Australian Journal of Teacher Education

Volume 39 | Issue 1 Article 5

2014

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Recommended Citation
Tanriseven, I. (2014). A Tool That Can Be Effective in the Self-regulated Learning of Pre-service Teachers: The Mind Map. *Australian Journal of Teacher Education, 39*(1).
http://dx.doi.org/10.14221/ajte.2014v39n1.1

A Tool That Can Be Effective in the Self-regulated Learning of Pre-service Teachers: The Mind Map

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Abstract: The aim of this study is to analyse the effect of task planning with mind maps on the self-regulation strategies and motivational beliefs of pre-service teachers. A quasi-experimental design, with a pre-test and post-test control group, was applied in the research. The research group comprised of 60 pre-service teachers taking "Teaching Principle and Methods", in the second year at the Faculty of Education Elementary School Department at Mersin University, Turkey. Students in the experimental group planned their tasks individually by means of a mind map, whereas students in the control group directly realized their task. Before and after the experiment, both groups completed the "Motivated Strategies for Learning Questionnaire", while students in the experimental group also completed the open-ended questionnaire. The research results indicated that there was a meaningful difference between the self-regulated learning of both groups, in favour of the experimental group. Pre-service teachers comprising the experimental group stated that planning by means of mind map had positive effects on the use of self-regulation strategies and their motivation.

Introduction

Within the context of Turkish education, self-regulation is considered important aspect of a student's academic performance and success in classroom settings. Pintrich (2000: 453) defined self-regulation as "an active and constructive process whereby learners set goals for their learning and then attempt to monitor, regulate and control their cognition, motivation and behaviour, guided and constrained by their goals and the contextual features in the environment".

In his model based on Social Cognitive Theory, Pintrich (1999; 2000) asserted that the organisation of learning processes materialises through self-regulation strategies and motivational beliefs. Self-regulation strategies include; the opportunity provided for individuals to organise their learning processes; rehearsal used for activating knowledge in working memory; elaboration providing for the association of the newly learned with preliminary learning; organisation enabling the selection of knowledge by correlating between knowledge; metacognitive strategies for critical thinking and control of cognition; the time and study environment which students may use for organising their own surroundings and study environment; and effort management strategies (Pintrich, 1999; Pintrich, Smith, Garcia & McKeachie, 1991; Wolters, Pintrich & Karabenick, 2003).

Motivational beliefs, forming the second dimension of self-regulated learning, include the goals of the learner, their beliefs in the importance of the task to be performed, the beliefs of the learner in their performance skill with respect to a task, and the emotional reactions towards the task (Pintrich & De Groot, 1990). In this context, it is stated that individuals with developed self-regulation skills hold the properties of taking responsibility for their own

successes, taking efforts to learn, developing strategies to learn when faced with obstacles, trusting their learning abilities, planning for the effective use of time and environment, and the organisation of the study environment (Zimmerman, 1990; Pintrich, 2000; Wolters et al., 2003).

Teachers play a crucial role in promoting SRL (Lombaerts, De Backer, Elgels, Van Braak & Athanasou, 2009). While teachers can in practice teach self-regulation directly through reflection, metacognitive deliberation and participation, they can also teach it indirectly by setting a model and events necessitating reflective analyses concerning learning (Paris & Paris, 2001). However, Zimmerman, Bonner and Kovarch (1996) stressed that few teachers prepare students for effective learning, encourage them to set learning targets and evaluate their studies, or assess their motivational beliefs in learning. Smilarly Dignaht-Van Ewijk and Van Der Werf (2012), determined that few teachers address strategy instruction when being asked about their understanding of SRL. The setting of a model in class for the development of students' self-regulation, and their ability to teach self-regulation, depends to a great extent on teachers' self-regulation skills (Dembo, 2001). Educators and researchers believe that teachers' ability to cultivate learners who are self-regulated is tied to teachers' own self-regulation. (Michalsky & Schechter, 2013). Gordon, Dembo and Hocevar (2007) determined that there is a relationship between a teacher's own learning behaviour and their practices in class. There is a high correlation between teachers' self-regulation skills, and the skills of students in developing their self-regulation (Randi, 2004). In this context, research on both teachers (Perels, Merget-Kullman, Wende, Schmitz & Buchbinder, 2009) and pre-service teachers (Perry, Phillips & Dowler, 2004), suggests that learning programmes based on self-regulated learning have positive effects on the development of students' self-regulation skills.

