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Using the Mind Mapping Method in Web-Based Teaching: Pre-Service Teachers' Metacognitive Learning Strategies and Self-Directed Learning Skills

Zihin Haritalama Yönteminin Web Tabanlı Öğretimde Kullanımı: Öğretmen Adaylarının Bilişüstü Öğrenme Stratejileri ve Öz Yönetimli Öğrenme Becerileri

Cengiz GÜNDÜZALP*

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ABSTRACT: The study was carried out to determine the effects of the mind mapping method in web-based courses on students' metacognitive learning strategies and self-regulated learning skills and to determine the students' views on this. The study findings showed that there was a significant difference between the pre-test and post-test scores of the students in the experimental group regarding their metacognitive learning strategies and self-regulated learning skill levels. In addition, the study findings revealed that there was a significant difference in favor of the experimental group between the scores of the experimental and control groups regarding metacognitive learning strategies and self-regulated learning skill levels. On the other hand, the findings on student opinions showed that students generally had positive opinions about the mind mapping method. In addition, the use of the mind mapping method had significant contributions to the students' metacognitive learning strategies and self-learning skill levels. Considering the results of this study, the use of the mind mapping method in web-based courses significantly supported the metacognitive learning strategies of the students and contributed positively to the increase in self-learning skill levels.

Keywords: Mind mapping, web-based teaching, metacognition, self-management, learning strategies and skills

ÖZ: Çalışma web tabanlı derslerde zihin haritalama yönteminin kullanımının öğrencilerin bilişüstü öğrenme stratejileri ve öz yönetimli öğrenme becerilerine etkilerini ve buna ilişkin öğrenci görüşlerini belirlemek amacıyla gerçekleştirilmiştir. Çalışma bulguları, deney grubundaki öğrencilerin bilişüstü öğrenme stratejileri ve öz yönetimli öğrenme beceri düzeylerine ilişkin ön test son test puanları arasında anlamlı bir fark olduğunu göstermiştir. Bunun yanında çalışma bulgularından deney ve kontrol gruplarının bilişüstü öğrenme stratejileri ve öz yönetimli öğrenme beceri düzeylerine ilişkin puanları arasında deney grubu lehine anlamlı bir fark olduğu anlaşılmıştır. Öte yandan öğrenci görüşlerine yönelik bulgular ise öğrencilerin genel anlamda zihin haritalama yöntemine karşı olumlu görüşlere sahip olduğunu göstermiştir. Buna ek olarak öğrenci görüşlerine ilişkin bulgulardan zihin haritalama yönteminin kullanılmasının öğrencilerin bilişüstü öğrenme stratejileri ve öz yöntemli öğrenme beceri düzeylerine önemli katkılarının olduğu anlaşılmıştır. Çalışma sonuçları göz önünde bulundurulduğunda web tabanlı derslerde zihin haritalama yönteminin kullanılması öğrencilerin, bilişüstü öğrenme stratejilerini önemli ölçüde desteklemiş ve öz yöntemli öğrenme beceri düzeylerinin artmasına olumlu katkılar sağlamıştır.

Anahtar kelimeler: Zihin haritalama, web tabanlı öğretim, bilişüstü, öz yönetim, öğrenme stratejileri ve becerileri

* Asst. Prof. Dr., Kafkas University, Kars, Türkiye, cengizgunduzalp@kafkas.edu.tr, http://orcid.org/0000-0001-5108-437X

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Individuals need different skills and strategies for determining their own learning needs, and maintaining, managing, supervising, and evaluating their learning processes in order to be able to learn effectively. Learning skills and strategies can encourage reflection on the desired challenges and improve the use of knowledge and effective strategies during self-study (Yan et al., 2014). The effective use of learning skills and strategies has positive effects on long-term learning outcomes (Donker et al., 2014). At the same time, thanks to these skills and strategies, individuals can play an active role in their learning processes and perform original and independent learning. Considering the stated situations, the metacognitive learning strategies (MLS) and self-regulated learning skills (SLS) used by individuals during effective learning should be considered quite remarkable. MLS can be expressed as the strategies used in managing and supervising the learning process (Özer, 2008). While these strategies generally refer to monitoring the learning process consciously (Flavell, 1981) and controlling it with consecutive processes (Livingston, 2003), they include using high-level executive skills in the learning process (Cohen, 2014) and making various decisions at every stage of learning (Boekaerts & Simons, 1995). MLS can be used to plan, monitor, direct, and correct the processes in the learning process when necessary (Güven & Çögenli, 2014).

On the other hand, SLS includes skills that enable individuals to determine their own learning needs, enable them to continue and evaluate their learning processes (Aydar, 2021) and support the effective management of this process. According to Knowles (1975), in SLS, the individual takes the initiative for learning, determines learning needs, creates learning goals, determines the resources to be used, selects and implements the appropriate learning strategies for himself, and evaluates learning outcomes.

MLSs are essential for effective learning in terms of helping individuals in different subjects, such as providing attention and memory control in the learning process, increasing self-confidence, developing high-level cognitive skills, and performing meaningful learning independently (Warian, 2003). Individuals who use these strategies effectively are believed to be good at monitoring and evaluating their learning, having good work plans, taking responsibility, producing solutions to different problems, and making efforts to achieve in-depth learning (Sungur & Kahraman, 2011; Şen & Yılmaz, 2016). These individuals are described as individuals who are willing to learn.

