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Clustering Analysis of Attitudes of Prospective Computer Programmers towards Programming

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Abstract. This study aims to determine the clustering tendency of attitude variables of the students studying at computer programming department regarding computer programming. The study secondly aims to inspect whether factors such as gender, grade and type of education have an influence on the clusters obtained from the analysis. The study is conducted in fall semester of 2013-2014 academic year. The sample of the study consists of 947 students from 12 universities in different regions of Turkey. "Attitude Measure Regarding Computer Programming "is used as a data collecting tool. Clustering tendency of attitude variables are determined by hierarchical clustering analysis. Independent t-test is used to determine whether gender, grade and type of education influence these clusters. Attitude variables of the students are collected under six clusters. It has been seen that gender factor has an important effect on three clusters and, grade factor has an important effect on four clusters. Type of education factor has no statistically important effect on these clusters.

Keywords: Computer Programming, Cluster Analysis, Attitude, Hierarchical Clustering

Introduction

Rapid development in information technologies makes the teaching and learning of these technologies necessary and important. In terms of computer teaching, computer programming approach and teaching the information and skill relating to this approach come first (Korkmaz & Altun, 2013; Tüfekçi & Köse, 2013). Skill for computer programming requires to have high level thinking skills. These skills consists of firstly problem solving, logical and mathematical thinking (Fang, 2012; Korkmaz, 2012; Lau & Yuen, 2009). Computer programming courses are perceived as boring and difficult than a lot of courses by the students (Aşkar & Davenport, 2009; Başer, 2013a; Farkas & Murthy, 2005). The fact that the students towards the computer programming

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course as difficult from the beginning can be resulted in the failure of the students in these courses (Tan, Ting, & Ling, 2009).There are lot of studies in literature dealing with the difficulties relating to the computer programming learning (Hawi, 2010; Gomes & Mendes, 2007; Jenkins, 2002; Katai, Juhasz, & Adorjani, 2008; Korkmaz, 2012; Lau &Yuen, 2009; Milne & Rowe, 2002; Tan, Ting, & Ling, 2009). Furthermore there are several studies searching for the reasons for the difficulties encountered in learning the computer programming and some of these studies emphasize the fact that the difficulty arises from the perception of the students. The perception about the computer programming, difficult and boring, causes the students' developing low attitude towards the computer programming (Başer, 2013a).

There are also other studies emphasizing the fact that physiological factors such as negative perception, motivation and especially low attitude may affect the computer programming learning negatively (Anastasiadou & Karakos, 2011; Erdogan, Aydın, & Kabaca, 2008; Hawi, 2010; Hongwarittorrn & Krairit, 2010). Furthermore researches made in educational sciences' support this situation. Accordingly there are lots of studies arguing that attitudes of students attitudes towards the grade affect their success rate directly (Başer & Geban, 2007; Hwang, Wu, & Chen, 2012; Singh, Granville, & Dika, 2002; Tüysüz, 2010; Van De Gaer, Grisay, Schulz, & Gebhardt, 2012). Education given to the students of computer programming departments in universities aims to provide them knowledge and skills required by this occupation. Furthermore it is aimed to help students to be more effective in their occupational life with these knowledge and skills. One of the preconditions of the individuals' success in their occupational life is to develop positive attitudes towards their occupation. It is known that attitude is one of the factors determining the behaviour (Pehlivan, 2010). For this reason, it depends on developing positive attitude towards occupation to display some behaviours created by the occupation (Çağlar, 2013). It is possible to encounter with the studies about the attitudes towards computer science in general and computer programming in specific. The results of these studies have not a common point. While some of these studies argue that the attitude towards the computer programming has not a relation with gender (Lau & Yuen, 2009; McDowell, Werner, Bullock, & Fernald, 2003), the others argue that male students have more positive attitude towards programming (Chang, Shieh, Liu, & Yu, 2012; Korkmaz & Altun, 2013; Stoilescu & Egodawatte, 2010).

At the end of the literature survey, it is seen that, existing studies about the attitudes towards computer programming become dense in engineering departments and computer education and instructional technology department. A comprehensive study dealing with the attitudes of students studying in computer programming department has not been encountered. This is a huge lack for the studies made in educational sciences. The lack of these studies may cause the insufficiency of feedback of the education given in this field. In this regard it is very important to know the attitudes of the individuals towards programming who choose computer programming as an occupation and will engage in this occupation. Accordingly knowing this may contribute to the

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improvement activities of educational institutions (Korkmaz & Altun, 2013). In this context this study aim to determine the clustering tendencies of the attitude variables of students towards computer programming who studying in computer programming department. Furthermore these clusters are examined by the factors such as gender, grade and type of education. It is thought that this study will fill an important gap in literature and will enlighten the following studies.

