Examining Factors of Academic Procrastination Tendency of University Students by using Artificial Neural Network

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Abstract— The purpose of this study is to model the factors that are influential on academic procrastination behaviour with artificial neural network. The population of the research consisted of students in undergraduate programs of Ankara University. A sample was not selected from the population since access to the whole population was targeted. So, this study was carried out on 1271 university students. Information about personal and socio-demographic features in the research was gathered with a form prepared by the authors. The Academic Procrastination Scale and the General Procrastination Scale were applied in the study to explore the levels of academic procrastination and general procrastination of the participants. The influential factors on academic procrastination were scrutinized by using Radial Basis Function Artificial Neural Network. It is clear that the "general procrastination tendency", "self-assessment of course attendance", "studying habit satisfaction", "Preference in revision for exams" and "Planning before any kind of tasks" predictors are influential on academic procrastination tendency. In this study, neural network which is one of the robust and unbiased methods was applied to the educational data due to the its' predictive ability.

Keywords— *Academic Procrastination, General Procrastination, Artificial Neural Networks, Radial Basis Function.*

I. INTRODUCTION

In general, procrastination tendency is described as "a behavioral disposition or personal trait to postpone or delay decision-making and activities" [1]. The term is described as "postponement or delay of choices and decision-making" by [2], whereas Solomon and Rothblum (1984) [3] suggest that procrastination means the act of "needless delay of activities to a later time that causes self-disturbance". Such definitions might vary and increase in number but it is noticeable that most of them have similar content and the act of procrastination could be described by means of almost the same terms. When these definitions are carefully considered, it is likely to find out traces of different types of procrastination

in the literature. In other words, these definitions apparently highlight certain types of procrastination behavior: "postponement of decision-making", "postponement of activities (postponement in general sense/postponement of routine activities)" and so on.

It is likely to divide procrastination behavior into two: "personal trait procrastination (chronic procrastination)" and "situational procrastination". Personal trait procrastination is described as a personal tendency to procrastinate daily activities such as different fulfillments, responsibilities, deadline following, and shopping, and decision-making or tasks alike. In personal procrastination, the individual has the habit of postponing things and this has become chronic [4]. Certain types such as neurotic procrastination, dysfunctional procrastination, routine activity procrastination and decision-making procrastination might be considered within the scope of "personal trait procrastination" [4, 5].

"Personal procrastination" could be defined as postponing almost everything constantly or non-discriminating among tasks, duties and responsibilities, while situational procrastination is domain specific and is thus associated with constant procrastination of tasks, duties and responsibilities in a given area [4]. In this context, it is different from personal trait procrastination. In other words, when procrastination behavior is characterized as a personal trait, the individual tends to procrastinate things in many areas, but the tendency is domain specific in situational procrastination.

Another categorization in the literature is Chun and Choi's (2005) categorization [6]. The researchers divide procrastination behavior into two: "passive procrastination" and "active procrastination". They suggest that passive and active procrastinators vary cognitively, affectively and behaviorally. Passive procrastinators do not tend to display cognitive procrastination behaviors and are quick in decision-making. On the other hand, problems arise at decision practice stage. In other words, passive procrastinators cannot put decisions into practice. Active procrastinators are quick in decision-making and do not have any difficulty in practice, but the main problem in this group is frequent interruption

of work as they are cognitively engaged with other distracters.

Milgram and his friends (1993) [5] highlight that the number of comparative studies on different categorizations in the literature is not satisfactory; therefore, whether types of procrastination have different features or things in common remains uncertain.

Views about the reasons of procrastination behavior vary just like definitions and categorizations. When theoretical explanations are summarized, it is seen that psychoanalytic theory, which is deemed to be the first theory to define procrastination behavior, considers procrastination as a kind of "anxiety avoidance" behavior [7]. In this theory, procrastination is an avoidance behavior or avoidance oriented coping strategy used by human ego in threatening situations [7, 8]. Thus, an increase in anxiety will cause another increase in avoidance behavior. In this theoretical context, as "avoidance behavior" corresponds to "procrastination", threat perceptions of human ego will result in procrastination behaviors [3].

Explanations of cognitive behavioral supporters about the reasons of procrastination focus on irrational thoughts or beliefs people have [9, 10]. On the other hand, theorists of behavioral approach might define the term of procrastination as "a learned behavior that provides people with short term satisfaction" [11].

