RELATIONSHIPS AMONG SELF-REGULATED LEARNING COMPONENTS, MOTIVATIONAL BELIEFS AND COMPUTER PROGRAMMING ACHIEVEMENT IN AN ONLINE LEARNING ENVIRONMENT

ERMAN YUKSELTURK
SAFURE BULUT

Abstract – *This study analyzed relationships among motivational beliefs (intrinsic goal orientation, extrinsic goal orientation, control beliefs, task value, self-efficacy, and test anxiety), self-regulated learning components (cognitive strategy use, self-regulation) and computer programming achievement in an online learning environment. The study consisted of 38 participants from an online Information Technologies Certificate Program which is based on synchronous and asynchronous communication methods over the Internet. Data are gathered from two consecutive online computer programming courses in this online certificate program, where the second course followed the first one in content as well. Motivated Strategies for Learning Questionnaire (MSLQ) was used to collect relevant data. The results of the study indicated that the effect of self-efficacy variable on students' programming achievement was statistically significant in the first course and the effect of self-regulation variable on students' programming achievement was statistically significant in the second course.*

Introduction

With the improvements in technology, information and communication technologies (ICT) have been transforming our society in the last century. New human communications media, such as mobile phones, computers, and the internet, have emerged, and these are used by millions of people as an indispensable part of their daily life. With the help of these media, the old barriers of distance and time have been being broken down. In other words, the most advanced technologies have been used for disseminating information to members in our society (Jonassen, Davidson, Collins, Campbell & Haag, 1995; Rogers, 1995). These developments have led to major changes in the structure, management and organization of many fields. For these reasons, people need to learn how to cope with changes in different aspects of their lives and success depends on keeping up with technology through advanced training and lifelong learning. One of the effective ways to educate people, especially adults, is through

distance education. Adults need flexible and diverse educational delivery systems, and this is greatly facilitated by the information and communication technologies (Huang, 1997). Furthermore, as Sherritt (1996) notes, distance education overcomes many barriers—such as those of place and time—and helps even the odds for those learners who are negatively affected by them. Indeed, distance education helps open up access to learners in remote areas, eliminates the need for learners to be away from home, provide access and equity for learners outside the mainstream, and provides opportunities for higher education and technician level training to those incapable of pursuing traditional programs.

In the literature, distance education is simply defined as that form of education where the learner is in some way separated from the instructor and instruction is delivered through print or electronic communications media to the learners. Also, distance students are often placed in a situation in which neither teachers nor fellow students are physically present. Therefore, they take control over the time, place and pace of education. In other words, they have a more active role in their learning process. Bandura (1993) states that the rapid pace of technological change and accelerated growth of knowledge help to create environments for self-directed learning. On the other hand, these opportunities bring more responsibilities and difficulties to distance students in contrast to traditional ones (Simonson, Smaldino, Albright, & Zvacek, 2003). Therefore, one of the factors that determine the efficacy of distance education is distance students' characteristics. Many researchers agree that the dearth of research on distance education still leaves many unanswered questions about what type of students will have success in online education since much of the initial research completed in this field is related to the selection of media, the effectiveness of media or performance results of a given methodology (McIsaac & Gunawardena, 1996).

Recent research on students' learning and achievement has progressively included emphasis on student characteristics, especially on motivation, and on cognitive and metacognitive strategies. According to this research, motivation is known as a driving force that makes the student successful, and also self-regulated learning has emerged as a construct that provides more holistic views of motivation, use of cognitive strategy and metacognitive process. There is a great deal of research conducted to investigate the nature of these factors and the contribution of these factors to students' academic performance. For example, some predictor variables in online studies are self-efficacy (Multon, Brown & Lent, 1991); learning strategies—i.e. monitoring, elaboration, and rehearsal strategies—(Davidson-Shivers, Rasmussen, & Bratton-Jeffery, 1997), self-regulation (King, Harner & Brown, 2000); motivation or lack of motivation (Zalenski, 2001); and mastery goals (Chi-hung, 2002). However, few research

studies analyse these factors simultaneously to understand their relationships and their influence on student success, especially in online learning. This study therefore attempts to extend the empirical research on both motivational beliefs (intrinsic goal orientation, extrinsic goal orientation, control beliefs, task value, self-efficacy, test anxiety) and self-regulated learning components (cognitive strategy use, self-regulation) by documenting their relationships to computer programming achievements in an online environment.

Additionally, earlier studies generally measured these factors only one time at the beginning or at the end of course. However, these factors (i.e. self-efficacy) may fluctuate during a period of time (Lee & Witta, 2001). This study analyzed two consecutive online computer programming courses, where the second course followed the first one in content as well in order to avoid the pitfall of a one-shot measure of these factors and to provide a better understanding of relationships among these factors in the long period of time. At this stage in the research, the literature about self-regulated learning and motivation is given with discussing their theoretical framework used in this study.

Self-regulated learning

Research on self-regulated learning has increased exponentially in recent years and there are a number of definitions depending on theoretical perspective of the researcher from behaviorist to constructivist. Actually, examination of the literature reveals considerable overlaps in definitions. To summarize, the key feature in most definitions of self-regulated learning is the systematic use of metacognitive, motivational and/or behavioral strategies. The common conceptualization of self-regulated learners is that they are active participants in their own learning (Zimmerman, 1990).

