AN ANALYSIS OF AWARENESS OF STUDENTS IN THE UTILIZATION OF TECHNOLOGY

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ABSTRACT
With the rapid advancements in technology, people are being more tied with the technological tools and materials that meet the requirements of the society. The increase of knowledge with support from technology augments the factors that facilitate life. Therefore, the use of technology has turned to be affecting human life in all aspects. Technology is utilized in the field of education, too. In the information age we live in, students increasingly use more technology everyday. Technology-related educational methods are advised at all stages of education and these methods are included in practices, generally in proportion to economic capabilities. Hence, it has been necessary to identify the attitudes of students towards the technological tools used in the field of education and many related studies have been carried out. Many scientific research studies have shown that technology supported educational practices in chemistry education enhance student performance as compared to traditional methods. In order to identify how and to what level technology awareness has developed among the students who have undertaken technological practices, an item pool of 50 technology-awareness statements were presented to 162 students studying at Hacettepe University Department of Chemical Education. Responses to the 50 statements in the item pool have been evaluated with the Cluster Analysis method. Groups consisting of statements that define certain opinions about the use of technology have been formed and a broader statement has been used to categorize these groups of statements. According to the cluster analysis, the first group consists of "the statements that define the points of view of students and teachers about the use of technology"; the second group consists of "the statements that define in which situations technology utilization can prove to be successful"; another group consists of "the statements that define the measures to ensure an increase in the utilization of technology" while other groups consisted of "statements containing general opinions about the use of technology" as well as "the statements that proclaim negative stances about the utilization of technology and opinions at different dimensions".

Through the determination of what kind of groups are formed by which questions by looking at to what extent candidate chemistry teachers agree with the technology statements related to the utilization of technology, and through the identification of which arrangements should be made about the use of technology accordingly, we believe that the results of this study will contribute to the development of chemistry education.

KEYWORDS
Cluster Analysis, Utilization of Technology, Attitude towards Technology.

INTRODUCTION

Technological developments lead to changes in all fields of social life. Social development level of societies is related with the amount of scientific knowledge they produce and use. Information is produced by well-educated manpower, who translate scientific knowledge to technology and the utilization of technology. Therefore, with its current connotations, technology is considered as a field encompassing all social and economic activities as well as the organizations that proclaim the adaptation of scientific information to life. Thus, scientific knowledge is used in the advancement of technology, which then contributes to new inventions. Utilizing developing technologies and adapting to the 21st century would be possible by being informed about the technological developments and raising individuals who are able to comprehend the importance of technology in human and social life.

The education of teachers who assume the most efficient role in understanding the conceptual dimension of technology as well as the adaptation and creation of new technologies is as important as equipping educational organizations with technological facilities. Introducing the staff, who will put technology into practice, to new technological developments is not enough on its own. Teachers should be made to comprehend technology and, by using new teaching techniques, acquire skills in arranging learning activities (Percival and Ellington, 1988). According to the 1995 report of the US Office of Technology Assessment, teachers should not only be individuals who convey knowledge but also ones who produce knowledge and make best use of technology (OTA, 1995). Thus, the requirement that teachers should be individuals who are capable of using diverse information technologies most efficiently and economically is highlighted. There have been many studies about technology utilization by teachers. The results of these research studies indicate that pre-service teachers are not knowledgeable enough about computer literacy (Fisher, 1997; Hizal, 1989; Sheffield, 1988). It has also been found that teachers lack the required practical experience on the use of computers and other technological materials (Hizal, 1989; Scrum and Dehuney, 1997). It has been reported that teachers do not have positive approaches to the importance the use of technology in natural sciences (White, 1996). In addition, there are many studies in literature revealing the fact that pre-service teachers in teacher educating institutions, too, lack the sufficient level of knowledge about the use of technology (Gabriel and Mac Donald, 1996; Lambdin, 1997; Norton and Spraque, 1997; Schrum, 1996).

