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BAHÇEŞEHİR ÜNİVERSİTESİ

INVESTIGATING THE ROLE OF THE SELF-REGULATION AND LEARNING STRATEGIES ON ACHIEVEMENT VIA STRUCTURAL EQUATION MODEL

Master Thesis

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Assoc. Prof. Dr. Tunç Bozbura

Acting Director

This is to certify that we have read this thesis and that we find it fully adequate in scope, quality and content, as a thesis for the degree of Master of Science.

Examining Committee Members:

Assoc. Prof. Dr. Adem KARAHOCA (supervisor) :

Asst Prof. Dr. Yalçın ÇEKİÇ :

Asst. Prof. Dr. Alper Tunga :

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June, 30, 2011 Oğuz Mustapaşa

ABSTRACT

INVESTIGATING THE ROLE OF THE SELF-REGULATION AND LEARNING STRATEGIES ON ACHIEVEMENT VIA STRUCTURAL EQUATION MODELLING

Mustapaşa, Oğuz

Computer Science Master Program

Supervisor: Assoc. Prof. Dr. Adem Karahoca

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Aim of this study is to investigate the learners' profile, inspect students' learning models and provide a better structure for learners that can help to improve their learning experience and success on engineering students via a non-math course using an e-learning portal. Using the LASSI (Learning and Study Strategies Inventory) and ILS (Index of Learning Styles) questionnaires on over 400 Software Engineering and Mathmetics & Computing students taking "History of Civilization" course which is a project based online course. 400 students took the LASSI and ILS questionnaires and their grades at the end of the term were collected. The data collected from students was examined by confirmatory factor analysis (CFA) and structural equation modeling (SEM). As the analysis results show, the LASSI scales referring to cooperation and self-regulation have positive effect and correlation with eachother where those scales also effect students' achievement on the course in a positive way. Also, the ILS results for students seem to effect their grades taken from the course which also has an effect on their achievement on "History of Civilization" course. The work presented here puts forward a learning model for engineering students on a non-math course in order that students' achievement on a non-math course gets better.

Keywords: E-Learning, Self-Regulation, Learning Strategies, Structural Equation Model

ÖZET

YAPISAL EŞİTLİK MODELİ İLE ÖZDÜZENLEME VE ÖĞRENME STRATEJİLERİNİN BAŞARI ÜZERİNDEKİ ETKİLERİNİN ARAŞTIRILMASI

Mustapaşa, Oğuz

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Bu çalışmanın amacı uzaktan eğitim üzerinden alınan bir alan dışı ders için, mühendislik öğrencilerinin öğrenme modellerini ve profillerini inceleyerek, öğrencilere eğitimleri sürecinde yarcımcı olabilecek ve daha iyi öğrenmeleriyle beraber derslerinde daha başarılı olmalarını sağlayacak bir model sunmaktır. LASSI (Öğrenme ve Çalışma Stratejileri Envanteri) ve ILS (Öğrenme Becerileri Envanteri) anketleri, "History of Civilization" dersi alan 400 Yazılım Mühendisliği ve Matematik-Bilgisayar bölümü öğrencisi üzerinde uygulandı ve öğrencilerin dönem sonu notlarıyla birlikte kaydedildi. Toplanan bu veriler, doğrulayıcı faktör analizi ve yapısal eşitlik modeli kullanılarak incelendi. Analiz sonuçlarının gösterdiği üzere, LASSI ölçeklerinden öğrencilerin beraber çalışması ve öz yeterlilikleri ile ilgili olanların kendi içlerinde yüksek korelasyon değerlerine sahip olduğu ve ayrıca bu ölçeklerin öğrencilerin dönem sonundaki başarılarını olumlu etkilediği tespit edildi. Aynı zamanda, ILS ölçeği sonuçlarının da öğrencilerin dönem içerisindeki notlarına olan etkisinin de dolaylı olarak başarıya olan etkisi gözlemlendi. Yapılan analiz çalışmaları sonunda, bu çalışma mühendislik öğrencilerinin alan dışı bir ders üzerindeki başarılarını arttırmak üzere bir öğrenme modeli sunmaktadır.

Anahtar Kelimeler: E-Learning, Özdüzenleme, Öğrenme Stratejileri, Yapısal Eşitlik Modeli

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

ANOVA	:	Analysis of Variance
CFA	:	Confirmatory Factor Analysis
CFI	:	Comparative Fit Index
CSV	:	Comma Separated Values
FK	:	Foreign Key
ILS	:	Index of Learning Styles
LASSI	:	Learning and Study Strategies Inventory
NFI	:	Normalized Fit Index
PHP	:	Hypertext Preprocessor/Personal Home Page
PK	:	Primary Key
RMSEA	:	Root Mean Square Error of Approximation
SEM	:	Structural Equation Model
SPSS	:	Statistical Package for the Social Sciences

SYMBOLS

1. INTRODUCTION

As the World Wide Web spreads around the world and number of internet users are increasing every day, web pages and web services are getting more popular. In recent years, online web portals for e-learning, e-government and e-commerce became a very popular part of Web. For a better quality of service and personalization of services, web portals were in need of discovering user preferences and behavior. This analysis can be used on educational purposes, especially on distance learning and course management systems where both can be used as a support to traditional education and distance learning intentions. The aim of discovering student's learning model over current e-learning portals and course management systems are achievable via applying some approved questionnaires over a web platform.

Thinking of a traditional education scenario, students usually react with their lecturers and ask questions. At this point lecturer also may refer to teachers or academicians are the ones who guide the students in every stage of this scenario. Instead of having a face-to-face relation, online learning portals leave the student on their own. Students can access course materials, post their homework, interact with classmates via private messages or public forum messages. Since face to face communication is minimized to discrete amounts, some assistance or mechanisms like a virtual trainer as a support for the learners on e-learning were proposed. With having such a system for educational purposes, students can learn at their own pace and road themselves during learning process to suit themselves and their needs in educational scenarios.

1.1 PROBLEM DEFINITON

As a common fact, engineering students' successes on non-math courses tend to be minor, considering their success' being major on math related courses. Especially when students get such non-math courses over online web portals, say e-learning, face to face communication is cut and students are on their own pace if no such helping mechanism like a virtual trainer or an assisting lecturer exists. Considering the difference of engineering students' success on non-math courses, the aim of this research is to investigate and examine the self-regulating learning strategies and academic performance on the students of Mathematics & Computing and Software Engineering students over GEP1006 – History of Civilization course, which is an online course that students reach its materials over an open source e-learning portal, also referred as course management system, named Moodle. Confirmatory Factor Analysis, Exploratory Factor Analysis and Structural Modeling were used and results were examined.

1.2 GOAL OF THE STUDY

Considering "History of Civilization" course's being an online and project based course, students are expected to have high correlation values on Study Aids, Motivation, self-study and self-testing scales with a considerable effect on academic performance.

Moreover, students are encouraged to work with their classmates or project partners on their assignments. So that, the LASSI scales including working with partners, information sharing with classmates, or organizing their own learning strategy during their learning process should lead them to a more successful result at the end of the term. Results of this study shows that out hypothesis and expectations were right, and students of this course are tend to work with others and share their knowledge.

2. LITERATURE REVIEW

In the literature, different techniques are used in learner modeling; these techniques cover different aspects of learner behavior and knowledge depending on the application used in the learner model such as Felder and Silverman Learning Style Model - Index of Learning Styles Questionnaire and Learning and Study Strategies Inventory (Solomon & Felder, 1991; Weinstein, Schulte, & Palmer, 1987; Weinstein & Palmer, 2002).

Studies in the literature show that there are many proposals of applications of e-learning and learner modeling applications and many researchers built their own frameworks and lecture management systems. For ease of time and common usage, Moodle used as the course management system and additional web pages were prepared for handling my processes on learner modeling. The usage of Moodle and some tools that helps to determine user's learning model was pointed by Kinshuk & Graf in 2006 and they also provided a practical example.

Some studies show that self-regulation and its scales depending on LASSI have positive effects on students' performance and success. Pintrich studied the relationship between 7^{th} grade students' self-regulating learning and academic performance on English and Science lessons. As a result, self-regulation, self-sufficiency and anxiety found to predict students' academic performance (Pintrich & De Groot, 1990).

Eilam and Aharon, studied students' self-efficacy behaviors over a 1-year-long on a science project on 35 of 9^{th} grade students. The results show that students who found to be successful have a better sense of self-efficacy, time management and organization of learning content than the others (Eilam & Aharon, 2003).

Iqbal, Sohail and Shahzad investigated what learning and study strategies were used by university students at Pakistan. The research was made over 400 students, LASSI was applied on these students and results were examined via Analysis of variance (ANOVA). Results show that Pakistani students are above 50% in information

processing, self testing and use of support techniques and material. They are below 50% in rest of the seven LASSI scales. Also results showed that the significant difference among faculties for self testing. The study points towards the need for students to improve their skills to avoid serious problems succeeding in university (Iqbal, Sohail, & Shahzad, 2010).

Braten & Olaussen studied Norwegian college students and students found to score remarkably low on the Motivation subscale of the LASSI in relation to American norms. Research was made on 15 Norwegian college students and then they were interviewed about their responses to the scale items and their beliefs about academic motivation. Only the students having the highest scores on the Motivation scale seemed to wholeheartedly value the activities described by the scale items and conceive of motivation in the self-discipline and duty-oriented way reflected by the scale. In contrast, the students having the lowest scores did not value the activities described by the scale items and clearly defined academic motivation in terms of interest, enjoyment, and excitement. It is suggested that one important reason why so many Norwegian students score low on the LASSI. Motivation scale might be that they have a strong sense of autonomy and are intrinsically rather than extrinsically motivated (Braten & Olaussen, 2000).

As some papers point at the LASSI scales and self-regulation's importance, some others also refer to gender's being a coefficient on students' success and academic performance. As Patrick, Ryan and Pintrich studied, self-efficacy, meta and organization of learning content and their relationship considering gender differences. Data collected at the beginning and at the end of the term. The results show that female students' have a better understanding of motivation and in addition female students' awareness of their meta is better than the male students. The regression analysis results show that male students' motivation is affected from their low self-efficacy at the beginning of the term, their lack of organization of learning content and lack of meta, and also low performance in the end of the academic year. Female students' motivation is found to have a relation with their increasing self-efficacy in time, and better organization of learning content with meta (Pintrich, 1999).

Pokay and Blumenfeld studied motivation and learning strategies' usage and their relation with academic performance and how students' gender affects it. This research is done on students taking "Geometry" course and the results show that gender does not seem to have any effect on academic performance, and also pointed gender does not have an important effect. What makes a good effect on the academic performance are found to be metacognition, students' efforts and cognitive strategies (Pokay & Blumenfeld, 1990).

Also, there are some papers that point at the negative effect of gender on students' academic performance and success. As an example, Chen studied the differences on self-regulation over lecture and laboratory parts of "Introduction to Information System" classes. Results show that in lecture hour students putting effort to try understanding seems to have a good effect where help-seeking from friends or working with friends having a negative effect on learning information technology and its concepts (Chen, 2002).