In this study, following the work of Pintrich & DeGroot (1990), self-regulated learning conjoins three major constructs:

(1) Cognitive strategies that students use, remember, and understand the material. The cognitive strategies include:

- *Rehearsal:* Rehearsal strategies involve reciting or naming items from a list to be learned. These strategies are best used for simple tasks and activation of information in the working memory rather than acquisition of new information in the long-term memory.
- *Elaboration:* Elaboration strategies help students store information into the long-term memory by building internal connections between items to

be learned. Elaboration strategies include paraphrasing, summarizing, creating analogies, and generative note-taking.

- *Organization:* Organization strategies help the learner select appropriate information and also construct connections among the information to be learned.
- *Critical thinking:* Critical thinking refers to the degree to which students report applying previous knowledge to new situations in order to solve problems, reach decisions, or make critical evaluations with respect to standards of excellence.

(2) Students' metacognitive strategies for planning, monitoring, and regulating their cognition. Metacognitive strategies include:

- *Planning:* Planning activities such as goal setting and task analysis help to activate, or prime, relevant aspects of prior knowledge that make organizing and comprehending the material easer.
- *Monitoring:* Monitoring activities include tracking of one's attention as one reads, and self-testing and questioning: these assist the learner in understanding the material and integrating it with prior knowledge.
- *Regulating strategies:* Regulating refers to the fine-tuning and continuous adjustment of one's cognitive activities. Regulating activities are assumed to improve performance by assisting learners in checking and correcting their behavior as they proceed on a task.

In addition, metacognition is defined as the conscious awareness and frequent self-checking to determine if one's learning goal has been achieved and, if necessary, selecting a more appropriate strategy to achieve that goal (O'Neail & Abedi, 1996). In other words, it is essentially thinking about thinking and is an important countenance of academic performance, problem-solving, and student learning (Corno & Mandinach, 1983). Furthermore, metacognition is not merely an individual process; as Jost, Kruglanski & Nelson (1988) have noted, it is part of the social world as well. These authors argue stated that metacognition has much to do with one's own personal and family experiences, the social groups to which we belong, ongoing social situations, and cultural backgrounds.

(3) Students' management and control of their effort on classroom academic tasks. Management strategies include managing time and study environment, effort management, peer learning, and help seeking.

In addition to self-regulated learning, being a self-regulated learner is another important issue. Zimmerman (1986) explains that self-regulated learners are students who are '...metacognitively, motivationally, and behaviorally active participants in their own learning process.' And also he states that 'self-regulated learners perceive themselves as competent, self-efficacious, and autonomous' and 'self-regulated learners select, structure, and create environments that optimize learning.' (p. 309).

The importance of self-regulated learning is supported by previous studies (Zimmerman, 1986, 1990; Pintrich & DeGroot, 1990). For example, Pintrich & De Groot (1990) examined the relationship of seventh-graders' self-efficacy, intrinsic value, test anxiety, cognitive strategy use, self-regulation tendency and academic performance, and they found that the best predictors are self-regulation tendency, self-efficacy, and test anxiety. Another study claimed a causal model that showed a combined influence of self-efficacy and goals on academic achievement among ninth and tenth graders (Zimmerman, Bandura & Martinez-Pons, 1992).

In addition to traditional environment, research about self-regulated learning in computer and internet based environments has begun to feature in the literature in the last years. For example, Young (1996) investigated students' application of self-regulatory strategies in a learner-controlled computer-based instructional (CBI) environment. He found that students with a high level of self-regulatory learning strategies performed better in a learner-control CBI environment than in a program-controlled CBI environment. However, students with low self-regulatory learning strategies were at a notable disadvantage in the learner-controlled CBI environment than the program-controlled CBI environment. According to another study in a hypermedia concept lesson by Davidson-Shivers, Rasmussen & Bratton-Jeffery (1997), high performance learners showed higher numbers of learning strategies—such as monitoring, elaboration, and rehearsal strategies—than the average and low performance learners. Hill & Hannafin (1997) have also pointed out that self-regulatory skills, such as metacognitive knowledge, perceived orientation, and perceived self-efficacy, are key factors for learning with computer-networked hypertext/hypermedia learning environment, such as the WWW.

Researchers have identified the importance of self-regulation as a predictor of academic success in traditional classrooms. However, the effects of self-regulated learning on students' achievement in online courses have not yet been completely examined. In addition, Miltiadou & Savenye (2003) stated that more researches are needed in the context of the online environment to predict student success and lower attrition rates.

Motivation

One of the most important components of learning in any educational environment is motivation. Pintrich & Schunk (1996) expressed that motivation influences how and why people learn and also it influences how people perform. In other words, motivation and motivational beliefs are among the best predictors of student achievement. The motivational beliefs includes several different constructs that have been generated by different theoretical models, such as attribution theory, goal theory, and intrinsic motivation theory. In this research, the theoretical framework for conceptualizing student motivation is an adaptation of general expectancy-value model of motivation (Pintrich, 1990). The model proposes that there are three motivational components that may be linked to the three different components of self-regulated learning: (a) *expectancy component*, which includes students' beliefs about their ability to perform a task (self-efficacy and control beliefs), (b) a *value component* which includes students' goals and beliefs about the importance and their interest in the task (goal orientation and task value beliefs) and (c) an *affective component*, which includes students' emotional reactions to the task (test anxiety). This study is one of the few studies that include such a large number of cognitive and motivational variables in the same study and moreover which investigates the joint effect of those variables on computer programming achievement in two consecutive courses in an online environment.

