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The Determination of Metacognitive Awareness Situations of Secondary School Students Receiving Programming Education with Alice

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ABSTRACT

Metacognition or metacognitive awareness is defined as the comprehension of individuals of their possessed skills, the controlling of these skills by those individuals and the stimulation of cognitive processes possessed by individuals in order to complete the learning process at high level (Flavell, 1979). Metacognitive awareness means the knowledge of individuals regarding metacognition system they possess. The metacognitive knowledge of individuals and their opinions regarding the control level of this metacognitive knowledge reveal metacognitive awareness (Yıldırım, 2010). The goal of the conducted study is to determine the metacognitive awareness situations of secondary students receiving 3-B programming education with Alice. The study group of the study consists of 186 students in 6th grade in Konya. Pre-test – Post-test single subject quasi-experimental method is used as research model. "Metacognitive awareness scale for children" prepared by Karakelle and Saraç (2007) is used as data collection tool. The scale is 5 point likert type and consists of 18 items. Additionally, the Cronbach alpha value of the scale is calculated as =.80. SPSS package program is used in the analyses of data obtained. As a result of analysing the data obtained during their study, the following conclusions are made; metacognitive awareness situations of secondary students receiving programming education with Alice have increased, their metacognitive awareness situations differ meaningfully in terms of their sexes and their metacognitive awareness situations don't differ in terms of their possession of computers, possession of internet and weekly internet usage situations.

Keywords: *Information and communication technologies, programming instruction, metacognition awareness, Alice programming*

INTRODUCTION

It is necessary to be programmed in order to be able to use the technology in the direction of various needs with the tools developed in the 21st century and the programming languages required for programming are defined as all commands consisting of special words and symbols prepared for using the devices in accordance with the determined needs (Ersoy, Madran and Gülbahar, 2011). In today's society, software plays an important role and many tools that are used in modern life can be managed by different software, which is very important to educate well educated programmers in today's world where programming becomes important (Tüzün, 2007). Since the training given in the field of programming is an educational field that is important in the development stage of computer technologies and enables the software works to manage these development stages, it is important to educate individuals who are able to produce high quality products in programming within the society and in the society, work needs to be done to increase the number of experts in this field (Kert and Uğraş, 2009). Individuals' skills in programming are emerging as an individual skill that requires not only writing a program but also using high-level thinking skills that today's people need to include in their features. In other words, when individuals are programming to direct the behaviour of computers or other electronic devices, they learn how to respond to the problems they encounter in this process and how to think systematically

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(Yükseltürk and Altıok, 2015). Alice, the 3D programming environment, was used in the study. Alice, through the rich 3D visual programming environment, attracts the interest of the students and gives positive feedbacks (Sykes, 2007). As a result of the examinations carried out on the courses continued using Alice, the result is that the students show a significant increase in the understanding of the programming and in the confidence in programming (Bishop-Clark, Courte, Evans and Howard 2007). In Europe and America, programming education is shown at different ages with different activities and lessons. It aims to train individuals who learn the problem-solving logic of computers and can solve the problems they face in daily problems so that the requirements in the field of information technology can be removed (Kukul and Gökçearslan, 2014).

The development of technology in the last period and the necessity of differentiation in the needs of the individuals and the necessities of the individuals as the foregrounds. Along with the technological improvements, the communities are trying to increase their knowledge and skills and reach the advanced level thanks to the unlimited possibilities of knowledge. Today, when the level of societal development is measured by the knowledge and skills that are possessed, the generation of new information is an important part of how information is transferred to other individuals. Traditional methods are abandoned in the process of transferring this information to other learners as the amount of information that needs to be learned increases in our age (Yıldız, 2012). Traditional education based on the memorization of knowledge leaves its place to innovative methods today. In the period we are in, the shape of the student has become student-centered. In this way, students are able to improve their mental ability and learn by structuring existing knowledge. It is known that the students actively participate in the information learning process and they organize themselves in accordance with the originality of the information (Dilci and Kaya, 2012). Metacognition is one of the concepts that have driven the day-to-day popularity of the 1970s (Bağçeci, Döş and Sarıca, 2011). Metacognition or metacognitive awareness is defined as the comprehension of individuals of their possessed skills, the controlling of these skills by those individuals and the stimulation of cognitive processes possessed by individuals in order to complete the learning process at high level (Flavell, 1979). Metacognitive awareness means the knowledge of individuals regarding metacognition system they possess. The metacognitive knowledge of individuals and their opinions regarding the control level of this metacognitive knowledge reveal metacognitive awareness (Yıldırım, 2010). Information about metacognition is relevant to the cognition. It also includes strategic knowledge of individuals, knowledge of cognitive responsibilities, contextual and conditional information, and information about individuals themselves (Başbay, 2007). Clementve and Fullo (1984) found that students who work in the field of programming are more reflective and have different thinking skills and higher cognitive and guidance skills than non-programmers. In the researches on the training in metacognition and computer environments, new models are suggested for metacognitive processing and development of the individual and the environmental factors and the interactions between them (Clements and Nastasi, 1999). Volet (1991) suggests that the results of the students' in computer programming and metacognitive strategy development are positive.

