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DEVELOPMENT OF AN ANXIETY SCALE FOR CHEMISTRY PREPARATION OF AN ANXIETY TREE

KİMYA DERSİNE YÖNELİK KAYGI ÖLÇEĞİ GELİŞTİRİLMESİ KAYGI AĞACI OLUŞTURMA

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ABSTRACT: This study has been carried out to develop a tool to measure the level of anxiety of students studying in the 10th and 11th grades of high schools in Turkey. The scale has been created by the application of a pool of items consisting of 45 sentences based on student opinions and expert advice to 365 students and the branching of the results with the "Classification Trees" method to prepare a tree of 23 leaves. The prepared scale is called the Anxiety Tree and is a suggested guidance tool to identify existing anxieties about chemistry for chemistry teachers. It has features to be used as a tool to measure performance.

Keywords: anxiety about chemistry, classification trees, regression analysis, attitude scale.

ÖZET: Bu araştırma, Türkiye'de öğrenim gören lise 10. ve 11. sınıfta kimya dersini alan öğrencilerin, kimya dersine yönelik kaygı düzeylerini ölçebilecek bir araç geliştirmek amacıyla gerçekleştirilmiştir. Ölçek; öğrenci görüşleri ile uzman önerileri göz önünde bulundurularak kimya dersiyle ilgili kaygıları belirleyici tutumları ifade eden 45 cümlelik madde havuzunun 365 öğrenciye uygulanması ve sonuçların "Classification Trees" yöntemine göre dallandırılarak 23 yapraklı bir ağaç haline getirilmesi ile oluşturulmuştur. Hazırlanan ve adına, Kaygı Ağacı denen ölçek, kimya dersine yönelik mevcut kaygıların belirlenmesinde ve kimyaya eğilimin ölçülmesinde; Kimya öğretmenleri içinse, performans ölçücü özellik taşıması açısından önerilen bir yönlendirme aracıdır.

Anahtar sözcükler: kimyaya yönelik kaygı, sınıflama ağaçları, regresyon analizleri, tutum ölçeği.

1. INTRODUCTION

Behavioural objectives of education can be explained by a threefold classification namely cognitive, psychomotor and affective objectives (Anderson, 1970; Bloom, 1979; Turgut, 1977). Of these three behaviours subject to educational research, affective properties cover qualities such as interests, values, attitudes, and habits. Bloom (1979) states that there is correlation between affective behaviours and cognitive as well as psychomotor behaviours and that this has been proved by many research activities. The relation between affective behaviours and cognitive and psychomotor behaviours is determined by attitudes. Attitudes explain the different behaviours of the individual within the events and relations in her/his life (Kiesler, Collins , & Miller, 1969). There is a one-to-one relationship in the comprehension of each attitude object and the behaviour that the individual develops. Having examined various definitions of attitude, Allport (1954) outlined that attitude has three important fundamental features. Attitude, 1) is organised based on experience, 2) is stimulated at the existence of all situations and objects it is connected with, and 3) is preparation and readiness for positive or negative reactions (Anderson, 1988). Fishbein and Ajzen (1975, 1980) have defined three important aspects of attitude with regard to the behaviour of the individual as "attitude is learned and makes the action appropriate and as such, attitudes are shaped by negative behaviours towards the object and fear and tension felt under a threat". Spielberg (1972) has defined these fear and stress situations as ANXIETY and asserted that these are observable reactions. Izard and Tomkins (1971) explained that anxiety is an affective feature and has effects on human behaviour. Anxiety can be expressed as fear and tension felt in the existence of a threat (Buyukozturk, 1997). As Buyukozturk (1997) reports, Spielberg (1972) defines anxiety as unpleasant emotional and observable reactions stimulated by stress causing situations such as sorrow, perception, and tension. In the studies of Spielberg (1971), two types of anxiety namely "situational anxiety" and "continuous anxiety" determined by factor analysis are defined. Situational anxiety is defined as a temporary emotional phase characterised by subjective feelings of tension and fear whereas continuous anxiety indicates the