In the literature, there are many studies related to motivation and distance education students, especially related to their perception, achievement, dropout, and attitudes. For example, a study analyzed high achieving and low achieving open university students in regard to their study habits, purpose for learning, approaches to study, use of support systems, other commitments and self-perceptions. The study showed that motivation is a factor affecting achievement (Jegede, Fan, Chan, Yum & Taplin, 1999). Another study with 1200 distance learners investigated the complex relationships between the motivation and cognition of university students in a distance learning mode. Results showed that mastery goals and efficacy beliefs were the most important predictors in the use of different forms of self-regulated and learning strategies over time (Chi-hung, 2002). Shih & Gamon (2001) studied 99 students enrolled in two courses delivered via the web. In this study, learning style, motivation and attitudes were examined for their effects on achievement. An adapted version of the Motivation Strategies for Learning Questionnaire (MSLQ) was used to assess student motivation. The researchers reported that student motivation explained over one-fourth of student achievement as measured by course grades. In another study, Riddle (1994) studied factors that contributed to student satisfaction in courses

delivered by interactive video networks. Riddle included learning style, self-efficacy, and a host of demographic variables in the study. It was concluded that self-efficacy contributed to explaining the variance in student satisfaction in a distance education course. Similarly, Zalenski (2001) studied a different measure of success in a distance delivered course, attrition. The sample of this included 815 undergraduate students in liberal studies program. The researcher reported that motivation, or lack of motivation, can also affect graduation and attrition rates in distance education.

To sum up, students' motivation beliefs and self-regulated learning components in distance education is important for people or institutions who work in this area to give students support and counseling. In other words, such studies will assist educators and teachers to recognize the importance of motivational beliefs and self-regulated learning components on students' academic achievement and find suitable ways to get better these wanted characteristics. For these aims, participants and online computer programming courses are analyzed from an online Information Technologies Certificate Program in this study.

An Online Information Technologies Certificate Program

An Online Information Technologies Certificate Program (ITCP) is one of the first Internet Based Education Projects of the Middle East Technical University (METU) in Ankara, Turkey. It was based on synchronous and asynchronous communication methods over the Internet offered by the Computer Engineering Department in cooperation with the Continuing Education Center at METU. The online certificate program was started in May 1998, and it is still active. It includes eight fundamental courses of the Computer Engineering Department and comprises four semesters lasting nine months in all. The courses in the program are given by the instructors from Computer Engineering Department. The main aim of the online ITCP is to train the participants in the IT field to meet the demands in the field of computer technologies in Turkey. Furthermore, the online ITCP provides opportunities for the people who could not get education in information technologies or computer engineering, but interested and willing to improve themselves in this area and enthusiastic about making progress in their existing career. University students and people who graduated from 2 or 4 year university courses have been accepted on the programs. In addition, the participants are expected to be computer literate and to have an intermediate level of English.

The program provides online lecture notes, learning activities and visual aids, and each course has a textbook to follow. An instructor and an assistant are

assigned to each course. In order to promote interaction between instructors and participants, and among participants, each course has an e-mail address, discussion list as well as chat sessions. At the end of each term, there are face-to-face sessions for each course on the METU campus. For each course at least three or four assignments are given to the participants during the semesters. At the end of each semester, there are traditional final examinations within the campus of the University. The participants' final grades are based on the final examinations, assignments, attendance to chat sessions and discussion lists. At the end of the program, graduates receive an official certificate approved by the president of the METU, the chair of the Computer Engineering Department and the president of the Continuing Education Center. The courses given in this program are as follows:

First Semester (lasting two months)

- Computer Systems and Structures
- Introduction to Computer Programming with C (stated as course-1 in this study)

Second Semester (lasting two months)

- Data Structure and Algorithms with C (stated course-2 in this study)
- Operating Systems with Unix

Third Semester (lasting two months)

- Software Engineering
- Database Management Systems

Fourth Semester (lasting two months)

- Computer Networks
- Software Development Project

There are two programming courses given in this program. Introduction to Computer Programming with C (course-1) given in the first semester, and Data Structure and Algorithms with C (course-2) given in the second semester were chosen for this study. The aim of the first course is to teach students who have no knowledge about computer programming by using C programming language. The basic programming concepts and applications are given to students with the help of examples. At the end of the course, students will be able to write variant basic C programs. Some topics of the course are as follows: variables, operations, conditionals, loops, arrays. The main aim of the second

course is to teach basic data structures and algorithms concepts to use in preparing many different programs. The aim of giving these basic concepts is not only using them in solving some problems during course but also teaching them how to use them while finding solutions when they encounter problems. The course content is given from C programming strategies to pointers, data structures, lists, trees, searching, sorting and algorithms. These two similar and consecutive courses were selected to decrease the content effect on the results of this study.

Research design

The problems of the study are the following:

- How well can computer programming achievement be explained in terms of motivational beliefs (intrinsic goal orientation, extrinsic goal orientation, control beliefs, task value, self-efficacy, test anxiety) and self-regulated learning components (cognitive strategy use, self-regulation) in online programming course-1 (Introduction to Computer Programming with C Course)?
- How well can computer programming achievement be explained in terms of motivational beliefs (intrinsic goal orientation, extrinsic goal orientation, control beliefs, task value, self-efficacy, test anxiety) and self-regulated learning components (cognitive strategy use, self-regulation) in online programming course-2 (Data Structure and Algorithms with C)?