Research problem

Critical thinking, problem solving, analytical thinking, cooperative working and information and communication technologies literacy which are defined as 21st century qualifications, are the qualifications which individuals shall possess in information communities. The easy accession to information by individuals and the productive usage of this information by individuals are aimed at present time. The most important factor in achieving this goal is the usage of technology. Programmes provide the designing of technology by individuals according to their needs. The purposive usage of technology will be possible with the instruction of computer programming to individuals. If computer programming and design tools are instructed, the acquisition of 21st century qualifications by individuals and the integration of technology in lives and fields of living will be facilitated. Programming has been being instructed through "Information Technologies and Software" lesson in primary and secondary schools as of 2013. The program used in the application stage of this study is Alice which is the graphical programming language. The goal of this study is to determine the metacognitive awareness situations

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of secondary school students receiving programming education with Alice. Metacognition is used for monitoring and regulating cognitive processes such as 21st century qualifications and learning. Therefore, individuals gain particular advantages in programming and developing algorithms by using the information they obtain productively. The answers to the following questions are sought within the scope of this study;

1. Is there a meaningful difference in metacognition awareness situations of secondary students receiving programming education with Alice?
2. Do metacognition awareness situations of secondary students change in terms of their genders?
3. Do metacognition awareness situations of secondary students change in terms of their computer possession situations?
4. Do metacognition awareness situations of secondary students change in terms of their internet possession situations?
5. Do metacognition awareness situations of secondary students change in terms of their weekly internet usage situations?
6. Do metacognition awareness situations of secondary students change in terms of their mobile device availability situations?

METHOD

Research Model and Study Group

Quantitative research method was adopted in this research and research was carried out with an experimental design. Pre-test - Post-test single subject quasi-experimental design is used in this study in which quantitative research method is adopted. This research consists of 186 students receiving education in Konya province in 2016-2017 Fall semester.

Information on gender status of middle school students participating in the study is given in Table 1 below.

Table 1. Demographical Data of Participants

		N	%
Sex	Female	86	46,2
	Male	100	53,8
	Total	186	100,0

As seen in Table 1, 86 (46.2%) of the 186 secondary students participated in the study are female and 100 (53.8%) are male.

Data Collection Tools

Personal information form which is developed by researchers and through which demographical data of study group students are obtained and the B form of "Metacognition Awareness Scale" which is developed by Karakelle and Saraç (2007) for the determination of metacognition awareness of secondary students are used in this study. The B form of the scale consists of 4 dimensions (the organization of cognition - inspection, cognition knowledge - duty, the organization of cognition - monitoring and cognition knowledge - personal awareness) 5 point likert type and 18 items. The Cronbach alpha value of the scale is calculated as 0.80.

Data Analysis

The data obtained within the scope of the study are analysed via SPSS package program. Since obtained data meet parametric test assumptions (N=186), parametric tests are used while analysing the data. Within this context, the tests used for each sub-goal are explained below. Demographical data obtained from participants are demonstrated with descriptive statistical methods. In order to test whether a meaningful difference occurs or not in terms of the metacognitive situations, genders, computer possession situations and internet possession situations of participants before and after the application, t-test for unrelated samples is used. Moreover, in order to determine the weekly internet usage situations of secondary students, one-way analysis of variance is used.

Application process

With the participation of the students of the study group, the application process realized in "Information Technologies and Software" course lasted 3 + 8 for a total of 11 weeks. Students were given a preliminary test for the first 3 weeks,

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detailed information about the process, about the lesson, and various examples of the Alice program. During the 8 weeks following the 3-week informative process, applications that meet the course achievements are required to be made using the Alice program from the study group's students. At the end of the process, the final test was performed and data were collected.

FINDINGS

Findings regarding the 1st research question; "Is there a meaningful difference in metacognition awareness situations of secondary students receiving programming education with Alice?"

The results of the comparison of the pre-test and post-test (paired sample t test) to determine the metacognitive awareness status of the study group students as a result of the application are given in Table 2.

Table 2. Pre-test – Post-test Comparison Results of the Study Group

	Test	N	$\overline{X}$	Ss	Sd	t	p
Study Group	Pre-test	186	78,44	9,52	185	112,31	.000
	Post-test	186	64,12	10,55			

*p<0.05

As it is clear in Table 2, a statistical difference (p<0.05) is detected between pre-test and post-test grades (pre-test average is $\overline{X}$ =64,12; post-test average is $\overline{X}$ =78,44) of study group students for *p<.05 relevance level. It is determined that metacognitive awareness situations of secondary students receiving programming education with Alice increased (Table 2).