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relative anxiety tendency of the individual, and is a situation in which situational anxiety is condensed and continuous. As Buyukozturk (1997) also reports, numerous researches have been carried out examining the relation between the anxiety for a domain or anxiety for a lesson and the performance in that lesson, excluding examination anxiety (Oner, & Le.Comte, 1983). In a study, Buyukozturk (1997) developed a valid and dependable measuring tool to measure the anxieties of undergraduate and graduate students towards research. The developed scale is a one-dimensional and 12-article Likert-type scale with a dependability of 0.8724. In the study, positive and significant relations were found between anxiety level and situational, as well as continuous anxiety levels. In research studies they carried out, Richardson (1972) and Betz (1978) examined the relation between mathematics anxiety and mathematics success of students and found that the success of students with higher levels of anxiety is lower. In a study Klausmeier and Goodwin (1971) stress that anxiety simplifies learning. Buyukozturk (1996) found that research-oriented attitudes of students were low and that anxiety played an important role in this low level of attitude. In his study carried out parallel to the studies of Pretorius and Norman (1992), Koklu (1996) identified that there is negative correlation between the statistical anxiety grade and statistical success grade. In addition, Reece and Gable (1982), Hakkinen (1994), Brosnan (1998), Chua, Chen, & Wong (1999), Mikkelsen and Ogaard et al. (2002), found that anxiety for computer use negatively affects the learning and cognitive performances of the individual and that this anxiety influence the effective use of computers. The effective of anxiety in computer use on trainee teachers have also been examined and it has been found that as their anxiety levels for computer use increase, they are unable to use (become insufficient in using) the coping mechanism of seeking social support (Ceyhan, & Namlu, 2000; Ceyhan, 2004).

1.1. Problem

How are the attitudes towards anxiety for chemistry?

1.2. Assumptions

Students replied to the propositions in the anxiety scale accurately.

1.3. Limitations

The research is limited to anxieties for chemistry of a total of 365 volunteer students within the 15 – 17 age group, randomly selected from among the students studying in the educational institutions in Turkey.

1.4. Development of the Measuring Tool

Phase 1: While developing the measuring tool, a group of 30 individuals constituted randomly from among 10^{th} and 11^{th} grade secondary education students were requested to write an essay reflecting their emotions and opinions about the chemistry lesson.

Phase 2: The essays were read by the researcher and from among the expressions in them, those that can be used as anxiety statements were identified. They were paraphrased converted to meet the itemised writing technique.

Phase 3: The converted and attitude statements were evaluated taking anxieties for chemistry, and behavioral, cognitive and affective elements into consideration. In implementing this, care was given to equalize the number of positive and negative statements, according to which of the components they represented. After being read and evaluated with regard to language and scope by a group of four specialists, experts in developing psychological measurement tools, the anxiety statements were itemized and prepared for the test application. The context validity (scope validity) of the ASFC (Anxiety Scale for Chemistry) is related to whether it can measure what it intends to measure and it can be explained based on expert opinion (Balci, 1995). Experts evaluated the adequacy of the anxiety statements to measure the chemistry anxiety of the students, and the related sampling and scope in the draft form prepared to this end. Based on the evaluation, it was concluded that the ASFC is an appropriate information-collecting tool to measure anxieties related to chemistry lesson.

Phase 4: The 45 items prepared are listed in the draft form so that there will not be consecutive positive and negative statements. Open ended and definite expressions such as "definitely, never…" were not used in the attitude statements.

Half of the statements in the scale on the test form reflect positive and half reflect negative anxiety. Attitude Scale 5-pointscale used "I totally agree", "I agree", "Neither agree nor disagree", "I don't agree", "I totally disagree". The responses given to the items in the measuring tool were graded by giving numerical values from 5 to 1 for statements reflecting the situation of direct anxiety. For reversed statements that do not reflect the situation of direct anxiety, this calculation is applied in the opposite direction. Thus, high marks obtained from the scale indicate high anxiety and low marks indicate low anxiety. Table 1 lists the 45-item "Attitude Scale for Chemistry" statements.

2. METHOD

The study involves the evaluation of the 45-statement item set regarding anxiety, the preparation process of which is clearly defined above, made according to the classification tree method. Classification trees, being a type of multivariable statistical data analysis, have been used in some studies (Breiman et al., 1984; Rao, 1952, 1965; Ripley, 1981, 1996; Roy, 1958, 1967). Here, it was aimed to create decision trees by using the multivariable data set. The objective of classification tree, which is a nonparametric statistical method, is to determine the classification conditions that enable the most accurate forecasts or classifications of the units using the algorithms written and to facilitate their forecasting within new units.

In multivariable data analysis, classification trees are preferred to traditional classification and regression analysis methods since it does not make any distribution assumptions or a limitation to the variables examined, analyzes all types of variables, avoids the problems caused by lost observations during analysis and is easy to evaluate its conclusions. Classification trees are generally used in order to make classifications and determining strategies to achieve an aim. By using classification trees, a tree structure is tried to be created by breaking the variables into units. A classification tree consists of a root, branches, nodes and leaves. The first node in this tree structures is the root; root-branch-node-branch…- node chain is a leaf. Nodes stand for characteristics; leaves indicate classifications; and branches show the value range of the characteristic on the node that caused branching (Rao, 1952; Rao, 1965; Ripley, 1981; Ripley, 1996; Roy, 1958; Roy, 1967).