Individuals who are willing to learn are responsible for planning, maintaining, and evaluating the results of learning in SLS (Merriam et al., 2007). Individuals who carry out SLS by taking this responsibility are effective, creative, cognitively open, and prone to selfless learning, know the learning process, can learn independently, are self-motivated, and have a high motivation for success (Jude-York, 1991). The skills for students in SLS are considered necessary and natural for the learning processes and encourage students to learn effectively (Radnitzer, 2010). In this context, using different MLS and self-directed learning skills effectively in the learning process can help individuals to achieve effective learning. MLS and SLS have a very important place among the qualifications determined by contemporary educational understandings and the qualities that students should have, and it should be ensured that students can use these strategies and skills effectively at all levels of education. It is necessary to realize this in different types of education. Web-based teaching, which has recently been

widely used in education during the pandemic, is among these. While web-based teaching motivates participation in learning with the options in different modes it offers (Yang & Gao, 2020), it supports individuals to achieve effective learning by using these skills and strategies.

On the other hand, problems experienced by students with different technologies in web-based teaching (Al Rawashdeh et al., 2021; Cook, 2007) and their unfamiliarity with this type of teaching (Al Rawashdeh et al., 2021; Dhawan, 2020) can negatively affect individuals' ability to use these skills and strategies effectively and prevent them from learning in a productive manner. An increase in cognitive load in courses conducted with web-based teaching (Zhang & Zou, 2021), issues such as the inability to fully motivate web-based teaching (Felix, 2001; Soussi, 2020), the need for more self-motivation, organization, and planning as compared to a traditional course (Jingyu, 2014), and the fact that a large part of the responsibility for learning belongs to the individual may prevent students from using different cognitive learning strategies and SLS. In this context, to achieve effective learning in web-based teaching, individuals may need to make adjustments and arrangements concerning the limitations related to web-based learning (Pacheco, 2005) and benefit from different tools and methods in this process.

The mind mapping method developed by Tony Buzan (Nebojsa et al., 2011) has an important place among the alternatives. Mind mapping is considered a metacognitive tool that facilitates the acquisition of knowledge through meaningful learning (Abdel-Hamid, 2017). Although it is possible to see many studies in the literature to prove the effectiveness of the mind mapping method, there are only a few definitive results (Liu et al., 2014) representing the effects of the method on the learning-teaching process. In this sense, it is anticipated that the results of this study on the effects of the mind mapping method on MLS and SLS during the learning and teaching process can make an essential contribution to the literature.

Mind mapping can be expressed as using keywords and shapes to store and organize information in a particular order of importance (Buzan, 2009a). In mind mapping, all concepts associated with and related to a particular main idea or title are visualized (Siochos & Papatheodorou, 2011). Mind mapping, which is a creative and easy to use (Buzan & Buzan, 2006; Eppler, 2006) method utilized in learning, remembering, and organizing the content of a subject, can be widely used especially in context-based teaching (Eppler, 2006; Shavelson et al., 2005). In this context, the mind mapping method can be used at various levels of education, especially in cases such as visualizing information, organizing concepts, taking notes, brainstorming, and so on (Dhindsa et al., 2011; Fu et al., 2019; Pennebaker, 2017). Thanks to mind mapping, by visualizing the processes of thinking, understanding, and organizing (Somers et al., 2014), learners can establish the connections between concepts quickly and effectively (Christensen & Hooker, 2000).

Mind mapping can also help learners, who create and develop conceptual schemas in a complex manner in the process of thinking and absorbing new information (Zhao, 2003). Thanks to mind mapping, students can develop a positive attitude towards the lesson (Buzan, 2009), make learning more fun, and increase the knowledge retention by using colors and pictures (Trevino, 2005). In this context, the mind mapping method opens the brain for learning by removing lessons from being ordinary and supporting

students to gain self-confidence, thus increasing concentration and creativity in students (Shafir, 2003). With the mind mapping method, students will be more active in their learning process by generating new ideas and establishing connections between concepts and will be more involved in this process (Peterson & Snyder, 1998). In this way, students can take action for learning by activating metacognitive learning processes, choosing the most appropriate strategies for themselves, and applying them. This movement process, which is carried out individually, can be supported by SLS. In fact, many of the situations mentioned regarding the mind mapping method have the potential to affect students' SLS directly or indirectly.

Considering the importance of the situations mentioned above, it is noteworthy that the number of studies in the literature revealing the effects of the mind mapping method on metacognitive learning strategies and self-directed learning skills is negligible. Studies in this field generally have results suggesting that the mind mapping method has indirect effects on metacognitive learning strategies and self-directed learning skills. On the other hand, it has been determined that there is no study in the literature examining the effects of the mind mapping method on metacognitive learning strategies and self-directed learning skills, especially in web-based courses. In this context, it is anticipated that the study will fill an important gap in the literature. From this point of view, this study has aimed to reveal the effects of the mind mapping method on students' MLS and SLS and their views on the issue. For this purpose, we sought answers to the following research questions.

1. Is there a significant difference between the scores of the groups regarding MLS and SLS levels?

2. Does the use of the mind mapping method in web-based courses have an impact on students' MLS and SLS levels?

3. What are the students' views on the effects of using mind mapping in web-based courses on MLS and SLS levels?

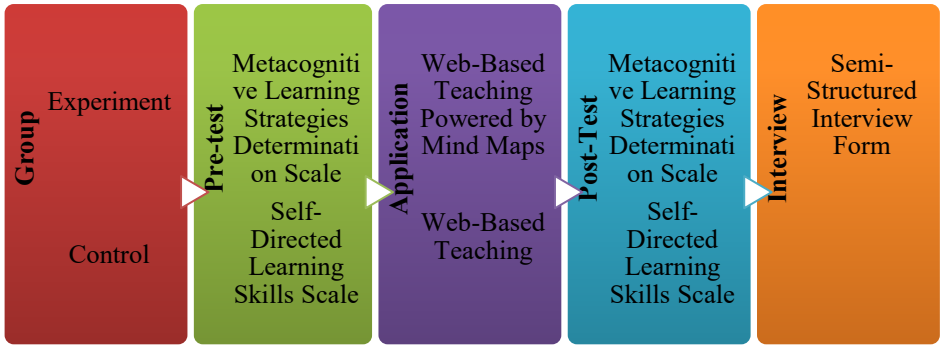
Method

Research Model

The study was designed with a two-group quasi-experimental design, which is among the quantitative research approaches. With this design, it was examined whether the use of the mind mapping method in web-based courses created a significant difference between the groups in terms of students' MLS and self-directed learning skill levels. Quasi-experimental design can be used in cases where it is impossible to create experimental and control groups randomly, and alternatively, where existing classes are used (Fraenkel & Wallen, 2000; McMillan & Schumacher, 2010). In this design, the groups are compared according to the pre-test scores of the variables in the study. The design process of the study is presented in Figure 1.