In order to examine the problems, two hypotheses are formulated. These hypotheses are stated in the null form and tested at a significance level of 0.05.

- **H1:** The eight variables together (intrinsic goal orientation, extrinsic goal orientation, control beliefs, task value, self-efficacy, test anxiety, cognitive strategy use, and self-regulation) do not explain a significant amount of variance in students' computer programming achievement in course-1 given online.

- **H2:** The eight variables together (intrinsic goal orientation, extrinsic goal orientation, control beliefs, task value, self-efficacy, test anxiety, cognitive strategy use, and self-regulation) do not explain a significant amount of variance in students' computer programming achievement in course-2 given online.

Subject of the study

The subject of this study was from the 7th programs' participants of online certificate program (October 2003 - June 2004). The number of participants who registered in the 7th online ITCP was 70. All participants who registered to the programs are computer literate and have an intermediate level of English. Table 1 presents the demographic characteristics of the participants. The number of male participants was greater than the number of female participants, and the participants' age ranged from 20 to 40 and above. The majority of the participants aged between 20 to 29. In addition, the majority of the participants attended the online ITCP from Ankara and Istanbul (the biggest cities in Turkey), and were university graduates and undergraduate students in universities.

The subjects of study were chosen from volunteer participants who attended 7th online certificate program and also the subjects that attended both online programming courses. However, all participants did not complete all the courses in the program due to problems related to dropouts. Therefore, 38 participants attended this study. Their demographic characteristics and percentages were similar to the participants who registered to the program.

Instrumentation

Motivated Strategies for Learning Questionnaire (MSLQ) was used to collect relevant data. It is an adapted version of the relevant sections from the MSLQ developed by Pintrich, Smith, Garcia & McKeachies (1991). MSLQ, a self-report, Likert-scaled instrument was designed to assess motivation and use of learning strategies. The motivation scales tap into three broad areas (1) value (instrinsic and extrinsic goal orientation, task value), (2) expectancy (control of learning beliefs, self-efficacy), and (3) effect (test anxiety). The learning strategy section is comprised of ten scales, which can be distinguished as cognitive, metacognitive, and research management strategies. The cognitive strategy scale includes (a) rehearsal, (b) elaboration, (c) organization, and (d) critical thinking. Metacognitive strategies are assessed by one large scale that includes planning, monitoring, and regulating strategies. Resource management strategies include (a) managing time and study environment, (b) effort management, (c) peer learning, and (d) help-seeking.

The MSLQ was translated into Turkish and some minor adjustments were made to a few items to ensure applicability to all students. The pilot study was administrated to students enrolled in Department of Foreign Languages Education

at METU, Turkey (Hendricks, Ekici & Bulut, 2000). Also, it was used in the study of investigating mathematics achievement and self-regulated learning in the city of Denizli, Turkey with 752 ninth-grade students from high schools (Ozturk, 2003).

TABLE 1: The demographic characteristics of the participants

	7th online ITCP's participants			
Sex	**N1**	**P1**	**N2**	**P2**
Female	19	27	10	26
Male	51	73	28	74
Age				
19 and below	2	3	–	–
20-24	25	36	14	36
25-29	23	33	14	36
30-34	15	21	8	21
35-39	2	3	2	5
40 and above	3	4	1	3
Cities the participants from				
Ankara	48	69	28	74
Istanbul	10	14	4	11
Izmir	2	3	–	–
Others	10	14	6	16
Education Levels				
University graduates	36	51	21	55
Undergraduate students	28	40	15	39
Graduate students	6	9	2	5

N1: Number of participants who register to the program, P1: Percentage of participants who register to the program, N2: Number of participants who attend the study, P2: Percentage of participants who attend the study

Data collection and analysis

The online certificate program starts the first semester with giving two courses. One of them is a programming course, Introduction to Computer Programming with C (course-1). It lasts two months online and at end of the two months, participants come to the university campus for two days. On the first day, a face-to-face session to explain and discuss course topics is given by course instructors to the participants in two hours and on the second day, participants take a paper-based final examination. The second semester, like the first one, starts by giving two courses. One of them is a programming course, Data Structure and Algorithms with C (course-2) and it lasts two month online and at end of the two months, participants come to the university campus for two days, and a face-to-face session and a paper-based final examination are given. Motivated Strategies for Learning Questionnaire (MSLQ) was distributed by the researcher to the participants that attended both of the two courses when they come to the university campus. The structures of online certificate program or courses given in this program were not changed for this study and researchers did not affect the participants or instructors of courses during study.

In this study, the participants' achievement scores are based on assignments (six assignments given in course-1 and three assignments given in course-2) and the traditional final examinations (paper based test) at the end of the course.

In this study, descriptive statistics such as mean and standard deviations of subjects were calculated for the scale scores and Linear Stepwise Regression analysis was used to assess how well programming achievement can be explained in terms of motivational beliefs (intrinsic goal orientation, extrinsic goal orientation, control beliefs, task value, self-efficacy, test anxiety) and self-regulated learning components (cognitive strategy use, self-regulation) in programming course-1 and course-2 online. Then, the data were displayed into tables so that the conclusions could be reasonably drawn and verified.