Findings regarding the 2nd research question; "Do metacognition awareness situations of secondary students change in terms of their genders?"

Table 3 demonstrates the t-test results for unrelated samples performed in order to determine the metacognitive awareness situations of the study group in terms of their sexes.

Table 3. Results of Metacognitive Awareness Scale Grades in terms of Sex

Groups	N	$\overline{X}$	S	Sd	t	p
Female	86	76,6279	9,29269	184	-2,447	,001
Male	100	80,0100	9,49055			

*p<0.05

The averages of grades students obtained from metacognitive awareness scale (average of males is $\overline{X}$ =80,01; average of females is $\overline{X}$ =76,62) are different, therefore the result is meaningful since it is .001 < .05 for *p<.05 relevance level as it is seen in Table 3. In other words, metacognitive awareness situations of students differ meaningfully in terms of their sexes.

Findings regarding the 3rd research question; "Do metacognition awareness situations of secondary students change in terms of their computer possession status?"

Table 4 demonstrates the t-test results for unrelated samples performed in order to determine the metacognitive awareness situations of the study group in terms of their computer possession status.

Table 4. Results of Metacognitive Awareness Scale Grades in terms of Computer Possession Status

Groups	N	$\overline{X}$	S	Sd	t	p
Yes	88	79,43	9,45	184	1,340	.182
No	98	77,56	9,54			

*p<0.05

The averages of grades students obtained from metacognitive awareness scale (average of those possessing computer is $\overline{X}$ =79,43; average of those who don't possess computer is $\overline{X}$ =77,56) are close to each other, therefore the result is not meaningful since it is .182 > .05 for *p<.05 relevance level as it is seen in Table 4. In other words, metacognitive awareness situations of students don't differ meaningfully in terms of their computer possession status.

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Findings regarding the 4th research question; "Do metacognition awareness situations of secondary students change in terms of their internet possession status?"

Table 5 demonstrates the t-test results for unrelated samples performed in order to determine the metacognitive awareness situations of the study group in terms of their internet possession status.

Table 5. Results of Metacognitive Awareness Scale Grades in terms of Internet Possession Status

Groups	N	$\overline{X}$	S	Sd	t	p
Yes	111	79,61	9,36	184	2,049	,042
No	75	76,72	9,56			

*p<0.05

The averages of grades students obtained from metacognitive awareness scale (average of those who possess internet is $\overline{X}$ =79,61; average of those who don't possess is $\overline{X}$ =76,72) are different, therefore the result is meaningful since it is .042 < .05 for *p<.05 relevance level as it is seen in Table 5. In other words, metacognitive awareness situations of students differ meaningfully in terms of their internet possession status.

Findings regarding the 5th research question; "Do metacognition awareness situations of secondary students change in terms of their weekly internet usage status?"

Table 6 demonstrates the single factoral variance analysis (one way anova) results for unrelated samples performed in order to determine the metacognitive awareness situations of the study group in terms of their weekly internet usage status.

Table 6. Results of Metacognitive Awareness Scale Grades in terms of Weekly Internet Usage Status

Weekly internet usage	N	$\overline{X}$	S
0-3 hours	130	77,56	9,51
3-6 hours	30	80,03	10,23
6-9 hours	9	81,77	8,30
9 hours and over	17	80,64	8,52
Total	186	78,44	9,52

	Variance Source	Total of Squares	sd	Average of Squares	F	p	Difference
Weekly internet usage	Inter-groups	359,550	3	119,850	1,328	,267	No
	Intra-groups	16426,412	182	90,255			
	Total	16785,962	185				

As it is clear in Table 6, according to results obtained through single factoral variance analysis (ANOVA) for unrelated samples, there isn't any meaningful difference between grades of students obtained from metacognitive awareness scale [F(3-182)= 1,328, .267>.05]. In other words, metacognitive awareness situations of students don't differ meaningfully in terms of their weekly internet usage status.

Findings regarding the 5th research question; "Do metacognition awareness situations of secondary students change in terms of their mobile device availability situations?"

Table 7 demonstrates the single factoral variance analysis (one way anova) results for unrelated samples performed in order to determine the metacognitive awareness situations of the study

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group in terms of their mobile device usage competence status.

Table 7. Results of Metacognitive Awareness Scale Grades in terms of Mobile Device Usage Competence Status

Mobile Device Usage Competence Status	N	$\overline{X}$	S
1.Very inadequate	13	73,46	9,81
2. Inadequate	9	76,77	10,25
3. Adequate in medium-level	44	77,29	7,90
4. Adequate	70	78,20	10,18
5.Very adequate	50	81,40	9,14
Toplam	186	78,44	9,52

	Variance Source	Total of squares	sd	Average of squares	F	p	Difference
Mobile Device	Inter-groups	846,81	4	211,70	2,404	,051	No
	Intra-groups	15939,14	181	88,06			
	Total	16785,96	185				

As it is clear in Table 7, according to results obtained through single factoral variance analysis (ANOVA) for unrelated samples, there isn't any meaningful difference between grades of students obtained from metacognitive awareness scale in terms of their mobile device usage competence status [F(4-181)= 2,404, .051>.05]. In other words, metacognitive awareness situations of students don't differ meaningfully in terms of their mobile device usage competence status.