Figure 1

The design process of the study



Research Group

The research group of the study consists of undergraduate students studying in their first year in the faculty of education, who take the information technology course online. A total of 74 students participated in the study. The convenience sampling method was used to determine the research group of the study. This sampling method was used since the researcher delivered the information technology course to the research group. In this way, an easy-to-reach sample was determined, and the research was accelerated (Yıldırım & Şimşek, 2021). The participants of the study were divided into two different groups. One of these groups was determined as the experimental group and the other as the control group. A total of 37 students participated in each of the groups. The experimental group consisted of 20 females and 17 males, and the control group consisted of 21 females and 16 males. The students in the research group had never used digital mind maps in their lessons before.

In cases where there is no significant difference between the pre-test scores of the groups, either group is determined as the experimental group and the other as the control group. In the study, it was found that there was no significant difference between the pretest scores of the students' MLS and SLS levels. The results obtained from the pre-tests of the groups were collected from the experimental group ($M_{Metac.Lrn.Str.}$= 118.13, $SD_{Metac.Lrn.Str.}$= 9.96), ($M_{Self\text{-}Direction.\ Lrn.}$= 73.45, $SD_{Self\text{-}Direction.\ Lrn.}$= 8.41) and the control group ($M_{Metac.Lrn.Str.}$= 117.13, $SD_{Metac.Lrn.Str.}$= 10.09), ($M_{Self\text{-}Direction.\ Lrn.}$= 73.75, $SD_{Self\text{-}Direction.\ Lrn.}$= 7.25) showed that there was no significant difference between the groups in terms of MLS and SLS levels ($t(72)_{Metac.Lrn.Str.}$= -.163, p= .871), ($t(72)_{Self\text{-}Direction.\ Lrn.}$= .429, p= .669. This showed that the groups had similar characteristics in terms of MLS and self-directed learning skill levels. For this reason, one of the groups was randomly determined as the experimental group and the other as the control group.

Digital Mind Maps

In the implementation phase of the study, the "Coggle" (https://coggle.it/) website was used by the researcher and students to create digital mind maps. This site was preferred because it is easy to use and free of charge up to a certain usage limit and allows the digital mind maps created to be used and shared individually and collaboratively. In this context, students were allowed to log in to this site using their

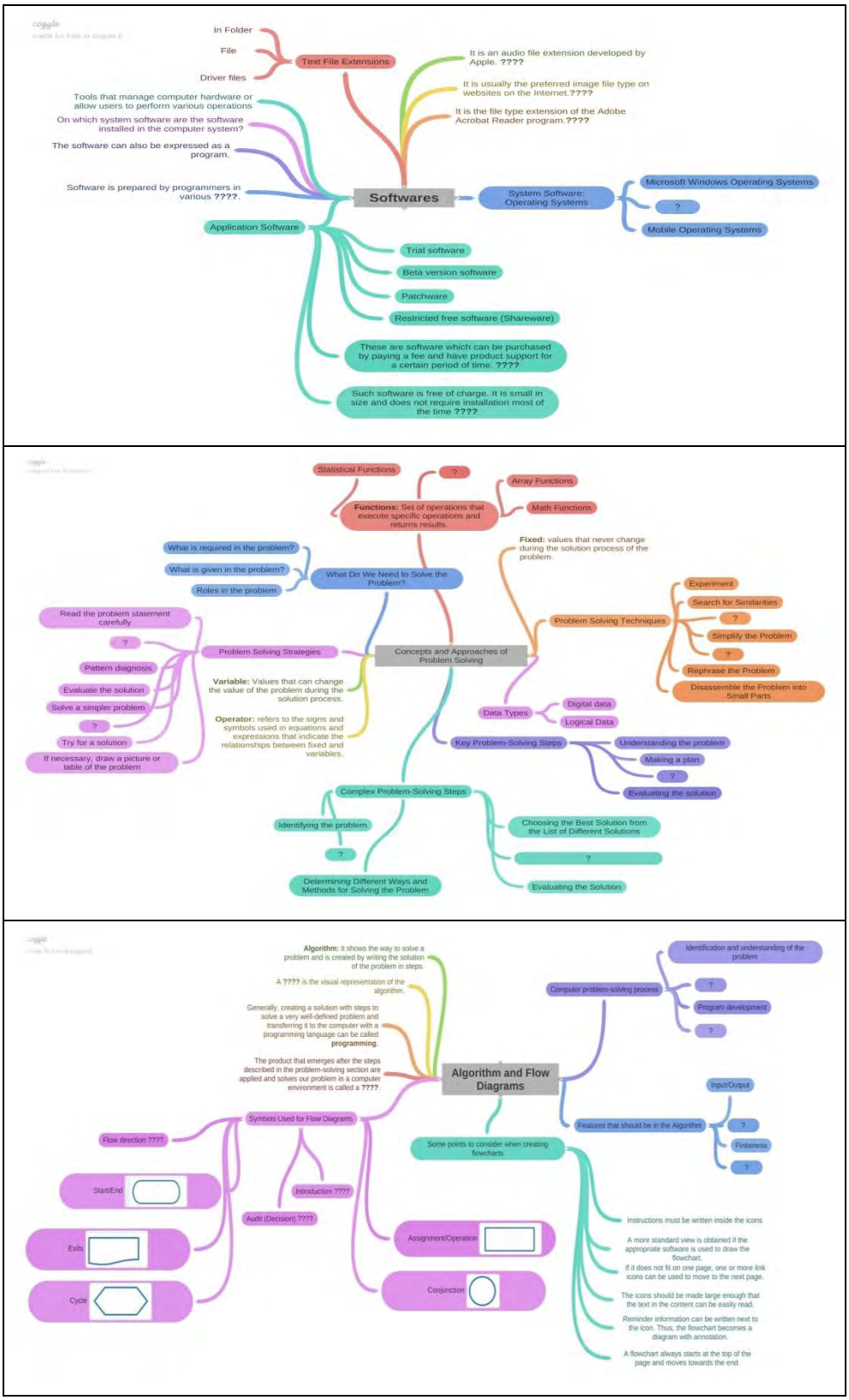
Gmail accounts and create digital mind maps individually or collaboratively. Digital mind maps created by the researcher on the topic of the study each week using the "Coggle" website were converted into pdf or image format and shared with students through the Microsoft Teams software and Google Drive.