In addition to the above mentioned explanations of the reasons of procrastination, Solomon and Rothblum (1984) [3] point out that there are two main reasons of procrastination; "work specific avoidance" and "fear of failure". Day and his friends (2000) [12] categorize the reasons of procrastination behavior in the following six groups: "fear of evaluation", "timidity and depressive behavior", "indecisiveness", "social activeness", "resistance to authority" and "addiction to instructions". Yet, one may think that a number of variables associated with procrastination behavior that are mentioned in the following parts of the paper could be considered among the reasons of procrastination.

Academic procrastination behavior is a kind of procrastination included in the "situational procrastination" group and is almost the most frequently examined type of procrastination [13, 14]. There have been studies conducted with university students and research has emphasized that the issue is common in university students [12, 15].

General procrastination behavior can be described as postponing daily activities in the routine of life whereas academic procrastination means postponing academic tasks [16]. Senecal and his friends (2003) [17] define academic procrastination as "the tendency to postpone the start or the end of academic tasks with irrational excuses". Research on academic procrastination has findings of what academic tasks are procrastinated to what extent. For instance, Solomon and Rothblum (1984) [3] found out that approximately 46% of students postponed term papers, 30% weekly reading assignments, 27% revision for exams, 23% different tasks and 10% participation in school activities. A study by Onwuegbuzie (2004) also showed that almost 60% of university students postponed weekly reading assignments, 42% term papers, and 40% revision for exams [8]. Beswick and his friends (1988) [18] concluded that 46% of students postponed term papers, 31% revision for exams and 47% weekly reading assignments. It was highlighted that postponing the task of "revision for exams", the common point in all of the aforementioned studies, caused an increase in anxiety levels of students at the same time [19]. What's more, although these studies revealed the frequency of procrastination behavior varied according to the quality of academic tasks, a lot of studies conducted in different years agreed that procrastination was largely observed especially among university students whatever the frequency was. For instance, O'Brien (2002) [20] and Steel (2007) [21] showed 95% of university students in America displayed procrastination behavior before or during task performance. Rothblum and his friends (1986) [19] emphasized that more than 40% of the students included in their study had a "high" procrastination tendency.

In the light of the aforementioned explanations and justifications, the purpose of this study is to model the factors that are influential on academic procrastination behavior with artificial neural network. To this end, general structure of the Radial Basis Function Artificial Neural Network was approached in mathematical terms and then the method was applied to the data set of the study. Application of unbiased, robust statistical methods in scientific research with cause-effect relationships is critical. Generally speaking, it introduces a necessity to encourage researchers who conduct qualitative research in social sciences to employ artificial neural networks because they are robust methods to explore inter-variable relations and maximize the reliability of findings. This could be considered as the indirect (latent) aim of the study.

II. MATERIALS AND METHODS

Material

The population of the research consisted of students in undergraduate programs of Ankara University, Faculty of Educational Sciences. A sample was not

selected from the population since access to the whole population was targeted. The population consisted of a total of 1788 students. When the distribution of the students included in the population by undergraduate programs is examined, the following numbers are obtained: a total of 222 (12.38%) undergraduates at Department of Computer Education and Instructional Technologies (CEIT), a total of 283 (15.84%) undergraduates at Department of Religion and Moral Education Teaching (RMET), a total of 265 (14.83%) undergraduates at Department of Pre-school Education (PE), a total of 288 (16.12%) undergraduates at Department of Psychological Counseling and Guidance (PCG), a total of 306 (17.12%) undergraduates at Department of Classroom Teaching (CT), a total of 214 (11.97%) undergraduates at Department of Social Sciences Teaching (SST) and a total of 210 (11.74%) undergraduates at Department of Mentally Handicapped Children Teaching (MHCT). When the distribution of students by grade is examined, the following numbers are obtained: a total of 518 (28.99%) first graders, 447 (25.00%) second graders, 372 (20.79%) third graders and 451 (22.00%) fourth graders. Besides, the descriptive statistics of predictors were summarized in Table 1.