Findings

Descriptive statistics

Table 2 and Table 3 show the descriptive statistics (range, min, max, mean, standard deviation) of variables, such as, intrinsic goal orientation (Intr), extrinsic goal orientation (Extr), task value (Tskv), control beliefs (Cont), self-efficacy (Slef), test anxiety (Tanx), cognitive strategy use (Stru) (Stru provides a measure

of the use of rehearsal, the use of elaboration strategies, organization strategies and use of the critical thinking strategies), self-regulation (Slrg) (Slrg was constructed from metacognitive self-regulation and effort regulation) and programming achievement (Achive). In other words, tables show the descriptive statistics of MSLQ subscale scores and programming achievement converted into 7-point Likert-type scale, just like in the original scale.

TABLE 2: Descriptive statistics of MSLQ subscale scores and programming achievement for course 1

Predictors	**N**	**Range**	**Min**	**Max**	**Mean**	**Std.**
Intr	38	3.75	3.25	7.00	5.33	0.96
Extr	38	4.25	1.00	5.25	3.63	1.19
Tskv	35	2.83	4.17	7.00	5.86	0.74
Cont	38	3.50	3.50	7.00	5.52	0.87
Slef	36	3.88	2.63	6.50	5.06	0.90
Tanx	36	3.60	1.40	5.00	3.19	0.98
Stru	36	2.44	3.50	5.94	4.78	0.61
Slrg	34	2.16	3.26	5.42	4.43	0.59
Achive	38	64	32	96	76.63	17.68

Table 2 demonstrates that mean scores of the motivational subscales range from 3.19 to 5.86 for the course-1. Participants tend to reflect an 'agree' perspective toward their motivational beliefs about programming with regard to intrinsic goal orientation, task value, control beliefs, and self-efficacy. However, they tend to reflect a 'disagree' perspective toward their motivational beliefs about programming with regard to extrinsic goal orientation and test anxiety. In addition, they tend to reflect an 'undecided' perspective on self-regulated learning components in computer programming with mean scores ranging from 4.43 to 4.78.

Furthermore, Table 3 demonstrates that mean scores of the motivational subscales range from 3.39 to 5.29 for the course-2. Participants tend to reflect an 'agree' perspective toward their motivational beliefs with regard to task value, control beliefs and 'disagree' perspective about extrinsic goal orientation and test anxiety like course-1. However, they are 'undecided' about intrinsic goal orientation and self-efficacy. In addition, they tend to reflect an 'undecided' perspective on self-regulated learning components in computer programming with mean scores ranging from 4.16 to 4.42.

TABLE 3: Descriptive statistics of MSLQ subscale scores and programming achievement for course 2

Predictors	N	Range	Min	Max	Mean	Std.
Intr	38	5.00	2.00	7.00	4.65	1.02
Extr	38	4.25	1.00	5.25	3.61	1.12
Tskv	36	5.00	2.00	7.00	5.29	1.05
Cont	38	5.00	1.75	6.75	5.21	1.09
Slef	38	3.63	3.00	6.63	4.75	0.98
Tanx	38	4.80	1.00	5.80	3.39	1.08
Stru	30	2.69	3.13	5.81	4.42	0.66
Slrg	32	2.74	2.63	5.37	4.16	0.71
Achive	38	101	5	106	58.34	27.42

Results of testing hypotheses

Two problems of this study are examined by means of their associated hypotheses and the hypotheses are in the null form and tested at a significance level of 0.05. For each course, the interrelationships among variables before testing hypotheses are examined due to the concern about the issue multicollinearity. Therefore, pearson product moment correlations to examine the interrelationships among measures are conducted. The correlation matrixes are presented in Table 4 and Table 5.

TABLE 4: Pearson product moment correlations among measures for all subjects of the study for course 1

Variables	2	3	4	5	6	7	8	9
1. Intr	0.22	0.65	0.29	0.67	-0.12	0.23	0.32	0.46
2. Extr		.091	-0.29	0.011	0.08	0.01	0.12	0.00
3. Tskv			0.37*	0.70	-0.17	0.35*	0.45*	0.28
4. Cont				0.36	-0.16	-0.11	-0.11	0.05
5. Slef					-0.35*	0.48	0.41*	0.51
6. Tanx						-0.46	-0.08	-0.02
7. Slrg							0.65	0.32
8. Stru								0.27
9. Achive								–

*p<0.05

Table 4 shows that predictor variables do not have high correlations among themselves. Therefore we deduced that multicollinearity was not a problem for course 1.

TABLE 5: Pearson product moment correlations among measures for all subjects of the study for course 2

Variables	2	3	4	5	6	7	8	9
1 .Intr	-0.03	0.79	0.50	0.62	-0.14	0.35	0.31	0.25
2. Extr		-0.21	-0.39*	0.00	0.37*	0.25	0.12	0.32
3. Tskv			0.62	0.75	-0.28	0.27	0.33	0.13
4. Cont				0.46*	-0.41	-0.30	0.03	-0.17
5. Slef					-0.34*	0.40*	0.35*	0.33*
6. Tanx						0.09	0.07	0.15
7. Slrg							0.75	0.54
8. Stru								0.26
9. Achive								–

*p<0.05

Table 5 also shows that predictor variables do not have high correlations among themselves. Therefore we deduced that multicollinearity was not a problem for the course 2.