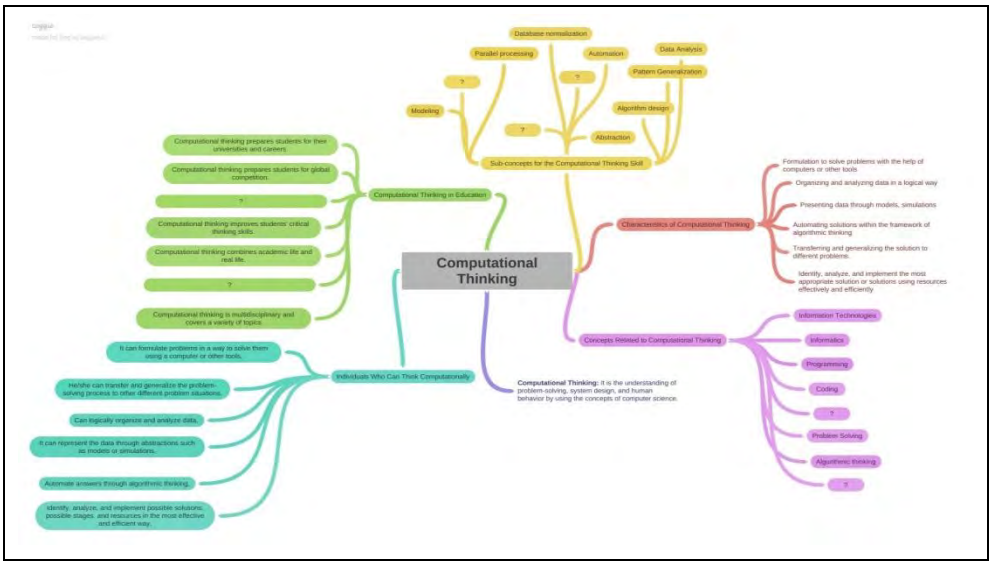
The digital mind maps prepared for the study are designed to provide meaningful and permanent learning and to support individual or collaborative work. Different measures were taken while preparing digital mind maps to prevent students' cognitive loads from increasing. In this context, Mayer's (2009) multimedia design principles were considered. While preparing the digital mind maps by the principle of consistency, extraneous elements that are not related to the subject were excluded from the designs. Considering the principle of attracting attention, criteria such as the concepts, sub-concepts, relationships, and connections that are considered important in mind maps were emphasized. Based on the principle of positional proximity, concepts, sub-concepts, connections, and relationships related to each other are given in mind maps in a way that they are close to each other. In the context of the multimedia principle, shapes, pictures, and writings are presented together in digital mind maps.

In addition, in the digital mind maps prepared, question marks were added to some boxes in order to provide memory support and interaction, and the information here was filled in by the students. Associating the subjects with the question marks helps the student to remember and, at the same time, reduces the cognitive load. Memory supporters are one of the seven components of the theory of detailing teaching (Wilson & Cole, 1992) and refer to the support of knowledge again with verbal and more visual coding to increase the permanence of the subject to be learned (Şendağ, 2016). For meaningful learning to occur, the limitation of students' short-term memory capacities (Sweller et al., 1998) was considered in the design process of mind maps. As a matter of fact, the teaching material designed by the principles of design and learning can alleviate the cognitive burden of the student (Angeli et al., 2009). Students were also asked to pay attention to these principles in the digital mind maps they prepared individually. Field experts provided feedback on digital mind maps prepared for students. Examples of digital mind maps created during the implementation process of the study are given in Figure 2.

Figure 2

Examples of Digital Mind Maps Created During the Application Process





Data Collection Tools

Three different data collection tools were used in the study. These are the MLS determination scale, SLS scale, and semi-structured interview form. The MLS determination scale was developed by Güven and Çögenli (2014). The scale consists of a total of 28 items and four sub-dimensions. The sub-dimensions of the scale are planning (9 items), monitoring (8 items), evaluation (4 items), and effective strategies (7 items). The scale is a five-point Likert scale. The scale items were rated as 1 "*Disagree*" and 5 "*Completely Agree*". The Cronbach Alpha value in the original version of the scale was found to be 0.874. In this study, the Cronbach Alpha value of the scale was calculated as .948. Reliability coefficients for planning, monitoring, evaluation, and affective strategies in the original version of the scale were found to be .76, .68, .58, and .53, respectively. In the study, these values were calculated as .84, .73, .64, and .62.