In the light of the results of the analysis made using classification tree method, it was possible to classify the statements according to 23 scale items instead of forty-five. Figure I displays a tree with 23 nodes branched according to the degrees of importance as a result of the analysis on 45 statements (Figure I. Classification Tree).

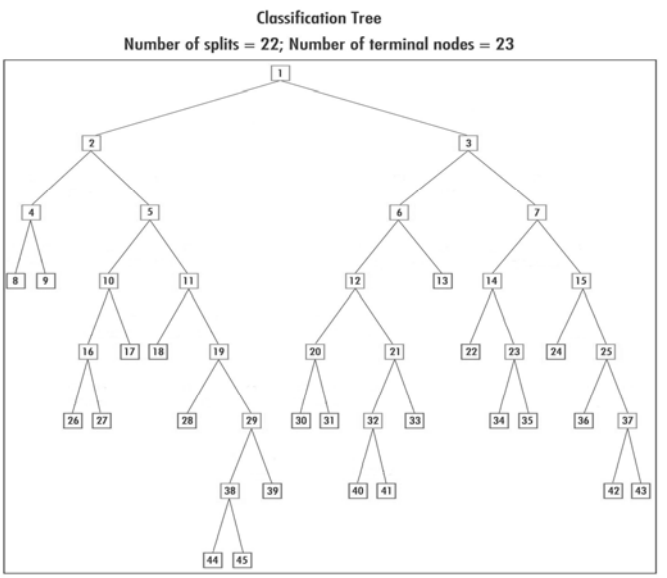

Figure1:Clasification Trees.

Table 1: Attitude Scale For Chemistry

	I totally agree	I agree	Undecided	I don't agree	I totally disagree
1) I don't want to learn chemistry unless I have to.					
2) I get stomachaches in chemistry lessons without a reason.					
3) I don't feel confident about being successful in chemistry					
4) I feel tired when I am learning chemistry.					
5) The word chemistry' is enough to make me uneasy.					
6) The thought of learning chemistry disturbs me.					
7) I am afraid of encountering embarrassing and difficult situations in chemistry lessons.					
8) I generally feel unhappy as I am learning chemistry.					
9) I quickly get tired of learning chemistry.					
10) Since I dislike chemistry, I am not worried about the problems that may occur while learning chemistry.					
11) I don't have self-confidence in being able to learn chemistry.					
12) I am always irritated by the fact that chemistry is a compulsory lesson in our curriculum.					
13) You don't need to learn chemistry to be successful in life.					
14) The idea of learning new concepts, new formula and symbols about chemistry always creates tension in me.					
15) No matter how much I study chemistry, I always get the feeling that I am going to be unsuccessful.					
16) I am unwilling to learn chemistry.					
17) Since chemistry lessons will be of no use for the occupation I am considering, I think that learning this lesson is a waste of time.					
18) I feel very distressed when I go into the chemistry class.					
19) Chemistry examinations scare me.					
20) As I learn chemistry, my interest in chemistry increases.					
21) The source of my anxieties in chemistry lessons is the chemistry teachers.					
22) Apart from my worries about passing, chemistry lessons are enjoyable.					
23) Since I have the idea that chemistry will not be useful for me in my daily life, I always feel that I am learning for nothing when I learn chemistry.					
24) I generally review what I learned the night before the examination.					
25) I take notes on small pieces of paper instead of the notebook during the lesson.					
26) I revise the topics of the lesson regularly because I have to.					
27) I keep all my course notes in my notebook only for getting high scores.					
28) I get nervous during the chemistry test and I can't get the success I deserve.					
29) When I study chemistry, I stand up and wander because of boredom and worry. (I feel happy dealing with different things.)					
30) Even if I know the correct answer, I generally do not answer questions or join in repetitions.					
31) I generally go to bed late and since I don't sleep enough, I am half asleep in the classroom.					
32) Sometimes I have to study as I watch TV or when others are talking in the room.					
33) I cannot think of certain examples that display the general principles and rules I learnt at chemistry.					
34) When I am preparing for the chemistry examination, I find it difficult to study because of nervousness, tension, and unrest.					
35) Before I start studying chemistry, reading the paragraph headings and the following sentences and skimming through to have a general idea, facilitates my understanding.					
36) I'd rather prepare homework instead of taking the examination for chemistry.					
37) When I learn that I have been unsuccessful in the chemistry examinations, I start to think that I am not as clever as I believe.					
38) When I enter the chemistry laboratory, I feel very uneasy and annoyed.					
39) If there were more laboratory work, I could like chemistry more.					
40) During the chemistry lesson, I realise that I unconsciously vibrate my legs and knock on the desk with my fingers.					
41) Chemical activities around me do not appeal to me.					
42) When the subject is explained through current events in the chemistry lessons, I understand better.					
43) I could understand chemistry better if there are examples related to daily events during chemistry courses.					
44) What is important for the teacher and the type exams he will prefer are of little interest to me.					
45) What is important for the teacher and how s/he will make the examination is for little interest to me.					