In addition, the stated hypotheses (H1 and H2) were examined by using Linear Stepwise Regression at a significance level of 0.05.

The results of Course-1:

As Table 6 indicates, a variable (self-efficacy) explained a significant amount of variance in students' computer programming achievement, R^2=0.289, adjusted R^2=0.262, F(1,27)=10.568, p=0.003. 28.9 percent of the variances are explained by this variable. The value of Standardized Coefficients is 0.538 and Standard Error is 14.4 for this variable.

Intrinsic goal orientation, extrinsic goal orientation, control beliefs, task value, test anxiety, cognitive strategy use, and self-regulation are excluded from the equation because they do not have significant contributions to variance in computer programming for course-1 (p>0.05). Table 7 shows the results of linear stepwise regression analysis of seven excluded variables.

TABLE 6: Linear Stepwise Regression Analysis Results for one significant predictor variables on programming achievement in course 1

Regression Statistics					
Multiple R	0.538				
R Square	0.289				
Adjusted R Square	0.262				
Standard Error	14.4				
	Df	SS	MS	F	Sig F
Regression	1	2198.647	2198.647	10.568	0.003
Residual	26	5409.067	208.041		
Total	27	7607.714			

*p<0.05

TABLE 7: Results of linear stepwise regression analysis of seven excluded variables in course 1

Variables	**Beta In**	**t**	**p-value**	**Partial Correlation**	**Tolerance**
Intr	0.058	0.247	0.807	0.049	0.50
Extr	0.045	0.267	0.791	0.053	1.00
Tskv	-0.264	-1.073	0.294	-0.210	0.449
Cont	0.110	-0.623	0.539	-0.124	0.894
Tanx	0.253	1.493	0.148	0.286	0.91
Slrg	0.119	0.635	0.531	0.126	0.79
Stru	0.086	0.463	0.647	0.092	0.82

The results of Course-2:

As Table 8 indicates, a variable (self-regulation) explained a significant amount of variance in students' computer programming achievement, R^2=0.277, adjusted R^2=0.249, F(1,27)=9.957, p=0,.04. 27.7 percent of the variances are explained by this variable. The value of Standardized Coefficients is 0.526 and Standard Error is 22.99 for this variable.

Intrinsic goal orientation, extrinsic goal orientation, control beliefs, task value, self-efficacy, test anxiety, and cognitive strategy use are excluded from the

TABLE 8: Linear Stepwise Regression Analysis Results for one significant predictor variables on programming achievement in course 2

Regression Statistics					
Multiple R	0.526				
R Square	0.277				
Adjusted R Square	0.249				
Standard Error	22.99				
	Df	SS	MS	F	Sig F
Regression	1	5261.610	5261.610	9.957	0.004
Residual	26	13739.105	528.427		
Total	27	19000.714			

*p<0.05

TABLE 9: Results of linear stepwise regression analysis of seven excluded variables in course 2

Variables	**Beta In**	**t**	**p-value**	**Partial Correlation**	**Tolerance**
Intr	-0.041	-0.228	0.821	-0.046	0.904
Extr	0.158	0.918	0.367	0.181	0.944
Tskv	-0.065	-0.370	0.714	-0.074	0.933
Cont	-0.202	-1.215	0.236	-0.236	0.988
Slef	0.107	0.587	0.563	0.117	0.860
Tanx	-0.013	-0.073	0.942	-0.015	0.981
Stru	-0.332	-1.333	0.195	-0.258	0.434

equation because they do not have a significant contributions to variance in computer programming for course-2 (p>0.05). Table 9 shows the results of linear stepwise regression analysis of seven excluded variables.

Conclusion

The main purpose of this study was to further understand the relationships among self-regulated learning components, motivational beliefs and programming achievements in an online environment. In order to fulfill this

purpose we conducted some analyses with data gathered from the online certificate program participants and programming courses.

In the result of the study, Table 4 and Table 5 display correlations among the motivational, cognitive, and achievement variables. In the first course (course-1), intrinsic goal orientation, task value, control beliefs, self-efficacy, cognitive strategy use and self-regulation were positively correlated with programming achievement. However, test anxiety and extrinsic goal orientations were only variables that negatively correlated with programming achievement in course-1. In addition, in the second course (course-2), all variables except control beliefs were positively correlated with programming achievement in self-regulation.

According to the regression analyses of this study, self-efficacy beliefs in course-1 and self-regulation in course-2 have a significant effect on student programming achievement in online courses. The fact that self-efficacy beliefs related to computer programming was the only variable to enter regression equation, accounting for 28.9 % of the variance in students' programming achievement, indicates that programming achievement can partly be explained by the students' judgments of their own capabilities to accomplish specific programming tasks in an online environment. Self-efficacy beliefs can determine how people feel, think, motivate themselves, and act. Bandura (1977) pointed out that, in the basis of self-efficacy there lies a mechanism of changing, continuing and generalizing of behavior. Result is also consistent with the findings of the previous studies stating the effects of self-efficacy beliefs on academic achievement (Pintrich & De Groot, 1990, Zimmerman & Martinez-Pons, 1990). They demonstrated the central role of self-efficacy beliefs in students' academic achievement with empirical support from correlational studies. Multon, Brown & Lent (1991) reviewed a comprehensive list of studies that examined self-efficacy in achievement situations. Findings suggested that self-efficacy beliefs were positively related to academic performance. Also, Lim (2001) has indicated that, self-efficacy in computer knowledge was the only statistically significant variable that can help predict achievement. Therefore, it can be deduced from the literature that self-efficacy beliefs are a strong predictor of academic achievement and this study results state that programming achievement in online environment is influenced by students' self-efficiency beliefs as well.