It has also been found that negative attitudes developed by faculties towards technology lead to a downbeat in the attitudes of pre-service teachers (Brownell, 1997; Camphell and Young, 1996; Ferry et al, 1996; Gabriel and Mac Donald, 1996; Slough and Zoubi, 1996; Hawkridge, 1983). Another study measuring the attitudes of students towards the concept of technology has been developed to identify the technology concepts and attitudes of Thai students. A technology attitudes scale prepared for American students has been modified to suit the Thai secondary school students and applied on them and the results showed differences between the attitudes of the American and Thai students towards technology (Becker and Maunsiyat, 2002). These dissimilarities are attributed to the differences in educational systems and the culture as well as the fact that Thai teachers prefer the teacher centered method in teaching. In another study conducted in Taiwan, an attitude scale to measure the attitudes of high school students towards the use of the internet was developed. The study explored the effects of gender and internet experience on attitudes and relations thereof. Although the 753 Taiwanese high school students who participated in the study had varying genders and internet experience, no statistically significant differences were found among their opinions about the use of the internet, while it has in terms of gender been found that male students had a higher attitude score (Tsai, Lin and Tsai, 2001). In another study that looked at the attitudes of primary and secondary school students towards technology, a scale based on oral investigation was applied on 574 students, a two-factored scale, namely interest/ability and alternative properties, was developed at the end of the related analyses carried out, which revealed significant differences including gender-related issues between primary and secondary school students (Frantom, Green and Hoffman, 2002). In order to measure the attitudes of teachers towards computer use, a valid and dependable, 32-statement attitude scale was developed on 621 teachers (Christensen and Knezek, 2000). In a study, the topic of which was the place of technology in higher education, technology utilization models of 26 faculty members in lessons were examined. The study showed that faculty members utilized technological means and the internet in their courses (Tanguma, Martin and Crawford, 2002). In another study conducted in the Eastern Mediterranean University in Cyprus, the attitudes of university students towards the internet were measured. The results showed that the attitudes of those students with access to a computer at home were more positive towards the utilization of the internet (Isman and Dabaj, 2004). In a study carried out by Yavuz (2004), a Likert-type 19-item scale was prepared to examine the attitudes of candidate chemistry teachers towards the use of technology. The dependability of the scale prepared by Yavuz is 0.8668. Cluster Analysis was carried out within the framework of the study to group awareness statements about the use of technology.

Cluster analysis is an exploratory data analysis tool for solving classification problems. Its object is to sort cases (people, things, items, events, etc) into groups, or clusters, so that the degree of association is

strong between objects of the same cluster and weak between objects of different clusters. Each cluster thus describes, in terms of the data collected, the class to which its objects belong; and this description may be abstracted through use from the particular to the general class or type.

Cluster analysis is thus a tool of discovery. It may reveal associations and structure in data, which, though not previously evident, nevertheless are sensible and useful once, found. The results of cluster analysis may contribute to the definition of a formal classification scheme, such as a taxonomy for related animals, insects or plants; or suggest statistical models with which to describe populations; or indicate rules for assigning new cases to classes for identification and diagnostic purposes; or provide measures of definition, size and change in what previously were only broad concepts; or find exemplars to represent classes (Anderberg, 1973).

A common problem in real data is the lack of homogeneity among variables (items). In measuring associations among variables, different types of scales present difficult problems. For example, it is intuitively appealing that there should be a considerable degree of association between the variables "age" and "favorite movie stars"; but defining a meaningful measure of this association maybe frustrating (Anderberg, 1973).

When clustering data units, it is necessary to combine all the variables into a single index of similarity. The contribution of each variable to this composite depends on its scale of measurement and that of the other variables as well (Anderberg, 1973).

THE PURPOSE OF THE STUDY

As the improvements in the world increase, people are being more tied everyday with the technological tools and materials that meet the requirements of the society. Therefore, the use of technology in educational environments has much more been a requisite and requirement. Within the scope of this study, the objective is to investigate and analyze to what extent the items of the scale in the 50-statement item pool of the "Likert-type attitude scale towards the use of technology" developed by Yavuz (2004) by applying "Cluster Analysis" on it. Statements containing expressions about the use of technology are expected to be transformed into grouped forms of opinions on certain topics, which briefly means an attempt to reveal whether the groups of statements divided in technology-related categories reflect certain opinions. Thus, it is aimed to identify the groups constituted by similar thoughts about the use of technology and gather statements that express certain opinions in the form of groups.

EXPERIMENTAL DETAILS

The Subject

162 students studied in the Hacettepe University Educational Sciences Faculty, Department of Chemical Education in 2003 – 2004 Spring semester participated in the study.

The Test Instrument

A Cluster Analysis activity, in which the interests and tendencies of candidate chemistry teachers for the use of technology were branched in categories, was carried out.