CONCLUSION

The students who participated in the application have reached the result that they have developed in positive direction. It was also concluded that the metacognitive skills of secondary students compared to the post-test grades show a significant difference in terms of their sexes. Metacognitive skills of secondary students do not depend on the status of having a computer; however, they depend on internet possession status and they do not change in terms of their weekly internet usage. The study group of the study which aims to determine the metacognitive awareness status of secondary students receiving programming education with Alice consists of 186 students (86 (46,2%) of them are female and 100 (53,8%) are male). According to the results obtained in this study, the study group students were found to differ statistically from the pre-test – post-test grades they received from the metacognitive awareness scale for * p <.05 relevance level. It has been determined that secondary students who are trained in programming with Alice increased their metacognitive awareness. Sykes (2007) also found that despite the technical difficulties encountered in the study, the performance of the individuals who received training with programming with Alice increased. Individuals specializing in programming are found to have higher metacognitive levels than inexperienced individuals (Eteläpelto, 1993). Programming can improve cognitive skills when the right conditions are met. However, it is thought that these conditions can be difficult to apply widely everywhere (Salomon and Perkins, 1987). When analysing the t-test results of the unrelated samples performed to determine the metacognitive status of the students in terms of their sexes, it is observed that the average of grades of the study group students obtained from the metacognitive awareness scale was different and the metacognitive awareness status of the study group students showed a significant difference in terms of their sexes. Accordingly, male students' metacognitive awareness levels are higher than female students. However, it is seen that the levels of metacognitive awareness did not differ in terms of their sexes in studies conducted at other age levels (Dilci and Kaya, 2012). Bağçeci, Döş and Sarıca (2011) stated that female students' metacognitive awareness levels were higher than male students. As a result of the t-test for unrelated samples performed to determine metacognitive awareness status of students, the averages of grades students obtained from metacognitive awareness scale are close to each other, therefore the result is not meaningful and metacognitive awareness

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situations of students don't differ meaningfully in terms of their computer possession status. Oktay and Çakır (2013) found that computer use did not make a difference in the level of metacognitive awareness. In addition, they emphasized that metacognitive awareness situations of students developed with the information they learned in the process. As a result of the t-test for unrelated samples performed to determine metacognitive awareness status of the students in terms of their internet possession status, the average of grades of the study group students on the metacognitive awareness scale differed. In this case, the metacognitive awareness status of the study group students varies in terms of their internet possession status. Özkaya, Aydoğdu and Çağıran (2016) have found that there is a significant difference between the experimental group in which activities based on metacognitive activities are used and the attitudes towards the lesson according to the control group. In the single factoral variance analysis for unrelated samples used in the analysis to determine metacognitive awareness situations of students in terms of their weekly internet usage status, it is concluded that there isn't any difference among the total of grades of students in terms of their weekly internet usage status. According to this result, the metacognitive awareness status of the study group students does not change in terms of their weekly internet usage situations. Kramarski and Feldman (2010) point out that the weekly course on the internet contributes significantly to motivation but does not contribute to the level of metacognitive awareness. In the single factoral variance analysis for unrelated samples used in the analysis to determine metacognitive awareness situations of students in terms of their mobile device usage competence status, it is concluded that there isn't any difference among the total of grades of students in terms of their mobile device usage competence status. According to this result, the metacognitive awareness status of the study group students does not change in terms of their mobile device usage competence status. The study by Türkyılmaz (2015) indicates that metacognitive awareness levels of students with mobile devices and social networking profiles are low. The following suggestions could be made in the direction of these conclusions;

- In-depth interpretations of the study group's process and orientation can be analyzed by conducting in-depth studies on the process with experimental studies and the different educational output effects of the students and qualitative studies.

- Different studies can be performed by comparing different educational outcomes and different qualifications of students.

- Technology-assisted programming training is crucial to the development of next-generation successful coders, as students' technology and internet usage status are influencing their metacognitive state.
- It is important for younger learners to be trained with new coders to practice different applications such as Alice, Scratch, which allows them to write applications without having to learn complex code structures of traditional programming languages.
- Computer programming or coding training is also used for computational thinking in students and for developing different educational situations (Calao, MorenoLeon, Correa and Robles, 2015). Therefore, it is important to practice such applications as Alice, Scratch in order to improve the different competences and educational situations of the young students.

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