A self-regulated learning skills scale was developed by Aşkın Tekkol and Demirel (2018). The scale consists of 21 items. In addition, the scale has four dimensions. These are motivation (7 items), self-monitoring (5 items), self-control (5 items), and self-confidence (4 items). The scale is in the form of a five-point Likert structure and graded as 5 "*Always*" and 1 "*Never*". The original Cronbach Alpha value of the scale was .895, and the Cronbach Alpha value in this study was .904. The original scale's reliability coefficients were .82, .79, .76, and .69 for motivation, self-control, self-monitoring, and self-confidence dimensions, respectively. In the study, these values were calculated as .84, .81, .79, and .71.

The semi-structured interview form, which is the last data collection tool of the study, was developed by the researcher. The interview form was prepared to reveal students' views on the effects of the mind mapping method in web-based courses on MLS and SLS levels. Different field experts were consulted during the interview form preparation. Two of these experts are experts in computer and instructional technologies, two in educational sciences, and one in the field of measurement and evaluation. There are two open-ended questions in the interview form.

The scope of the questions in the interview form is limited to metacognitive learning strategies and self-directed learning skills and their sub-dimensions. Before collecting the data with the interview form, information and explanations were given to

the students about metacognitive learning strategies and self-directed learning skills and their sub-dimensions. The students' opinions in the experimental group were taken with the interview form.

Data Analysis

Since the data obtained from the MLS and SLS scales of the study showed normal distribution ($Skewness_{MLS=}$ .113, $Kurtosis_{MLS=}$ -1.005, $Skewness_{SLS=}$ .056, $Kurtosis_{SLS=}$ -.323) the dependent sample t-test was used to compare the pre-test and post-test results of the groups. In addition, the post-test results of the groups were examined with the independent sample t-test to determine whether the mind mapping method affected students' MLS and SLS levels. The effect size value was examined to determine whether the results obtained with dependent and independent sample t-tests were significant in practice. In this context, the Eta square ($\eta 2$) value was considered.

In addition, student views on the effects of using the mind mapping method in web-based courses on MLS and SLS levels were analyzed by the content analysis method. In this analysis process, related themes and codes were determined in line with the answers given by the students to open-ended questions. Then, the relationships between these themes and codes were revealed. In this way, an in-depth analysis was done.

Implementation Process

The application phase of the study was carried out in a total of ten weeks within the scope of the information technology course. During the implementation phase, different subjects in the information technology course curriculum were explained to the students. In practice, the lessons were taught to the experimental group with digital mind maps and to the control group with traditional methods (direct instruction, question-answer, discussion). In this context, digital mind maps were used in different parts of the online courses held in the experimental group and in some extracurricular activities. In the lessons with the experimental group, digital mind maps were used in the stages of drawing attention, informing the target, reminding about previous subjects, and introducing the new subject. In addition, digital mind maps were used effectively at every stage of the course in subjects where the number of newly learned concepts is higher in technological terms, and the complex relationships between these concepts are difficult to understand. In addition, in the last sections of the lessons, repetition and determination of the points that are not understood were carried out using digital mind maps.

In extracurricular activities, students were asked to perform activities individually to create mind maps in digital environments. For this purpose, the "Coggle" website, where students can create collaborative or individual digital mind maps on the internet without paying a fee was proposed, and they were encouraged to use this website. This process was carefully followed by the researcher. The researcher planned and conducted all the courses with the experimental and control groups using the information technology course curriculum. Web-based courses were carried out using the Microsoft Teams program. The introduction of the experimental and control groups to online courses was carried out at different times.

In order to determine the MLS and SLS levels of the experimental and control groups of the study, the "Metacognitive Learning Strategies Determination Scale" and "Self-Managed Learning Skills Scale" were applied during the pre-test and post-test phases. In this context, the "Semi-Structured Interview Form" was used to reveal student opinions. The differences between the pre-test and post-test scores of the groups were examined to determine the effects of using the mind mapping method in web-based courses on students' MLS and SLS levels. Then, the post-tests of the experimental and control groups were compared, and the effects of the mind mapping method on MLS and SLS levels were revealed. At the last stage, students' views in this context were analyzed.

Findings

The Scores of the Groups Regarding MLS and SLS Levels

The dependent sample t-test was used to determine whether there was a statistically significant difference between the pre-test and post-test scores of the students in the groups regarding their MLS and SLS levels. The findings obtained from this test were found to be statistically significant (t= -2.206, p< .05), and control (t= -.105, p< .05) results showed that there was a significant difference between the pre-test and post-test scores of the MLS of the groups (Table 1).

Table 1

Dependent Sample T-Test Results Related to MLS of the Groups

Groups		*n*	M	*sd*	*t*	*df*	*p*	η2
Exp. Group	Pre-test	37	118.14	9.97	-2.206	36	.034	.118
	Post-test		123.08	11.23				
Control Group	Pre-test	37	117.14	10.10	-.105	36	.917	-
	Post-test		117.41	10.68				

It was observed that there was a significant difference between the pre-test and post-test scores of the students in the experimental group (t= -2.226, p< .05) in terms of self-directed learning skill levels of the students in the groups. In the control (t= -.574, p> .05) group, there was no significant difference between the scores of these tests (Table 2).

Table 2

Dependent Sample T-Test Results Regarding the SLS Levels of the Groups

Groups		*n*	M	*sd*	*t*	*df*	*p*	η2
Exp. Group	Pre-test	37	73.46	8.41	-10.073	36	.001	.738
	Post-test		92.68	8.26				
Control Group	Pre-test	37	73.76	7.25	-1.03	36	.306	-
	Post-test		76.49	15.72				

The Impact of Mind Mapping Method in Web-Based Courses on Students' MLS?