Table 2 shows the observations in predicted and observed classes and the tree structure of the child nodes.

Table 2: Tree Structure (anxiety) Child Nodes, Observed Class n's, Predicted Class, And Split Condition For Each Node.

Node	Left Branch	Right branch	n in cls Female	n in cls Male	Predict. Class	Split Constant
1	2	3	40	88	M	-3.45801
2	4	5	198	167	F	-3.42523
3	6	7	158	79	F	-3.83945
4	8	9	6	5	F	-3.69319
5	10	11	34	83	M	-4.17359
6	12	13	126	26	F	-3.46383
7	14	15	32	53	M	-4.74284
8			0	4	M	
9			6	1	F	
10	16	17	31	32	M	-3.36329
11	18	19	3	51	M	-4.66667
12	20	21	126	12	F	-3.01809
13			0	14	M	
14	22	23	8	37	M	-4.95853
15	24	25	24	16	F	-2.69200
16	26	27	29	4	F	-3.50000
17			2	28	M	
18			0	34	M	
19	28	29	3	17	M	-5.00000
20	30	31	13	4	F	-4.42308
21	32	33	113	8	F	-4.40708
22			1	28	M	
23	34	35	7	9	M	-3.86439
24			15	1	F	
25	36	37	9	15	M	-5.00000
26			0	4	M	
27			29	0	F	
28			0	7	M	
29	38	39	3	10	M	-3.60000
30			2	4	M	
31			11	0	F	
32	40	41	21	8	F	-4.25000
33			92	0	F	
34			2	7	M	
35			5	2	F	
36			0	7	M	
37	42	43	9	8	F	-4.37500
38	44	45	3	4	M	-4.50000
39			0	6	M	
40			21	4	F	
41			0	4	M	
42			9	2	F	
43			0	6	M	
44			0	3	M	
45			3	1	F	

In Table 2, the importance of 45 attitude statements is listed within the range of maximum 100 and minimum 10.

Table 3. Table Showing The Importance of The Predictor Variable in Rankings.

Predictor Variable Importance Rankings (anxiety) Based on unvaried splits 0=low importance; 100=high importance												
Item	**Ranking**	**Item**	**Ranking**	**Item**	**Ranking**	**Item**	**Ranking**	**Item**	**Ranking**
1	100	**10**	44	**19**	27	**28**	34	**37**	52
2	24	**11**	45	**20**	55	**29**	55	**38**	51
3	55	**12**	82	**21**	56	**30**	23	**39**	37
4	81	**13**	64	**22**	52	**31**	14	**40**	32
5	30	**14**	40	**23**	46	**32**	29	**41**	31
6	40	**15**	72	**24**	24	**33**	27	**42**	21
7	81	**16**	44	**25**	70	**34**	43	**43**	10
8	47	**17**	39	**26**	32	**35**	44	**44**	29
9	20	**18**	79	**27**	48	**36**	25	**45**	26

3. RESULTS

The research is limited to the anxieties for chemistry lesson of a total of 365 volunteer students within the 15 – 17 age group, randomly selected from among students studying in the educational institutions in Turkey.

This study is carried out to identify the anxieties for the chemistry lesson of a total of 365 volunteer students within the 15 – 17 age group, randomly selected from among the students studying in various educational institutions in Turkey. The statistical evaluation of the results of the study was carried out with the Classification Trees technique. As a result of the application of this technique, the 45-item scale was reduced to 23 statements and the comments made were based on 23 statements. The sentence creating the widest branching according to the Classification Trees method is the 1st sentence, "I don't want to learn chemistry unless I have to". The branching constituted according to the Classification Trees method at the same time defines two different groups namely, "Those who don't like chemistry" and "Those who like chemistry but have anxieties due to several reasons".