In addition, self-regulation related to computer programming was the only variable to enter regression equation in the course-2 regression analyses and that was accounted for 27.7 % of the variance in students' programming achievement. Self-regulation refers to students' ability to understand and control their learning (Zimmerman, 1994). According to Zimmerman (1994), learners who self-regulate possess three important characteristics. First, they actively control their own learning by employing a range of cognitive strategies that assist in the construction

of meaning and retention of information. Second, learners mindfully use metacognitive strategies such as planning and monitoring to control their own progress towards their educational goals. Finally, they are intrinsically motivated, focused upon the task at hand, and thoughtfully control emotional difficulties. In academic contexts, self-regulation refers to processes that involve the activation and maintenance of cognitions, behaviors and effects which are systematically oriented toward the attainment of goals (Zimmerman, 1989). In summary, research states that self-regulation and its strategies are crucial to be successful in distance education (King, Harner & Brown, 2000). However, empirical research relating these abilities to distance learners' motivation and learning outcomes is not seen much in the literature.

In conclusion, distance education students take more responsibility in their learning in comparison to traditional ones. Their motivation beliefs and self-regulated learning strategies are among important variables that may affect their achievement in distance education. In this study, students' self-efficacy beliefs and self-regulation have strong and positive influence on their academic achievement in online programming courses. According to this study, although self-efficacy beliefs were enough to affect students' academic achievement for the introductory programming course, students' academic achievement for advanced programming course were affected by self-regulation. According to the results, it can be concluded that instructors and instructional designers of distance education can benefit from self-efficacy beliefs of students at the beginning and alter the students' inaccurate judgments about online tasks gradually. Also, they can design their courses and online environments for students to be self-regulated learners in further and detailed courses.

In addition, this study indicates that motivation and self-regulated learning components may change in the period of time during online education. This change may be affected by some other factors. For example, participants may be more competent in the use of a given online environment and computer technology. Furthermore, there may be a maturation effect and content effect in this study even though course-2 was given after course-1 immediately and courses had similar aims and topics.

Recommendations for further studies

In this study, motivation and self-regulated learning components were analyzed in online computer programming courses. Much more study is needed on these variables and their effects on student achievements. In other words, these components should be analyzed in various online courses and programs with

larger samples to generalize the results of these types of study. In addition, other variables (i.e. attitude, satisfaction, learning style) can be examined with these selected components together. The experimental approach can be used to identify causal relationships between self-regulated learning and achievement.

Another study can be conducted about relationships of interaction types, collaborative activities that are more prepared in online learning environments, and student characteristics (motivational beliefs and self-regulated learning strategies) together.

Erman Yukselturk *works as an online learning coordinator at the Internet Based Education Project (http://idea.metu.edu.tr) of Middle East Technical University. His main areas of interest are distance education, designing online learning environments, online collaboration, and instructional technology. He can be contacted by email: ermany@metu.edu.tr*

Safure Bulut *is instructor in the department of secondary science and mathematics education at Middle East Technical University, Ankara, Turkey. Her research interests are factors affecting mathematics achievement, development of measuring instruments, teacher education. She can be contacted by email: sbulut@metu.edu.tr*

References

Bandura, A. (1977) 'Self-efficacy: Toward a unifying theory of behavioral change.' *Psychological Review*, Vol.84, No.2, pp.191-215.

Bandura, A. (1993) 'Perceived self-efficacy in cognitive development and functioning.' *Educational Psychologist*, Vol.28, No.2, pp.117-148.

Chi-hung, N. (2002) 'Relations between motivational goals, beliefs, strategy use and learning outcomes among university students in a distance learning mode: A longitudinal study.' *Paper presented at the Annual Conference of Australian Association for Research in Education, Brisbane*. Retrieved May 30-05: http://www.aare.edu.au/02pap/ng02462.htm

Davidson-Shivers, G.V., Rasmussen, K.L. & Bratton-Jeffery M.F. (1997) 'Investigating learning strategies generation in a hypermedia environment using qualitative methods.' *Journal of Computing in Childhood Education*, Vol.8, Nos.2/3, pp.247-267.

Jegede, O., Fan, R.Y.K., Chan, M.S.C., Yum, J. & Taplin, M. (1999) 'Locus of control and metacognition in open and distance learning: A comparative study of low and high achievers.' *Paper presented at the 13th Annual Conference, Asian Association of Open Universities*. The Central Radio & TV University, Beijing, China. Retrieved May 30 2005 from http://www.ouhk.edu.hk/CRIDAL/papers/jegedeo.pdf

Hendricks,N.J., Ekici, C. & Bulut, S.(2000) 'Adaptation of Motivated Strategies for Learning Questionnaire.' *Unpublished research report*.

Hill, J. R., & Hannafin, M.J. (1997) 'Cognitive strategies and learning from the World Wide Web.' *Educational Technology Research and Development*, Vol.45, No.4), pp.37-64.

Huang, J. (1997) *Distance Education: A Key Strategy for Lifelong Learning in Chinese Taipei*. ERIC Document ED411890.