Methodology

Descriptive approach of the general scanning methods and relational scanning model are used in this study. In relational scanning model, existence and degree of covariance is tried to be determined. (Karasar, 2006).

Participants

This study is conducted in the fall semester of 2013-2014 academic year. 947 students studying at computer programming department in 12 universities in different regions of Turkey have participated in the study. Universities are code as A ... L. Numbers of the students by gender, grade and type of education are given in Table 1.

Table 1: Distribution of students according to the university, gender, grade and type of education

Universities	Gender		Grade		Type of education		Total number of students
	Female	Male	1	2	Daytime education	Evening education	
A	22	65	33	54	57	30	87
B	9	28	8	29	27	10	37
C	18	31	21	28	33	16	49
D	14	42	42	14	25	31	56
E	17	33	-	50	33	17	50
F	13	19	17	15	10	22	32
G	35	74	47	62	83	26	109
H	7	24	-	31	6	25	31
I	42	99	58	83	64	77	141
J	37	80	68	49	65	52	117
K	18	61	34	45	34	45	79
L	52	107	97	62	95	64	159
Total	284	663	425	522	532	415	947

As it is seen in Table 1, the sample group consists of 284 female and 663 male students. 425 of these students are in first grade and 522 of them are second grade. 532 of them are registered in daytime education, others are in evening education.

Instrument

Attitude Scale toward Computer Programming (AStCP) developed by Başer (2013a) is used as a data collecting tool in this study. AStCP consists of 38 items and it is designed as 5-point Likert scale as to give answer to the choices such as "strongly disagree", "disagree", "undecided", "agree", "strongly agree".

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Answers given to the each item by the students are listed as a numerical value as 1-5. Validity and reliability examination of the scale is conducted by the researcher (Başer, 2013a) and Cronbach-α reliability coefficient is found out as 0.953.

Data Analysis

This study has two objectives. The first one is to research the clustering tendencies of attitude variables of students of computer programming department towards the computer programming. The other one is to determine whether these clusters have any difference in terms of gender, grade and type of education. Hierarchical clustering method is used in accordance with the first objective. Ward method is used for calculating the similarities. Squared euclidean distance is chosen as similarity-difference measure in calculation of distance between the variables. Similarities between the attitude variables are presented with dendrogram. The influence of gender, grade and type of education factors on these clusters is examined with independent t-test accordance with the second objective. Negative items are inverted before the data are analyzed with independent t-test and attitude points in accordance with the clusters are calculated in that way. SPSS 16.0 statistical pocket program is used for data analysis.

Findings

In this study clustering analysis of attitude variables of the students studying computer programming towards the programming is conducted. Responses given by the students to the AStCP are subjected to the hierarchical clustering analysis. Items in the AStCP are coded as M1 … M38. The dendrogram obtained from this analysis is presented in figure 1.