An independent sample t-test was used to determine whether the mind mapping method has an effect on students' MLS in web-based courses. The findings obtained from this test showed that there was a significant difference between the pre-test and post-test scores (p< .05) in favor of the experimental group in terms of MLS (Table 3).

Table 3

Independent Sample T-Test Results Related to MLS of the Groups

Groups	*n*	M	*sd*	*t*	*df*	*p*	η2
Exp. Group	37	123.08	11.23	2.226	72	.029	.064
Control Group	37	117.40	10.68				

Does the use of the mind mapping method in web-based courses affect students' self-directed learning skill levels?

An independent sample t-test was used to evaluate the effect of the mind mapping method on the self-directed learning skill levels of the students in the experimental and control groups. Among the findings related to the test, there was a significant difference between the scores of self-directed learning skill levels of the students (p< .05) in favor of the experimental group (Table 4).

Table 4

Dependent Sample T-Test Results Regarding the SLS Levels of the Groups

Groups	*n*	M	*sd*	*t*	*df*	*p*	η2
Exp. Group	37	92.67	8.26	5.541	72	.001	.298
Control Group	37	76.48	15.72				

The Students' Views on the Effects of Using Mind Mapping in Web-Based Courses on MLS and SLS Levels

The content analysis method was used to analyze students' views on the effects of using the mind mapping method in web-based courses on MLS and SLS levels. The students were asked two open-ended questions through the interview form. The first one was "*How do you think the use of mind mapping in your lessons affects your metacognitive learning strategies?*" and secondly, "*How do you think the use of mind mapping in your lessons affects your self-regulated learning skills?*" was asked. The answers given to these questions were analyzed in detail. In this context, the themes and codes were created by taking into account the data obtained, and subsequently, the categories were determined (Table 5, 6).

Table 5

The Effects of the Mind Mapping Method on Determining the Metacognitive Learning Strategies According to the Students

Theme	Category	Codes	*f*
Metacognitive learning strategies	Planning	Determining study strategies according to course subjects	32
		Setting goals according to the subject of the course	30
		Determining the needs related to the subject	29
		Recognizing mistakes and correcting them	30
	Monitoring	Thinking about better learning	29
		Reflection on regulations	32
		Thinking about Methods and Strategies	30
		Monitoring the processes related to the subjects	27
	Assessment	Asking and answering questions about the subject	24
		Self-assessment	27
	Affective Strategies	Don't believe you'll succeed	29
		Minimizing the level of anxiety	25
		Being able to cope with negative situations	22

According to Table 5, the students who used the mind mapping method in their lessons stated that they determined their study strategies (*f*= 32), goals (*f* = 30), and needs (*f*= 29) according to the course subjects with the help of this method; thus, they realized their mistakes related to the subject and corrected them (*f*= 30). Students stated that they could better follow the processes related to the subjects (*f*= 27) by thinking about how to learn better using this method (*f*= 29), the necessary arrangements (*f*= 32), and the methods and strategies used (*f*= 30). In addition, the students stated that the method helps them in following the processes related to the course subjects (*f*= 27), asking and answering questions about the subject themselves (*f*= 24), and making self-evaluations (*f*= 27). In addition, students reported that the mind mapping method minimized their anxiety levels towards learning by increasing their beliefs about being successful (*f*= 29) and coping with negative situations (*f*= 22) (*f*= 25). Codes were created and classified by using the data on student opinions. In line with the answers given by the students to the open-ended questions, the relevant codes and themes were determined. Then, the relationships between these codes and themes were revealed within the scope of certain expressions and keywords. Some of the students' views on this are given below.

"This method is effective in making plans for different situations and implementing these plans for learning. In addition, this method can help us develop positive attitudes about what we will learn, increase our motivation, and recognize our mistakes and correct them." (S:13).

"The mind mapping method helped me to identify the knowledge and skills I needed on different topics, to decide how I could learn better, and to determine the strategies to follow for this." (S:17).

"This method eliminated the complexity by following the processes related to the subjects, I asked and answered questions to myself while studying with mind maps, and also made my self-assessment in general." (S:32).

Table 6

The Effects of the Mind Mapping Method on Self-Regulated Learning Skills According to Students

Theme	Category	Codes	*f*
Self-regulated learning skills	Motivation	Identifying learning needs	30
		Establishing learning objectives	27
		Being open to learning	25
		Self-sufficiency	27
	Self-Monitoring	Reviewing the learning process	29
		Learning performance evaluation	28
		Identifying learning gaps	28
	Self-Control	Systematic monitoring of the learning process	22
		Self-criticism	20
		Leveraging different learning strategies	25
	Self-confidence	Managing the learning process effectively	25
		Enjoying learning	29
		Being responsible for his/her decisions	23

In Table 6, it can be seen that the students stated that the mind mapping method helped them in determining their learning needs (*f*= 30), revealing their learning goals (*f*= 27), being open to learning (*f*= 25), and finding themselves sufficient (*f*= 27). Using this method, students stated that they could review their learning processes (*f*= 29), evaluate their learning performance (*f*= 28), and determine their learning deficiencies (*f*= 28). In addition, students reported that the method was effective in systematically monitoring the learning process (*f*= 22), self-criticism process (*f*= 20), and benefiting from different learning strategies (*f*= 25). Furthermore, the students stated that the mind mapping method also supports their ability to manage the learning process effectively (*f*= 25), enjoy learning (*f*= 29), and taking responsibility for their decisions (*f*= 23). Codes were created and classified by using the data on student opinions. In line with the answers given by the students to the open-ended questions, the relevant codes and themes were determined. Then, the relationships between these codes and themes were revealed within the scope of certain expressions and keywords. Some student views that display the following situations are presented below:

"I can use my time effectively with the mind mapping method. In addition, using this method, I can evaluate my performance as an individual." (S:18).

