information increases with the number of connections between information in memory. Semantic encoding refers to the process of organizing and storing information in memory in a way that is meaningful and easily retrievable. This can involve creating mental associations between new information and previously learned concepts or using mnemonic devices to help remember information (Roediger & Karpicke, 2006). The transfer occurs when information and productions are connected to different contents in long-term memory. According to Merry (2021), encoding strategies such as mnemonics are extremely effective in maximizing the generalization and transfer of learning. Research has shown that semantic encoding can improve transfer of learning, which refers to the ability to apply knowledge and skills learned in one context to new situations. This is because semantic encoding helps to create a deeper and more durable understanding of the material, rather than just rote memorization (Karpicke & Blunt, 2011). When information is understood and connected to other concepts, it is more likely to be retained and applied in different contexts. For example, if a student learns about a scientific concept by understanding how it relates to real-world phenomena, they are more likely to be able to apply that concept to new problems or situations than if they had simply memorized definitions or formulas without understanding their meaning. Similarly, if a learner creates mental associations between new material and concepts they already understand, they may be better able to recall and apply that material in the future. Overall, semantic encoding can be an effective way to facilitate transfer of learning by helping learners create a deeper and more meaningful understanding of the material (Weaver & Bryant, 2013). In this context, examining how information encoded affects transfer performance is essential.

As many studies were made and are still being made on learning transfer in traditional learning platforms, the transferability of learning both in e-learning and e-learning platforms has revealed a new research area with the reflection of technological developments on learning platforms. Bonk and Reynolds (1997) stated that these platforms should be organized to connect individuals' past and new learning to provide a high level of thinking on a web platform. Two restrictions are making the transfer in e-learning platforms more difficult. The first is a lack of guidance in making learning transfer, and the second is a need for adequate care for platform design. In order to achieve success in e-learning, the factors affecting the transfer of learning should be considered in the design of these environments (Chan, Tsai, & Huang, 2006; Chen, Huang, & Chu., 2005; Kabassi & Virvou, 2003; Zhu, 2007).

Few studies were found on learning transfer in e-learning environments. The number of researches showing that information and skills acquired in e-learning environments are transferred to other contexts is limited (Young, Lim & Park, 2011). Studies on learning transfer in e-learning platforms were mostly on flight training, transfer of nurses' clinical skills, teamwork skills in large companies, and management skills of MBA students. In this research, issues related to the learning transfer performance of individuals in e-learning environments were examined on a cognitive basis. Strategy instruction was provided on a web platform based on three different strategies (articulation strategies, chunking strategies, and mnemonics) on semantic encoding. This research aims to examine the effect of semantic encoding strategy instruction offered in e-learning environments on the students' near and far transfer performances. This study was guided by the following research questions:

- Does semantic encoding strategy instruction offered in the e-Learning environment significantly affect near transfer?

- Does semantic encoding strategy instruction in the e-Learning environment significantly affect far transfer?

3. Methodology

3.1. Research Model/Design

The research was performed by quasi-experimental pre-test post-test control group research design. In the quasi-experimental design with the pretest-posttest control group, there is a different group that is not affected by the independent variable in addition to the experimental group exposed to the independent variable (Fraenkel & Wallen, 2006). The dependent variables of the research were near and far transfer performances. The Independent variable was strategy instruction on encoding. Also, recalling performance was included in the research as a control variable.

3.2. Data Collecting Tools

Two data collection tools were used in the research: the enhanced clue recall test and the transfer test. Detailed information on data collection tools is given below.

3.2.1. Enhanced Clue Recall Test

The enhanced cue recall test was developed by Grober, Buschke, Crystal, Bang, and Dresner (1988) and adapted by Solomon et al. (1998) by including a 7-minute test. Validity and reliability studies on the Turkish sample were carried out by Saka, Mihci, Topçuoğlu, and Balkan (2006). The more critical the coding (conceptual-semantic/perceptual-physical) in different types of memory, the more critical the interaction between the presentation of information and the clues used during recall (Cangöz, 1999; 2002). The function and importance of recall cues are explained by the "transfer-appropriate information processing" approach. According to this principle, memory performance increases as the similarity between semantic and physical cues in the encoding and recall phase increases (Fay, Isingrini, Ragot, & Pouthas, 2005). The use of semantic clues to learn and remind the items presented in the ECHR enables us to distinguish whether the source of the memory problem is due to the recording (storage) problem or the recall problem. This test, which is a neuropsychological paper-and-pencil test, was transferred to the computer environment by making a norming study by Aşkar, Altun, Cangöz, Çevik, Kaya, and Türksoy (2010). The software has been developed for the treatment and evaluation of the test in the computer environment, and the software's equivalence has been investigated.