The Cluster Analysis towards Technology

The 50 statements intended to be categorized with the Cluster Analysis method are given in Table 1.

Table 1. The Pilot Scale of Attitude towards Technology

Dear Student, In this scale, purpose is to determine pre-service chemistry teachers' attitude towards technology. There is no right or wrong answers in this scale. Please, mark the blank that represent your stance toward each item in the scale. Thanks for your contribution.	**Strongly Agree**	**Agree**	**Undecided**	**Disagree**	**Strongly Disagree**
1. Daily and yearly plans should be prepared by teachers using computers.					
2. Teachers do not need to use computers for course preparation.					
3. Lessons should often include computer-aided instruction.					
4. Technological tools do not need to be used in course instruction.					
5. Students should do their homework on computers using the Internet.					
6. Using computers is useless in student education.					
7. Teachers should be given regular in-service training on new technologies.					
8. Students should be given introductory information on the use of new technologies.					
9. New technologies should be utilized more in teacher education.					
10. Learning is more permanent through television since it is both visual and auditory.					
11. Using television with printed materials has no effects on education.					
12. Through distance learning via television a wide range of people could be reached.					
13. Because the videotapes could be watched again, students could get feedback.					
14. Recording some parts of the lesson on videotapes could provide the students the opportunity to see their mistakes.					
15. Computer aided education should be teacher-centered.					
16. A minimum level of computer knowledge is enough to reach knowledge via the Internet.					
17. On the Internet, one could reach unlimited information on any subject.					
18. Difficult or dangerous-to-do experiments could be taught through computer-aided instruction.					
19. Foreign languages could be practiced through the computers or the Internet.					
20. Computer aided instruction increases students' achievement.					
21. Using technological tools does not affect students' motivation.					
22. E-mail is only for communication; it cannot be used in education.					
23. Equipment like overhead, slides and projection should not be preferred as they consume operational time.					
24. Technological tools could be used for practice or revision.					
25. Advanced knowledge is needed in order to use computers.					
26. Technological tools could only succeed when they address all the sense organs.					
27. Students should receive basic education on computer literacy.					

28. Teaching could reach its goal only together with technology.

29. Teaching abstract concepts could be more concrete through using technology.

30. Using the Internet in the learning process is nothing but a waste of time.

31. A university student must definitely be able to use certain software such as Word and Excel.

32. Being given homework at school that requires computer usage puts me in stress.

33. If I were to give a seminar, I would prefer using OHP or PowerPoint to using chalk and board.

34. I believe that the information technology usage is not adequate in Turkey.

35. One does not have to use technological facilities in order to be successful in life.

36. I believe that using appropriately diverse technological environments could eliminate waste of time in education and teaching process.

37. In order to use the technological facilities, one should know at least one foreign language.

38. Opportunities brought about by technology have a positive effect on efficient studying and learning.

39. Using technology would facilitate understanding difficult subjects.

40. Using current technologies would promote the improvement of new ones.

41. While determining the aims of course subjects, planning should be done taking the technological age in education into consideration.

42. Using technology wastes the thinking potential of humans away.

43. Turkey should have a technology policy.

44. Technology is used within an ethical framework and is included in the national objectives of the nations.

45. In order to be able to graduate from the university, the competency to "use the technological materials of the field" should be rated, too.

46. I believe that educators are inadequate in using technology.

47. Technological changes should be kept in mind when experiencing change processes.

48. A life full of technology may also affect an individual in a negative way.

49. When technology is mentioned, the first things I think of are using computers and multimedia.

50. When technology is mentioned, the first things I think of are using tools and materials as well as maintenance.

RESULTS AND DISCUSSION

Cluster analysis grouping technique was used to group the agreeing/disagreeing responses of the pre-service teachers to the statements expressing positive or negative attitudes about the utilization of technology in categories reflecting opinions on certain topics. Accordingly, when the ratios of the choices which pre-service teachers marked as "strongly agree", "agree", undecided", "disagree", and "strongly disagree" were considered, it was concluded that six cluster categories formed and that each category had a meaning.

The aim is actually to establish clusters such that items within a cluster are similar to each other and among clusters, the items are reasonably far from each other. When clustering items or variables is considered, the measure of association among items becomes very important. The degree of association

among variables could be used to classify items, that is, a classification may be achieved using Pearson correlation as a distance, which is a measure of relation between two items or variables. When the distance among clusters is asked to be very small, it means there will be pretty many clusters. The number of clusters really depends on the desirable distance. Decreasing the distance increases the number of clusters.