In 1999, Marina S. Lemos studied students' goal and self-regulation in classroom on 6th grade students. And she proposed that the relations found between students' control beliefs and their motivational strategies may involce a cyclic process of strategy implementation followed by control beliefs restructuring, which points at strategy and meta scales of LASSI. Within such a perspective, the representation of the "self" as competent and autonomous would lead to successful coping under stress. In turn, the experience of being able to fulfill the needs for competence and autonomy would enhance control and agency beliefs. In the same line of thinking, strategies for maintaining perceived control and autonomy may influence goal setting. For students who adopt a flexible strategy, stressful events have an ultimately positive effect on perceived control and autonomy. These events inform the student that his or her needs are not met and that goal setting should be activated and also restructured when needed (Marina, 1999).

3. METHODOLOGY

In this section, research model, research group and their demographic and descriptive statistics, structural equation model, self-regulation tests, LASSI, ILS, and how the analysis done are explained.

3.1 RESEARCH MODEL

In this study Felder and Silverman Learning Style Model - Index of Learning Styles Questionnaire was used (Solomon & Felder, 1991). Then same group of students will be examined via Learning and Study Strategies Inventory (Weinstein, Schulte, & Palmer, 1987; Weinstein & Palmer, 2002).

While building the structure, user types were classified in database so that cognitive learning styles, and learning and study strategies inventory could be used as a dependency factor for our hypothesis. Reliability analysis, regression analysis, correlation analysis and structural equation modeling were done on the collected data via using ILS and LASSI questionnaires. SEM is done via AMOS and SPSS is used for other statistical needs on this research.

3.2 MATERIALS

Material of this study consists of 400 students taking a course on an e-learning portal for a year, and their web logs on web servers. In this study, examination of current learning models on students taking the course, students' final grades and results using web mining techniques were done. Referring to the learning models, Index of Learning Styles Questionnaire and Learning and Study Strategies Inventory applied on those students and examined their answers to these questions. For this purpose modification of the existing Moodle database system needed, and an additional web page to measure

each students learning model for both principles were prepared. Related page and questionnaires can be found in Appendix.

Table 3.2a : Profile of respondents

Gender	**Frequency**	**Percentage**
Male	162	73,6%
Female	58	26,4%
Total	220	100,0%
Academic Year	2	100%
First	220	50%
Second	220	50%
Occupation		
Student	220	100%
Age		
19	220	100%
Course Type		
Official	220	100%
Visiting	0	0%
Total	220	100%

The sample characteristics of the research group were: 26.4% of the population was sampled as female and 73.6% were sampled as male students. All of the students were taking the course in their regular semester, there were no visiting students. Also 220 samples out of 400 were found to be useful in this research, after filtering the data using regression analysis and filtering on WEKA.

Table 3.2b : Grade distribution of the students of History of Civilization course

Letter	A-	C-	F	C+	B	C	A	B-	B+	D+	I	D
Weight	.26	.03	.04	.06	.07	.04	.32	.007	.09	.02	.01	.01

Students' grade distribution calculated via Naive-Bayes method can be seen in Table 3.2b.

3.3 INVESTIGATING STUDENTS' LEARNING STYLE

For defining students' learning style, Index of Learning Styles Questionnaire applied on the research group which was used as an instrument to assess preferences on four defined dimensions; active/reflective, visual/verbal, sequential/global and sensing/intuitive. These are formulated by Richard M. Felder and Linka K. Silverman and the questionnaire is developed by Barbara A. Soloman and Richard M.Felder's with the name of "Index of Learning Styles Questionnaire" (Felder & Soloman; Felder & Spurlin, 2005; Felder & Brent, 2005). The aim is to get to know each student's preferences on education and learning. The questionnaire results were written to the database with user's answer and its text where some modifications were done on the database for ease of use and efficiency. Data left on the server as questionnaire results were not exactly the same as it is used in Index of Learning Style Inventory, since the data from the server had to be retrieved and processed just to get it in the right format and meaningful state (Graf, Viola, Kinshuk, & Leo, 2007; Graf, Viola, & Kinshuk, 2007).

At the end of the test results are written into our database and each learning style classification has a range, (-12, 12); the values that fall in (-12, 0) interval gets a tag "b"; the values that fall in (0, 12) interval gets a tag "a" e.g. -7b or 7a.

Table 3.3 : Learning Styles

Classification	**Definition**	***Range***
act_ref	Active – Reflective	*(-12,+12)*
vis_verb	Visual – Verbal	*(-12,+12)*
sen_int	Sensing – Intuitive	*(-12,+12)*
seq_glo	Sequential – Global	*(-12, +12)*

As described in Table 4.1, cognitive learning styles are divided into four classifiers. The aim of the index of learning styles questionnaire was to discover these preferences of students. In the development period there had to be a way of storing those data into our database and a Php page which does the needed calculation. Students classified on a learning style formula such as:

x € {act_ref, vis_verb, sen_int, seq_glo },

y € {act, vis, sen, seq},

z € {ref, verb, int, glo} | A student "S" is most likely to be X(y) = 1;

S is most likely to be X(z) = 3; and

"S" is likely to be between X(y) and X(z) : X(y|z) = 2.

Since we have 3 different classification of learning styles, in the way we cluster our students, we can have a maximum number of 27 possible different ls_code that can describe a student.

3.4 INVESTIGATING STUDENTS' LEARNING STRATEGY – LASSI

The Learning and Study Strategies Inventory is defined as "LASSI is a 10-scale, 80-item assessment of students' awareness about and use of learning and study strategies related to skill, will and self-regulation components of strategic learning. The focus is on both covert and overt thoughts, behaviors, attitudes, motivations and beliefs that relate to successful learning in post-secondary educational and training settings and that can be altered through educational interventions. Research has repeatedly demonstrated that these factors contribute significantly to success in college and that they can be learned or enhanced through educational interventions such as learning strategies and study skills courses." By which is proposed by Weinstein (Weinstein & Palmer, 2002; Weinstein, Schulte, & Palmer, 1987).

As Weinstein announced, "the LASSI is designed to be used as a screening measure to help students develop greater awareness of their learning and studying strengths and weaknesses; a diagnostic measure to help identify areas which students could benefit most from educational interventions; a basis for planning individual prescriptions both remediation and enrichment; a means for instructors to use for examining individual students' scores and class trends to help them decide where to place the greatest emphasis for assignments, projects, individual logs, journals, portfolios and other class activities; a pre-post achievement measure for students participating in programs or courses focusing on learning strategies and study skills; an evaluation tool to assess the

degree of success of intervention courses of programs, and an advising/counseling tool for college orientation programs, advisors, developmental education programs, learning assistance programs, and learning centers."

As mentioned before these 8 scales underline in three main categories that are skill, will and self-regulation. The scale names and their main categories are given in Table 3.4a.

Table 3.4a : Main Scales of LASSI

Skill	Information Processing, Main Ideas, and Testing Strategies
Will	Anxiety, Attitude, and Motivation
Self-Regulation	Concentration, Self-Testing, Study Aids, and Time Management

When speaking of 8 scales in 3 main categories, the scale definitions are given in the LASSI Manual and as the author has described, the definitions are:

"**Information Processing:** assesses how well students' can use imagery, verbal elaboration, organization strategies, and reasoning skills as learning strategies to help learn new information and skills and to build bridges between what they already know and what they are trying to learn and remember.

- **Selecting Main Ideas**: assesses students' skill at identifying important information for further study from less important information and supporting details;
- **Test Strategies**: assesses students' use of both test preparation and test taking strategies.
- **Anxiety**: assesses the degree to which students worry about school and their academic performance.
- **Attitude**: assesses students' attitudes and interests in college and achieving academic success.
- **Motivation**: assesses students' diligence, self-discipline, and willingness to exert the effort necessary to successfully complete academic requirements.
- **Concentration**: assesses students' ability to direct and maintain their attention on academic tasks.

- **Self Testing**: assesses students' use of reviewing and comprehension monitoring techniques to determine their level of understanding of the information or task to be learned.
- **Study Aids**: assesses students' use of support techniques, materials or resources to help them learn and remember new information.
- **Time Management:** assesses students' use of time management principles for academic tasks."

In this study, a modified version of LASSI with 100 questions in 11 scales for an e-learning program course "GEP1006 – History of Civilization" on Mathematics & Computing, Computer Science and Engineering, and Software Engineering students is applied. The LASSI questionnaire is applied on "History of Civilization" course students via Moodle Course Management System where History of Civilization course is a project dependent course where students are graded by their success on their projects as a group so the course is based on learning/teaching style. (Sertel, 2005)
The LASSI scale attributes I used can be seen in Table 3.4b.

Table 3.4b : LASSI scale attributes and related questions

Name	Range	Related Questions
Attitude	[1, 7]	47, 76, 81, 90, 94, 96
Concentration	[1, 7]	13, 18, 29, 54, 56, 68
Information Processing	[1, 7]	15, 20, 27, 58, 59, 62, 83
Meta	[1, 7]	12, 31, 38, 46, 55, 73, 77, 82, 87
Motivation	[1, 7]	57, 60, 65, 66, 69, 84, 86,91, 92, 97
Selecting Main Topics	[1, 7]	39, 40, 41, 42, 48, 71
Self Study	[1, 7]	23, 26, 30, 37, 43, 45, 52, 61, 67
Self-Testing	[1, 7]	1, 2, 3, 4, 5, 6, 7, 8
Study-Aids	[1, 7]	36, 63, 70, 72, 75, 79, 88, 89, 95, 99
Self-Reflection	[1,7]	9, 10, 14, 28
Testing Strategies	[1, 7]	21, 22, 24, 44, 49, 50, 51, 78, 80, 85, 93, 100
Time Management	[1, 7]	11, 16, 17, 19, 32, 35

3.5 STATISTICAL METHODS

To be able to propose a new model for the experimental subjects of this study, data analysis should be done. This analysis process consists of Confirmatory factor analysis (CFA) and Structural equation model (SEM). In this part, CFA and SEM are briefly explained.

3.5.1 Confirmatory Factor Analysis

Confirmatory Factor Analysis is a multivariate statistical procedure that is used to test how well the measured variables present the number of constructs. While using CFA, researchers can specify the number of factors required in the data set to represent a latent variable. CFA is also a tool that is used to confirm or reject the measurement theory.

CFA is frequently used as a first step to assess the proposed measurement model in a structural equation model. Many of the rules of interpretation regarding assessment of model fit and model modification in structural equation modeling apply equally to CFA. To apply CFA, SPSS AMOS is used on this research.

3.5.2 Structural Equation Model

Structural Equation Model is a statistical technique for testing and estimating relations using a combination of statistical data and qualitative assumptions.
SEM is suited both for theory testing and theory crafting. SEM takes into account the modeling of interactions, nonlinearities, correlated independents, measurement errors, correlated error terms, multiple latent independents each measured by multiple indicator and one or more latent dependents also each with multiple indicators. SEM may be used

as a more powerful alternative to multiple regression, path analysis, factor analysis, time series analysis, and analysis of covariance.

SEM, compared to multiple regression include more flexible on assumptions, uses confirmatory factor analysis to reduce measurement errors by having multiple indicators per latent variable, desirable on testing models overall rather than coefficients individually, the ability to test models with multiple dependents, the ability to model mediating variables rather than be restricted to an additive model, the ability to model error terms, the ability to test coefficients across multiple between-subject groups, and ability to handle difficult data. Moreover, where regression is highly susceptible to error of interpretation by misspecification, the SEM strategy of comparing alternative models to assess relative model fit makes it more robust.