While the test is being applied, the practitioner and the person who will take the test sit opposite each other. A4 page size cards are shown to the individual with four pictures of black and white drawings on each page. The individual is expected to code the pictures by giving clues about the pictures. A4-page-sized cards are shown to the individual with four pictures of black and white drawings on each page. Again, the individual is expected to code the pictures by giving clues about the pictures. Four cards are in total within the test, and the individual is shown 16 object images on these cards throughout the test. While the individual looks at the card, the practitioner gives verbal clues for each object. For example, "There is a piece of furniture on this card; what is its name?". If the individual answers "table," the practitioner moves on to the next clue. If the individual cannot respond and gives an incorrect answer, the practitioner says, "it is a table," and moves on to the next object. After the four objects on each card are correctly identified, the practitioner shows the individual a blank page and asks for the shapes he has just coded 30 through "instant recall" using the same clues. For example, "I just showed you a piece of furniture; what is its name?" as. If the individual recalls all objects, the practitioner moves to the next card. However, if there is an error at this stage, the process is started from the beginning by returning to the same card again. However, if a new mistake is made, the process is not repeated a third time. The same rules apply to the 2nd, third and fourth cards. During the whole process, the unique codes a total of 16 different objects that he will remember later. At the end of the process, the individual is asked to say what they remember from the pictures. Hints are given for pictures he does not know; each picture he knows is scored 1 point.

Afterward, the participant is kept busy by giving an interim activity that lasts 10-15 minutes. Then he is asked to say the shapes he remembers. Next, hints are given for shapes he needs help remembering. No points are awarded for that word if he still cannot remember it. Finally, the remembered words are summed, with 1 point for each. Again, a final interim activity lasting 10-15 minutes is made, and the person lingers and the same process is repeated. Unremembered words are not scored, and the individual's total score is calculated by adding the scores from the three tests. The highest score that can be obtained from the test, which takes 30-40 minutes on average, is 48.

3.2.2. Transfer Test

Within the scope of the research, the transfer test, which was developed by the researcher and ensured validity and reliability, was applied as a pre-test, post-test, and retention test. The transfer test consists of multiple-choice questions whose validity and the researcher has provided reliability. The test covers three instructional design models that will be taught in the e-learning environment within the scope of the research. First, a two-part transfer test consisting of 29 questions and 29 items thought to be able to measure near transfer and far transfer was formed, and expert opinion was sought for content validity. Experts were asked to rate the multiple-choice items' transfer levels from 1 to 5. For the reliability of the comparative agreement among experts, the Cohen KAPPA coefficient was calculated and found to be .819. Six questions that the experts could not reach a consensus on were excluded from the test. Then, the pilot treatment of the test was applied to 162 students studying in the 3rd and 4th grades of the CEIT Department of the Faculty of Education of Erzincan University. After the treatment, the construct validity of the test was checked. For this purpose, factor analysis was performed using tetrachoric correlation to test unidimensionality for near and far transfer tests. At the same time, the test was subjected to item analysis. In total, two questions were removed from the near transfer test and three questions from the far transfer test, and the test was given its final form with 18 questions (9 near, 9 far). The Cronbach's alpha reliability of the developed achievement test was calculated as .83

3.3. Participants

The research was carried out with 67 students selected from Hacettepe University Education Faculty CEIT Department students using a purposive sampling method. As recalling performances would be controlled to determine the students participating in the research, individuals in the same performance group were studied. After these individuals were determined, a pre-test was applied to the content. The students were clustered into three groups according to their low, medium, and high knowledge. Afterward, students were randomly assigned to Experimental I, Experimental II, and Control groups in a balanced number from all three clusters. The path followed in determining the research group and the statistical analyses are below.

In order to include students with similar recall performance levels in the study, an enhanced clue recall test was applied to 105 students (detailed information about the test is given in the data collection tools section). The test treatment took approximately 15-20 minutes for each student. The same researcher tested all students. The students took the test individually and explained the process to each. At the end of the treatment, the upper and lower groups, whose test scores were 1 standard deviation from the mean, formed the groups with "low" and "high" recall performance. The individuals among these groups formed the groups with "intermediate" recall performance. 76 students with moderate recall performance were selected for this study. However, 6 students wanted to avoid participating in the research. The research process started with 70 students. All participants voluntarily contributed to the research in their spare time outside of class hours.

It was planned to randomly assign the students to three groups (Experiment I, Experiment II, and Control). However, before randomly assigning the students to the groups, it was decided to form the groups according to the pre-test scores in order to eliminate the internal validity problem that may occur because there were students from two different grade levels in the research group and one of these groups had taken the instructional design course before.