In recent years, researchers conducting studies on the education of teachers has emphasized that lack of transfer from theory to practice of teacher education programs, and that pre-service teachers are unable to reflect their knowledge and skills onto real classroom environments (Korthagen, Klaassen, & Russell, 2000). This condition can also be caused the structure of teacher education programs, as well as pre-service teachers. In this sense, providing timely opportunity to apply what they have learned and creating classroom settings suitable to apply what has been learned may be important factors for teacher education. Teacher educators have emphasized the need to implement programs based on active learning and develop the lifelong learning and self-regulation skills of teacher candidates (Kremer-Hayon & Tillema, 1999; Marchis, 2011). However, Buzza and Allinottle (2013) stated that not all teacher preparation programs offer opportunities to learn about and implement SRL practices. It is also stated that pre-service teachers do not use effective learning strategies as students at a sufficient level (McClendon, 1996). For this purpose it is necessary to correlate between professional courses in teacher education programmes, experience and self-regulation skills (Dembo, 2001). Research also suggests that there is a meaningful relationship between the self-regulation strategies and self-efficacy of pre-service teachers (Orhan, 2008; Uredi, 2008), and their academic successes (Hwang & Vrongistinos, 2002; Uredi, 2008). According to Dembo (2001), if pre-service teachers see the positive effects of self-regulation skills on their own learning, they will believe in its importance and become motivated to develop their students' self-regulation skills. Therefore, it is possible to say that teacher education programmes must create learning environments where pre-service teachers can structure their learning. The efficiency of learning environments with regard to improving pre-service teachers' self-regulation skills during teacher education process has been tried and tested with many researches, as well. These researches suggest the positive effects of cooperative learning supported with reflection materials (Guvenç, 2011), portfolio assessments (Strijbos, Meeus & Libotton, 2007), technology-based teaching activities (Kramarski & Michalsky, 2010) and scaffolding applications (Perry, Hutchinson & Thauberger, 2008) on self-regulation. Vrieling, Bastiaens and Stijnen (2012) put forth that

student teachers' use of metacognitive skills and motivation for learning increased significantly in learning environments with increased SRL opportunities. It is believed that one important factor, in ensuring the development of pre-service teachers' self-regulation skills, is the use of mind maps in the learning-teaching process.

Mind maps have a long history. Representation type examples of mind map such as diagrams related to concepts, flow charts, some speacial distribution, map of physical objects or graphically visualized the concept categories can be seen in ancient times. This kind of graphic representation has existed for centuries, as evidenced by cave drawings of primitive man, hieroglyphics of ancient Egypt, and sketches of great thinkers such as Michaelangelo and Leonardo da Vinci (Mento, Martinelli & Jones, 1999). But mind maps were very popular at the end of the 1960s based on studies by Tony Buzan and his colleagues with regard to learning and retrieval. They are a visual tool that enable the detection of preliminary information, the correlation between preliminary and new information, and the organisation of ideas and memorising, thereby increasing effective learning (Buzan & Buzan, 1993; 2011). This visual tool is based on the placement of the main idea at the centre of the paper, and sub ideas are placed below the main idea by organising them hierarchically using shapes, images, codes, symbols and keywords (Goldberg, 2004). This process ensures the use of both lobes of the brain and their joint functioning, as it includes both analytical inference and special tasks (Brinkmann, 2003). Research examining the efficiency of mind maps on the learning process has shown that mind maps have positive effects on students' comprehension, retention (Aslan, 2006; Aydın, 2010), success (Abi-El-Mona & Adbkhalick, 2008; Akinoglu & Yasar, 2007; Cunnigham, 2005; Polson, 2004), attitude towards the course, concept learning (Akinoglu & Yasar, 2007), motivation (Goodnough & Woods, 2002; Keles, 2012; Polson, 2004), construction of knowledge (Dhindsa, Makarimi & Anderson, 2011; Eppler, 2006), metacognitive knowledge and problem solving (Ismail, Ngah & Umar, 2010).

When research into mind maps is analysed, it is seen that these studies primarily focus on the positive effects mind maps have on students' learning. Previously conducted studies haven't used the mind map technique as a planning tool in learning processes. However, in addition to increasing the effectiveness of education as a learning and teaching tool, mind maps have others uses such as target formation, presentation preparation, planning, project construction, and test preparation in the context of ensuring individual development (Buzan & Buzan, 2011). These processes, based on the planning of events to be held, thinking of the alternatives, reflection and observation at the same time, include self-regulation skills (Eilam & Aharon, 2003). As teachers represent one of the most important factors that influence students' learning and the development of self-regulation skills, it is necessary to develop the self-regulation skills of teacher candidates during their pre-service education. In this context, it is possible to say that studies on the development of self-regulation skills among teacher candidates, and on the role of mind maps in developing self-regulation skills, will contribute significantly to effective learning during teacher education. In particular, planning and time management strategies comprise important cognitive structures of self-regulation for academic success (Zimmerman & Risemberg, 1997, cited in Eilam & Aharon, 2003). Therefore, the use of mind maps by pre-service teachers as a planning tool in the learning process will develop their self-regulation skills, increase their motivation, and thereby contribute to the setting of a model for their students' self-regulation. Furthermore, despite the fact that there are numerous studies regarding the effect of mind maps on learning, there are no previous studies regarding its effects on self-regulation. In this respect, it is believed that the current study will contribute to the development of a new perspective and understanding regarding the development of self-regulation skills among teacher candidates. It is further believed that it will contribute to teacher candidates' ability to implement what they have learned, and that it will serve as a basis for future studies. The use of mind maps and task-planning tools will provide teacher candidates with the opportunity to structure their own learning. From this viewpoint, the aim of this study was to analyse the effect of task planning

with mind maps on pre-service teachers' self-regulation strategies and motivational beliefs. Answers are sought for the following questions in this respect:

1. Are there any differences in the self-regulated learning strategies and motivational beliefs of teacher candidates between the experimental and control group?
2. What are the views of teacher candidates on the effects of task planning by using mind maps in their self-regulated learning strategies and motivational beliefs?