The SEM process centers around two steps: validating the measurement model and fitting the structural model. The former is accomplished primarily through confirmatory factor analysis, while the latter is accomplished primarily through path analysis with latent variables. One starts by specifying a model on the basis of theory. Each variable in the model is conceptualized as a latent one, measured by multiple indicators. Several indicators are developed for each model, with a view to winding up with at least two and preferably three per latent variable after confirmatory factor analysis. Based on a large ($n>100$) representative sample, factor analysis (common factor analysis or principal axis factoring, not principle components analysis) is used to establish that indicators seem to measure the corresponding latent variables, represented by the factors. The researcher proceeds only when the measurement model has been validated. Two or more alternative models (one of which may be the null model) are then compared in terms of "model fit," which measures the extent to which the covariances predicted by the model correspond to the observed covariances in the data. "Modification indexes" and other coefficients may be used by the researcher to alter one or more models to improve fit.

Table 3.5 : Proposed model fit values.

Model goodness of fit indexes	Recommended Value
Chi-Square/degree of freedom	≤ 3.00
Comparative Fit Index (CFI)	≥ 0.90
Normalized Fit Index (NFI)	≥ 0.90
Root Mean Square Error of Approximation (RMSEA)	≤ 0.08

Some of the most commonly used measurements of fit are Chi-Square, Root Mean Square Error of Approximation, Comparative Fit Index and Normalized Fit Index. For a statistical analysis' being acceptable and reliable, boundaries for these fit indexes were proposed in reference papers as seen in Table 3.5.

- Chi-Square is a function of the sample size and the difference between the observed covariance matrix and the model covariance matrix.
- Root Mean Square Error of Approximation (RSEMA)
  Good models are considered to have a RMSEA of 0.05 or less. Models whose RMSEA is 0.1 or more have a poor fit (Schumacher, Randall, & Lomax, 2004; Hu & Bentler, 1999).
- Comparative Fit Index (CFI) depends in large part on the average size of the correlations in the data. If the average correlation between variables is not high, then the CFI will not be very high (Fan, Thompson, & Wang, 1999).
- Normalized Fit Index (NFI) was developed as an alternative to CFI where NFI does not need to do Chi-Square calculation values. NFI values greater than 0.95 are good; values between 0.90 and 0.95 are acceptable, and below 0.90 indicate the need of a re-specifying process on the model (Ullman, 2001).

Indicators are observed variables, sometimes called manifest variables or reference variables, such as items in a survey. Four or more is recommended and three is acceptable and common practice. However, two indicators or even a single indicator may be acceptable if the researcher is confident in the measure's validity and reliability. In fact, the prime consideration in selecting indicators is whether they are theoretically sound and reliably measured. Also, allowing one- and two-indicator latents to a model may allow the testing of theoretically important latent-level control relationships which

otherwise might not be possible. However, with one indicator, error cannot be modeled but rather one must specify a fixed measurement error variance. Also, models using only two indicators per latent variable are more likely to be underidentified and/or fail to converge and error estimates may be unreliable. By convention, indicators should have pattern coefficients (factor loadings) of 0.7 or higher on their latent factors.

Latent variables are the unobserved variables or constructs or factors which are measured by their respective indicators. In the example above, PriorAbility and PostAbility are latent variables. Latent variables include both independent, mediating, and dependent variables. The representation of latent variables based on their relation to observed indicator variables is one of the defining characteristics of SEM (Ruspini, 2002).

Model-trimming is deleting one path at a time until a significant chi-square difference indicates trimming has gone too far. A non-significant chi-square difference means the researcher should choose the more parsimonious model (the one in which the arrow has been dropped). The goal is to find the most parsimonious model which is well-fitting by a selection of goodness of fit tests, many of them based on the given model's model-implied covariance matrix not be significantly different from the observed covariance matrix. This is tantamount to saying the goal is to find the most parsimonious model which is not significantly different from the saturated model, which fully but trivially explains the data. After dropping a path, a significant chi-square difference indicates the fit of the simpler model is significantly worse than for the more complex model and the complex model may be retained. However, as paths are trimmed, chi-square tends to increase, indicating a worse model fit and also increasing chi-square difference. In some cases, other measures of model fit for the more parsimonious model may justify its retention in spite of a significant chi-square difference test. Naturally, dropping paths should be done only if consistent with theory and face validity." (Structural Equation Modeling). SEM is done via using specific application software such as LISTREL and AMOS (Garson, 2007).

3.6 PREPARING THE DATA SET

Dataset contains information about 400 students who are getting their GEP1006 lecture over an e-learning portal which is in use at engineering faculty in software engineering department.

Table 3.6a : ls_content table

Classification	**Definition**	***Type***
ls_code	Generated Learning Styles Code depending on Learning Style scale values for the user, changes when a change on user preference is found.	
view_order	Suggested view order for the student depending on the ls_code field.	e.g.: 1, 2...n
content_type	File extension/Content type of the suggested content.	e.g. : html, swf, ppt etc.

Related information about those students are kept in a database and each database table is related to another table for being able to build a relational database. Each user is defined by a unique user_id to be able to separate them from each other. Tck attribute also holds the social security number for Turkish students, which is also, can be used as a unique id. As expected students' full name was needed to identify who they are and we keep the learning modeling scale values in our database. The related database attributes and their types are shown in Table 3.6a.

Table 3.6b : tbl_learning_styles table

Classification	**Definition**	**Type**
User_Id	Student ID	Unique, number
tck	tck which is the Turkish application of SSN	Unique, number
name	Student's name	String, varchar
surname	Student's surname	String, varchar
act_ref	Index of Learning Styles scale representative of Active – Reflective learning	In a range between -12 and +12.
sen_int	Index of Learning Styles scale representative of Sensing – Intuitive learning	
vis_verb	Index of Learning Styles scale representative of Visual – Verbal learning	

Table 3.6b : tbl_learning_styles table Continued

seq_glo	Index of Learning Styles scale representative of Sequential – Global learning	In a range between -12 and +12.
ls_code	Generated Learning Styles Code depending on Learning Style scale values for the user, changes when a change on user preference is found.	In the next log in session the "ls_code" field is filled and associated with "ls_content" table.

"ls_content" table holds the suggested view order for students, depending on their learning style that we get to know after letting them solve a special test. The table includes an ls_code, view order that we suggest, e.g.: 1, 2...n and also a type of the content as a parameter.

"tbl_learning_styles" keeps the results of "learning style" test we applied on students. After each student is done with answering these questions, results are recorded to database with the following attribute values: userId (FK), tck (PK) which is the Turkish application of Social Security Number, name, surname as basics. act_ref, sen_int, vis_verb and seq_glo attributes has a range between -12 and +12. If an attribute is close to be negative, such as:
-7, it's recorded as 7a; if the value is close to be positive than the value is 7a. After those fields are successfully filled, in the next log in session the "ls_code" field is filled and associated with "ls_content" table.

3.7 DATA ANALYSIS

Traditional assumption of analyzing data on e-learning includes the hypothesis that students starts reading lecture contents and navigates through the system as he or she continues his or her route of education. Also students can start viewing questions, answer questions and learn their grades as a result of their learning scenario.
A learning scenario can be described as a student's preference of viewing order of lecture contents and student's preference of studying in a way he or she thinks it's the best choice of learning the context.

Considering the general data mining and data analysis concepts, these require some of these steps:

- Collection of user data
- Pre-processing data
- Applying data mining/analysis techniques
- Analyzing results and announcement of findings

Since the course management system was already in use at the faculty, I had the chance to examine previous years' data. Also, user data during development phase was collected. To be able to apply data mining techniques on e-learning data, some steps had to take place such as filtering and classification of some fields or specifications related to students.

Pointing at the "Index of Learning Styles" questionnaire and the code snipped given in table, the goal of classifying students on their learning styles by representing this variable in 3-digit form that can have a maximum number of 27 possibilities was achieved. Since the data is numerical, the filtering progress is already done.

The research was made on an online course named History of Civilization on engineering faculty students on 2 year-long-user data left on servers.
At first, user data had to be in shape that it could be used for investigation via statistic tools. At this part, a web page is developed to collect investigated student's navigation on the system and collects data or handles the current data and writes it on new created relational database tables built on database. By doing so, data editing or say modeling part is automated. After the data is written to the database in needed format, it was easy to get them into an excel file and convert it to coma separated values than to SPSS input data format.

Then, the data had to be prepared for filtering and classification. So that converting the student data into "Comma Separated Values" – "*.csv" is done and then the related file was converted into SPSS Input File Format "*.sav".

In this classification method, each of the learning style attributes is represented by 7 values. As we know the range of those attributes are falling in the interval (-12, 12),

attributes in (-12, -9) are tagged with a prefix of “V_”; attributes in (-9, -6) are tagged with a prefix of “LTB_”; attributes in (-6, -3) are represented by attribute name only; attributes in (-3, 3) are tagged as “BALANCED”; attributes in (3, 6) are represented by attribute name only; attributes in (6, 9) are tagged with a prefix of “LTB_”;
attributes in (9, 12) are tagged with a prefix of “V_” where
a € {“ACT”, “SEN”, “VIS”, “SEQ”}; b € {“REF”, “INT”, “VERB”, “GLOBAL”}; attributes are represented as (a + b) and for intervals (-12,-3) the prefix is followed by a member of “a” and for intervals (3, 12) the prefix is followed by a member of “b” considering a[0] is associated with b[0], a[n] is associated with b[n] only.

Then, a LASSI questionnaire is applied on the research group and students’ response to LASSI questionnaire and its scales are examined. LASSI scales’ correlation with other scales checked on SPSS and using Pearson Correlation and quick regression on the same dataset applies to see the data distribution; just to be sure whether these scales are significant.
Correlation showed that the scales named as Selecting Main Topics, Study-Aids, Attitude, Motivation, Self-Study, Self-Testing, Testing Strategies have the highest correlation rates with others and Time Management has the lowest correlation rate. After this step correlation scatter plots are examined.

The Linear Regression results were pointing at Selecting Main Topics, Study-Aids, Self-Study, Motivation, Meta, Self-Testing and Information Processing scales being significant with a significance value less than 0.05; rest of the scales we used in LASSI were found to be insignificant and Time Management scale had the biggest significance value that is 0,988 where it has no effect on the results and data, in a way time management does not affect learning Testing Strategies and does not help the students improve their learning.

After the classification of data and statistical work is completed, Structural Equation Model had to be done with Confirmatory Factor Analysis support. So, AMOS v16 is used for SEM. Since I had my data set in *.sav file format, AMOS which runs over SPSS, it was only modeling step left. (Psychology Network)

At first, all the LASSI and ILS scales were put directly into the model and examined the results. At this point, the results of LASSI questionnaire and its scales and ILS scales were used as an input into the SEM. All of these scales were represented as unobserved variables in the model, and data fields which are scale values were connected to these unobserved scales representing the related scales the questions or data values fit in. When the model was ready, it was time to examine the output values of the model and try to fit to model to the statistical values.