The question is where to cut the brunches to form sub brunches that constitute clusters. This can be achieved by drawing a graph summarizing the items on tree brunches as below in Figure 1. Item's number is placed on the horizontal line whereas the distance is shown on the vertical line. The tree constitutes the whole items. As can be seen from the Figures below, the decision where to cut the brunches should give the number of significant clusters. This cut is done just a little above 1.03 in Figure 1 and the result is clear from the graph that a three-main cluster will constitute that tree. Each cluster members is shown with a different color. The largest cluster has got 40 items, 2, 6, 21, 30, 4, 7, 8, 9, 22, 23, 15, 18, 32, 33, 45, 26, 28, 43, 44, 37, 12, 13, 14, 24, 27, 31, 41, 47, 36, 49, 3, 20, 5, 1, 19, 17, 29, 38, 39 and 40 on it shown with the blue color. Perhaps technology scale could be achieved with the largest cluster of 40 items. The second largest (shown in bright pink) cluster has nine items, 16, 25, 10, 11, 46, 34, 35, 48 and 50 on it. The item 42 alone itself is resulted in the third cluster.

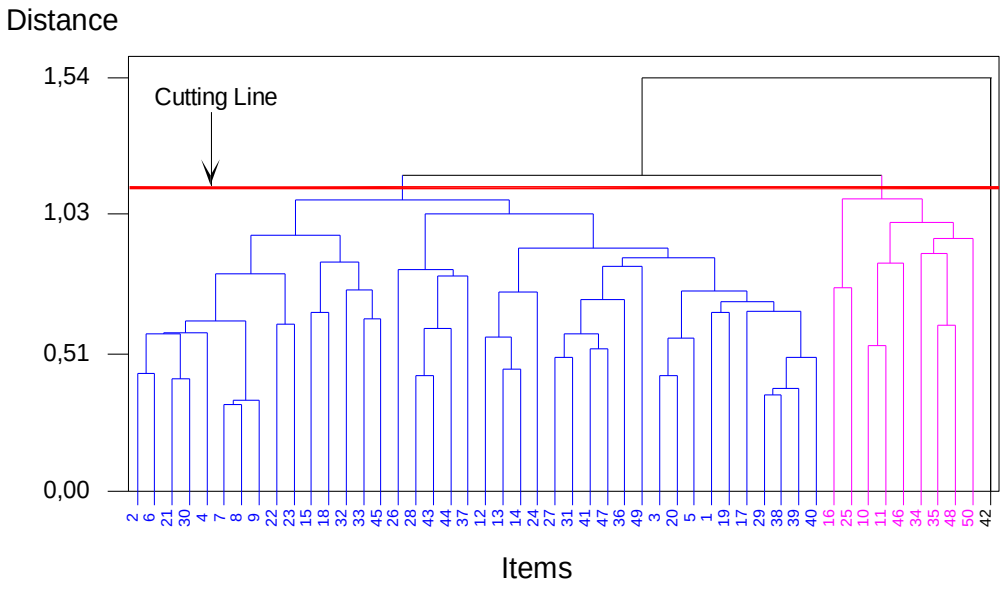

Figure 1. Tree Diagram for Technology Scale with Three Clusters

Shifting the red line just a bit down results in the increase of the number of clusters from three to four and the representation is shown in Figure 2.