According to the pre-test results applied to the students, the total scores of the near and far contexts were taken. Then, cluster analysis divided the students into three clusters (low, high, and medium). Factor scores were produced to understand which groups were low, high, and moderate. In order to ensure the accuracy of the clustering analysis, discriminant analysis was performed. The result obtained showed that the clustering analysis correctly clustered the students at the level of 98.6%. As a result of the clustering analysis, low, medium, and high-level students were randomly distributed to the Experimental I, Experimental II, and Control groups with the help of the .rnd function in excel, with a balanced number of students from each level in each group. Group 1 (experimental group 1) received instruction on semantic encoding strategy in e-learning environment and then instruction on instructional design models in e-learning environment integrated with these strategies, and Group 2 (experimental group 2) received encoding strategy instruction in e-learning environment and instruction on instructional design models in e-learning environment not integrated with strategies. Group 3 (control group) received instruction on instructional design models in e-learning environment not integrated with strategies and didn't receive encoding strategy instruction. On the other hand, three students in the research group expressed their request to exit the research after participating in the pre-test. As a result, the data collected from 67 students were analyzed.

3.4. Research Procedures

3.4.1. E-Learning Environment

The preparation of the learning environment was carried out in three stages. First, the contents to be included in the learning environment were developed. Later, an educational web page was created, and the developed contents were transferred to the web page. Finally, the necessary arrangements were made in the learning environment by taking the experts' opinions on the learning environment. As a result, two different contents were developed within the scope of the research. The first content includes semantic encoding strategies, and the second content includes flexible instructional design models. In teaching semantic encoding strategies, there are three basic strategies and different ways of using these strategies (articulation, organization, and mnemonics). In addition, there are three models for teaching flexible instructional design models (Assure, Gerlach & Ely and Kemp, Morrison & Roos Models).

3.4.2. Treatment Process

At the beginning of the treatment, before the students were divided into groups, they were subjected to a pre-test developed for flexible instructional design models. For all students to take the test simultaneously, the test was carried out by determining a typical day and time. A total of 70 students participated in the pre-test. As explained in detail in the section on determining the research group, there are students from two different grade levels in the research group. For this reason, to eliminate the internal validity problem, it was decided to form the groups according to the pre-test scores, so the test was applied without dividing the students into groups. Experiment I, Experiment II and Control groups were formed according to the pre-test scores. Before starting the treatment, three separate Facebook groups were created for Experiment I, Experiment II and Control groups, and announcements about the process were made on these group pages.

Facebook was preferred as a communication tool because all students have an account and are familiar with the environment. At the beginning of the implementation process, it was decided that the Experimental I and Experimental II groups should receive semantic encoding strategies taught in the e-learning environment in the laboratory environment, under the supervision of a researcher, in order to preserve the internal validity of the research. The students worked individually on the relevant teaching through the e-learning environment. In the process, first of all, the online environment was introduced to the students by the researcher, and then users were allowed to enter the environment. Then, information was given about the purpose of the learning activity they faced during the online treatment process, and the students were left alone with the environment. Students were given one hour for the treatment, and it was observed that the given time was appropriate. The control group did not participate in this practice. After the pre-test, three students who participated in the pre-test expressed their demands not to participate in the rest of the research. As a result, the research continued with 67 students, and the data collected from these students were analyzed. In the second stage of the implementation process, all three groups provided access to the e-learning environment whenever and wherever they wanted. All three groups took three courses on three flexible instructional design models. At the beginning of the process, students were given three days to complete learning activities for each lesson. Log records were kept of students' entrances, exits, and movements in the environment, and feedback was given to students who did not enter the environment. When it was seen that the given three days were not enough and only some students completed the activity, the duration was increased to one week. For three weeks, students carried out learning activities related to flexible instructional design models in an e-learning environment. Immediately after the treatment, the post-test was applied to the three groups separately in the classroom environment. After three weeks after the treatment of the post-test, the permanence test was applied in the same environment. The table regarding the implementation process of the research is given below.

Table 1.

Treatment Process

Group	Pre-Test	Treatment Process	Post-Test	Retention Test
Experimental Group I	X	Strategy instruction+integrated content	X	X
Experimental Group II	X	Strategy instruction+non-integrated content	X	X
Control Group	X	Non-integrated content	X	X

3.5. Data Analysis

In order to determine whether the obtained data set showed a normal distribution, the difference scores between the pre-test and post-test scores obtained from both parts of the transfer test were taken as the basis. For this purpose, the Kolmogorov-Smirnov test was applied to the data set obtained from 67 students. As a result of the test (p>.05), it was found that the Experiment I, Experiment II, and Control groups showed normal distribution according to the difference scores of both the near transfer and far transfer tests of this data set.

Table 2.

Normality of Near Transfer Test

	Statistics	df	p
Experiment I	.17	22	.12
Experiment II	.18	22	.06
Control	.16	23	.14

Table 3.