"This method helped me identify my learning needs, review the process, and manage it effectively." (S:20).

"The mind mapping method gave me systematically in my learning process." (S:11).

"I think this method is effective on my learning skills because it has contributed to me in determining my needs while producing solutions to many problems." (S:34).

Ethical Procedures

Ethical permission (31.01.2022-E-66323135-900.99-4512) was obtained from Kafkas University Social and Humanities Ethics Committee institution for this research.

Discussion and Conclusion

This study was carried out to determine the effects of the use of the mind mapping method in web-based courses on students' MLS and SLSs and to determine the students' views on this. The differences between the pre-test and post-test scores of the students in the experimental and control groups regarding their MLS and SLS levels were examined separately in the experimental and control groups. The results showed a significant difference between the pretest-posttest scores of the experimental group and no significant difference between the pretest-posttest scores of the control group. In addition, the post-test scores of the experimental group regarding MLS and SLS levels were found to be higher than the control group. This shows the positive effects of using the mind mapping method in web-based lessons on the MLS and SLSs of the students in the experimental group. It can be said that the mind mapping method developed and applied in the experimental group has significant contributions to students' different MLS and SLSs. The change in the pre-test and post-test scores of the experimental group regarding MLS and SLS levels have clearly shown the contribution of the mind mapping method to the process. Thanks to the mind mapping method, students in the research group were successful in using different MLS and self-directed learning skills effectively. This method increased the effective use of cognitive learning strategies of the students in the experimental group and increased their self-learning skill levels. This situation may be due to the positive contributions of mind mapping on issues such as the connections and relationships between knowledge, thoughts, ideas, concepts, visualization, association, concretization, categorization, and remembering (Mutlu et al., 2019). However, the fact that the students in the experimental group made cognitive activities easier by eliminating the gaps and deficiencies in the course subjects and visualizing the concepts with the mind mapping method (Hardy & Stadelhofer, 2006; Nesbit & Adesope, 2006) may also have affected the situation. In the literature, the number of studies examining the effects of mind mapping method on metacognitive learning strategies and self-directed learning skill levels is negligible. However, it is possible to reach studies that are thought to have similar results in the literature. (Al-Jarf, 2011; Brinkmann, 2007; Corebima et. al, 2018; Çoban & Selçuk, 2017; D'Antoni, 2009; Dhindsa et al., 2011; Ismail et al., 2010; Kelepçe, 2021; Maltepe & Gültekin, 2017; Sarıpınarlı, 2018; Shihusa & Keraro, 2009; Tucker et al., 2010). These studies examined the effects of mind mapping method on academic achievement, attitude, cognitive load, summarizing, questioning, reading comprehension, spelling, writing, programming, problem-solving skills and different variables associated with these skills.

On the other hand, there are other findings in the literature that differ from those of this study (Çamlı, 2009; Nurlaila, 2013; Tümer, 2006). The results of this study are

particularly related to the time-consuming aspect of the method. The fact that mind mapping has a metacognitive structure that facilitates the acquisition of information in the meaningful learning process (Abdel-Hamid, 2017), as well as visualizing the processes of thinking, understanding, and organizing information (Somers et al., 2014), allows establishing the connections between concepts in a short and effective manner (Christensen & Hooker, 2000). Mind mapping can be seen as a powerful method for planning, grouping, and organizing thoughts according to certain standards and revealing creativity (Buzan, 2008). In fact, the students in the experimental group were able to develop various thinking skills by establishing connections and relationships between pieces of information and different concepts using the mind mapping method (Israel et al., 2020). In this study, an effective learning environment could be created by visualizing the course contents (Şeyihoğlu & Kartal, 2010) in order to organize learning regularly with the mind mapping method. In addition, thanks to this method, the lessons became enjoyable, and ensured the students' willing participation, which aided them in structuring and remembering information (Evrekli & Balım, 2010). In this context, through the mind mapping method, effective learning was achieved by enabling students to use different MLS and SLSs.

In the study, it was understood that there was a significant difference between the experimental and control groups in terms of scores related to MLS and SLS levels. The scores of the students in the courses supported by the mind mapping method regarding the MLS and self-directed learning skill levels were found to be higher than the students whose courses were conducted with traditional methods. It is possible that this situation was brought on by the experimental group's use of the mind mapping method. The fact that the mind mapping method can help students in the experimental group to make the brain more open to learning (Shafir, 2003) on behalf of storing, organizing, and ordering information (Buzan, 2009a) by visualizing the thinking, understanding, and organizing processes (Somers et al., 2014) with different forms and connections, may have affected this situation. Moreover, it can be said that the students in the research group can organize their thinking systems with the mind mapping method and produce different ideas and thoughts more easily (Lutfia, 2020).

There are no studies in the literature in which the study variables are included together. However, there are studies in the literature examining the effects of mind mapping on variables associated with these variables (Al-Jarf, 2011; Brinkmann, 2007; Buran & Filyukov, 2015; D'Antoni, 2009; Dhindsa et al., 2011; Erdem, 2017; Ismail et al., 2010; Parikh, 2016; Saori, 2020; Sarıpınarlı, 2018; Shihusa & Keraro, 2009; Stankovic et al., 2011; Thi Van Anh, 2020; Tucker et al., 2010).