In the branching constituted by the 2nd question, it can be concluded from the statements consisting of 19 leaves that the students don't like chemistry at all. In chemistry lessons, the student has negative attitudes such as "stomach ache", "weariness", "unrest", "unhappiness", "tiredness", "lack of confidence", and "reluctance". The researcher defines the members of this group of 19 nodes that cover these feelings as, "Students who do not like chemistry from the start, those who have negative attitudes towards chemistry". The 10th node statement created by the 5th node defines those "who don't like chemistry and don't care about chemistry, either". The 16th statement, which is the next lower node of this statement, informs the researcher about "the existence of a group unwilling to learn chemistry". This fact is not considered particularly striking. Because, when the fact that this node is one of those which constitute the lower lines in the branching is considered, the idea that along with this node, nodes 26 and 27 express an ordinary feeling come to mind as the student within this group does not like chemistry. However, to meet the requirements of the lesson stipulated by the lesson environment, by necessities, and to be successful, s/he is aware although s/he doesn't like it. Consequently, these statements are thought to define students whose attitudes are generally negative but who show positive behaviors (Allport, 1954; Anderson, 1970; Balcı, 1995). Thus, the researcher once again underlines that despite the unwilling attitude of the group at the 16th node statement and their seemingly positive attitude at the 26th and 27th node sentences, it cannot be concluded from these

three statements that, "the student has positive attitudes for chemistry," because the node statements that in fact evidence negative attitudes constitute the statements that are at quite lower level node statements. As a matter of fact, when node 11 and its sub-node statements are looked at, the fact that the student does not like chemistry gets clearer. The student who dislikes chemistry studies the subject less and is tense while studying and during the examination. This confirms the above opinion that the branching created by the 2nd node statement defines "Students who have negative attitudes towards chemistry, those who don't like Chemistry". In addition, statements related to the chemistry laboratory exist on the node points in both sides of the branching.

The nodes in the branching created by the 3rd statement fully consist of statements defining "Students who like chemistry, but who have anxieties about it. As a result of this study along with the interviews of students, and the evaluation of the essay their feelings and opinions, these suggestions can be made to eliminate situations that can create anxiety in students;

1) An anxiety of being unsuccessful in chemistry is in question in Statement 3. The anxiety of failure becomes more evident with phrases such as "disturbing" (6th statement), "fear" (7th statement), "tension" (14th statement), "fear of being unsuccessful" (15th statement). If a student suffers such troubles in any one subject, this is situational anxiety. This unwillingness of the student must be understood by the teacher and the attitude must be changed Reactions that develop a negative attitude can be spotted by an experienced teacher quickly. In making this a temporary emotional situation encountered only in the beginning, the teacher has the most important responsibility (Selim, & Shrigley, 1983). There are two features that differentiate a competent and incompetent teacher. First, teachers who are experts in their subject areas and jobs use *body language* well when they are teaching, which enables an enjoyable learning experience. Secondly, competent teachers know that being a teacher is not only teaching but also that establishing good relations is important (Baltas, 1999; Fontana, 1985; Klausmeier, & Goodwin, 1971).

2) The second most important source of anxiety about chemistry is the psychological tensions that the student suffers when s/he is studying chemistry. The statement that constitutes the 30th node and statements that constitute the 14th, 37th, and the 41st node indicate these tensions. What negatively affects learning, reasoning, and examination success and results in the lack of self-confidence of the student is high anxiety. The student who fails to understand the subject in the classroom and who does asks questions because of fear of embarrass will not want to study chemistry. Which s/he could not understand within the classroom environment and which s/he developed negative preoccupations about, will postpone understanding and learning to as possible future times as possible, and as a result of these behaviors, the situation will bring about irrevocable results. In addition, the inappropriate studying environments of the students, which are an outcome of their social surrounding, are important stimulants of their anxiety (the 31st and the 32nd node statements). When the fact that the studying environment of the students is a dormitory or a student house far away from their home, where they used to live with their families, it can be thought that productive activities they can carry out by themselves in peaceful environments would gradually degrease to turn into aimless, haphazard activities. For success in a lesson subject, the situation of the student in non-classroom environments and her/his adaptation, skills, activities, shortly her/his behaviors are as important as her/his motivation and activity in the classroom environment.)

3) Again, the statements constituting the 21st, 30th, 37th and 40th nodes are statements related to the role of the classroom environment and the teacher in the formation of anxiety. The emphatic manners of chemistry teachers towards their students, activities they do to popularise the lesson, and, most importantly, making students want to learn the subject without any fear of examinations are critical experiments linked with daily life will rescue the students from the irritating odours of chemicals and the cold environment of the laboratory (extracts from student essays). They will create a different environment that facilitates learning, and students will start to produce creative ideas on how these experiments could be done in the laboratory environment. Thus student, fears about chemistry laboratories will fade away. When giving the lessons, student learning should be ensured to the extent possible, later, must be followed up in meetings out of the classroom. The use of audiovisual tools must not be neglected during teaching.