Normality of Far Transfer Test

	Statistics	df	p
Experiment I	.17	22	.12
Experiment II	.18	22	.06
Control	.16	23	.14

Frequency, arithmetic mean, and standard deviation statistics were calculated to analyze the data obtained from the applied transfer test. In the data analysis, repeated measures ANOVA analysis was used between groups and for groups. If a significant difference was determined as a result of the analysis, pairwise comparisons were made with the Bonferroni test to determine the source of the difference. At the same time, effect sizes were calculated to decide the significant difference's size. In the statistical analyses, the significance level was accepted as p<.05 in analyzes made within groups by using Bonferroni verification to control Type 1 error, while the significance level was accepted as p<.016 in cases where comparisons were made between groups. According to Bonferroni's correction, the p-value should be kept much more tightly to reduce the possibility of nonsignificant results being found significant (Akbulut, 2010). In this study, partial Eta square values were calculated.

4. Findings

4.1. The effect of semantic encoding strategy instruction on near transfer in e-learning environment

“Does semantic encoding strategy instruction offered in the e-Learning environment significantly affect near transfer?” In order to answer this question, first of all, the homogeneity of variances assumption was tested. As a result of the Levene test, it was found that the assumption of homogeneity of variances was provided (F= .63; p=.54). Then, repeated measures between groups ANOVA analysis were performed. Analysis results are given in the Table 4.

Table 4.

Repeated Measures Analysis of Variance Results on the Effect of Semantic Encoding Strategy Instruction on Near Transfer

Group	Pre-Test		Post-Test		Retention Test		F	p	η2
	X̄	sd	X̄	sd	X̄	sd			
Experiment I	4.55	1.37	7.05	1.25	6.36	1.26	7.77	<.001	.20
Experiment II	4.23	1.02	5.77	1.30	5.64	1.43			
Control	4.39	1.43	5.30	1.33	4.96	1.26			

When the pre-test, post-test, and retention test scores were examined, there was a statistically significant difference between the groups regarding near transfer performance. Furthermore, the effect value revealed the magnitude of the significant difference. The results of the Bonferroni test to determine the source of the significant difference are given in Table 5.

Table 5.

Comparison of Near Transfer Performances of Groups

Group (I)	Test (J)	Mean Differences (I-J)	S. Error	p
Experiment I	Experiment II	.77(*)	.29	.014
	Control	1.10(*)	.29	.003
Experiment II	Experiment I	-.77(*)	.29	.014
	Control	.3	.29	.65
Control	Experiment I	-1.10(*)	.29	.003
	Experiment II	-.33	.29	.65

According to the findings obtained as a result of the analysis, the far transfer performances of the students (Experiment I) who received semantic encoding strategy instruction and content-oriented instruction integrated with the strategies; differs significantly from the students who received semantic encoding strategy instruction and not integrated with the strategies (Experiment II) and the students who did not receive strategy instruction and received instruction for the content that was not integrated with the strategies (Control) (p<.016). There was no significant difference between Experiment II and Control groups (p>.016).

4.2. The effect of semantic encoding strategy instruction on far transfer in e-learning environment

"Does semantic encoding strategy instruction offered in the e-Learning environment significantly affect far transfer?" In order to answer this question, first of all, the homogeneity of variances assumption was tested. As a result of the Levene test, it was found that the assumption of homogeneity of variances was provided ($F= 1.94$; $p=.15$). Then, repeated measures between groups ANOVA analysis were performed. Analysis results are given in Table 6.

Table 6.

Repeated Measures Analysis of Variance Results on the Effect of Semantic Encoding Strategy Instruction on Far Transfer

Group	Pre-Test		Post-Test		Retention Test		F	p	η2
	X̄	sd	X̄	sd	X̄	sd			
Experiment I	2.82	.96	5.45	1.22	4.50	.86	6.18	<.001	.16
Experiment II	2.73	1.08	4.23	1.11	4.00	1.20			
Control	3.22	1.41	3.52	1.04	3.48	1.20			

When the pre-test, post-test, and retention test scores were examined, there was a statistically significant difference between the groups regarding distant transfer performance. The effect value revealed the magnitude of the significant difference. The results of the Bonferroni test to determine the source of the significant difference are given in Table 7.

Table 7.

Comparison of Far Transfer Performances of Groups

Group (I)	Test (J)	Mean Differences (I-J)	S. Error	p
Experiment I	Experiment II	.61(*)	.25	.012
	Control	.85(*)	.25	<.001
Experiment II	Experiment I	-.61(*)	.25	.012
	Control	.25	.25	.76
Control	Experiment I	-.85(*)	.25	<.001
	Experiment II	-.25	.25	.76

According to the findings obtained as a result of the analysis, the distance transfer performance of the students (Experiment I) who received semantic encoding strategy instruction and content-oriented instruction integrated with the strategies; differs significantly from the students who received semantic encoding strategy instruction and not integrated with the strategies (Experiment II) and the students who did not receive strategy instruction and received instruction for the content that was not integrated with the strategies (Control) ($p<.016$). There was no significant difference between Experiment II and Control groups ($p>.016$).