Table 3.7 : Items Removed at CFA & SEM

	Questions to Remove	**P**
Step #1	58, 59, 37, 30,12, 46, 73, 77, 82, 64	< 0.3
Step #2	27, 20, 26, 23, 52, 38, 55, 73, 87, 21, 85, 80, 78, 51, 50, 49, 100, 24, 22, 60, 74, 33, 86, 53, 25, 96, 94, 90, 47, 56, 54, 29, 18, 48, 40, 39	< 0.4
Step #3	28	< 0.4
Step #4	76, 42	< 0.4
Step #5	67, 71	< 0.45
Step #6	57, 75	< 0.45
Step #7	-	< 0.45

When the first results for the very initial model were examined at the Confirmatory Factor Analysis step, it's found that the statistical values did not fit the proven values and also some data values, questions related to scales which are unobserved variables in the model at the moment, had very low regression weights and covariances. Hence, these data values were removed from the model, which the process is called model-trimming. While removing those data values, none of the unobserved scales had to be left with only one data value representing this unobserved variable. In the cases when an unobserved variable was left alone with only one data item pointing it, the unobserved variable and the related data value were removed from the model.

After removing the variables which reduce the redundancy and reliability of the data set, the proposed structural model is revised and this process repeated itself for 7 times and

finally I had a model which fits the statistical ratios that are proven to be acceptable, which are given in the table below, so that the final model was statistically reliable and ready for analysis. The unobserved variables removed from the model are represented in Table 3.7.

4. FINDINGS & RESULTS

In this study, after all the statistical work done, the Chi-Square and RMSEA values fit the proven range in statistical analysis. In two-floating point measurement, CFI value which is 0.87 approximately equal to 0.9 in one-floating point measurement. Only NFI value is approximately 0.1 below the proven statistical values and we rule out that difference for instance. Statistical summary of the model fit proves the results of this study are reliable.

Table 4.1 : Statistical summary of model fit.

Model goodness of fit indexes	Recommended Value	Results in this Study
Chi-Square/degree of freedom	≤ 3.00	2.07
Comparative Fit Index (CFI)	≥ 0.90	0.87
Normalized Fit Index (NFI)	≥ 0.90	0.78
Root Mean Square Error of Approximation (RMSEA)	≤ 0.08	0.06

As the items with low regression weights and coefficients were removed in previous stages of this work, the final SEM is represented in the figure given below.

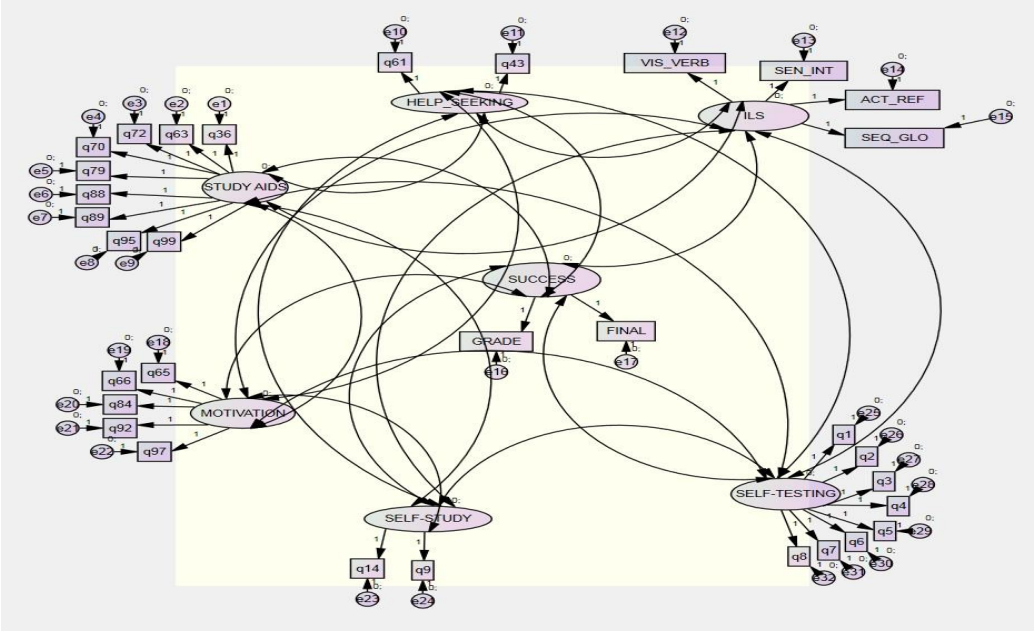

Fig 4.1 : Proposed Model for the student behavior in relationship with self-regulation scales having an effect on grades.

As seen in the figure above, Self-Study, Self-Testing, Study Aids and Motivation scales and ILS values obtained from the students seem to have an effect on Success. Rest of the LASSI scales and the questions related to these scales were removed in the model-trimming part of the structural equation modeling part. To be able to study these scales and their relation with each other, the calculated correlation matrix of the model has to be seen. The correlation matrix of the data set is presented in the Table 4.2.

Table 4.2 : Correlation Table

	Success	Self-Study	Notivation	Study-Aids	Help-Seeking	ILS	Self-Testing	FINAL	GRADE	SEQ_GLO	ACT_REF	SEN_INT	VIS_VERB
Success	1.000												
Self-Study	.304	1.000											
Motivation	.254	**.683**	1.000										
Study-Aids	.233	**.554**	**.705**	1.000									
Help-Seeking	.174	**.717**	**.784**	**,996**	1.000								
ILS	-.229	-.014	.043	.076	.105	1.000							
Self-Testing	.233	**1.051**	**.655**	**.548**	**.696**	,138	1.000						
FINAL	**-.959**	-.291	-.243	-.224	-.167	.219	-.224	1.000					
GRADE	**.888**	.270	.226	.207	.155	-.203	.207	**-.852**	1.000				
SEQ_GLO	-.121	-.008	.023	.040	.056	**.528**	.073	.116	-.107	1.000			
ACT_REF	-.049	-.003	.009	.016	.023	.215	.030	**.047**	-.044	.114	1.000		
SEN_INT	-.150	-.009	.028	.050	.069	**.657**	.091	.144	-.133	.347	.142	1.000	
VIS_VERB	-.083	-.005	.016	.028	.038	.364	.050	.080	-.074	.193	.078	.239	1.000

Correlation table shows that sequential-global has a correlation with a value of 0.53; sensing/intuiting scale has 0.66 correlations with ILS where active/reflective scale's correlation with ILS is 0.21 and visual/verbal scale's correlation is found to be 0.36.
This shows that the students who were included in this study did have an ILS preference built on sequential/global and sensing/intuiting abilities.
Students' FINAL grade which is the final exam result of this course, is in correlation with students' average grade calculated from midterms with a value of 0.85 and with ILS scale active/reflective having a correlation value of 0.47.

The correlation over FINAL, GRADE also affects students' success which is represented by SUCCESS in the table given above with correlation values of 0.96 and 0.89 respectively. This correlation was expected since the grade distribution done at the end of the term totally based in midterm and final exam results and this correlation is proven.

Also, Self-Study has 0.69 correlation with Help-Seeking where both Self-Study and Help-Seeking having a correlation value of 0.66; SELF-TESTING and STUDY-AIDS with a correlation value of 0.55; SELF-TESTING and MOTIVATION with a correlation value of 0.66.
MOTIVATION scale seems to have high correlations with other scales. Its correlation with SELF-STUDY calculated as 0.68; its correlation with STUDY-AIDS is 0.70; MOTIVATION's correlation with HELP-SEEKING is 0.78.

Moreover, SELF-STUDY scale also has high correlation values with other scales as calculated via AMOS. SELF-STUDY' correlation with MOTIVATION calculated as 0.68; its correlation with STUDY-AIDS is calculated as 0.55; its correlation with HELP-SEEKING is calculated as 0.71; and its correlation with SELF-TESTING is calculated as 1.00 as seen in the table. These correlation values show that, SELF-STUDY, MOTIVATION, HELP-SEEKING and SELF-TESTING are the most dominant scales in the correlation table among others.

Table 4.3 : Covariance of the LASSI and ILS scales found

	Estimate	S.E.	C.R.	P
SELF-TESTING<->SELF-STUDY	0.080	0.036	2,237	0.025
HELP-SEEKING<->SELF-STUDY	1.020	0.175	5,824	***
STUDY-AIDS<->SELF-STUDY	0.858	0.162	5,290	***
MOTIVATION<->SELF-STUDY	1.048	0.174	6,013	***
SELF-STUDY<-> SUCCESS	5.768	2.533	2,260	0.024
SELF-TESTING<->HELP-SEEKING	0.048	0.022	2,186	0.029
SELF-TESTING<->STUDY-AIDS	0.041	0.019	2,163	0.031
SELF-TESTING<->MOTIVATION	0.049	0.023	2,184	0.029
HELP-SEEKING<->STUDY-AIDS	1.405	0.197	7,136	***
HELP-SEEKING<->MOTIVATION	1.096	0.178	6,162	***
STUDY-AIDS<-> SUCCESS	4.393	2.163	2,031	0.042
MOTIVATION<-> SUCCESS	4.737	1.750	2,708	0.007

After examining the results and correlation matrix, now covariance between latent variables, LASSI and ILS scales for this study, were examined. Covariance of the LASSI and ILS scales after all are given in Table 4.3.

The covariance table contains the estimates, standard errors and p values of given pairs. The P values of these pairs given in the table were below 0.05 as expected. All the pairs given in the covariance table are also the scale variables mentioned in correlation table above. The P values mentioned as *** are significantly different than zero at 0.001 level and these statements are approximately correct for large samples under suitable assumptions.

Table 4.3 also includes the Critical Ratio (C.R) values in the table. For the structural (regression) weights, the critical ratios (C.R) below 1.96 at 0.05 levels are insignificant. The minimum CR value on regression weights was found to be 15.7 and minimum was 2.22 which show that the results of this study are significant at 0.05 levels.

- SELF-TESTING<->SELF-STUDY: Covariance between SELF-TESTING and SELF-STUDY is estimated to be 0,080. The covariance estimate 0,080 has a standard error of about 0,036. Dividing the covariance estimate by the estimate of its standard error gives z = 0,080/0,036 where z = 2,222. In other words, the covariance estimate is 2,222 standard errors above zero. The probability of getting a critical ratio as large as 2,237 in absolute value is 0,025.

- SELF-STUDY<-> SUCCESS: Covariance between SELF-STUDY and SUCCESS is estimated to be 5,768. The covariance estimate 5,768 has a standard error of about 2,553. Dividing the covariance estimate by the estimate of its standard error gives z = 5,768/2,553 where z = 2,259. In other words, the covariance estimate is 2,259 standard errors above zero. The probability of getting a critical ratio as large as 2,260 in absolute value is 0,024.

- SELF-TESTING<->HELP-SEEKING: Covariance between SELF-TESTING and HELP-SEEKING is estimated to be 0,048. The covariance estimate 0,048 has a standard error of about 0,022. Dividing the covariance estimate by the estimate of its standard error gives z = 0,048/0,022 where z = 2,181. In other words, the covariance estimate is 2,181 standard errors above zero. The probability of getting a critical ratio as large as 2,186 in absolute value is 0,029.

- SELF-TESTING<->STUDY-AIDS: Covariance between SELF-TESTING and STUDY-AIDS is estimated to be 0,080. The covariance estimate 0,080 has a standard error of about 0,036. Dividing the covariance estimate by the estimate of its standard error gives z = 0,080/0,036 where z = 2,222. In other words, the covariance estimate is 2,222 standard errors above zero. The probability of getting a critical ratio as large as 2,237 in absolute value is 0,025.