Among the studies examining the effects of the mind mapping method on different variables, few studies show that the method is ineffective. The results of Kartal and Turan's (2015) study that mind mapping has no effect on academic achievement can be shown as an example. Evrekli et al. (2011) study on the use of mind maps in science teaching constitutes a different example in this sense, in terms of motivation for science learning, attitude towards science and technology, and perception levels of questioning learning skills. The fact that mind mapping method can easily be used in learning, remembering, and organizing content related to a subject (Buzan & Buzan, 2006; Eppler, 2006) and can help multifaceted thinking (Stankovic et al., 2011) have supported the positive effect of MLS and SLS levels of the students in the experimental

group. In this sense, the mind mapping method affected the results obtained by allowing the students in the experimental group to develop their skills and abilities such as attention, logic, reasoning, analysis, planning, coordination, and integration (Wen-Cheng et al., 2010).

This study revealed that students' views on the application of the mind mapping method in web-based courses were generally positive. The students stated that the mind mapping method helped them use MLS effectively. In this context, students emphasized the issues related to the dimensions of planning, monitoring, evaluation, and effective strategies in their views on the effects of the mind mapping method on MLS. Different results were obtained from the students on the issues related to these dimensions. Using the mind mapping method, students' opinions were able to determine the needs, goals, and working strategies according to the course subjects in the planning dimension. Thus, they were able to correct them by anticipating their mistakes. In the monitoring dimension, students could follow the process in a healthy way by thinking about how better learning can be realized, which arrangements should be made, and the methods and strategies to use. In the evaluation dimension, the method was able to help students in obtaining answers and make self-evaluations by asking questions about the subjects. In addition, students were able to minimize their anxiety levels by increasing their beliefs about being successful and coping with negative situations by using the method in the affective strategies dimension. Similar findings were found in Nurlaila's (2013) study on students' positive perceptions of how mind mapping increases interest and motivation for the lessons. It is possible to see similar results in the literature (Erdem, 2017; Eşmekaya, 2019; Ismail et al., 2010; Mohaidat, 2018; Nurlaila, 2013; Parikh, 2016; Stankovic et al., 2011; Şeyihoğlu & Kartal, 2010; Tonga, 2022).

Students could not actively participate in the learning process by using the mind mapping method, and thus their interest in the lesson increased. (Edwards & Cooper, 2010) In this sense, students stated that they could use their SLSs effectively and develop these skills with the mind mapping method. In their views on the effects of the method on SLSs, students touched on the issues related to motivation, self-monitoring, self-control, and self-confidence. Different results were obtained from the opinions of the students on these dimensions. The study showed that the mind mapping method increased students' motivation by providing support in determining their learning needs, expressing goals, being open to learning, and finding themselves sufficient. Students were able to continuously review the learning process using the method, determine their learning deficiencies, evaluate their learning performance, and perform self-monitoring. The method was able to help students perform self-control by systematically monitoring the learning process, benefiting from different learning strategies, and criticizing themselves. In addition, it was found that the students who used the mind mapping method increased their self-confidence by effectively managing their learning processes, taking responsibility for their decisions, and enjoying learning. The mind mapping method may have contributed to the situation by significantly supporting students' skills and abilities, such as attention, logic, reasoning, analysis, planning, coordination, and integration (Wen-Cheng et al., 2010). Additionally, students can develop their critical thinking skills by effectively establishing the connections and relationships between knowledge and concepts thanks to the mind mapping method (Israel et al., 2020). There

are similar results in the literature (Jones et al., 2012; Kartal & Turan, 2015; Nurlaila, 2013; Parikh, 2016; Stankovic et al., 2011; Tonga, 2022).

There are not many studies that contain negative opinions about the mind mapping method. In this sense, the results of the studies show that the method is time-consuming (Nurlaila, 2013; Tümer, 2006). However, no such finding was found this study's results on student opinions. In fact, the increase in the interest of the students, as well as their love, and curiosity towards the lesson in terms of effective gains with the mind mapping method have increased their self-confidence and enabled them to be more motivated for the lesson (Pullu & Kan, 2022).

As a result, in this study, it was found that there was a significant difference between the test scores of the students who used the mind mapping method in web-based courses regarding their MLS and self-learning skill levels. In addition, the study showed a significant difference in favor of the experimental group between the scores related to MLS and self-learning skill levels of the experimental and control groups. From the findings on student opinions, it was understood that the students had positive opinions about the mind mapping method. In addition, the students' opinions showed that this method made significant contributions to their MLS and self-learning skill levels. In this context, the study will guide the people and future studies related to the field that will benefit from the mind mapping method to support students in using and developing different learning strategies and skills in web-based courses. From this point of view, various suggestions were presented to the researchers based on the findings and results of the study.

In the study, the effects of the mind mapping method on prospective teachers' MLS and SLS in web-based courses were examined. Research variables can be diversified by selecting different study groups in future studies. The study was designed and conducted with a quasi-experimental design. In this sense, methods based on qualitative research approaches can be used in future studies. The students' readiness levels in the study's research group to prepare digital mind maps were ignored. In this regard, paying attention to this situation in future studies may further increase the effectiveness of the study. A significant majority of the students expressed positive opinions about the use of mind mapping method in web-based courses. In this respect, the mind mapping method can be used in courses and activities at different educational levels.

Author Biography

He was born in 1983 in Kars. He completed her primary and secondary education in Kars. He completed his undergraduate education at Mersin University Tarsus Technical Education Faculty Electronics and Computer Department. He completed his master's degree at Kafkas University. Cengiz Gündüzalp is currently working as a Ph.D. Lecturer in the Computer-Aided Design and Animation program of the Kazım Karabekir Vocational School of Technical Sciences, Computer Technologies Department at Kafkas University. He has completed her Ph.D. degree in the Department of Computer Education and Instructional Technology from Ataturk University in Turkey. His research interests are in computer-based instruction, interactive videos in education, digital plays, web 2.0 technologies, teaching methods, e-learning, distance learning, instructional design, and research methods.

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