TABLE 1
DESCRIPTIVE STATISTICS OF THE PREDICTORS

Predictors	Categories	Frequency	%
Gender	1- Female	857	67
	2- Male	414	33
Age	1- Between 17-22	585	46
	2- 23 and upper 23	686	54
Preferred studying times in a day	1- In the daytime	225	17,7
	2- At night	569	44,8
	3- No difference	477	37,5
Efficient use of time	1- Yes	439	34,5
	2- No	832	65,5
Planning before any kind of tasks	1- Yes	1004	79
	2- No	267	21
Self-Assessment of Course Attendance	1- I attend courses as much as possible	894	70
	2- I reach the maximum absence accrual limit until the end of the course	195	15,5
	3- I'm never absent from courses I like	182	14,5
Studying habit satisfaction	1- Yes	513	40,4
	2- No	758	59,6
Preference in revision for exams	1- Alone	883	69,1
	2- With friends	75	5,9
	3- No difference	313	24,5
Procrastination of general life (Clustered with two-step cluster analysis)	1- Low	194	15,3
	2- Medium	506	39,8
	3- High	571	44,9

When Table 1 is examined, it is obvious that the following variables are included in the model as predictors: gender, age, preferred studying times in a day, efficient use of time, planning before any kind of tasks, self-assessment of course attendance, studying habit satisfaction, preference in revision for exams, procrastination of general life. The transcript score of the student is a predictor which is a continuous variable and the mean of the score is 2,69 with 0,42 standard deviation. The transcript scores of the students ranged from 1,08 to 3,97. The dependent variable which was an interval (continuous) type was obtained from The "Academic Procrastination Scale". The mean of the scale score was nearly 56,22 with 8,37 standard deviation.

Information about personal and socio-demographic features of the pre-service teachers in the research was gathered with a form prepared by the authors. The Academic Procrastination Scale and the General Procrastination Scale were applied in the study to explore the levels of academic procrastination and general procrastination of the participants. Information about the scales developed by Çakıcı (2003) [22] is briefly given below.

Academic Procrastination Scale: The scale was developed to determine whether students performed tasks they were responsible for in their academic life (studying, revising for exams, project preparation

etc.) on scheduled time; in other words, whether they postponed such tasks or not. The Academic Procrastination Scale consists of two sub-dimensions: "Procrastination" and "Regular Studying Habits". The Cronbach-alpha internal consistency coefficients of the two factors were found 0.89 and 0.84, respectively. The Cronbach-alpha internal consistency coefficient of the entire scale was calculated as 0.92. The scale with a final form of 19 statements consisted of 12 negative and 7 positive statements. The scale with the five-point Likert type was responded in the range from "it does not reflect me at all" to "it completely reflects me". High scores meant students had high academic procrastination tendencies [22].

General Procrastination Scale: It is developed by Çakıcı (2003) [22] to determine whether individuals perform daily tasks on time or in other words they procrastinate tasks or not. The General Procrastination Scale consists of two factors: "Procrastination" and "Efficient use of Time". The Cronbach-alpha internal consistency coefficients calculated to explore the reliability of the scale were found 0.88 and 0.85, respectively. The Cronbach-alpha internal consistency coefficient of the entire scale was found 0.91. The final form of the scale that consisted of a total of 18 statements had 11 negative and 7 positive statements. The statements in the scale were responded in the range from "it does not reflect me at all" to "it completely reflects me" with the five-point Likert type. High scores meant the participants had high general procrastination tendencies.

In the scope of the research, the General Procrastination Tendency Scale scores (continuous variable) were discreted into a three-category polytomous variable (1: Low, 2: Medium, 3: High) by two-step cluster analysis and then were included in the model.

Method

Radial Basis Function Artificial Neural Network
In this study, Radial Basis Function Artificial Neural Network (RBFANN) method was used to predict the relationship between dependent and independent variables. In general, Artificial Neural Network (ANN) is known as a robust method that learns the structures of the current data, establishes a new relations network and conducts many statistical processes such as making parameter estimation, classification, optimization and time series in this relations network. In neural network, basis functions are inferred from data, giving neural network a great potential for capturing complex interactions between predictor variables [23-25].

Similar to the structure of the other architectures, the RBFANN has three layers (input, hidden and output). The output layer in the RBFANN has a linear form while the hidden layer is supported with a non-linear