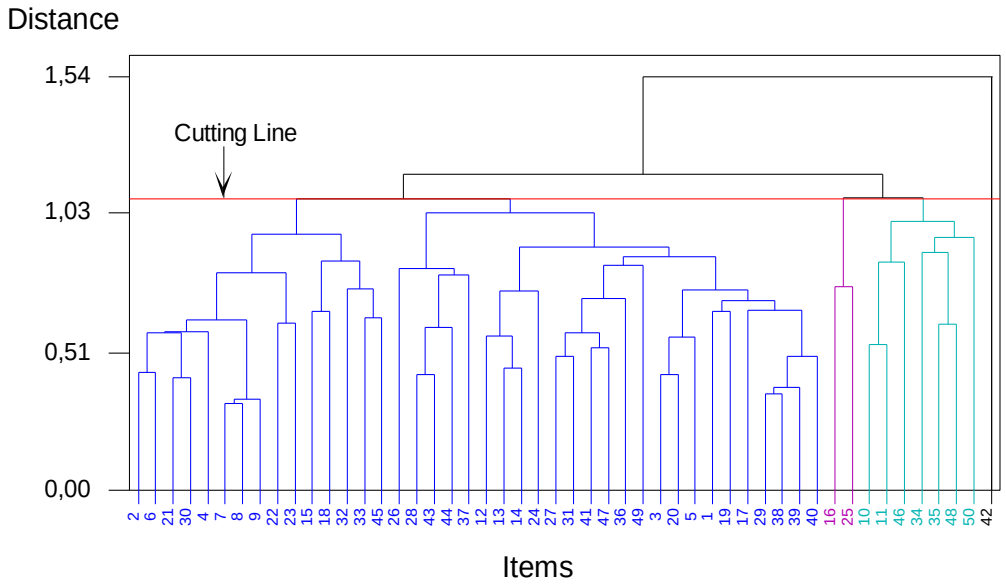

Figure 2. Tree Diagram for Technology Scale with Four Clusters

As can be seen from Figure 2, the main cluster in Figure 1 is remained the same (40 items) as shown with the blue color, whereas the second main cluster as shown with the bright green color has lost the branch of item 16 and 25. In fact, item 16 and 25 constitute cluster 3 and finally item 42 alone itself is a cluster 4.

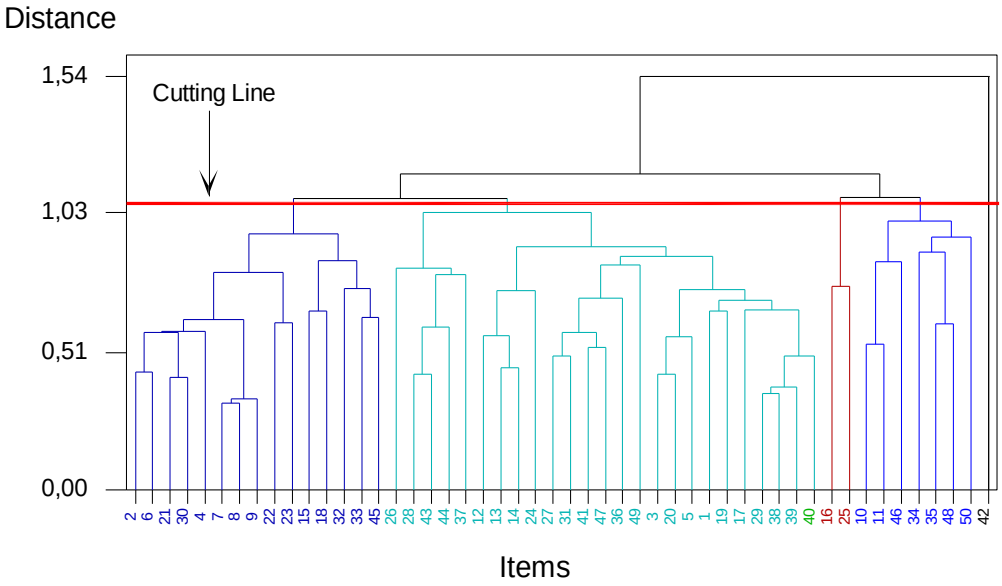

Figure 3. Tree Diagram for Technology Scale with Five Clusters

Figure 3 above represents five clusters that each cluster is composed of brunches the items numbers are placed just below the brunches of the tree diagram. The red line in Figure 3 is shifted down just a bit when compared to Figure 2. The result is there are five main clusters when the distance is decreased just a bit, compared to Figure 2. The main cluster as shown with the bright green color has changed, one of its brunches has been cut, and in fact, the cut brunch from the main cluster 1 in Figure 2 constitutes the second main cluster as shown with the color of dark blue. The items 2, 6, 21, 30, 4, 7, 8, 9, 22, 23, 15, 18, 32, 33 and 45 are in cluster 2 whereas cluster 2 in Figure 2 is renamed to be cluster 3. In addition, the cluster 3 is renamed as Cluster 4 and the cluster 4 with the item 42 alone itself is renamed as Cluster 5.