Method

Research Design

For this study a quasi-experimental design with a pre-test and post-test group was used. As part of the research, both groups discussed the main concepts of teaching, its principles and contemporary approaches, planning, teaching methods and techniques. Students were assigned a research task within the scope of these subjects. Students in the experimental group individually planned their task by using mind maps, while the students in the control group directly realized their task. The self-regulation strategies and motivational beliefs of both groups were compared before and after the experiment.

Research Group

The research group was comprised of 60 pre-service teachers taking "Teaching Principle and Methods" in the second year of the autumn semester during the 2011-2012 academic year, at the Faculty of Education Primary School Department at Mersin University. One group of students taking the "Teaching Principle and Methods" course was randomly selected as the experimental group (n=30), while students in the other section were randomly selected as the control group (n=30). Eighteen students in the experimental group were female, while 12 were male. Sixteen students in the control group were female, while 14 were male.

Data Collection Tools

Data was collected by means of the Motivated Strategies for Learning Questionnaire (MSLQ) and an open-ended questionnaire.

Motivated Strategies for Learning Questionnaire

The Motivated Strategiesfor Learning Questionnaire (MSLQ) is a self-report instrument designed to assess college students' motivational orientations and their use of different learning strategies for a college course. The MSLQ, based on a general cognitive view of motivation and learning strategies, contains two sections. The motivation section consists of 31 items that assess students' goals and value beliefs for a course. The learning strategies section includes 31 items regarding students' use of different cognitive and metacognitive strategies and 19 items concerning student management of different resources (Pintrich et al. 1991). This was developed by Pintrich et al. (1991) and adapted into Turkish by Büyüköztürk, Akgün, Özkahveci and Demirel (2004) to measure the self-regulation strategies and motivational beliefs of students. The fifteen different scales on the MSLQ can be used together or singly. The scales are designed to be modular and can be used to fit the

needs of the researcher or instructor (Pintrich et al. 1991). In accordance with the aim of this research, the following subscales were used: goal orientation (Cronbach alpha = .59), self-efficacy regarding learning and performance (item; Cronbach alpha = .86), test anxiety (5 items; Cronbach alpha = .69) in motivation section and rehearsal (4 items; Cronbach alpha = .62), organisation, (4 items; Cronbach alpha = .61), elaboration (4 items; Cronbach alpha = .74), metacognitive self-regulation (11 items; Cronbach alpha = .75), time and study environment (8 items; Cronbach alpha = .61), and effort management (3 items; Cronbach alpha = .41) in learning strategies section. Students rate themselves on a seven point Likert scale from "not at all true of me" to "very true of me." Scales are constructed by taking the mean of the items that make up that scale. Examples related to items of the subscales of the MSLQ which fall into learning strategies section are presented below (Pintrich et al. 1991):

"I make good use of my study time for this course" (time and study environment subscale, item 43)

"When I study for this class, I set goals for myself in order to direct my activities in each study period" (metacognitive self regulation subscale, item78)

"Even when course materials are dull and uninteresting, I manage to keep working until I finish" (effort regulation subscale, item 74)

Open-ended Questionnaire

The questionnaire asked two open-ended questions: "What effects do using mind maps to plan have on your learning processes?" and "What effects do using mind maps to plan tasks have on your course motivation? The opinion of two experts was taken to understand the clarity of the questions.

Procedures

Research during the "Teaching Principles and Methods" course comprised of three hours of theory, and continued for a semester (thirteen weeks). In the first week, the experimental group was informed about the content of the course and the use of mind maps explained; how they are constructed, why they are used, and their difference from concept maps (Buzan & Buzan, 1993; 2011).

Centralizing the main idea during the period of study given with respect to the preparation process of mind maps, identifying the sub-themes under the main idea, drawing and illustrating the connections between ideas, and a study respecting the usage of key words and pictures were put through. In the study regarding how mind maps are formed and which was conducted inside the classroom, students were asked to construct mind maps on the subject of "My Goals Regarding Teaching Principles and Methods". Feedback was provided by analyzing the mind maps generated by students. Starting with a central image and key words, colors, codes, symbols, view of diagram related to concepts their mind maps were different from more traditional methods of outlining such as list and traditional note taking.

In line with these explanations, students were asked to construct mind maps to plan the task they would complete throughout the semester. It was indicated clearly that during the process of generating mind maps with the aim of planning, teacher candidates would designate their ideas in accordance with the questions of "Why?", "What?", "Who?", "When?", "Where?" and "How?" while studying in conformity with the plan they would develop.