RBF activation function. The mentioned structure of the RBFANN is shown in Figure 1.
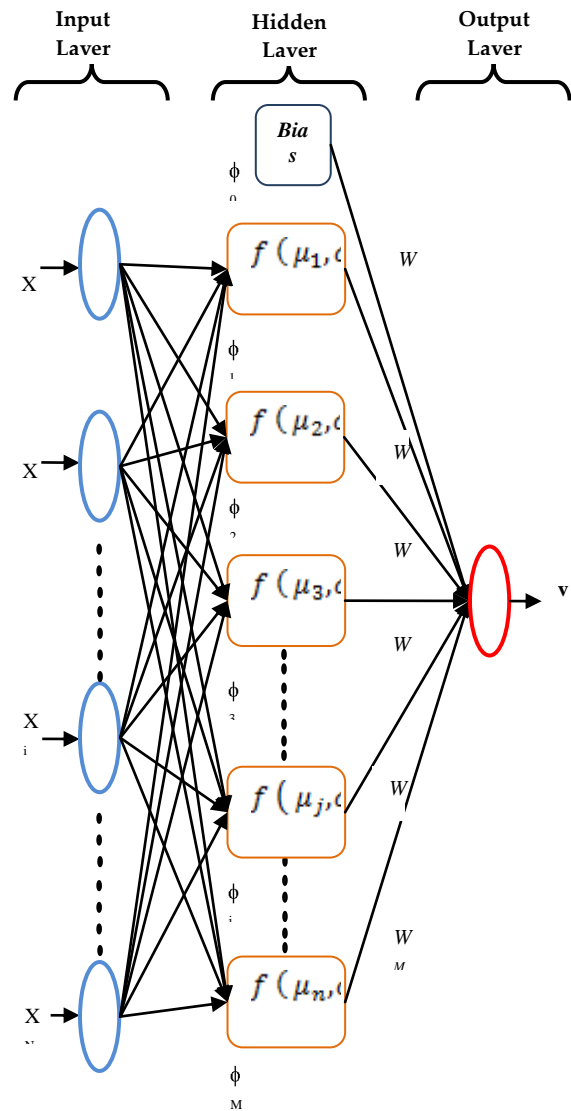

Fig. 1 The basic structure of the Radial Basis Function Neural Network [25]

Basically, an ANN consists of three sections: Input, hidden and output layers. The input layer consists of independent variables (x) of the research. All mathematical and logical processing belong to model occur in the hidden layer and finally the completed prediction of y is resulted by the output layer. Besides, in the hidden layer, neurons in ANN provide the all connections among layers. RBFANN is widely used due to its robustness for exploring the relationship among predictors and target variable. In this study, the goodness of fit measurements is sum-of-squares error (SSE), the correlation coefficient (CE) and the root mean square error (RMSE).

In the research model, the total point of academic procrastination is dependent variable and the "gender", "age", "preferred studying times in a day", "efficient use of time", "general procrastination tendency", "self-assessment of course attendance", "studying habit satisfaction", "Preference in revision

for exams" and "Planning before any kind of tasks" factors are independent variables.

Before building the model, multi-collinearity test was done which examined high inter-correlations or inter-associations among the input variables. The Variance Inflation Factor (VIF) was used to examine the multi-collinearity problem. If the value of VIF is greater than 10 or the tolerance value is less than 0.1 then there is a serious multi-collinearity problem among the predictors [26]. In this study, the values of VIF were between 1.026 and 1.059 and the values of tolerance were between 0.944 and 0.990. These indicators show that there is no multi-collinearity problem among the predictors.

III. RESULTS

The RBFANN was applied to the data set in order to build the model and reveal the relationships between the predictors and the target variable. Input layer consists of 10 independent (predictor) variables, the number of hidden layer is 1 and the optimal number of units in the hidden layer (bias) is 8, which is the best number of hidden units in order to yield the smallest error in the testing data. The error function of the output layer is sum of squares (SSE) and error computations are based on the testing sample. The findings belong to the performance of the model was described in Table 2.

TABLE 2
THE PERFORMANCE OF THE RBFANN

Neural Network Architecture	Relative Error	SSE	Correlation	RMSE
RBF	0,173	31,583	0,896**	3,873

. *Correlation between the observed and the predicted data is significant at the 0.01 level.*

Table 2 shows that the correlation between the observed and the predicted data in the RBFANN is very high (correlation coefficient: 0,896, p<0,01). The correlation coefficient showed that the findings of the RBFANN were robust and unbiased. Besides, the results of RMSE and CE provide the robustness for neural network's findings as well.