4) Subject presentation techniques and the teacher's point of view about the contents of the lesson can be stated as another source of anxiety developed against chemistry. Chemistry should be presented by the teacher "Not as the implantation of unquestionable facts as readymade information to minds but as a questioning technique that asks, enquires, creates answers, corrects mistakes, rechecks and makes the necessary corrections after each checking within the main framework", which means running towards what is more correct with an ever more careful approach (Herron, 1971; Hurd, Bybee, Kahle, & Yager, 1980; Tamir, 1983, 1985). In traditional chemistry education, the whole stress is on the question "What". The question "How" is much less asked. Likewise, the chemistry curriculum neglects the issue of how to teach and seeks answers to the question of what to teach (Eltinge, Roberts, 1993). An aspect of a subject that is considered vital in the eyes of a teacher may seem as a totally irrelevant detail for a child. The teacher may often fail to know on which level of ready knowledge her/his new information will be based. In short, the students in the teacher's mind might be different from the actual students s/he is confronting (Osborne, & Wittrock, 1983). Consequently, the lessons given where there is no communication can not succeed either for the teacher or the student. Lessons delivered without a sufficient level of teaching result in the accumulation of misconceptions and non-understanding. This means failure and sets the scene for the student to alienate from the subject. The presentation by the teacher of chemistry that can explain the reasons of some events confronted in daily life will lead chemistry education into a much fluent, remaining, and useful way (the 43rd node statement). As such, in addition to knowing that lessons delivered as identified with daily life will be more remaining, it is considered that presentations delivered so will be more appealing and contribute to the elimination of missing links in the minds of students.

REFERENCES

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior.* Englewood Cliffs, NJ: Prentice-Hall.

Allport, G.W. (1954). The historical background of modern social psychology. *In handbook of social psychology, G. Lindsey (Ed.).* Reading, MA:Addison-Wesley,.

Anderson, R. D. and et al. (1970). *Developing childeren's thinking trough science.* New Jersy: Prentice-Hall.

Anderson, L.W. (1988). Attitude measurement: attitudes and their measurement. In Keeves, J.P.(Ed).

Balci, A., (1995). *Research, method, concepts, and principles in social sciences*. Ankara.

Baltas, A. (1999). *Üstün başarı* (6th ed.). Remzi Kitabevi.

Betz, N.E. (1978). Prevalence distrubution and correlates of math. Anxiety in college students. *Journal of Counseling Psychology*, *25*(5), 441-448.

Bloom, B. S., (1979). *Human characteristics and school learning*. (Trans. D.A. Ozcelik). Ankara: Ministry of national Education Publishing.

Breiman, L., Freidman, J.H., Olshen, R.A. & Stone, C.J. (1984). C*lassification and regression trees*. Wadsworth.

Brosnan, M.J., (1998). The impact of computer anxiety and self-efficacy upon performance. *Journal of Computer Assisted Learning*, *14*(3), 223-234.

Buyukozturk, Ş., (1996). Research education in turkish higher education. A.U Social Sciences Institute, Unpublished Doctorate Thesis.

Buyukozturk, Ş., (1997). Development of research oriented anxiety scale. *Educational Management inTheory and Practice, 3*(4), 453- 464.

Ceyhan, E ve Namlu, A. (2000). Computer anxiety scale (CAS): validity and dependability study, *A.U. Education Faculty Journal*, *10*(2), 77-93.

Ceyhan, E (2004). Stress coping behaviours of candidate teachers with different anxiety levels, *Education and Science*, *132*(29), 15-24.

Chua, S. L., Chen, D.T.& Wong, F.L.(1999). Computer anxiety and its correlates: A meta- analysis, *Computers in Human Behavior*, *15*, 609-623.

Eltinge, E, M. & Roberts, C,W., (1993). Linguistic content analysis: a method to measure science as inquiry in textbooks, *Journal of Research in Science Teaching*, *30*(1), 65-83.

Fishbein, M., & Ajzen, I., (1975). *Belief, attitude, intention and behavior*. Reading, M.A: Addison-Wesley.

Fontana, D. (1985). Classroom control, *British Psychological Society*, London.

Hakkinen (1994). Changes in computer anxiety in a required computer course, *Journal of Research on Computing in Education, 27*(2), 141-154.

Herron, M.D. (1971). The nature of scientific enquiry, *School-Review*, *79*(2),171-212.

Hurd, P.D., Bybee, R.W., Kahle, J.B., & Yager, R.E. (1980). Biology education in secondary schools of the United States, *The American Biology Teacher*, *42*(7), 388-404, 409-410.

Izard, C. E. & Tomkins, S. S., (1971). A*ffect and behavior anxiety as a negative affect. anxiety and behavior* (third ed.) Edit. (81-125).C. D. Spielberger. New York: Academic Press Inc.

Kerlinger, F. N., (1973). *Foundations of behavioral research. (second ed.)* London: Holt, Reinhart and Winston.