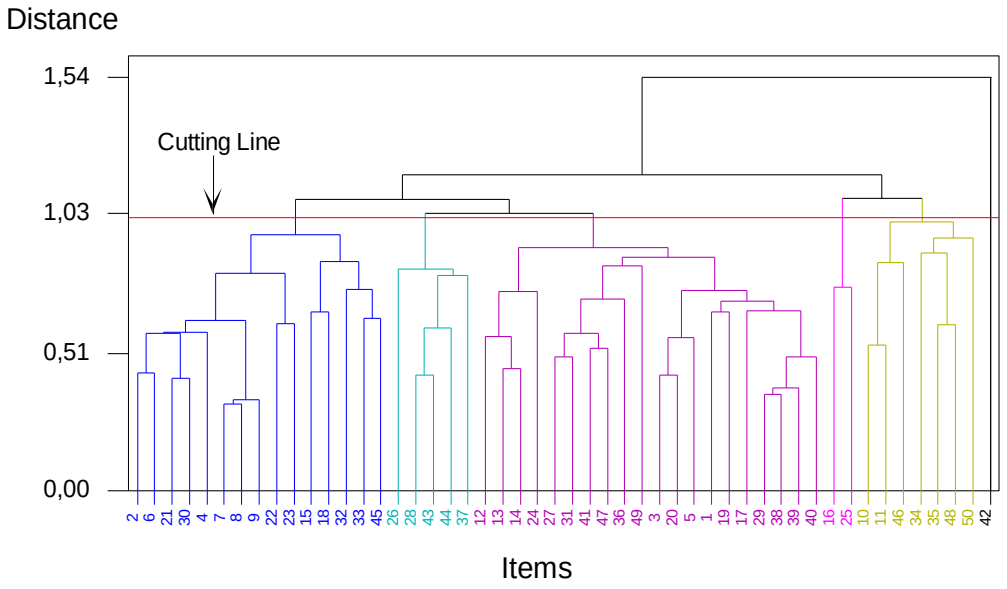

Figure 4. Tree Diagram for Technology Scale with Six Clusters

As can be seen from Figure 4, the cutting line is shifted just a little down when compared to the cutting line in Figure 3. As a result, the number of clusters has been increased to six. Here the main cluster, cluster 1, has lost one more one of its brunches. In fact, the main cluster in Figure 1 is divided into three clusters as shown in Figure 4 with three different colors. The rest of the clusters in Figure 3 are the same here. The items 26, 28, 43, 44 and 37 constitute a new cluster, which is extracted from the main cluster 1 in Figure 3. The other clusters' members or items are the same as Figure 3.

The clustering done throughout our analysis shows that when the number of clusters is increased, the related or correlated items are gathered in the same cluster. The items in each cluster are in a position representing a different goal for technology scale.

The main cluster, the largest, may help us interpret a technology scale for pre-service chemistry teachers. It is probably wise to say that the main cluster will contribute for technology scale most. If the cutting line is just a bit lifted above, the main cluster will be a combination of cluster 1 and cluster two. In addition, the number of clusters decreases from five to three. We suggest that cluster 1 and 2 should be combined and the items (the number of items becomes 40) that belong to those clusters contribute for technology scale most.

The statements that make up the first cluster are the statements: 2, 4, 6, 7, 8, 9, 15, 18, 21, 22, 23, 30, 32, 33, and 45:
2. Teachers do not need to use computers for course preparation.

4. Technological tools do not need to be used in course instruction.
6. Using computers is useless in student education.
7. Teachers should be given regular in-service training on new technologies.
8. Students should be given introductory information on the use of new technologies.
9. New technologies should be utilized more in teacher education.
15. Computer aided education should be teacher-centered.
18. Difficult or dangerous-to-do experiments could be taught through computer-aided instruction.
21. Using technological tools does not affect students' motivation.
22. E-mail is only for communication; it cannot be used in education.
23. Equipment like overhead, slides and projection should not be preferred as they consume operational time.
30. Using the Internet in the learning process is nothing but a waste of time.
32. Being given homework at school that requires computer usage puts me in stress.
33. If I were to give a seminar, I would prefer using OHP or PowerPoint to using chalk and board.
45. In order to be able to graduate from the university, the competency to "use the technological materials of the field" should be rated, too.

When these statements are categorized in terms of opinions, it is seen that the statements in this cluster contain expressions outlining the *"Teacher and student points of view about the use of technology"*. Another benefit of this analysis done with cluster method is that the meaning of statements, on which subjects participating in the survey convene in relation to a topic, is easily revealed. Here, while approaches to the utilization of technology from two angles (student – teacher) are revealed, it is also observed that statements expressing diverse convictions (the anxiety to use computers, the opinion that using technology will lead to loss of time, teacher centered computer use practice, the requirement to ensure that teachers acquire the ability to use technology, the utilization of computer aided education in chemistry laboratories, lack of information about the utilization of technology, etc.) are included within the group. The statements in the first cluster contain phrases that express positive, negative, and even wrong convictions about the utilization of technology.