The distribution of the observed and the predicted data was shown in Figure 2 and Figure 3. In parallel with the performance criteria (such as SSE, RMSE, CE) of the RBFANN, the predictive ability between the observed and the predicted data was concluded in a good light. Besides, the distribution of the residual and the predicted value was shown in Figure 3.
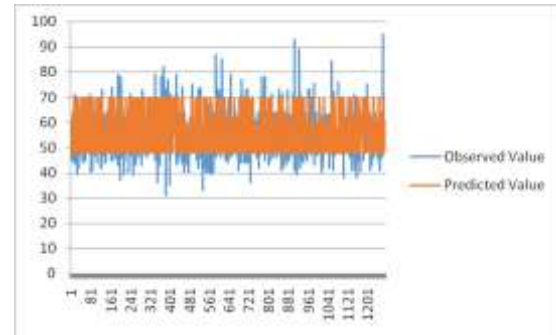

Fig. 2 The distribution of the observed and the predicted data
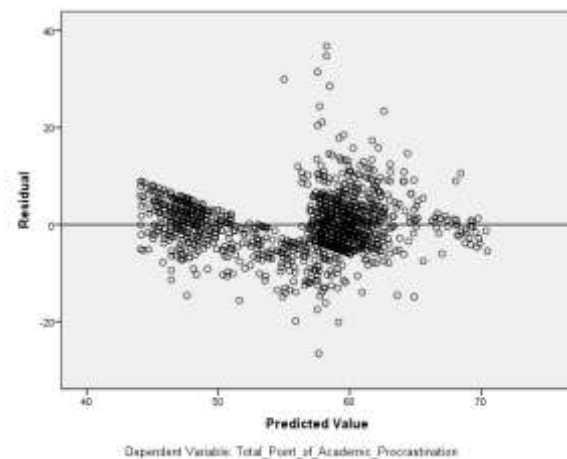

Fig. 3 The distribution of the residual and the predicted value

All things considered, the predictors influential on the target variable in the RBFANN architecture are reliable, unbiased and robust findings. The importance of the independent variables is shown in Table 3 and Figure 4.

TABLE 3
THE INDEPENDENT VARIABLE IMPORTANCE

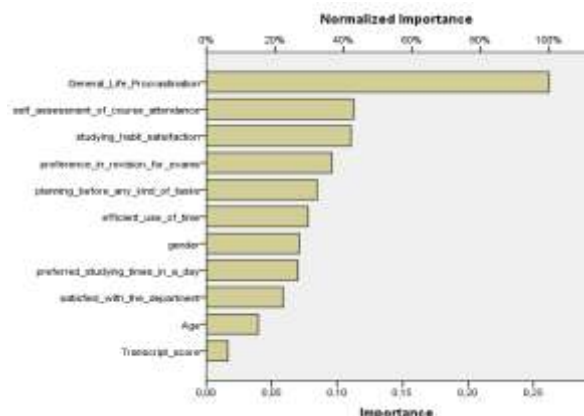| Predictors	Importance	Normalized Importance (%)
Procrastination of general life	**0.262**	**100**
Self-assessment of course attendance	0.113	43
Studying habit satisfaction	0.111	42.3
Preference in revision for exams	0.096	36.7
Planning before any kind of tasks	0.085	32.3
Efficient use of time	0.078	29.7
Gender	0.071	27.1
Preferred studying times in a day	0.070	26.8
Age	0.040	15.2
Transcript score	0.017	6.3

Fig. 4 The normalized importance of the predictors

When Table 3 and Figure 4 are examined, it is clear that the first predictive variable that influenced academic procrastination tendency is "general procrastination tendency" with the importance value of 0.262 and the normalized importance of 100%.

The second predictive variable that influenced academic procrastination tendency was "Self-assessment of course attendance" with the importance value of 0.113 and the normalized importance of 43%. It could be suggested that "self-assessment of course attendance" variable has a "moderate" influence on academic procrastination tendency with the normalized importance of 43%. Similarly, "studying habit satisfaction" seems "moderately" influential on academic procrastination tendency with the normalized importance of 42.3%.

It was also concluded that two predictors, "Preference in revision for exams" and "Planning before any kind of tasks" included in the model, were influential on academic procrastination tendency with the normalized importance of 36.7% and 32.3% respectively.

It was observed that the other predictors included in the model (efficient use of time, gender, preferred studying times in a day, satisfaction with the department and age) have relatively lower influences on academic procrastination tendency and their normalized importance ranged from 15,2% to 29,7%. The predictor with the least influence on academic procrastination tendency was transcript score. The normalized importance of transcript score was 6.3%. It is remarkable that students' academic achievement is not influential on academic procrastination tendency, which is inconsistent with the findings in the literature.

IV. DISCUSSION and CONCLUSION

In the study, the factors which influence academic procrastination tendency are modeled with the Radial Basis Function Neural Network. Goodness of fit the Radial Basis Function Neural Network structure is at good level and the findings obtained by such a structure are considered reliable.