The tasks planned by students using mind maps as below:

- Relationship between the main concepts of teaching: The main concepts of teaching were discussed by the pre-service teachers who then used mind maps to plan their tasks regarding the relationships between these concepts.
- Examining the elementary programme: Pre-service teachers were randomly divided into groups of six people. Each group was assigned the task of examining the elementary programme. Each pre-service teacher constructed a mind map on their own within their group, and in accordance with the group's subject matter.
- Contemporary approaches in teaching: Pre-service teachers were each assigned the subject of contemporary approaches in education and teaching. The teachers were asked to research contemporary approaches in education, in accordance with the subject matter of their class work, and construct a mind map on their own.
- Presentation preparation: Each pre-service teacher was assigned subjects relating to teaching methods and techniques, and asked to use a mind map to plan a presentation in a classroom environment.
- Constructing a course plan: The pre-service teachers were asked to use a mind map to construct a course plan for an elementary school course of their choice.
- Preparation to test: Pre-service teachers explained how they prepared for the test by using a mind map.

The pre-service teachers submitted mind maps, together with assignments at the appointed time, and the instructor gave feedback the following week. Feedback regarding the minds maps comprised of the elaboration of the main idea, the relationship between ideas, including images of their own (Buzan & Buzan, 1993). A sample of pre-service teacher's Turkish mind map about presentation preparation is shown in Figure 1; English version of this figure is shown in Figure 2; instructor's feedback related to mind map is shown in Table 1 and student task related to presentation is shown in Figure 3.

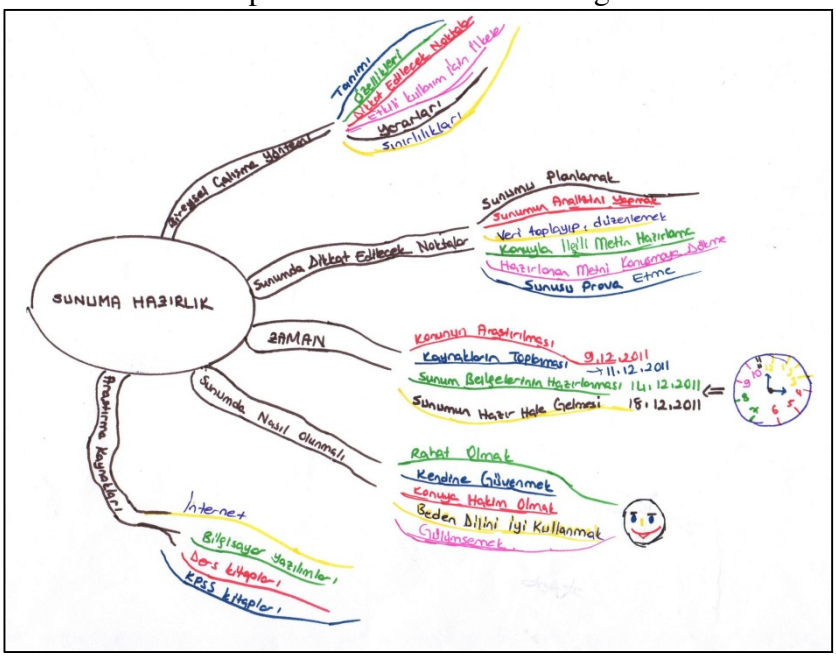

Figure 1. A Sample of Pre-service Teacher's Mind Map about Preparation of Presentation

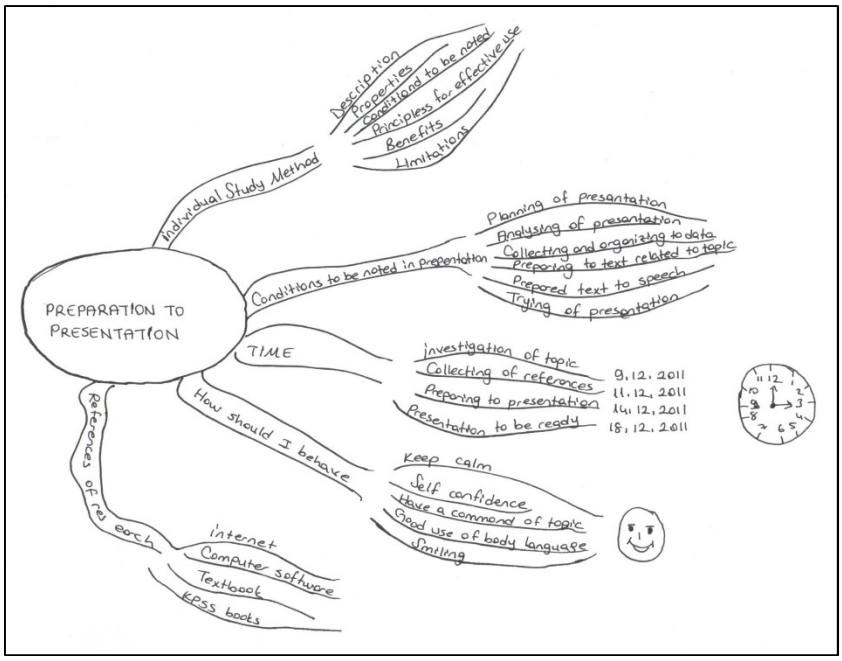

Figure 2. English Version of the Pre-service Teacher's Mind Map about Preparation of Presentation