- SELF-TESTING<->MOTIVATION: Covariance between SELF-TESTING and MOTIVATION is estimated to be 0,080. The covariance estimate 0,080 has a standard error of about 0,036. Dividing the covariance estimate by the estimate of its standard error gives z = 0,080/0,036 where z = 2,222. In other words, the

covariance estimate is 2,222 standard errors above zero. The probability of getting a critical ratio as large as 2,237 in absolute value is 0,025.

- STUDY-AIDS<-> SUCCESS: Covariance between STUDY-AIDS and SUCCESS is estimated to be 0,080. The covariance estimate 0,080 has a standard error of about 0,036. Dividing the covariance estimate by the estimate of its standard error gives z = 0,080/0,036 where z = 2,222. In other words, the covariance estimate is 2,222 standard errors above zero. The probability of getting a critical ratio as large as 2,237 in absolute value is 0,025.

- MOTIVATION<->BASARI: Covariance between MOTIVATION and SUCCESS is estimated to be 0,080. The covariance estimate 0,080 has a standard error of about 0,036. Dividing the covariance estimate by the estimate of its standard error gives z = 0,080/0,036 where z = 2,222. In other words, the covariance estimate is 2,222 standard errors above zero. The probability of getting a critical ratio as large as 2,237 in absolute value is 0,025.

Table 4.4 : Regression Weights

	Estimate	**S.E**	**C.R**	**P**
VIS_VERB ←ILS	1,875	0,856	2,191	0,028
SEN_INT ← ILS	2,996	1,433	2,076	0,038
ACT_REF ← ILS	1,000	-	-	-
SEQ_GLO ← ILS	2,112	0,953	2,216	0,027
Q61 ← HELP-SEEKING	1,000	-	-	-
Q43 ← HELP-SEEKING	0,868	0,094	9,227	***
Q36 ← STUDY-AIDS	1,000	-	-	-
Q63 ← STUDY-AIDS	1,164	0,105	11,102	***
Q72 ← STUDY-AIDS	1,115	0,098	11,368	***
Q70 ← STUDY-AIDS	1,000	0,097	10,309	***
Q79 ← STUDY-AIDS	0,804	0,093	8,660	***
Q88 ← STUDY-AIDS	1,016	0,097	10,498	***
Q89 ← STUDY-AIDS	1,051	0,100	10,551	***

Table 4.4 : Regression Weights Continued

Q95 ← STUDY-AIDS	1,101	0,102	10,849	***
Q99 ← STUDY-AIDS	0,986	0,100	9,862	***
Q65← MOTIVATION	1,000	-	-	-
Q66 ← MOTIVATION	0,967	0,092	10,557	***
Q84 ← MOTIVATION	0,923	0,102	9,038	***
Q92 ← MOTIVATION	0,898	0,103	8,704	***
Q97 ← MOTIVATION	0,891	0,100	8,903	***
Q14 ← SELF-STUDY	0,784	0,082	9,573	***
Q9 ←SELF-STUDY	1,000	-	-	-
GRADE ← BASARI	1,000	-	-	-
FINAL ← BASARI	-0,147	0,028	-5,178	***
Q1 ← SELF-TESTING	18,764	8,250	2,274	0,023
Q2 ← SELF-TESTING	18,160	8,003	2,269	0,023
Q3 ← SELF-TESTING	19,064	8,352	2,283	0,022
Q4 ← SELF-TESTING	17,907	7,871	2,275	0,023
Q5 ← SELF-TESTING	1,000	-	-	-
Q6 ← SELF-TESTING	21,630	9,443	2,288	0,022
Q7 ← SELF-TESTING	19,738	8,632	2,287	0,022
Q8 ← SELF-TESTING	17,346	7,666	2,263	0,024

Table 4.4 shows the calculated regression weights of our model's attributes including their standard error, estimate, and critical ratio and probability values.

As shown in Table 4.5, LASSI scales HELP-SEEKING, STUDY-AIDS, MOTIVATION, SELF-STUDY and SUCCESS were found to be significant. Other LASSI scale SELF-TESTING has about 0.023 probability calculated but due to its high standard error, the scale is not significant.

Also, the Index of Learning Styles values, VIS_VERB, SEN_INT, ACT_REF and SEQ_GLO were found to be insignificant due to their high standard error calculated at 0.05 levels.

Table 4.5 : Standardized Regression Weights

			Estimate
VIS_VERB	←	ILS	0,364
SEN_INT	←	ILS	0,657
ACT_REF	←	ILS	0,215
SEQ_GLO	←	ILS	0,528
Q61	←	HELP-SEEKING	0,700
Q43	←	HELP-SEEKING	0,644
Q36	←	STUDY-AIDS	0,694
Q63	←	STUDY-AIDS	0,804
Q72	←	STUDY-AIDS	0,818
Q70	←	STUDY-AIDS	0,744
Q79	←	STUDY-AIDS	0,620
Q88	←	STUDY-AIDS	0,763
Q89	←	STUDY-AIDS	0,758
Q95	←	STUDY-AIDS	0,784
Q99	←	STUDY-AIDS	0,710
Q65	←	MOTIVATION	0,742
Q66	←	MOTIVATION	0,734
Q84	←	MOTIVATION	0,681
Q92	←	MOTIVATION	0,681
Q97	←	MOTIVATION	0,678
Q14	←	SELF-STUDY	0,624
Q9	←	SELF-STUDY	0,748
GRADE	←	BASARI	0,888
FINAL	←	BASARI	-0,959
Q1	←	SELF-TESTING	0,745
Q2	←	SELF-TESTING	0,713
Q3	←	SELF-TESTING	0,797
Q4	←	SELF-TESTING	0,739
Q5	←	SELF-TESTING	0,033
Q6	←	SELF-TESTING	0,848
Q7	←	SELF-TESTING	0,840
Q8	←	SELF-TESTING	0,667

Table 4.5 shows the standardized regression weights of items included in the proposed model and their estimation values. The negative value on FINAL ← SUCCESS means that the relation is true on the opposite direction.

- Item “question 61” which is related to HELP-SEEKING scale of LASSI is significant and it explains 0.700 of the data.
- Item “question 43” which is related to HELP-SEEKING scale of LASSI is significant and it explains 0.644 of the data.
- Item “question 36” which is related to STUDY-AIDS scale of LASSI is significant and it explains 0.694 of the data.
- Item “question 63” which is related to STUDY-AIDS scale of LASSI is significant and it explains 0.804 of the data.
- Item “question 72” which is related to STUDY-AIDS scale of LASSI is significant and it explains 0.818 of the data.
- Item “question 70” which is related to STUDY-AIDS scale of LASSI is significant and it explains 0.744 of the data.
- Item “question 79” which is related to STUDY-AIDS scale of LASSI is significant and it explains 0.620 of the data.
- Item “question 88” which is related to STUDY-AIDS scale of LASSI is significant and it explains 0.763 of the data.
- Item “question 89” which is related to STUDY-AIDS scale of LASSI is significant and it explains 0.758 of the data.
- Item “question 95” which is related to STUDY-AIDS scale of LASSI is significant and it explains 0.784 of the data.
- Item “question 99” which is related to STUDY-AIDS scale of LASSI is significant and it explains 0.710 of the data.
- Item “question 65” which is related to MOTIVATION scale of LASSI is significant and it explains 0.742 of the data.
- Item “question 66” which is related to MOTIVATION scale of LASSI is significant and it explains 0.734 of the data.
- Item “question 84” which is related to MOTIVATION scale of LASSI is significant and it explains 0.681 of the data.

- Item “question 92” which is related to MOTIVATION scale of LASSI is significant and it explains 0.681 of the data.
- Item “question 97” that is related to MOTIVATION scale of LASSI is significant and it explains 0.678 of the data.
- Item “question 14” which is related to SELF-STUDY scale of LASSI is significant and it explains 0.624 of the data.
- Item “question 9” which is related to SELF-STUDY scale of LASSI is significant and it explains 0.748 of the data.
- Item “Grade” which is related to SUCCESS scale of LASSI is significant and it explains 0.888 of the data.
- Item “FINAL” which is related to SUCCESS scale of LASSI is significant and it explains 0.959 of the data. Since the calculated estimate on FINAL is negative, this means the relation on the table, also the relation on the proposed model, is given in opposite direction. The relation of FINAL and SUCCESS can be explained as SUCCESS ← FINAL.

5. CONCLUSION

As the research results shows, SELF-TESTING is the most dominant scale that affects students' behavior over online learning scenarios. Since Index of learning style scales do not seem to change during life time; these scales and measured behaviors are bound to us via birth, ILS scales have no effect on the SUCCESS scale which stands for the students' success and grades in this study.

On the research group, it is found that, SELF-TESTING is the dominant factor that affects student behavior on online learning system and students' success on the online course. SELF-TESTING affects SELF-STUDY, HELP-SEEKING, STUDY-AIDS and MOTIVATION scales where SELF-STUDY, STUDY-AIDS, and MOTIVATION affect SUCCESS as they are studied over the correlation and covariance tables.

But, only HELP-SEEKING, STUDY-AIDS, MOTIVATION, SELF-STUDY and SUCCESS scales were found to be significant. Other LASSI scales and ILS values were found to be insignificant due to their high standard errors at 0.05 levels.

Since the students find themselves uncomfortable with their situation on the online learning system, they seek to work with other friends, define their aim on the related course, and push themselves harder on trying to achieve their goal. More they work with others and define themselves new goals, more successful they get as results of this study shows.

In other words, students who feel themselves comfortable and refuses the idea to communicate and work with others are tend to be less successful than the ones who are willing to share the information and knowledge and define new goals for themselves to be achieved in the near future over a given course or project. This refers the need of using HELP-SEEKING, STUDY-AIDS scales mainly but also MOTIVATION, SELF-STUDY and SUCCESS as a result of these scales being used well.

Nevertheless, online learning portals are decreasing the face-to-face communication which takes an important role in traditional learning scenarios. Using a classroom or a

highly supported online discussion system where many other students tend to be online and share information with others may lead to a successful online learning scenario. Realizing the fact that engineering students find themselves less successful on non-math courses, information sharing and help seeking helped them a lot during their learning process as well as their self regulation and meta scale factors.

Nonetheless, students in Software Engineering and Mathematics and Computer Science department used the system well and got its benefits on learning the "History of Civilization" course content.

Future works related to this research topic may include or consider creating course contents that supports SELF-STUDY, HELP-SEEKING and STUDY-AIDS scale factors for students' perception. Also the teaching approach better be project based since it's easier to manage and students feel themselves more comfortable when working and sharing information with others. The lecturer may guide students to get themselves in a good situation considering students' SELF-STUDY and MOTIVATION. Such tools and course contents may lead to more successful e-learning and effect students' success at the end as the learning model in this study proposes.

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APPENDICES

APPENDIX A.1

For each of the 44 questions below select either -a- or -b- to indicate your answer. Please choose only one answer for each question. If both -a- and -b- seem to apply to you, choose the one that applies more frequently. When you are finished selecting answers to each question please select the submit button at the end of the form.

I understand something better after I

(a) try it out

(b) think it through.

I would rather be considered

(a) realistic.

(b) innovative.

When I think about what I did yesterday, I am most likely to get

(a) a picture.

(b) words.

I tend to

(a) understand details of a subject but may be fuzzy about its overall structure.