As it is well known, convergence of the real data and the predicted data is an indicator of the reliability of the built model in artificial neural networks. The level of convergence can be examined with the help of various criteria such as the mean square error, the root mean square error, the mean absolute error, the coefficient of efficiency and the coefficient of correlation [27]. It can be said that the values of the criteria are at good levels in this research. Another significant indicator of the evaluation of the capability of the structure in artificial neural networks to build a robust model is error of estimation, which is rather low in this study (Relative Error= 0.173). Performance values of the modeling show the variables influential on academic procrastination are unbiased and robust.

The most significant predictor in the study that influences academic procrastination tendency is "general life procrastination". This finding is parallel with the others in the literature [1]. In other words, it could be suggested that students with a high general procrastination tendency also have a high academic procrastination tendency.

Students' course attendance is considered as the second factor that is influential on academic procrastination tendency. In other words, it is known that students with a high academic procrastination tendency have a difficulty in attending courses as well as performing many academic tasks. Thus, academic procrastination tendency have negative results such as non-attendance at school/courses, failure and dropouts [28, 29]. Another predictor which has a moderate influence on academic procrastination tendency in the model is the variable of studying habit satisfaction. It is asserted in the literature that there is a negative correlation between academic procrastination tendency and self-assessment towards regular studying habits [3]. The variable is followed by the "preference in revision for exams" and "planning before any kind of tasks" with the normalized importance of 36,7% and 32,3% respectively. Individuals with high procrastination tendencies have a difficulty in setting and achieving personal goals. Efficient use of time or the ability to use the scheduled time seems closely associated with setting goals, planning and goal achievement. Therefore, it is frequently mentioned in the literature that students with high procrastination tendencies experience difficulties in those skills [30] and mostly make less efforts in academic tasks than planned (e.g: revision for exams) and accordingly get low marks and suffer from failure [31]. Again, in some other studies, it is argued that those with high academic procrastination tendencies cannot spare the planned time for revision for exams and study less in general [32, 33].

The following predictors are found to have a low influence on academic procrastination tendency

according to the model built in artificial neural network: "Efficient use of time", "gender", "preferred studying times in a day", "satisfaction with the department" and "age". The predictor that has the least influence on academic procrastination tendency in the model is transcript score.

Steel (2007) [21] argues that it is difficult to explore gender differences in procrastination tendency because the research findings of gender differences are inconsistent. There are also studies which highlight that procrastination tendencies do not vary according to gender [3, 19, 34-36] and that male students [13, 37] or female students have higher procrastination tendencies [38].

In association with the variable called "preferred studying times in a day", it is asserted in the literature that students with high procrastination tendencies are mostly those who prefer studying late at night or they are "night owls" while students with low procrastination tendencies are "day students" [3]. As for "age", McCown and Johnson (1991) [33] suggest in a study that 23% of first graders, 27% of second graders, 32% of third graders and 37% of fourth graders believe procrastination tendency influences their academic achievement. When we consider that grade is parallel with age or grade level increases as age increases, one may think age has an influence on procrastination. Ferrari and his friends (1995) [7] conclude that performing tasks at the last minute peaks in the mid-twenties and plus, particularly in male students.

The case observed in the studies in the literature is the same as the one summarized above although the study concludes that the effects of the variables such as efficient use of time, gender, preferred studying times in a day, age and so on are low.

As a result, it is likely to encounter in the literature with research on the relationship between procrastination tendency and various variables. However, outstanding intriguing aspects of the issue have proven the fact that certain factors have not been revealed clearly yet. For example, as mentioned in the literature, studies to examine whether there is a difference between types of procrastination are needed. As it is likely to have different causes or dynamics in different types of procrastination, these types will naturally have considerations or results for individuals.

It appears significant to have examples of the use of another important point that was mentioned above as the secondary (latent) aim of the research or the artificial neural networks quantitative studies in social sciences. It could be suggested that the analyses in the studies included in the literature review of the research were generally restricted to traditional analysis methods. However, from the viewpoint that artificial neural networks are stronger and more capable to produce more reliable results than traditional methods (e.g.: a traditional regression method) in many cases, they are essential

to widespread in research. In this sense, the study is expected to give way to further quantitative research. It is recommended that different variables influential on academic procrastination tendency that were not studied here in this paper should be analyzed with stronger analysis methods like artificial neural networks.

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