As shown by the Figure 1 and Figure 2, the student who would make a presentation on the subject of "Individual Study Method" had identified five sub-themes, under the main theme of preparation to presentation, which are respectively sub-headings to be covered by individual study method, conditions that need to be kept in mind while preparing for the presentation, time to be spent for preparation, the presentation process and relevant research resources. Tasks to be undertaken within the scope of every single sub-theme were listed.

Student 1	**Developing main idea**		**Establishing connections between ideas**		**Unique visuals**		**Consistency with task process**	
	APP	INAPP	APP	INAPP	APP	INAPP	APP	INAPP
1.Relationship between the main concepts of teaching	✓		✓			✓	✓	
2.Preparation of group work		✓	✓		✓			✓
3. Preparation for class work	✓		✓		✓		✓	
4. Preparation to presentation	✓		✓		✓		✓	
5.Constructing a course plan	✓		✓		✓		✓	
6.Preparation to test	✓		✓		✓			✓

Table 1. A Sample of Instructor's Feedback about Pre-service Teacher's Mind Maps

When Table 1 is examined, exemplary feedbacks on all the mind maps respecting any single teacher are visible. In order of the relationship between the main concepts of teaching, preparation for group work, preparation for class work, preparation for the presentation, constructing a course plan and preparation to test; these subjects listed above are listed by the column. On the other hand; the subjects of developing main ideas, establishing connections between ideas, unique visuals and consistency with task process are listed on the row. Evaluations concerning every single criterion are checked as "appropriate" or "inappropriate".

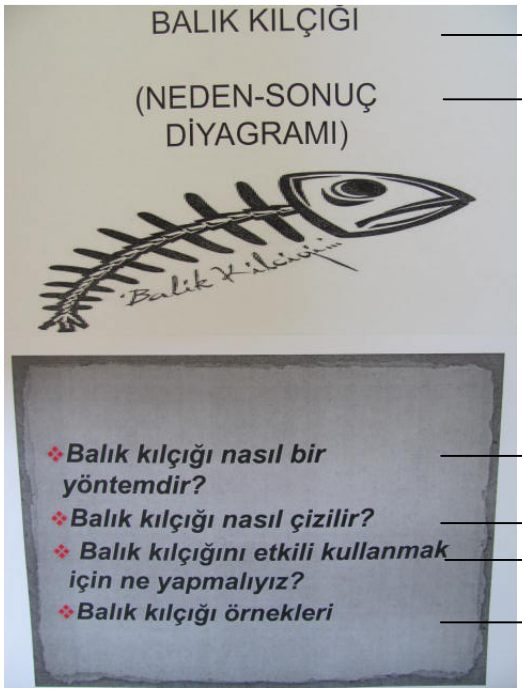

Figure 3. A Sample of Pre-service Teacher's Task about Presentation

In this research, each pre-service teacher was assigned subjects relating to teaching methods and techniques, and asked to use a mind map to plan a presentation related to this subject in a classroom environment. In Figure 3, an example from the power point presentation related to fishbone technique created by a pre-service teacher in accordance with his mind map structure is given. The student had identified the outline of the presentation he would give in this slide show. It was remarked that she would mention what a fishbone is, how it is drawn, its effective use and examples of it in the slide show respectively.

As with the experimental group, the control group of pre-service teachers was assigned the tasks of relating the main concepts concerning teaching, the examination of the elementary school programme in groups, examining contemporary approaches in teaching, presentation and course plan structuring. The students submitted their task on the dates they were assigned and held their presentations. Students received feedback concerning the task they completed. At the beginning and end of the teaching process, students in both the experimental and control groups completed the "Motivated Strategies for Learning Questionnaire". In addition, students in the experimental group completed the open-ended questionnaire.

Data Analysis

As the data conformed to normal dispersion, an "independent sample t-test" was applied to compare the self-regulation strategies and motivational beliefs of both groups, while a "paired sample t-test" was applied in paired comparisons within the same group. Content analysis was used to analyse the views of pre-service teachers on the effects planning with mind maps had on learning processes and motivation. During content analysis, coding was performed according to previously selected concepts. For the coding process, a list of themes was formed prior to data collection in accordance with the theoretical or conceptual framework that forms the basis of the study (Simsek & Yildirim, 1999). During the research, the dimensions present in Pintrich et al. (1991) "Motivated Strategies for Learning Questionnaire" were predicated for data encoding and construction of themes, while

frequencies of codes were stated. In this context, the elements of motivational belief and self-regulation strategies (which were part of the assessment tool) were considered as main themes. Characteristics pertaining to the conceptual framework were taken into consideration during the process of naming and designating the participants' statements.