Jonassen, D., Davidson, M., Collins, A., Campbell, J., & Haag, B.B. (1995) 'Constructivism and Computer-Mediated Communication in Distance Education.' *The American Journal of Distance Education*, Vol.9, No.2, pp.7-26.

King, F.B., Harner M. & Brown S. W. (2000) 'Self-regulatory behavior influences in distance learning.' *International Journal of Instructional Media*, Vol.27, No.2, pp. 147-155.

Knowles, M. (1984) *The Adult Learner: A Neglected Species* (3rd ed.) Houston, TX: Gulf Publishing.

Lim C.K. (2001) 'Computer self-efficacy, academic self-concept, and other predictor of satisfaction and future participation of adult distance learners.' *The American Journal of Distance Education,* Vol.15, No.2, pp.41-51.

McIsaac, M.S., & Gunawardena, C.N. (1996) 'Distance education.' In D.H. Jonassen (eds) *Handbook of research for educational communications and technology: a project of the Association for Educational Communications and Technology*. New York: Simon & Schuster Macmillan.

Miltiadou, M., & Savenye, W.C. (2003) 'Applying social cognitive constructs of motivation to enhance student success in online distance education. *Educational Technology Review*, Vol.11, No.1, pp.78-95.

Multon, K. D., Brown, S.D. & Lent, R.W. (1991) 'Relation of self-efficacy beliefs to academic outcomes: A meta-analytic investigation. *Journal of Counseling Psychology*, Vol. 38, No.1, pp.30-38.

Jost, J.T., Kruglanski, A.W. & Nelson, T.O. (1998) 'Social metacognition: an expansionist review.' *Personality & Social Psychology Review Special Issue: Metacognition*, Vol.2, No.2, pp.137-54.

Ozturk, B. (2003) 'Relationships among self-reulated learning components, motivational beliefs and matematics achivement.' *MS Thesis (unpublished)*, The Department of Secondary Sicence and Mathematic Education, Middle East Technical University, Turkey.

Pintrich, P.R. (1990) 'Implications of psychological research on student learning and college teaching for teacher education.' In W.R. Housten (ed*) Handbook of Research on Teacher Educaton*. New York: Macmillan.

Pintrich, P.R., & De Groot, E.V. (1990) 'Motivational and self-regulated learning components of classroom academic performance.' *Journal of Educational Psychology*, Vol.82, No. 1, pp.33-40.

Pintrich, P.R., & Schunk, D. H. (1996) *Motivation in Education: Theory, Research, and Application*. Englewood Cliffs, NJ: Prentice-Hall Inc.

Pintrich, P., Smith, D., Garcia, T. & McKeachie, W. (1991) 'A Manual for the Use of the Motivated Strategies for Learning Questionnaire.' *Technical Report 91-B-004*. The Regents of The University of Michigan.

Riddle, J.F. (1994) 'Factors which contribute to grade achicement and course satisfaction of distance education students.' *Dissertation Abstracts International*, 55 (09), 2742A.

Rogers, E.M. (1995) *Diffusion of Innovations.* New York, Free Press. [4th edition]

Shih, C. & Gamon J. (2001) 'Web-based learning: Relationships among student motivation, attitude, learning styles, and achievement.' *Journal of Agricultural Education*, Vol.42, No.4, pp.12-20.

Sherritt, C. (1996) *Distance education for disadvantaged adults*. ERIC Document ED389905.

Simonson, M., Smaldino, S., Albright, M. & Zvacek, S. (2003) *Teaching and Learning at a Distance: Foundations of Distance* Education. Upper Saddle River, NJ: Merrill/ Prentice-Hall. [2nd edition]

Young, J.D. (1996) 'The effect of self-regulated learning strategies on performance in learner controlled computer-based instruction.' *Educational Technology Research and Development*, Vol.44, No.2, pp.17-27.

Zalenski, A.W. (2001) 'Graduation and attrition from the Bachelor of Liberal Studies program: An analysis of selected variables.' *Dissertation Abstarcts International*, 62, (03), 944A.

Zimmerman, B. J. (1986) 'Becoming a self-regulated learner: which are the key subprocesses?' *Contemporary Educational Psychology*, No.11, pp. 307-313.

Zimmerman, B.J. (1989) 'A social cognitive view of self-regulated academic learning.' *Journal of Educational Psychology*, Vol.81, No. 3, pp.329-339.

Zimmerman, B.J. (1990) 'Self-regulating academic learning and achievement: The emergence of a social cognitive perspective.' *Educational Psychology Review*, Vol.2, No.2, pp.173-201.

Zimmerman, B.J. (1994) 'Dimensions of academic self-regulation: A conceptual framework for education.' In D.H. Schunk & B.J. Zimmerman (eds) *Self-regulation of Learning and Performance: Issues and Educational Applications*. Hillsdale, NJ: Erlbaum.

Zimmerman, B.J., Bandura, A. & Martinez-Pons, M. (1992) 'Motivation for academic attainment: The role of self-efficacy beliefs and personal goal setting.' *American Educational Research Journal*, Vol.29, No.3, pp.663-676.

Zimmerman, B.J. & Martinez-Pons M. (1990) 'Student differences in self-regulated learning: Relating grade, sex, and giftedness to self-efficacy and strategy use.' *Journal of Educational Psychology*, Vol.82, No.1, pp.51-59.