5. Results and Conclusion

Within the scope of this research, the effect of semantic encoding strategy instruction offered in the e-learning environment on students' near and far transfer performances was examined. For this purpose, three different groups were considered, and the effects of the instruction given according to the conditions were compared.

According to the data obtained, there has been an improvement in the near and far transfer performances of the students in Experiment I and Experiment II groups who received strategy instruction and the students in the control group. Students increased their pre-test scores and got higher scores on the post-test. However, the students' retention scores were lower than their post-test scores. The experimental group I had the highest score in both post-test and retention test scores. Although experimental group II got higher scores than the Control group in both score types, this height only sometimes made a significant difference. It was observed that the retention test scores of all three groups were lower than the post-test scores. The retention test scores are expected to be lower than the post-test scores. Bahrick and Hall (1993) emphasize that it is normal for the retention scores to decrease when the time between repeated tests is prolonged (expressed as days and weeks).

Semantic encoding strategies are essential in enabling individuals to understand better and encode important content that will enable them to be successful in a test. With the semantic encoding of information, semantic connections are established between previous and new information, its representation in memory is provided, and the transfer of learning becomes more manageable. It can be argued that the students who received strategy instruction showed significantly higher transfer performance than those who did not since the use of various strategies in this process makes the process more effective and facilitates the coding of information in long-term memory and then lays the groundwork for transfer. Reetz (1987) emphasizes that students' mastery of encoding strategies also helps them learn more efficiently and become independent learners. Therefore, it is important to include strategies in the teaching process; however, it is necessary to teach individuals about these strategies beforehand. Pressley and Woloshyn (1995) emphasize that when and how students can use strategies that support their learning processes, modeling by experienced individuals has an influential role in the success of strategies. Within the scope of this research, while the students were taught about semantic encoding strategies in the e-learning environment, each strategy was explained with its principles, and examples of how the strategies could be applied were given. This method may have supported the success of the students who received the strategy training.

Within the scope of the research, it was concluded that individuals who received strategy instruction provided higher transfer test scores than those who did not. This result is consistent with similar studies in the literature (Carney, Levin, & Levin, 1994; Heywood, 1994; Mastropieri & Scruggs, 1991). Heywood (1994), similar to the results obtained from this research, found that the students in the experimental group who received instruction in semantic encoding strategies were more successful in transfer than the students in the control group who did not receive instruction. Carney, Levin, and Levin (1994) also emphasize that strategy teaching positively affects the transfer success of individuals with learning disabilities. Also using semantic encoding strategy can greatly facilitate the process of creation of new schemas and transfer of learning (Gentner & Hoyos, 2017). Heather and Gibson (2009), on the other hand, did not look at the effect of strategy instruction on students' achievement; however, they also examined the students' attitudes towards the given instruction and found that they had a positive attitude.

In addition to including strategies in the teaching process, it is more important to teach these strategies to individuals in advance. Pressley and Woloshyn (1995) emphasize that when and how students can use strategies that support their learning processes, modeling by experienced individuals is influential in the success of the strategies. Within the scope of this research, while the students were taught semantic encoding strategies in the e-learning environment, the principles of each strategy were explained, and examples of how the strategies could be applied were given. This method may have supported the students who received strategy instruction to perform a better transfer. One of the main arguments in the literature regarding instructional strategies that support learning is that only one strategy should be taught at a time. While Pressley and Woloshyn (1995) emphasize that only one strategy should be taught at a time, Chamot (2006) argues that learning is a complex process and not every strategy can effectively achieve every lesson's objectives; therefore, it should be taught to students for multiple strategies. Likewise, Folse (2004) states that good learners are individuals who can use many different strategies. Within the scope of this research, it was decided to teach more than one semantic encoding strategy, taking into account the student differences and the differences in the target acquisitions to be gained, and this decision was implemented. According to the results obtained, this factor has an essential effect on increasing the success of strategy teaching.

Another significant result of the research is that semantic encoding strategies in e-learning environments significantly affect students' near transfer performance. Near-transfer of learning involves rote learning of facts and knowledge that is fragmented in nature (Fiorella and Mayer 2015), such as recognition of concepts and assumptions devoid of application to novel situations (Harrison, Saito, Markee & Herzog, 2017). Most previous training studies assessed training and transfer effects by using tasks with high structural similarity to measure near transfer (Schuster., et al. 2023). Experimental group I performed significantly higher than in the other groups. There was no significant difference between experimental group II and control groups regarding near transfer performances.