Two researchers evaluated the answers given by the pre-service teachers to the open-ended questions. In addition, participants were coded as **"S1, S2** …" by including quotations from the pre-service teachers' statements.

Findings

In the research primarily it has been analyzed whether self-regulation strategies and motivational beliefs of pre-service teachers differ in experimental and control group or not. For this purpose, comparisons were made of the MSLQ of self-regulatated learning strategies (rehearsal, elaboration, organization, metacognition, time and study environment, effort management) and motivational beliefs (intrinsic goal orientation, self- efficacy, test anxiety) dimensions. Pre-test and post-test scores of self-regulation strategies and motivational beliefs of experimental and control group have been compared with "independent sample t-test" and the results have been presented in Table 2.

		Pre-test			**Post-test**	
		Group	$\bar{x}$	**Sd**	$\bar{x}$	**sd**
Self-regulation Strategies	**Rehearsal**	Control	21.8667	3.48131	21.3667	3.65290
		Experiment	21.1333	4.42355	22.1000	4.44390
	Elaboration	Control	32.4000	5.06237	34.7000	5.43393
		Experiment	32.0667	5.81872	37.2667	3.58092
	Organiz.	Control	22.4000	3.67283	22.0667	5.00988
		Experiment	22.0000	3.96537	25.4333	2.01175
	Metacog.	Control	62.0333	8.84925	63.6000	8.20261
		Experiment	60.3333	8.20149	68.0000	5.62016
	Time and study env.	Control	37.4667	4.54657	38.6000	4.70949
		Experiment	38.6000	3.87387	43.5333	4.43134
	Effort manag.	Control	15.4000	2.93140	15.3667	3.81904
		Experiment	15.9333	3.46344	17.6000	3.15791
Motivational Beliefs	**Intrinsic goal orientation**	Control	22.3667	4.19756	22.7333	3.59054
		Experiment	21.8333	4.37141	24.6000	2.51341
	Self-efficacy	Control	43.5000	6.72489	45.3667	6.11659
		Experiment	42.7000	7.67508	49.0333	5.12925
	Test anxiety	Control	15.2333	7.55067	16.6667	7.17435
		Experiment	17.6333	6.77970	14.1667	5.40806

$n_{experiment}$= 30, $n_{control}$= 30, df=58

Table 2. T-test Results Concerning the Pre-test and Post-test Score of Experimental and Control Groups

According to Table 2, there is no difference between the experimental and control groups' pre-test results in a statistical sense. According to this finding, it is possible to state that the experimental and control groups' self-regulation strategies and motivational belief scores were equal before the experiment. However, when the independent sample t-test results are analysed, according to the experimental and control groups' post-test mean, it is seen that among elaboration, organisation, metacognitive self-regulation, time and study environment, effort management strategy, intrinsic goal orientation and self-efficacy perception, there is a meaningful difference in favour of the experimental group. It is also determined that there is no meaningful difference between the experimental and control groups' test anxiety and rehearsal strategies average post-test means.

In order to test whether the applications made in the experimental and control groups form a meaningful difference within the groups, a "paired sample t-test analysis" was made and the results are presented in Table 3.

		Control Group				Experiment Group			
		pre-post	sd	t	p	pre-post	sd	t	p
Self-regulation strategies	Rehearsal	.5000	2.23992	1.223	.231	-.9667	3.80094	-1.393	.174
	Elaboration	-2.3000	4.17835	-3.015	.005	-5.2000	5.39732	-5.277	.000
	Organization	.3333	3.84469	.475	.638	-3.4333	3.57851	-5.255	.000
	Metacognitive	-1.5667	7.60528	-1.128	.268	-7.6667	7.30769	-5.746	.000
	Time and study env.	-1.1333	6.02714	-1.030	.312	-4.9333	5.91860	-4.565	.000
	Effort management	.0333	4.34292	.042	.967	-1.6667	4.02863	-2.266	.031
Motivational beliefs	Intr. goal orientation	-.3667	3.89060	-.516	.610	-2.7667	4.01449	-3.775	.001
	Self-efficacy	-1.8667	5.43763	-1.880	.070	-6.3333	6.88994	-5.035	.000
	Test anxiety	-1.4333	5.99243	-1.310	.200	3.4667	6.11800	3.104	.004

$n_{experiment}$= 30, $n_{control}$= 30, $df_{experiment}$ =29, $df_{control}$ =29

Table 3. Paired Sample T-test Results Regarding the Differences Between the Experimental and Control Groups' Pre-test and Post-test Scores.

Table 3 shows there is a meaningful difference between the experimental group's pre- and post-test scores at a $p<.01$ level for elaboration, organisation, metacognitive self-regulation, time and work environment, intrinsic goal orientation and test anxiety. In addition, there is a meaningful difference between their pre- and post-test scores at a $p<.05$ level for effort management strategy.