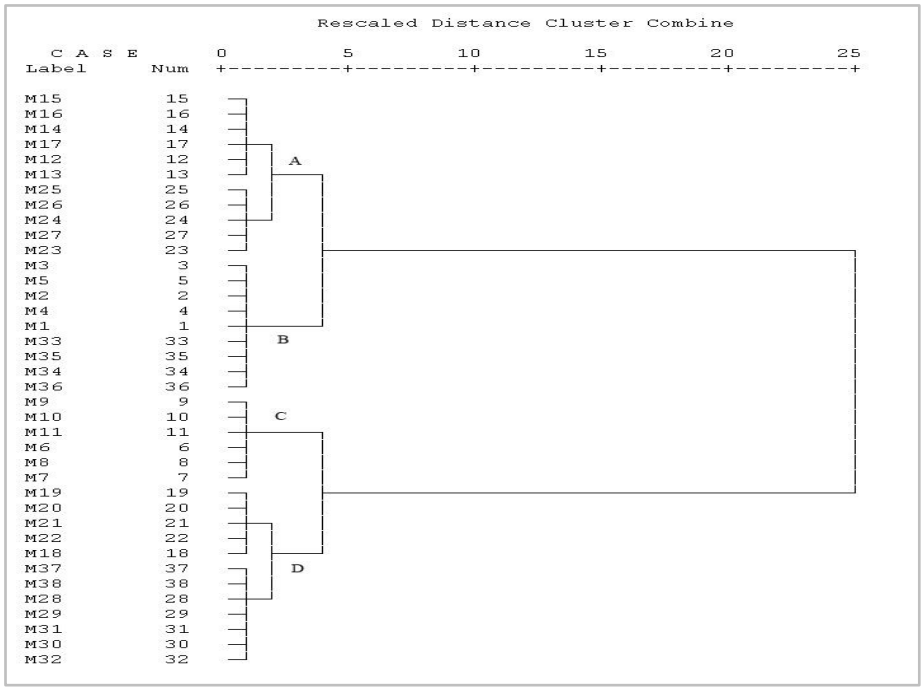

Figure 1. Dendrogram for attitude variables of students towards computer programing

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As it can be seen in Figure 1, attitude variables of students towards computer programing are collected under four main clusters listed as A, B, C and D. And cluster A consists of sub clusters listed as A1 and A2, accordingly cluster D consists of sub clusters D1 and D2. Items included in A, B, C and D including their sub clusters are listed as follows.

Custer A

A1:

(M15) Winning a prize in programming competitions is a wonderful thing for me.
(M16) It makes me happy to be the first in programming competition.
(M14) It makes me happy to get the highest point in programming course.
(M17) It is an important situation for me to be regarded as a smart student in programming course.
(M12) It makes me happy to be perceived as a magnificent student in programming course.
(M13) It makes me proud to be a student taking the attention in programming course.

A2:

(M25) To know programming will help me find a job.
(M26) Programming is important and useful.
(M24) I make effort for programming course, because I know how much it is necessary.
(M27) I will make use of programming in my occupational life in many way.
(M23) I will need for programming in my following studies.

Cluster B

(M3) I think I can cope with more difficult programming problems.
(M5) When it comes to programming, I have self confidence in high level.
(M2) I am certain that I will learn programming.
(M4) I can take good marks in programming class.
(M1) I feel confident in solving the computer programming problems.
(M33) When I encounter with a programming problem, I struggle to solve it till the end.
(M35) In the case of an unanswered question in programming class, I carry on think about it afterwards.
(M34) Computer programming problems that I cannot understand quickly whip me up.
(M36) When I start to work on a program, I have difficulty in stopping it.

Cluster C

(M9) I find programming highly difficult, even though I study it.
(M10) I can cope with lots of course, but I have no skill for programming problems.
(M11) The most unsuccessful class that I take is computer programming.
(M6) I am not good at programming.
(M8) I am not a person who can make computer programming well.
(M7) I do not think, I will success in computer programming course in the future.

Cluster D

D1:

(M19) If I get good marks in programming course, I ignore it.
(M20) If I get good mark in programming course once, I do not want again.
(M21) If I become a successful student in programming course, people will love me less than before.
(M22) I do not want people think about me as a successful student in programming course.
(M18) It does not attract me to win a prize in a competition relating to the programming.

D2:

(M37) The fact that the programming problem is difficult does not take my attention.
(M38) I cannot understand that people spend long time for writing program and enjoy it.
(M28) Programming has no importance for my occupational life.
(M29) Programming will not have importance in my occupational life.
(M31) Taking programming classes is a waste of time.
(M30) I will rarely use the programming in my occupational life.
(M32) I guess there will be few place to use the programming after school.

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Items included in the clusters and sub clusters arising from the hierarchical clustering analysis are examined and named. The names of the clusters and sub clusters in which there are attitude variables of the students towards the computer programming and the items they include are presented in Table 2.

Table 2: The clusters and sub clusters in which there are attitude variables of the students towards the computer programming

Clusters	Sub clusters	Variables	Names of Clusters
A	A1	M15,M16,M14,M17,M12,M13	To become prominent in programming
	A2	M25,M26,M24,M27,M23	Need for programming and importance of it
B		M3,M5,M2,M4,M1,M33,M35,M34,M36	Interest for programming and success rate
C		M9,M10,M11,M6,M8,M7	Failure in programming
D	D1	M19,M20, M21,M22,M18	Indifference in programming
	D2	M37,M38,M28,M29,M31,M30,M32	Unimportance of programming

Influence of the factors such as gender, grade and type of education on clusters obtained from the hierarchical clustering analysis is researched. Results of independent t-test showing the influence of gender factor on clusters can be seen in Table 3.