As a result of the research, it was found that semantic encoding strategy instruction in e-learning environments also had a significant effect on students' far transfer performance. . Far-transfer of learning refers to the transfer of knowledge and skills from instructional materials to new situations in which learners engage in new problems and scenarios (Fiorella and Mayer 2015). According to Strobach & Karbach (2016), to date, the most effective and systematic attempt to transfer skills is represented by cognitive strategy training. The presence or absence of far transfer is thus a valuable litmus test for theories of human cognition. Furthermore, knowing whether and under what conditions far transfer occurs would represent a breakthrough in education and training in general (Sala, G., et al. (2019). As with the near transfer performances, the far transfer performance of the Experimental I group is significantly higher than the other groups. There is no significant difference between the Experimental group II and the control groups regarding far transfer performance.

When the results regarding the differences in the near and far transfer performances of the groups are considered, it is seen that only getting strategy instruction does not make a significant difference in terms of both transfer types. The main difference between the groups' performances stems from integrating strategies into the content. The students in experimental group I, who received strategy instruction and instruction for content integrated with strategies, achieved the highest level of transfer performance in both far transfer and far transfer performance. In this case, integrating the strategies into the content and the strategy education enabled the students to be more successful in both types of transfer. This result highlights an important factor in designing content in e-learning environments. Accordingly, integrating semantic encoding strategies into the content given in e-learning environments facilitates the transfer of learning. Students find external support in the learning process more reliable, accurate, and easy to use. This shows that external factors are more effective in coding information (Intons-Peterson & Fournier, 1986). This factor may be influential in the transfer of learning supported by strategies. Looking at the literature, it is seen that similar studies have been conducted on students' learning in environments where semantic encoding strategies are integrated. For example, Aydın and Sunbul (2012) concluded that students who received content-oriented instruction integrated with memory-supporting strategies, which are among semantic encoding strategies, were significantly more successful in their study, which they based on success as a learning outcome. Similarly, Cheng, Lin & Chen (2013), Dolean (2014), and Murthy (2014) concluded that students achieved significantly more success in learning environments supported by semantic encoding strategies. Cobb (2013), on the other hand, looked at the effect of semantic encoding strategies integrated into content in e-learning environments, as in this study, and found that students who learned the content with strategies achieved significantly higher performance.

As a result of this research, the presentation of content in learning environments by integrating semantic encoding strategies emerges as the most critical factor that increases transfer. When we look at the literature, it is seen that when strategies are integrated into the content in traditional learning environments, it is seen that learning is more permanent and transferred more easily (Graaff, Verhoeven, Bosman, & Hasselman, 2007; Nelson, Burns, Kanive, & Ysseldyke, 2013). In addition to the studies conducted in traditional learning environments, some studies look at the effects of strategies integrated into the content in e-learning environments, as in this research. Contradictory results have been obtained from these studies. Yang, Goel, Bryan, Robertson, Lim, Islam, and Speicher (2014) concluded that integrating content into their strategies in e-learning environments significantly increases retention; Dornisch and Sperling (2004; 2006) emphasize that integrating strategies does not have a significant effect on retention. There may be some reasons for these contradictory results obtained in the literature. Individuals' ability to encode a piece of information in long-term memory and retrieve it later is affected by their prior knowledge, interests, and similar issues. Therefore, integrating strategies may have a different effect on every content. The fact that undergraduate students were studied within the scope of this research and that these students had prior knowledge of instructional design models may have enabled the strategies to work in the process because students carry their previous knowledge to all learning environments and perform the coding process by integrating their new knowledge with the previous ones. Such a result may have been encountered, as this ensures that the new information they acquire is more permanent and transferred.

6. Recommendations

In line with the findings obtained as a result of the research, various suggestions have been developed for research and practice. According to the research results, semantic encoding strategy instruction significantly impacted near and far transfer performance. Therefore, to ensure the transfer of learning in e-learning environments, before integrating various strategies that facilitate learning into the content, it may be recommended to teach students about these strategies, their general characteristics, and how they can be used. The results show that integrating strategies into the content has the most impact on near and far transfer. While creating content in e-learning environments, coding strategies that are suitable for the relevant content and will make it easier to remember later can be integrated into the environment. When integrating the strategies into the content, strategies suitable for the content should be selected. For example, if new information is desired to be understood concretely by establishing similarities between knowledge and old knowledge, articulation strategies; organizing strategies if it is aimed to group standard features between pieces of information; If concept teaching is carried out, memory-supporting strategies can be employed more intensively. By determining the factors that can help the coding of information in e-learning environments, research can be conducted to develop suggestions for arranging the design to ensure coding, permanence, and transfer. Conduct qualitative studies in which students' views on how they learn and use these strategies when needed and their views on the effects of these strategies.