In the research pre-service teachers have been given information form that includes open-ended questions in order the effect of task planning with mind map on self-regulation strategies and motivational beliefs to be supported with the opinions of pre-service teachers. The answers that pre-service teachers have given for open-ended questions have been presented in Table 4 and Table 5 by determining the themes and codes analyzed by means of "content analysis". The views of pre-service teachers on using mind maps and their effects on learning processes are presented in Table 4.

THM	Code	f	Sample Expressions
RHR	•Remembering what was learned	6	*"When I wish to repeat what has been told in class, looking at mind maps helps me remember what we had discussed during that course"(S10).*
	•Reinforcement	5	*"Mind maps both made me reinforce what I know, and learn what I could not understand" (S14).*
ELB	•Association with pre-learning	9	*"In the plan we will make, we associate our preliminary information related to the subject, make evaluations and correlate what we have learned by means of comparison" (S13).*
	•Preliminary knowledge acquisition	8	*"By constructing a mind map I acquire preliminary information on the subject. I decide on what to do and what I must do" (S14).*
ORG	•Seeing the whole picture	6	*"Mind maps made me see the whole picture and take up the subject with all its aspects" (S12).*
	•Organising ideas	7	*"I have noticed in course of time that such planning is a good pathfinder and that I have compacted and organised the disorganised knowledge and ideas in my mind" (S16).*
	•Concretion of tasks	7	*"When preparing a presentation and setting a goal, it enabled our tasks to transform from an abstract form into a concrete form" (S12).*
MTCG	•Learning awareness	10	*"Since the mind map bears all the details, we had more awareness concerning what we were doing in class. The visuals we used increased this awareness" (S28).*
	•Noticing the deficiencies	11	*"Thanks to mind maps I noticed my deficiencies in the subjects I was working on" (S2).*
	•Remedying the deficiencies	21	*"I decide whether the homework I have done homework is complete as I had wanted, and whether I have completed all subjects by looking at the mind map. Thereby I complete any possible deficiency" (S9).*
TSE	•Preparation for course	6	*"I was prepared for the course in advance thanks to mind maps since I had planned what I had to do both with respect to course preparation and doing homework" (S7).*
	•Effective use of time	7	*"Planning by means of mind maps prevented me from losing time in doing my homework" (S11).*
	•Planned study	21	*"Mind map made me become planned. It ensured that what and how I would make and the road I would follow were in order" (S17).*
ER	•Focusing on the target	15	*"In order not to digress from the mind map, I take the mind map and follow the steps after organising all the steps" (S18).*
	•Facilitating learning	8	*"Rendering down the subject in mind maps to keywords facilitated my learning" (S10).*
	•Increase in concentration	24	*"Mind maps made me focus on important subjects" (S4).*

Table 4. The Views of Pre-service Teachers on Using Mind Maps and Their Effects on Learning Processes.

Table 4 shows that the replies given by pre-service teachers are coded under the themes of rehearsal, elaboration, organisation, metacognitive self-regulation, time and study environment, and effort management. Most of the pre-service teachers' expressions are brought together under the theme of metacognitive self-regulation: learning awareness (f=10), noticing the deficiencies (f=11), and remedying deficiencies (f=21). Again, nearly all the pre-service teachers mentioned the positive effects of the mind map on an increase in concentration (f=24), while more than half mentioned its positive effects on planned study (f=21), and half of them mentioned the positive effects of focusing on the target (f=15).

The views of pre-service teachers on using mind maps and their effects on motivation are presented in Table 5.

THM	Code	f	Sample Expressions
IGO	• Interest in the course	9	*"I have noticed that I had more interest in the course than the previous training courses because I had planned with the mind map" (S14).*
	• Participation in the course	6	*"The shapes and colours in the mind maps increased my motivation and my propensity to do work. It made me become a participating student in the course" (S22).*
	•Will to learn	14	*"I listen to the course more willingly when I attend the course after making a mind map" (S6).*
	• Fun learning	7	*"Learning has ceased to be a boring matter by means of mind maps and has become a fun action" (S12).*
SE	•Self-consciousness	11	*"Attending the course having preliminary knowledge by making a mind map increased my self -confidence" (S24).*
	•Sense of mastery over the subject	9	*"I felt more at ease and secure because I mastered the subject" (S3).*
TA	• Test anxiety	7	*"When examinations were to take place, I wouldn't know where to study and therefore wouldn't want to study at all. Thanks to mind map such thing went away (S3)".*
	• Task anxiety	8	*"I don't suffer from anxiety over failing to do the course since I pre-determine the sub-titles and research phase in the homework I plan with mind map" (S30).*

Table 5: The Views of Pre-service Teachers on Using Mind Maps to Plan and Its Effect on Motivation.

As shown in Table 5, the views of pre-service teachers are grouped under the theme of intrinsic goal orientation by the codes; interest in the course (f=9), participation in the course (f=6), will to learn (f=14), and fun learning (f=7); while those grouped by the self-efficacy theme are shown with the codes of self-consciousness (f=11) and sense of mastery over the subject (f=9). The table shows that nearly half of the pre-service teachers mention the positive effects of mind maps on the will to learn and self-consciousness, while much less than half mention its positive effects on test anxiety.