Table 3: Result of independent t-test of the attitude clusters of students towards computer programming by gender

Cluster	Gender	n	Mean	Sd	t	p
(A1) To become prominent in programming	Female	284	4.2394	.84217	1.288	.198
	Male	663	4.1528	.99010		
(A2) Need for programming and importance of it	Female	284	3.8887	.65993	0.743	.458
	Male	663	3.8371	.84925		
(B) Interest for programming and success rate	Female	284	3.2218	.65993	-2.245	.025*
	Male	663	3.3488	.84925		
(C) Failure in programming	Female	284	3.0968	.95106	-2.906	.004*
	Male	663	3.3095	1.06434		
(D1) Indifference in programming	Female	284	4.2289	.80063	3.018	.003*
	Male	663	4.0483	.86158		
(D2) Unimportance of programming	Female	284	3.7470	.79117	1.065	.287
	Male	663	3.6783	.95546		

$p < .05$

As it can be seen in Table 3, there is a significant difference in attitudes of students towards computer programming in clusters "Interest for programming and success rate" (p=.025), "Failure in programming" (p=.004), "Indifference in programming by gender" (p=.003) statistically. It is seen that attitudes of male students are more positive than that of female students in cluster "Interest for programming and success rate" and "Failure in programming". But it is seen that attitudes of female student are more positive than that of male student in cluster "Indifference in programming". In other clusters, "To become prominent in programming" (p=.198), "Need for programming and importance of it" (p=.458) and "Unimportance of programming" (p=.287), there is not a significant

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difference in attitudes in terms of gender statistically. The result of independent t-test showing the influence of grade factor on clusters can be seen in Table 4.

Table 4. Result of independent t-test of the attitude clusters of students towards computer programming by grade

Cluster	Grade	n	Mean	Sd	t	p
(A1) To become prominent in programming	1	425	4.2325	.93259	1.574	.116
	2	522	4.1351	.96002		
(A2) Need for programming and importance of it	1	425	3.9181	.98031	1.860	.063
	2	522	3.7992	.97673		
(B) Interest for programming and success rate	1	425	3.3864	.76711	2.640	.008*
	2	522	3.2490	.81959		
(C) Failure in programming	1	425	3.3702	.97979	3.356	.001*
	2	522	3.1443	1.06947		
(D1) Indifference in programming	1	425	4.1642	.81103	2.029	.043*
	2	522	4.0521	.87343		
(D2) Unimportance of programming	1	425	3.7903	.87404	2.799	.005*
	2	522	3.6245	.93151		

$p < .05$

As it can be seen in Table 4, there is a significant difference in cluster "Interest for programming and success rate" (p=.008), "Failure in programming" (p=.001), "Indifference in programming" (p=.043) and "Unimportance of programming (p=.005) in terms of grade statistically. Attitudes of students in the first grade are more positive that the ones in second grade in all these four clusters. Attitudes do not display any significant difference in terms of grade in clusters "To become prominent in programming" (p=.198) and "Need for programming and importance of it" (p=.458) statistically. The results of independent t-test results showing the influence of type of education on clusters can be seen in Table 5.

Table 5: Result of independent t-test of attitude clusters of students towards computer programming by type of education

Cluster	Type of education	n	Mean	Sd	t	p
(A1) To become prominent in programming	Daytime	532	4.1438	.94422	-1.287	.199
	Evening	415	4.2237	.95333		
(A2) Need for programming and importance of it	Daytime	532	3.8474	.95488	-0.186	.853
	Evening	415	3.8593	1.01155		
(B) Interest for programming and success rate	Daytime	532	3.2705	.77625	-1.756	.079
	Evening	415	3.3622	.82529		
(C) Failure in programming	Daytime	532	3.2265	1.00247	-0.645	.519
	Evening	415	3.2703	1.07769		
(D1) Indifference in programming	Daytime	532	4.1192	.81336	0.688	.491
	Evening	415	4.0810	.88966		
(D2) Unimportance of programming	Daytime	532	3.7054	.86355	0.250	.803
	Evening	415	3.6905	.96609		

$p < .05$

As it can be seen in Table 5, there is not any significant difference in attitudes of students towards computer programming in terms of type of education in all clusters statistically.