References

Akbulut, Y. 2010. *Sosyal bilimlerde SPSS uygulamaları.* İstanbul: İdeal Kültür Yayıncılık.

Assiter, A. (1995). *Transferable Skills in Higher Education.* London: Kogan Page.

Aydın, M., & Sunbul, A. M. 2012. "Effect of the Verbal Mnemonics on Students' Achievements and their Attitudes", *Procedia-Social and Behavioral Sciences*, *47*, 1506-1510.

Baddaley, A. D. (2001). Is working memory still working?. *American Psychologist, 56*, 851-864.

Bahrick, H. P., & Hall, L. K. (1993). Long intervals between tests can yield hypermnesia: Comments on Wheeler and Roediger. *Psychological Science, 4*, 206-207

Barnett, S. M., & Ceci, S. J. (2002). When and where do we apply what we learn? A taxonomy for far transfer. *Psychological Bulletin,* 128, 612-637.

Cargill, M. (2004). Transferable skills within research degrees: a collaborative genre-based approach to developing publication skills and its implications for research education. *Teaching in Higher Education, 9*, 83-98.

Carney, R. N., Levin, J. R., & Levin, M. E. (1994). Enhancing the psychology of memory by enhancing memory of psychology. *Teaching of Psychology, 21*(3), 171-174.

Chamot, A. U. (2011). Preparing language teachers to teach learning strategies. *Foreign language teaching in Asia and beyond. Current perspectives and future directions*, 29-44.

Chan, H. G., Tsai, P. H., & Huang, T. Y. (2006). Web-based learning in a geometry course. *Educational Technology & Society, 9* (2), 133-140.

Chen, J. N., Huang, Y. M., & Chu, W. C. (2005). Applying dynamic fuzzy Petri Net to Web learning system. *Interactive Learning Environments, 13* (3), 159 - 178.

Cheng, W, Lin, X., & Chen, C. 2013. Using modern teaching strategies to teach upper abdominal sonography to medical students, *Journal of the Chinese Medical Association, 76,* 395-400.

Cheng, E. W. L. & Hampson, I. (2008). Transfer of training: a review and new insights. *International Journal of Management Reviews, 10*, 327–41.

Cobb, C. (2013). *The use of an animated pedagogical agent as a mnemonic device to promote learning and motivation in online education* (Doctoral dissertation, Walden University).

De Graaff, S., Verhoeven, L., Bosman, A. M., & Hasselman, F. (2007). Integrated pictorial mnemonics and stimulus fading: Teaching kindergartners letter sounds. *British Journal of Educational Psychology*, *77*(3), 519-539.

Dornisch, M. M., & Sperling, R. A. (2004). Elaborative questions in web-based text materials. *International Journal of Instructional Media*, *31*(1), 49.

Dornisch, M. M., & Sperling, R. A. (2006). Facilitating learning from technology-enhanced text: Effects of prompted elaborative interrogation. *The Journal of Educational Research*, *99*(3), 156-166.

Fiorella, Logan, and Richard E. Mayer. (2015). Learning as a Generative Activity*: Eight Learning Strategies That Promote Understanding*. Cambridge: Cambridge University Press.

Folse, K. S. 2004. *Vocabulary myths: Applying second language research to classroom teaching*. Ann Arbor, MI: University of Michigan Press.

Fraenkel R.J. & Wallen E.N. (2006). *How to Design and Evaluate Research in Education*. McGraw-Hill, NewYork.

Gentner, D., & Hoyos, C. (2017). Analogy and abstraction. *Topics in cognitive science, 9*(3), 672-693.

Gick, M. L., & Holyoak, K. J. (1980). Analogical problem solving. *Cognitive Psychology, 12,* 306-355.

Halpern, D. F. (1998). Teaching critical thinking for transfer across domains. *American Psychologist, 53*(4), 449–455.

Halpern, D. F.,& Hakel, M. K. (2003). Applying the science of the learning to the university and beyond: Teaching for long-term retention and transfer, *Change, 35*(4), 36-41.

Harrison, D. J., Saito, L., Markee, N., & Herzog, S. (2017). Assessing the effectiveness of a hybrid-flipped model of learning on fluid mechanics instruction: Overall course performance, homework, and far- and near-transfer of learning. *European Journal of Engineering Education, 42*(6), 712-728.

Haskell, R. (2000). *Transfer of Learning: Cognition, Instruction and Reasoning*. San Diego: Academic Press.

Heather A., & Gibson, M. A. 2009. Using mnemonics to increase knowledge of an organizing curriculum framework, *Teaching and Learning in Nursing, 4*, 56-62.

Heywood, R. (1994). *The effects of the FIRST-Letter mnemonic strategy adaptation on the content achievement of at-risk nursing students*. Boston College.