Kiesler, C., Collins, B., & Miller, N. (1969). *Attitude change. A critical analysis of theoretical approaches.* New York: Wiley.

Klausmeier, CH. J., & Goodwin, W., (1971). L*earning and human abilities: educational psychology (fourthed.)*. New York: Harper and Row Publishers.

Koklu, N., (1996). Statistical anxiety scale, psychometric data, *Education and Science*, *20*(102), 45-49.

Likert, R.A. (1932). *Technique for the measurement of attitudes. Archives of psychology.*

Mikkelsen, A., Ogaard, T., Lindoe, P.H. & Olsen, O.E. (2002). Job charateristics and computer anxiety in the production industry. *Computers in Human Behavior*, *18*, 223-239.

Osborne & Wittrock, (1983). Science teaching, *Science Education*, *67*(4). 489-518.

Oner, N., & A. Le Comte (1983). Situational-continuous anxiety inventory hand book. Istanbul: Bogazici University Publication.

Rao, C.R., (1952). Advanced statistical methods in biometric research. New York: Wiley.

Rao, C.D., (1965). Linear statistical inference and its applications. New York: Wiley.

Reece, M.J., & Gable, R.K.(1982). The development and validation of a measure of general attitudes toward computers. *Educational and Psychological Measurement*, *42*, 913-915.

Richardson, F.C. & Suinn, R. M., (1972). The mathematic anxiety rating scale: psychometric data, *Journal of Counselling Psychology*, *19*(6), 551-54.

Ripley, B.D. (1981). *Special statistics*. New York: Wiley.

Ripley, B. D. (1996). *Pattern recognition and neural networks*. Cambridge: Cambridge University Pres.

Roy, J., (1958). Step-down procedure in multivariate analysis, *Annals of Mathematical Statistics*, *29*,1177-1187.

Roy, J., (1967). *Some aspects of multivariate analysis*. New York: Wiley.

Selim, M.A., & Shrigley, R.L.(1983). The group dynamics approach: A socio-psychological approach for testing the effect of discovery and expository teaching on science achievement and attitude of young, *Egyptian students. J. Res.Sci. Teach*, *20*,213-224.

Spielberg, C. D., (1971). *Theory and research on anxiety. Anxiety and behavior (third ed.)* Edit. C. D. Spielberg. New York: Academic Press Inc.

Spielberg, C. D., (1972). A*nxiety: current trend in theory and research*. New York: Academic Press.

Tamir, P., (1983). Inquiry and the science teacher, *Science Education*, *67*(5), 657-672.

Tamir,P., (1985). Content analysis focusing on inquiry, *Journal of Curriculum Studies*, *17*(1), 87-94.

Turgut, F., (1977). Measurement and Evaluation Methods in Education. (Fifth Edition), Ankara.

GENİŞLETİLMİŞ ÖZET

Tutum; bireyin, yaşamında geçirdiği olaylar ve ilişkiler içindeki farklı davranışlarını açıklar (Kiesler, Collins & Miller, 1969). Her tutum nesnesindeki kavrayış ile bireyin geliştirdiği davranışı arasında bire bir ilişki vardır. Allport(1954), tutumla ilgili muhtelif tanımları inceleyerek tutumun temelde üç önemli özelliği olduğunu ortaya koymuştur. Tutum, 1) Tecrübe ile organize edilir, 2) Tutum, bağlı olduğu bütün durumların ve objelerin varlığında harekete geçer, 3) Tutum, olumlu ya da olumsuz tepkiler için hazırlanma ve hazır olmadır(Anderson,1988). Fishbein ve Ajzen (1975,1980) de tutumun üç önemli özelliğini, bireyin davranışına yönelik olarak; "Tutum öğrenilir, eylemi uygun hale getirir ve bu şekilde, tutumları, objeye karşı olumsuz olarak gelişen davranışlar ile bir tehdit altında hissedilen korku ve gerginlik durumları ortaya çıkarır." olarak tanımlamışlardır. Spielberg(1972), bu korku ve gerginlik durumlarını KAYGI olarak tanımlamış ve bunların gözlenebilir tepkiler olduğunu ileri sürmüştür. Spielberg (1971)'in çalışmalarında faktör analizi ile belirlenen ve "durumluk kaygı", "sürekli kaygı" olarak isimlendirilen iki tür kaygı tanımlanmaktadır. Durumluk kaygı, öznel gerilim ve korku duygularıyla karakterize olan geçici duygusal bir durum olarak tanımlanırken; sürekli kaygı göreceli olarak bireyde var olan kaygı eğilimini göstermekte olup, durumluk kaygının yoğunlaşması ve süreklilik kazanması halidir.