(b) understand the overall structure but may be fuzzy about details.

When I am learning something new, it helps me to

(a) talk about it.

(b) think about it.

If I were a teacher, I would rather teach a course

(a) that deals with facts and real life situations.

(b) that deals with ideas and theories.

I prefer to get new information in

(a) pictures, diagrams, graphs, or maps.

(b) written directions or verbal information.

Once I understand

(a) all the parts, I understand the whole thing.

(b) the whole thing, I see how the parts fit.

In a study group working on difficult material, I am more likely to

(a) jump in and contribute ideas.

(b) sit back and listen.

I find it easier

(a) to learn facts.

(b) to learn concepts.

In a book with lots of pictures and charts, I am likely to

(a) look over the pictures and charts carefully.

(b) focus on the written text.

When I solve math problems

(a) I usually work my way to the solutions one step at a time.

(b) I often just see the solutions but then have to struggle to figure out the steps to get to them.

In classes I have taken

(a) I have usually gotten to know many of the students.

(b) I have rarely gotten to know many of the students.

In reading nonfiction, I prefer

(a) something that teaches me new facts or tells me how to do something.

(b) something that gives me new ideas to think about.

I like teachers

(a) who put a lot of diagrams on the board.

(b) who spend a lot of time explaining.

When I'm analyzing a story or a novel

(a) I think of the incidents and try to put them together to figure out the themes.

(b) I just know what the themes are when I finish reading and then I have to go back and find the incidents that demonstrate them.

When I start a homework problem, I am more likely to

(a) start working on the solution immediately.

(b) try to fully understand the problem first.

I prefer the idea of

(a) certainty.

(b) theory.

I remember best

(a) what I see.

(b) what I hear.

It is more important to me that an instructor

(a) lay out the material in clear sequential steps.

(b) give me an overall picture and relate the material to other subjects.

I prefer to study

in a study group.

(b) alone.

I am more likely to be considered

(a) careful about the details of my work.

(b) creative about how to do my work.

When I get directions to a new place, I prefer

(a) a map.

(b) written instructions.

I learn

(a) at a fairly regular pace. If I study hard, I'll –get it.-

(b) in fits and starts. I'll be totally confused and then suddenly it all -clicks.-

I would rather first

(a) try things out.

(b) think about how I'm going to do it.

When I am reading for enjoyment, I like writers to

(a) clearly say what they mean.

(b) say things in creative, interesting ways.

When I see a diagram or sketch in class, I am most likely to remember

(a) the picture.

(b) what the instructor said about it.

When considering a body of information, I am more likely to

(a) focus on details and miss the big picture.

(b) try to understand the big picture before getting into the details.

I more easily remember

(a) something I have done.

(b) something I have thought a lot about.

When I have to perform a task, I prefer to

(a) master one way of doing it.

(b) come up with new ways of doing it.

When someone is showing me data, I prefer

(a) charts or graphs.

(b) text summarizing the results.

When writing a paper, I am more likely to

(a) work on (think about or write) the beginning of the paper and progress forward.

(b) work on (think about or write) different parts of the paper and then order them.

When I have to work on a group project, I first want to

(a) have -group brainstorming- where everyone contributes ideas.

(b) brainstorm individually and then come together as a group to compare ideas.

I consider it higher praise to call someone

(a) sensible.

(b) imaginative.

When I meet people at a party, I am more likely to remember

(a) what they looked like.

(b) what they said about themselves.

When I am learning a new subject, I prefer to

(a) stay focused on that subject, learning as much about it as I can.

(b) try to make connections between that subject and related subjects.

I am more likely to be considered

(a) outgoing.

(b) reserved.

I prefer courses that emphasize

(a) concrete material (facts, data).

(b) abstract material (concepts, theories).

For entertainment, I would rather

(a) watch television.

(b) read a book.

Some teachers start their lectures with an outline of what they will cover. Such outlines are

(a) somewhat helpful to me.

(b) very helpful to me.

The idea of doing homework in groups, with one grade for the entire group,

(a) appeals to me.

(b) does not appeal to me.

When I am doing long calculations,

(a) I tend to repeat all my steps and check my work carefully.

(b) I find checking my work tiresome and have to force myself to do it.

I tend to picture places I have been

(a) easily and fairly accurately.

(b) with difficulty and without much detail.

When solving problems in a group, I would be more likely to

(a) think of the steps in the solution process.

(b) think of possible consequences or applications of the solution in a wide range of areas.

The code snippet we use to determine student's learning style is given below:

The code snipped shown below describes the way of classifying each student, who took the index of learning styles test.

```
$stu_id = $_POST["ID"];

        //Get learning style information
        $temp_query = "SELECT * FROM tbl_learning_styles WHERE uid=".$stu_id;

        $ls_query = mysql_query($temp_query) or die ("Could not get data: ".mysql_error());

        while($ls_row = mysql_fetch_array($ls_query))
        {
                // -11<= x <= +11
                //  a <  x < b
                $act_ref = $ls_row["act_ref"];
                $vis_verb = $ls_row["vis_vrb"];
                $seq_glo = $ls_row["seq_glo"];
        }
        //Boolean variables to switch between edges of intervals
        $act_flag = true;
        $vis_flag = true;
        $seq_flag = true;

        // Range of act_ref (-12,12)
        $act_ref_no = strpos($act_ref,"a");

                if(!$act_ref_no)
        {
                $act_ref_no = strpos($act_ref,"b");
```

```
		$act_flag = false;
	}
	// Range of vis_verb (-12,12)
	$vis_verb_no = strpos($vis_verb,"a");
	if(!$vis_verb_no)
	{
		$vis_verb_no = strpos($vis_verb,"b");
		$vis_flag = false;
	}
	// Range of seq_glo (-12,12)
	$seq_glo_no = strpos($seq_glo,"a");
	if(!$seq_glo_no)
	{
		$seq_glo_no = strpos($seq_glo,"b");
		$seq_flag = false;
	}
	//Check whether visual or verbal
	if($vis_flag)
	{
		if($vis_verb_no<-3)
		{
			//echo "Visual";
			$vis_verb = 1;
		}
		else if($vis_verb_no>-3 && $vis_verb_no<=0)
		{
			//echo "Balanced Visual";
			$vis_verb = 2;
		}
	}
	if(!$vis_flag)
	{
```

```
            if($vis_verb_no>=0 && $vis_verb_no<=3)
            {
                  //echo "Balanced Verbal";
                  $vis_verb = 2;
            }
            else if($vis_verb_no>3)
            {
                  //echo "Verbal";
                  $vis_verb = 3;                        }           }
      //Check whether act or ref
if($act_flag)
{
            if($act_ref_no<-3)
            {
                  //echo "Active";
                  $act_ref = 1;
            }
            else if($act_ref_no>-3 && $act_ref_no<=0)
            {
                  //echo "Balanced Active";
                  $act_ref = 2;
            }
}
if(!$act_flag)
{
            if($act_ref_no>=0 && $act_ref_no<=3)
            {
                  //echo "Balanced Reflective";
                  $act_ref = 2;
            }
            else if($act_ref_no>3)
            {
```

```
                    //echo "Reflective";
                    $act_ref = 3;
            }
    }




    //Check whether sequential or global
    if($seq_flag)
    {
            if($seq_glo_no<-3)
            {
                    //echo "Sequential";
                    $seq_glo = 1;
            }
            else if($seq_glo_no>-3 && $seq_glo_no<=0)
            {
                    //echo "Balanced Sequential";
                    $seq_glo = 2;
            }
    }
    if(!$seq_flag)
    {
            if($seq_glo_no>=0 && $seq_glo_no<=3)
            {
                    //echo "Balanced Global";
                    $seq_glo = 2;
            }
            else if($seq_glo_no>3)
            {
                    //echo "Global";
```

```
                    $seq_glo = 3;
                }
            }
            //combine results and form up stu_ls code for use.
            $stu_ls = $seq_glo.$vis_verb.$act_ref;
```

1. I believe I will get a good grade from this course.
2. I am sure I will understand the hardest content about this course on any book, paper, journal etc.
3. I am sure I will learn basic concepts thought in this course.
4. I am sure I will understand the most confusing topics presented by the instructor.
5. When content is hard to understand, I will leave it or study easy parts.
6. I am sure I will be successful on homework and exams of this course.
7. I am willing to be successful on this course.
8. I think I will gain expert knowledge on what is thought on this course.
9. Considering the toughness of this course, the lecturer of the course and my abilities, I think I will be fine on this course.
10. On e-learning portal while studying, I miss some important points since I start thinking other things.
11. I usually work on a place where I can easly concentrate and gain focus.
12. While studying this lecture, I prepare some questions to help me concentrate and gain focus.
13. While studying this lecture, I usually get bored and give up studying without finishing my schedule.
14. Even I have hard times understanding the content, I do my homeworks on my own without any help.
15. While studying this lecture, I will repeat the parts where I did not understand.
16. I use my working time and schedule on this course very well.
17. If I have problems with understanding the topic, I change my way of reading/studying.

18. Even I dont like what we do on the course, I work hard and try to be good.

19. I find it hard to adhere a schedule.

20. Just before studying the new content, I usually review the outline.

21. I keep questioning myself to be sure I understood what I have been working on.

22. I try to change the way I study for getting used to the course's needs
and the lecturer's teaching.

23. I ask the lecturer for repetation of the parts I did not understand.

24. While studying this lecture,not only reading, I also try to think and
find out what I have to learn from the topic

25. I have a separe place for studying this course.

26. When did not understand any topic on this course, I go and ask group friends on e-learning portal.

27. I am sure I do follow weekly reading and homework assignments of this
course.

28. I do attend the course regularly.

29. Even the content is not interesting and also boring, I keep studying till the end.

30. I will try to find mates on e-learning portal for asking questions in
time of need.

31. While studying this lecture, I try to figure out the concepts that I did not understand.

32. I usually think I dont pay enough attention/time for this course since
I have some other activities.

33. While studying this lecture, I try to state myself some targets on managing my activities.

34. If I get confused while taking notes on e-learning, I surely review and fix it.

35. I find it hard to find time for reviewing my notes and reading documents before the exam.

36. I prefer to go to library and study with friends.

37. I prefer to study on my own for learning a new topic.

38. Lecturer's asking questions related to a presented topic via e-learning on the lecture

39. Discussing any topic on e-learning portal given by the lecturer

40. Presentation of a successful students' projects on e-learning portal with public settings

41. Studying on a homework that includes questions designed to let me find
the correct answer.

42. Being a member of a panel where hot topics are discussed.

43. Having a friend who can help me understand a topic.

44. Having a desktop game (Eg. Monopoly) which can help me practise on the
topics on e-learning portal.

45. Studying with friends on a project with a little help from the lecturer.

46. Planning a project that I can do on my own.

47. Answering the lecturer's questions on e-learning portal

48. Reading other students' comments on any topic while following an asynchronous learning content.

49. Reading a new topic on e-learning portal when it is announced.

50. Answering questions in traditional way just after reading a new topic.

51. Learning important topics via visualizing them and viewing animations.

52. A friends teaching me one of the best things s/he can do.

53. Improving my vocabulary via using Flash Chart trial exams.

54. Accessing and attending online discussion panels.

55. Studying on my own for a topic I will be presenting on e-learning portal

56. Taking a trial exam to make sure I understood the chapter I read.

57. Discussing a topic where I dont agree with others.

58. Taking notes while watching and online course.

59. Doing cloze(fill in the blanks) type homeworks and tests.

60. Informing about my project choice and supporting my project candidate
to be accepted during project selection period.