Intons-Peterson, M. J., & Fournier, J. (1986). External and internal memory aids: When and how often do we use them?. *Journal of Experimental Psychology: General*, *115*(3), 267.

Judd, C.H. (1908). The relation of special training to general intelligence. *Educational Review, 36*, 28-42.

Kabassi, K., & Virvou, M. (2003). Using Web services for personalised Web-based learning. *Educational Technology & Society*, *6* (3), 61-71.

Karpicke, J. D., & Blunt, J. R. (2011). Retrieval practice produces more learning than elaborative studying with concept mapping. *Science, 331*, 772-775.

Lister, P. G. (2003). 'It's like you can't be a whole person, a mother who studies'. Lifelong learning: mature women students with caring commitments in social work education. *Social Work Education, 22*, 125-38.

Lobato, J. (2006). Alternative Perspectives on the transfer of learning: History, issues, and challenges for future research. *The Journal of the Learning Sciences, 15*(4), 431–449.

Merry, K. (2021). Instructional design for live online teaching: using mnemonics to support a UDL-centred approach. *Journal of Learning Development in Higher Education*, (22).

Mastropieri, M. A., & Scruggs, T. E. (1991). *Teaching students ways to remember: Strategies for learning mnemonically*. Brookline Books.

Murthy, R. K. 2014. *The effects of narratıon and mnemonıcs wıthın a gamıng envıronment for the achıevement of conceptual and procedural knowledge on undergraduate busıness students at* (Doctoral dissertation, Indiana University of Pennsylvania).

National Science Foundation. (2002). Transfer of Learning: Issues and Research Agenda.

Nelson, P. M., Burns, M. K., Kanive, R., & Ysseldyke, J. E. (2013). Comparison of a math fact rehearsal and a mnemonic strategy approach for improving math fact fluency. *Journal of school psychology*, *51*(6), 659-667.

Phye, G.D. (2001). Problem-solving instruction and problem-solving transfer: The correspondence issue. *Journal of Educational Psychology, 93*(3),571-578.

Pressley, M., & Woloshyn, V. 1995. *Cognitive strategy instruction (2nd ed.)*. Cambridge, MA: Brookline Books.

Reetz L. J. (1987). Memory strategies for college students. Paper presented at the National Conference on Student Success Courses, Orlando, FL. (ERIC Document Reproduction Service No. ED 291332).

Roediger, H. L., & Karpicke, J. D. (2006). The power of testing memory: Basic research and implications for educational practice. *Perspectives on Psychological Science, 1*(3), 181-210.

Sala, G., et al. (2019). Near and Far Transfer in Cognitive Training: A Second-Order Meta-Analysis. *Collabra: Psychology, 5*(1): 18.

Schunk, D. H. (2009). *Öğrenme Teorileri – Eğitimsel Bir Bakış* (çev. ed. M. Şahin). Ankara: Nobel Yayın Dağıtım.

Schuster, C., Stebner, F., Geukes, S., Jansen, M., Leutner, D., & Wirth, J. (2023). The effects of direct and indirect training in metacognitive learning strategies on near and far transfer in self-regulated learning. *Learning and Instruction, 83*, 101708.

Skinner, B. F. (1953). *Science of Human Behavior.* New York: Free Press.

Singley, M. K., & Anderson, J. R. (1989). *Transfer of Cognitive Skill.* Cambridge, MA: Harvard University Press.

Strobach,T., &Karbach,J. (2016).*Cognitive training: An overview of features and applications*. New York:Springer.

Thompson, D. E., Brooks, K. & Lizarraga, E. S. (2003). Perceived transfer of learning: from the distance education classroom to the workplace. *Assessment & Evaluation in Higher Education, 28*, 539–47.

Thorndike, E. L.,& Woodworth, R. S. (1901). The influence of improvement in one mental function upon the efficiency of other functions. *Psychological Review, 8*, 247-261.

Weaver, C. A., III, & Bryant, D. J. (2013). The role of semantic memory in the development of expert reading skills. *Journal of Educational Psychology, 105*(4), 898-913.

Yang, A., Goel, H., Bryan, M., Robertson, R., Lim, J., Islam, S., & Speicher, M. R. (2014). The Picmonic® Learning System: enhancing memory retention of medical sciences, using an audiovisual mnemonic Web-based learning platform. *Advances in medical education and practice*, *5*, 125.

Young, J. J., Lim, K. Y., & Park, S. Y. (2011). Investigating the structural relationships among organizational support, learning flow, learners' satisfaction and learning transfer in corporate e-learning. *British Journal of Educational Technology, 42*(6), 973-984.

Zhu, X. H. (2007). Extending the SCORM specification for references to the open content object. *Educational Technology & Society, 10* (1), 248-264