Araştırma, Türkiye'deki çeşitli ortaöğretim kurumlarında öğrenim gören, rasgele seçilmiş, gönüllü, 15-17 yaş grubundaki toplam 365 öğrencinin kimya dersine yönelik kaygıları ile sınırlıdır.

Kaygı ile ilgili 45 cümlelik madde havuzunun değerlendirilmesi, bu çalışmada sınıflama ağacı yöntemine göre gerçekleştirilmiştir. Son zamanlarda, çok değişkenli istatistiksel veri analizinin çeşitlerinden biri olan sınıflama ağaçları, bazı çalışmalarda kullanılmaktadır (Breiman et al., 1984; Rao, 1952, 1965; Ripley, 1981, 1996; Roy, 1958, 1967). Burada çok değişkenli veri kümesi kullanılarak karar ağaçlarının oluşturulması sağlanmaktadır. Parametrik olmayan, istatistiksel bir yöntem olan sınıflama ağaçlarında amaç, genellikle ağaç yapısının oluşturulmasında yazılan algoritmalar yardımıyla, birimlerin en doğru kestirimini ya da sınıflamasını sağlayan ayrım koşullarını belirleyerek, yeni birimler içinde kestirimlerin kolaylıkla yapılmasını sağlamaktır.

Sınıflama ağaçları, incelenen değişkenler üzerinde hiçbir dağılım varsayımı ve kısıtlama gerektirmemesi, tüm değişken türlerini incelemesi, kayıp gözlemlerin analizde yarattığı sıkıntıları gidermesi ve çıkan sonuçların yorumunun oldukça basit olması nedeniyle çok değişkenli verilerin incelenmesinde klasik sınıflama ve regresyon analiz yöntemlerine göre daha çok tercih edilmeye başlanmıştır. Bu tekniğin uygulanması sonucunda, 45 maddelik ölçek, 23 maddeye indirgenmiş ve yapılan yorumlar 23 cümleye göre yapılmıştır. Classification Trees tekniği ile en büyük dallanmayı yaratan cümle, birinci cümle olan "Mecbur kalmadıkça kimya öğrenmek istemem" cümlesidir. Classification Trees yöntemine göre oluşturulan dallanma, "Kimyayı sevmeyen" ve "Kimyayı seven, ama çeşitli nedenlerden dolayı kaygıları bulunanlar" olmak üzere, aynı zamanda iki farklı grubu tanımlamaktadır. 2. sorunun oluşturduğu dallanmada 19 yapraktan oluşan cümlelerden, öğrencilerin kimyayı sevmediği sonucuna varılabilmektedir. 3. sorunun oluşturduğu dallanmadaki düğümler ise; tamamıyla "Kimya'yı seven fakat kimya dersi ile ilgili kaygı taşıyan öğrencileri" tanımlayan cümlelerden oluşmaktadır.

Bir konunun öğretmen gözünde çok hayati sayılan bir yönü, çocuk için bütünüyle ilgisiz bir ayrıntı gibi görünebilir. Öğretmen derslerde, çoğu zaman kavransın diye ortaya koyacağı yeni bilgilerin, öğrencide hazır nasıl bir bilgiler bütünü üzerine oturacağını bilemeyebilmektedir. Kısaca, öğretmenin hayalindeki öğrencilerle, karşısındaki öğrenciler çok farklı olabilmektedir (Osborne & Wittrock, 1983). Bunun sonucunda da iletişimsiz ortamlarda verilen derslerin başarıya ulaşması hem öğrenci açısından hem de öğretmen açısından imkansız hale gelmekte, yeteri kadar öğretilmeden işlenen dersler öğrencilerde yanlış kavramalar ve hatalı, eksik bilgiler bütününe dönüşmektedir. Bu, başarısızlıkla eşdeğer olmakta, öğrencinin dersten soğumasına, kimya dersini başaramama düşüncesi oluşturmasına, sonuç olarak da kimya dersine karşı ön yargılı olan ve kaygılar besleyen öğrenci yığınları meydana gelmesine zemin hazırlamaktadır. Ayrıca, öğretmen tarafından kimya derslerinde anlatılan konuların, günlük yaşamda karşılaşılan bazı olayların da nedenlerini açıklayabilecek bir tarzda öğrenciye aktarılması, kimya öğretimini çok daha akıcı, kalıcı ve faydalı bir hale dönüştürecektir. Bu şekilde, günlük yaşamla özdeşleştirilmiş olarak verilen derslerin hatırda daha kalıcı olduğunun bilinmesi yanında, bu şekilde yapılan anlatımların daha ilgi çekici olması ve öğrencinin belleğinde oluşan kopuklukların giderilmesinde de faydalı olacağı, anlamlı öğrenmeyi sağlayacağı düşünülmektedir.