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Discussion and Conclusion

Studies relating to the attitude have an important role in understanding how the thoughts in education are shaped, measured and change (Maio & Haddock, 2010). Determining the attitudes of the students has an importance for designing the teaching methods and materials of the subjects (Grandell, Peltomäkı, Back, & Salakoskı, 2006). In this regard, this study aims to determine the clustering tendencies of the attitudes of students studying in computer programming department towards the programming. Hierarchical clustering method is used in accordance with this aim. Ward method is used for creating optimum clusters according to the similarities and differences of variables. Attitude variables of students are collected under four main clusters listed as A, B, C, and D according to the analysis of the data obtained from the study. And cluster A have two sub cluster as A1 and A2, accordingly cluster D have two sub clusters as D1 and D2. Among them, clusters A and B include positive attitude variables, clusters C and D include negative attitude variables. Names of clusters A and B including their sub clusters are stated as "A1: To become prominent in programming", "A2: Need for programming and importance of it", "B: Interest for programming and success rate". Accordingly names of clusters C and D including their sub clusters are listed as "C: Failure in programming", "D1: Indifference in programming" and "D2: Unimportance of programming".

Clusters obtained from the study are analyzed by the gender, grade and type of education factors. There are studies in huge number having such a result that male students develop more positive attitudes towards the computer programming than female students (Başer, 2013b; Chang, et al., 2012; Özgen & Korkmaz, 2013). In the analysis made by gender factor in this study, it is seen that attitudes of male students are more positive than that of female students in clusters "B: Interest for programming and success rate" and "C: Failure in programming". In terms of this, result of the study supports the literature. However in cluster "D1: Indifference in programming", it is seen that attitudes of female students are more positive than that of male student. In other word female student have a bigger interest for the programming than male students. Kormaz and Altun (2013) state that belief of students for the necessity for learning computer programming are generally in high level, but their eagerness for learning are in middle level. Bennedsen (2003) states that students are eager to learn the programming but they find learning the programming difficult. Attitudes of female students are more negative than that of male students in clusters "B: Interest for programming and success rate" and "C: Failure in programming", while they have more positive attitudes than male students in cluster "D1: Indifference in programming". In terms of this situation, it can be concluded that female students are interested in programming, but they cannot succeed in programming and they have difficulty in the learning process. Apart from these, in clusters "A1: To become prominent in programming", "A2: Need for programming and importance of it" and "D2: Unimportance of programming", it is seen that attitudes of the students do not display any difference in terms of gender. Literature includes the studies showing that both male and female students display the same attitude in terms of importance of

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learning programming and programming skill (McDowell, et al., 2003; Lau & Yuen, 2009; Pioro, 2004). Finding of this study support the literature in that way.

Clusters obtained in the study are compared by taking into consideration the grade and type of education factors. In terms of grade factor, a significant difference is seen in clusters "B: Interest for programming and success rate", "C: Failure in programming", "D1: Indifference in programming" and "D2: Unimportance of programming" statistically. In all these clusters, students in first grade have more positive attitudes that the ones in second grade. This may be arise from the fact that students in first grade haven't encountered the difficulty in learning programming. Because students in second grade spend more time for programming than the ones in first year. For this reason the positiveness in the first grade may decline in second grade. It is seen that there is not any statistically significant difference in other clusters "A1: To become prominent in programming", "A2: Need for programming and importance of it" in terms of grade factor. There is not statistically significant difference in all the clusters obtained at the end of the analysis made in terms of type of education. The reason for this situation may be the fact that both the daytime and evening students get the same education. Therefore these students getting the same education display the same attitudes towards the computer programming.

In conclusion, both male and female students think computer programming is important and necessary. However when their responses are compared, male students give more positive response in terms of their success in programming than female students. Therefore they display more positive attitudes in clusters including the variables of interest and success rate for the programming. It is seen that attitudes towards the programming differs in terms of grade. All the students in both 1st and 2nd grade think programming is important and necessary. However success in programming and interest for programming are in low level for the student in 2nd grade. Type of education does not influence the attitudes of students towards the programming. The difference between the students' attitudes towards the programming can be examined in detail in the following studies. Hence, new steps for overcoming the difficulties encountered in the process of computer programming education can be taken.

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