61. Learning a new thing or a solution to a problem from a friend on e-learning portal.

62. Playing a game where i can practice the things I have learnt.

63. Working with others on a suggested project by the lecturer.

64. Reading a book for learning on any topic.

65. Attending an activity that the lecturer questioned/pointed their students on e-learning portal

66. Sharing my ideas on a specific topic on e-learning portal with others.

67. Lecturer's sharing a guideline for a homework or a projects solution

68. Watching other specialists' ideas on the lecture via e-learning and attenting the event

69. Preparing biographies of important people related to this course and putting myself on their shoes.

70. Meeting with a group mate to review our project.

71. Selecting the keywords that are contained in the summary of my project
and presenting them in a way that keywords aggregate with eachother.

72. Planning projects with friends on a topic I am working on.

73. Working on a topic that I choose, on my own.

74. Lecturer's pointing his/her expectations from the lecture in a clear way.

75. Listening to my classmate's ideas about a topic.

76. I also follow my lecturer while watching an asynchronous online course

77. Doing homeworks such that I can check wheter each question answered is
true of false.

78. Forming term projects related to my undergrad science discipline and informing about my course.

79. Reviewing chapters related to upcoming exam with different project group members.

80. Preparing a contest about a topic held in e-learning and group members' editing questions depending on the feedback they get from others.

81. Searching on a topic I like to report.

82. Making and independent work on any project I choose.

83. Lecturer's asking questions to students about the course and me, as a student, memorizing and answering them in the final exam day.

84. Talking to others face-to-face on a topic I am interested in.

85. Watching asynchronous presentation of a new topic on e-learning portal.

86. Working on the easiest part of a project we, as a project group, choose which I can easly handle.

87. Being a member of a panel where project progressions will be discussed.

88. Working at a suitable place with a friends who is helping me on my project.

89. Preparing a project with a group of classmates for presenting on e-learning portal.

90. Working on my own for gathering information on a topic I am interested
in.

91. Lecturer's questioning me on e-learning portal when I am online.

92. Lecturer's guiding me to a discussion about my project or a new topic.
93. Planning a new way for regular feedbacks.
94. Learning a new content/topic where lecturer provides all the information
95. Working with other classmates on project planning and development stages.
96. Going to library for gathering more information about a topic, on my own.
97. A lecturer's inviting me to a face-to-face meeting where the project progression will be discussed.
98. Listening to classmates talking/giving ideas on any topic.
99. Preparing a writing/report with a group of students.
100. Selecting keywords of my project and searching them on the database.

APPENDIX A.2

1. Bu dersten çok iyi bir not alacağıma inanıyorum.
2. Bu dersle ile ilgili kitap, dergi, makale vb. de yer alan en zor konuları anlayabileceğimden eminim
3. Bu derste öğretilen temel kavramları öğrenebileceğimden eminim.
4. Bu derste öğretmen tarafından sunulan en karmaşık konuları anlayabileceğimden eminim.
5. Dersin konuları zor olduğunda, ya bırakırım ya da sadece kolay kısımları çalışırım.
6. Bu dersteki ödevler ve sınavlarda çok başarılı olabileceğimden eminim.
7. Bu derste başarılı olmayı bekliyorum.
8. Bu derste öğretilmekte olan becerilerde uzmanlaşabileceğimden eminim.
9. Dersin zorluğunu, öğretmenini ve kendi becerilerimi göz önüne aldığımda, bu derste iyi olacağımı düşünüyorum.
10. Online ortamda ders esnasında başka şeyler düşündüğüm için önemli noktaları çoğunlukla kaçırırım.
11. Genellikle çalışmama konsantre olabileceğim bir yerde ders çalışırım.
12. Bu derse çalışırken, odaklanmama yardım edecek sorular oluştururum.
13. Bu derse çalışırken, sık sık sıkılırım ve yapmayı planladıklarımı bitirmeden çalışmayı bırakırım.
14. Bu dersteki konulan öğrenmede zorluk çeksem bile, ödevleri kimseden yardım almadan kendim yaparım.
15. Bu derse çalışırken, bir yeri anlamadığım zaman, geri döner ve anlamaya çalışırım.
16. Bu ders için çalışma zamanımı iyi kullanırım.
17. Eğer ders ile ilgili verilenleri anlamakta zorlanırsam, konuyu okuma şeklimi değiştiririm.
18. Bu derste yaptıklarımızdan hoşlanmasam bile, iyi yapmak için çok çalışırım.
19. Bir çalışma programına bağlı kalmakta zorlanırım.
20. Yeni ders konularmı çalışmadan önce, nasıl organize edildiğini görmek için sık sık gözden geçiririm.

21. Bu derste çalıştığım konuları anladığımdan emin olmak için, kendime sorular sorarım.

22. Dersin gereklerine ve öğretmenin dersi işleyiş stiline uymak için çalışma şeklimi değiştirmeye çalışırım.

23. Öğretmenden, iyi anlamadığım kavramları açıklamasını isterim.

24. Bu ders için çalışırken, sadece okumak yerine, konu üzerinde düşünmeye ve bundan ne öğrenmem gerektiğine karar vermeye çalışırım.

25. Ders çalışmak için ayrılmış düzenli bir yerim var.

26. Bu dersteki herhangi bir konuyu anlayamadığımda,online ders ortamındaki grup arkadaşlarımdan yardım isterim.

27. Bu dersin haftalık okumalarını ve ödevlerini takip ettiğimden eminim.

28. Bu derse düzenli olarak devam ederim.

29. Ders konuları ilgi çekmese ve sıkıcı olsa bile konuyu bitirene kadar çalışmayı başarırım.

30. Online ders ortamında gerektiğinde yardım isteyebileceğim arkadaşları saptamaya çalışırım.

31. Bu derse çalışırken hangi kavramları iyi anlamadığımı belirlemeye çalışırım

32. Diğer etkinlikler nedeniyle, bu derse çok fazla zaman ayırmadığımı sık sık fark ediyorum.

33. Bu ders için çalışırken, her bir etkinliğimi yönlendirmek için kendime hedefler koyarım.

34. Online ders ortamında not alırken kafam karışırsa, sonradan bunu mutlaka düzeltirim

35. Sınavdan önce, ders ile ilgili notlarımı ya da okumaları gözden geçirmek için zaman bulmakta zorluk çekerim.

36. Bir öğrenci grubu ile kütüphaneye giderek araştırma yapmak

37. Yeni bir bilgiyi öğrenmek için tek başma çalışmak.

38. Sunulmuş bir projebölümü ile ilgili, öğretmenin online ortamdan GEP1006 grubuna soru yöneltmesi

39. Online ders ortamında öğretmen tarafından önerilen bir konu hakkında sanal ortamda tartışmak.

40. Bir konu üzerinde çok iyi olan öğrencilerin online ders ortamında hazırlanan projelerinin online ortamda herkese açık sunulması.. .

41. Doğru cevabı bulmama yardımcı olacak şekilde düzenlenmiş sorulardan oluşan bir ödev üzerinde çalışmak.

42. Güncel konuların tartışıldığı bir panelin üyesi olmak.

43. Anlamakta zorluk çektiğim bir konuyu öğrenmemde yardım edebilen bir arkadaşımın olması.

44. Online ders ortamındaki konularla ilgili alıştırma yapmama yardımcı olan bir masa üstü oyunu (monopoly, borsa gibi) oynamak.

45. Öğretmenden biraz yardım alarak, diğer öğrencilerle birlikte bir proje üzerinde çalışmak.

46. Tek başıma çalışabileceğim bir proje planlamak.

47. Online ders ortamında öğretmenin sorularına sanal olarak cevap vermek.

48. Bir konu üzerinde asenkron online ders ortamı sırasında diğer öğrencilerin fikirlerini yazılı görmek.

49. Online ders ortamında yeni bir konu ilan edildiğinde onu okumak.

50. Henüz okuduğum bir konu hakkındaki sorulara yazılı olarak cevap vermek.

51. Medeniyetler tarihi dersinin önemli savaşlarını animasyonlar aracılığı ile canlandırıp öğrenmek.

52. Arkadaşlarımdan birinin özellikle iyi yaptığı bir şeyi bana öğretmesi.

53. Flash chart deneme sınavlarını kullanarak kelime dağarcığımı bu uygulama aracılığıyla geliştirmek.

54. Online ders ortamında genel tartışmalara girip görüş bildirmek.

55. Online ders ortamında sunumunu yapacağım bir konu üzerinde yalnız başıma çalışmak.

56. Okuduğum bir ünite bölümünü anladığımı görmek için online ders ortamında bir deneme sınavı almak.

57. Diğer öğrencilerin söylediklerine katılmadığım bir konuda tartışmak.

58. Online ders ortamında ders izlerken not almak.

59. Eksik kelimeyi yazarak cümle tamamlama ödevleri yapmak

60. Proje seçim sürecinde seçilmesini istediğim proje ile ilgili bilgilendirme vermek ve kendi seçtiğim konunun kabul edilmesini sağlamayı desteklemek.

61. Online ders ortamında yer alan bir öğrenciden yeni bir bilgi ya da bir proje probleminin nasıl çözüldüğünü öğrenmek.

62. Öğrendiğim bir konu üzerinde alıştırma yapabileceğim bir oyun oynamak

63. Öğretmenin önerdiği bir proje üzerinde, diğer öğrenciler ile çalışmak.

64. Herhangi bir. konuda öğrenmek amacıyla bir kitap okumak

65. Öğretmenin online ders ortamındaki kişilere belirli konular hakkında sorduğu bir konu üzerinde etkinliğe katılmak.

66. Belirli bir konudaki online tartışmalarda düşüncelerimi diğer öğrenciler ile paylaşmak.

67. Öğretmenin bir ödev ya da projenin nasıl yapılacağı konusunda somut adımlar içeren bilgiler vermesi.

68. Ders ile ilgili başka uzman kişilerin de online ortamda bir konu hakkında bilgilerini izleyerek katılmak.

69. Medeniyetler tarihindeki önemli liderlerin biyografik analizlerini hazırlayarak onların yerine kendimi koymak.

70. Hazırladığım proje bölümlerini gözden geçirmek için gruptan bir arkadaşım ile buluşmak.

71. Proje konusu ile ilgili özette yer alan anahtar kelimelerin seçilerek bir bütünlük oluşturacak şekilde sunulması.

72. Çalıştığım bir konuyla ilgili arkadaşlarla proje planlamak.

73. Seçtiğim bir konu üzerinde kendi başıma çalışmak.

74. Öğretmenin online ders ortamından ne beklediğini açıkça belirtmesi.

75. Sınıf arkadaşımm bir konu hakkındaki düşüncelerini dinlemek.

76. Online ders ortamında ders izlerken hocayıda asenkron olarak takip ederim.

77. Her bir soruyu yaptıktan sonra doğru yapıp yapmadığımı kontrol edebileceğim şekilde hazırlanmış bir ödev yapmak.

78. Öğrencisi olduğum bilim dalına ilişkin dönem proje oluşturmak ve ders kapsamını ilişkilendiren bilgiler sunmak.