Conclusion and Discussion

Based on the study results, it can be said that the experimental group, which planned tasks by using mind maps, had higher scores than the control group in the elaboration, organization, metacognitive self-regulation, time and study environment, and effort management strategies. Self-regulation strategies ensure that knowledge is activated in working memory, that the newly learned are associated with pre-learning, that correlation is made between information, and cognition is controlled (Pintrich, 1999; Pintrich et al., 1991). Elaboration strategies including paraphrasing, summarizing and generative not-taking help students store information into long long-term memory while organization strategies help the learner select appropriate information and also construct connections among the information to be learned. Also metacognitive self-regulation such as planning, monitoring and regulating refers to the awareness, knowledge and control of cognition. Time management involves planning and managing one's study time while study environment management refers to the setting where the student does her class work. Effort management reflects a commitment to completing one's study goals, even when there are difficulties (Pnitrich et al., 1991). However, mind maps aid the organisation of knowledge; it is a tool contributing to the memorising of knowledge. It repeats, summarises, correlates between information, and increases the student's awareness of these cognitive structures (Brinkmann, 2007). It is possible to say that with this aspect of self-regulation, strategies including cognitive procedures at simple and complex levels are used in the construction of mind maps. In particular, it is thought that there is a direct relationship between the use of mind maps in the planning process and self-regulation. This is because planning is an important metacognitive strategy including target determination and work analysis towards an easier organisation of the learning material (Pintrich, 1999). Moreover, Farrand, Hussain and Hennessy (2002) established that mind maps are an effective working technique. In parallel to these results, this research shows that mind maps have a positive effect on the time-study environment pre-service teachers use in organising their study environment and their effort management

strategies. The comparisons between the replies to the open-ended questions in the experimental group, and their pre-test and post-test scores also support the quality of the results. According to results, most of the replies the pre-service teachers gave to open-ended questions are coded under metacognitive self-regulation, effort management and time-study environment themes. Nonetheless, the lack of an effect of planning by using a mind map on rehearsal strategy is a striking result of the research. This is because the mind map is based on key concepts and visuals; it is directly related to the memory processes including retention of knowledge and remembering (Buzan & Buzan, 1993). However, when the replies the pre-service teachers gave to open-ended questions are reviewed, it is determined that a small part of their expressions are cumulated under the codes of remembering what has been learned and reinforcement by the rehearsal theme. Based on all the results it can be said that planning with mind maps has a positive effect on the use of pre-service teachers' self-regulation strategies. Based on the study results, it can be said that the experimental group had higher intrinsic goal-orientation and self-efficacy scores than the control group. Intrinsic goal orientation is related to participation in learning due to reasons such as curiosity and complete learning, while self-efficacy is related to the learner's perception of their performance (Pintrich et al., 1991). The expressions by pre-service teachers that their interest in the course, their participation, and their will to learn have all increased, and they trust themselves with learning, may be thought of as an indication that they have become involved in the learning process due to intrinsic reasons, and have a positive perception concerning their performance. The research also shows that mind maps have a positive effect on the students' motivation (Goodnough & Woods, 2002; Keles, 2012; Polson, 2004). According to a further result of the research, no meaningful difference was found between the test anxiety post-test scores of the experimental and control groups in a statistical sense. Nonetheless, the fall of the experimental group's average test anxiety score, after the experiment, and the grouping of part of the replies they gave to open-ended questions under the anxiety theme by the codes of test anxiety and task anxiety, makes one think that mind maps may be an effective variable on anxiety. Based on all the results it can be said that task planning with mind maps has a positive effect on intrinsic goal orientation and self-efficacy perception. Although research results show that planning with mind maps has a positive effect on the use of pre-service teachers' self-regulation strategies and motivational beliefs, those results of this research are limited to the students' personal assessment at the end of the course. This research also is realized a sort period of time. It was believed that different measures are needed to acquire more significant results related this research. For this purpose, it can be examined whether some or any of this students continued to use mind map technique in the following semester in other courses and whether they sought to use it in their classroom teaching. In this process, observing of the student practices as well as their self-assessments will provide more meaningful results.

In light of the study results, it can be said that pre-service teachers should plan classroom activities by using mind maps, and also endeavor to ensure that these activities can be implemented in real classroom environments. The effect of these mind map-based classroom activities on the perception of self-sufficiency can also be investigated. As they will be capable of better organizing their time, their activities and the classroom environment, pre-service teachers will have greater motivation to teach, and will also serve as better models for the development of self-regulation among students. It is further believed that activities conducted by teachers and pre-service teachers with their students on the development and use mind maps as planning tools will allow students to have a better understanding of the utilization of mind maps for the purposes of planning, goal-setting, exam preparation, and group activities. Further studies on this topic will contribute to literature on the development of self-regulation among students. Moreover, it is believed that such studies particularly need to focus on metacognitive self-regulation, which constitute the basis of self-regulation.

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