79. Başka bir proje grubunda yer alan öğrencilerle sınav konularını gözden geçirmek.

80. Online ders ortamında işlenen bir konuyla ilgili yarışma düzenleyerek, proje gurubunun sorulan soruları online aldığı geri dönüşlere uygun düzenlemek.

81. Yazmak istediğim bir konuda kütüphanede araştırma yapmak.

82. Kendi seçtiğim bir projede bağımsız olarak çalışmak.

83. Öğretmenin final günü medeniyetler tarihi ile ilgili tüm konuları ezbere sorması ve yanıtlamaya çalışmak.

84. İlgilendiğim bir konuda diğerleri ile yüzyüze konuşmak.

85. Online ders ortamında yeni bir konunun online ortamda asenkron sunumunu izlemek.

86. Seçtiğimiz proje konusunda kolay yapabileceğim bir bölümün üzerinde çalışmak.

87. Online ders ortamında proje ilerlemelerinin nasıl oluşturulacağına dair tartışmada bir panelin üyesi olmak.

88. Projem ilgili bana yardım eden bir öğrenci ile uygun bir ortamda çalışmak.

89. Online ders ortamında sunmak üzere bir grupla proje hazırlamak.

90. İlgilendiğim bir konuda bilgi toplamak üzere kendi başıma çalışmak.

91. Öğretmenin online ortamda beni sistemde gördüğünde soru yönlendirmesi.

92. Öğretmenin yüz-yüze görüşmede proje ile yeni bir konu üzerinde öğrenciyi tartışmaya yönlendirmesi.

93. Onlinr bir ortamda düzenli olarak geri gönderimlerde bir yenilik tasarlamak.

94. Online ortamda tüm bilgilerin öğretmen tarafından sunulduğu yeni bir konu öğrenmek.

95. Bir projenin planlanıp tamamlanmasında diğer öğrenciler ile birlikte çalışmak.

96. Bir konuda daha fazla bilgi edinmek için tek başıma kütüphaneye gitmek.

97. Projelerde ne yaptığımı görmek için bir öğretmenin beni yüz-yüze görüşmeye çağırması.

98. Bir konuda düşüncelerini anlatan öğrencileri dinlemek. ,

99. Bir grup ile birlikte yazılı bir rapor hazırlamak.

100. Ders projemde konunun anahtar kelimelerini seçmek ve veri tabanlarından araştırmak.

		ACIMLA	BCALIS	CGOSTER	DVERME	DHEDEF	DUZENL	HEDEFB	IHEDEF	OZYANS	OZYETE	STRATE	USTBIL	YARDIM	YINELE	ZAMAN
ACIMLA_AVG	Pearson Correlation	1	0,602376	0,687308	0,725375	0,761337	0,642765	0,75176	0,71565	0,564887	0,643401	0,820581	0,728534	0,709055	0,673338	0,485131
	Sig. (2-tailed)		4,08E-23	4,21E-32	3,26E-37	6,68E-43	4,91E-27	2,72E-41	7,91E-36	6,06E-20	4,21E-27	7,11E-55	1,12E-37	6,39E-35	2,04E-30	2,18E-14
	N	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220
BCALIS_AVG	Pearson Correlation	0,602376	1	0,607829	0,48892	0,635182	0,583809	0,58016	0,600574	0,505255	0,523776	0,680785	0,451306	0,806645	0,623939	0,414533
	Sig. (2-tailed)	4,08E-23		1,3E-23	1,27E-14	2,96E-26	1,71E-21	3,46E-21	5,93E-23	1,18E-15	6,73E-17	2,65E-31	1,95E-12	1,09E-51	3,88E-25	1,51E-10
	N	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220
CGOSTER_AVG	Pearson Correlation	0,687308	0,607829	1	0,677224	0,750309	0,605767	0,687378	0,651346	0,631749	0,593612	0,697872	0,711417	0,697239	0,677777	0,542791
	Sig. (2-tailed)	4,21E-32	1,3E-23		7,08E-31	4,7E-41	2,01E-23	4,13E-32	6,04E-28	6,57E-26	2,45E-22	1,94E-33	3,04E-35	2,34E-33	6,08E-31	2,96E-18
	N	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220
DVERME_AVG	Pearson Correlation	0,725375	0,48892	0,677224	1	0,704374	0,615157	0,727921	0,647591	0,568971	0,596131	0,743283	0,798638	0,670863	0,690136	0,415819
	Sig. (2-tailed)	3,26E-37	1,27E-14	7,08E-31		2,72E-34	2,7E-24	1,38E-37	1,52E-27	2,86E-20	1,47E-22	6,3E-40	5,64E-50	3,96E-30	1,87E-32	1,31E-10
	N	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220
DHEDEF_AVG	Pearson Correlation	0,761337	0,635182	0,750309	0,704374	1	0,564905	0,718703	0,743844	0,588028	0,612974	0,725293	0,73015	0,700095	0,634825	0,467586
	Sig. (2-tailed)	6,68E-43	2,96E-26	4,7E-41	2,72E-34		6,04E-20	2,95E-36	5,13E-40	6,41E-22	4,33E-24	3,35E-37	4,07E-38	9,95E-34	3,22E-26	2,38E-13
	N	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220
DUZENL_AVG	Pearson Correlation	0,642765	0,583809	0,605767	0,615157	0,564905	1	0,621011	0,525097	0,520769	0,593191	0,688033	0,634402	0,686098	0,640923	0,425728
	Sig. (2-tailed)	4,91E-27	1,71E-21	2,01E-23	2,7E-24	6,04E-20		7,46E-25	5,45E-17	1,08E-16	2,67E-22	3,43E-32	3,55E-26	5,95E-32	7,63E-27	4,25E-11
	N	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220
HEDEFB_AVG	Pearson Correlation	0,75176	0,58016	0,687378	0,727921	0,718703	0,621011	1	0,663042	0,568605	0,578515	0,746797	0,698584	0,712778	0,659483	0,440732
	Sig. (2-tailed)	2,72E-41	3,46E-21	4,13E-32	1,38E-37	2,95E-36	7,46E-25		3,11E-29	3,06E-20	4,75E-21	1,74E-40	1,57E-33	1,98E-35	7,77E-29	7,18E-12
	N	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220
IHEDEF_AVG	Pearson Correlation	0,71565	0,600574	0,651346	0,647591	0,743844	0,525097	0,663042	1	0,539108	0,536014	0,741278	0,687469	0,695492	0,637238	0,480351
	Sig. (2-tailed)	7,91E-36	5,93E-23	6,04E-28	1,52E-27	5,13E-40	5,45E-17	3,11E-29		5,5E-18	9,21E-18	1,3E-39	4,03E-32	3,92E-33	1,83E-26	4,23E-14

	N	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220
OZYANS_AVG	Pearson Correlation	0,564887	0,505255	0,631749	0,568971	0,588802	0,520769	0,568605	0,539108	1	0,77387	0,705721	0,631283	0,608847	0,67269	0,603652
	Sig. (2-tailed)	6,06E-20	1,18E-15	6,57E-26	2,86E-20	6,41E-22	1,08E-16	3,06E-20	5,5E-18		3,98E-45	1,8E-34	7,32E-26	1,05E-23	2,43E-30	3,13E-23
	N	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220
OZYETE_AVG	Pearson Correlation	0,643401	0,523776	0,593612	0,596131	0,612974	0,593191	0,578515	0,536014	0,77387	1	0,730291	0,660456	0,638706	0,692872	0,570861
	Sig. (2-tailed)	4,21E-27	6,73E-17	2,45E-22	1,47E-22	4,33E-24	2,67E-22	4,75E-21	9,21E-18	3,98E-45		6,16E-38	6,06E-29	1,29E-26	8,46E-33	2,01E-20
	N	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220
STRATE_AVG	Pearson Correlation	0,820581	0,680785	0,697872	0,743283	0,725293	0,688033	0,746797	0,741278	0,705721	0,730291	1	0,767386	0,800226	0,797395	0,541953
	Sig. (2-tailed)	7,11E-55	2,65E-31	1,94E-33	6,3E-40	3,35E-37	3,43E-32	1,74E-40	1,3E-39	1,8E-34	6,16E-38		5,86E-44	2,61E-50	1,02E-49	3,41E-18
	N	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220
USTBIL_AVG	Pearson Correlation	0,728534	0,451306	0,711417	0,798638	0,7315	0,634402	0,698584	0,687469	0,631283	0,660456	0,767386	1	0,639043	0,69039	0,532106
	Sig. (2-tailed)	1,12E-37	1,95E-12	3,04E-35	5,64E-50	4,07E-38	3,55E-26	1,57E-33	4,03E-32	7,32E-26	6,06E-29	5,86E-44		1,19E-26	1,74E-32	1,75E-17
	N	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220
YARDIM_AVG	Pearson Correlation	0,709055	0,806645	0,697239	0,670863	0,700095	0,686098	0,712778	0,695492	0,608847	0,638706	0,800226	0,639043	1	0,751277	0,47565
	Sig. (2-tailed)	6,39E-35	1,09E-51	2,34E-33	3,96E-30	9,95E-34	5,95E-32	1,98E-35	3,92E-33	1,05E-23	1,29E-26	2,61E-50	1,19E-26		3,26E-41	8,06E-14
	N	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220
YINELE_AVG	Pearson Correlation	0,673338	0,623939	0,677777	0,690136	0,634825	0,640923	0,659483	0,637238	0,67269	0,692872	0,797395	0,69039	0,751277	1	0,493687
	Sig. (2-tailed)	2,04E-30	3,88E-25	6,08E-31	1,87E-32	3,22E-26	7,63E-27	7,77E-29	1,83E-26	2,43E-30	8,46E-33	1,02E-49	1,74E-32	3,26E-41		6,44E-15
	N	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220
ZAMAN_AVG	Pearson Correlation	0,485131	0,414533	0,542791	0,415819	0,467586	0,425728	0,440732	0,480351	0,603652	0,570861	0,541953	0,532106	0,47565	0,493687	1
	Sig. (2-tailed)	2,18E-14	1,51E-10	2,96E-18	1,31E-10	2,38E-13	4,25E-11	7,18E-12	4,23E-14	3,13E-23	2,01E-20	3,41E-18	1,75E-17	8,06E-14	6,44E-15	
	N	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220

ÖZ GEÇMİŞ

Adı Soyadı :	Oğuz Mustapaşa
Sürekli Adresi :	
Doğum Yeri ve Yılı :	İstanbul, 1986
Yabancı Dili :	İngilizce, İspanyolca
İlk Öğretim :	Nilüfer Hatun İ.Ö.O.
Orta Öğretim :	Nilüfer Hatun İ.Ö.O.
Lisans :	Bahçeşehir Üniversitesi, Bilgisayar Mühendisliği
Yüksek Lisans :	Bahçeşehir Üniversitesi
Enstitü Adı :	Fen Bilimleri Enstitüsü
Program Adı :	Bilgisayar Mühendisliği
Yayımları :	Mustapaşa, O. et al. - Implementation of Semantic Web Mining on E-Learning, 2010 Mustapaşa, O. et al. – "Hello World" Web Mining for E-Learning, 2011
Çalışma Hayatı :	Bahçeşehir Üniversitesi, Mühendislik Fakültesi (2008, 2011) Yazılım Mühendisliği Bölümü, Araştırma Görevlisi