Statements 26, 28, 37, 43, and 44 constitute the second cluster. These statements constitute a category that forms an answer to the question, *"In which situations (environments) can the utilization of technology be successful?"* When this question is asked, the statements that constitute the "Solution proposals category" give the answer to this question in a meaningful order. This cluster contains the opinion that the utilization of technology will be successful if:

Technological tools address all the sense organs (26)
Teaching is carried out together with technology (28)
At least one foreign language is known (37)
Turkey has a technology policy (43)
Technology is used within an ethical framework and is included in the national objectives of the nations (44).

It should be pointed out that neither the correctness and affirmativeness or wrongness and negativity of the opinions about the utilization of technology are not discussed here. The discussion is only about which of the given statements are grouped/categorized under an opinion.

Statements 1, 3, 5, 12, 13, 14, 17, 19, 20, 24, 27, 29, 31, 36, 38, 39, 40, 41, 47, and 49 form the biggest cluster:
1. Teachers should prepare daily and yearly plans using computers.
3. Lessons should often include computer-aided instruction.
5. Students should do their homework on computers and using the Internet.
12. Through distance learning via television a wide range of people can be reached.
13. Because the videotapes could be watched again, students can get feedback.

14. Recording some parts of the lesson on videotapes can provide the students the opportunity to see their mistakes.
17. On the Internet, one could reach unlimited information on any subject.
19. The internet and computers help improve language capabilities, too.
20. Computer aided instruction increases students' achievement.
24. Technological tools could be used for practice or revision.
27. Students should receive basic education on computer literacy.
29. Teaching abstract concepts could be more concrete through using technology.
31. A university student must definitely be able to use certain software such as Word and Excel.
36. I believe that using appropriately diverse technological environments could eliminate waste of time in education and teaching process.
38. Opportunities brought about by technology have a positive effect on efficient studying and learning.
39. Using technology would facilitate understanding difficult subjects.
40. Using current technologies would promote the improvement of new ones.
41. While determining the aims of course subjects, planning should be done taking the technological age in education into consideration.
47. Technological changes should be kept in mind when experiencing change processes.
49. When technology is mentioned, the first things I think of are using computers and multimedia.

This cluster consists of statements about opinions on the *"measures to ensure an increase in the utilization of technology in education and training"* and mean a cluster entirely consisting of statements about what needs to be done. The third cluster is a group gathered together by the common marking ratios of pre-service teachers, who share the same views, in their responses to the 50-scale measuring tool. This group has constituted a category, in which opinions containing the answer to the question, "What could be done about the utilization of technology?": "The category of the musts of technology utilization".

The fourth cluster is one constituted by the 16^{th} and 25^{th} statements and is about computer use. This group contains the statements that "Advanced knowledge is needed in order to use computers" (The 2^{nd} statement) and "A minimum level of computer knowledge is enough to reach knowledge via the Internet" (the 16^{th} statement), which question opinions that the use of computers will be at different levels of difficulty based on requirements (relative) and that with a little computer literacy, a lot of information could easily be reached.

The fifth cluster is constituted by statements 10, 11, 34, 38, 46, 48, and 50:
10. Learning is more permanent through television since it is both visual and auditory.
11. Using television with printed materials has no effects on education.
34. I believe that the information technology usage is not adequate in Turkey.
38. Opportunities brought about by technology have a positive effect on efficient studying and learning.
46. I believe that educators are inadequate in using technology.
48. A life full of technology may also affect an individual in a negative way.
50. When technology is mentioned, the first things I think of are using tools and materials as well as maintenance.

This category expresses **"**general opinions about the use of technology". Among the statements in this group, there are negative statements along with the positive ones. The opinions in this cluster also reflect a failure to have a sufficient level of knowledge about the use of technology.

The sixth cluster is consisted of a single sentence in its entirety: "Using technology wastes the thinking potential of humans away". The potential of a single statement to form a cluster can be attributed to its capacity to reflect opinions related to the negative effects of the use of technology on its own. There are current discussions going on circled around the fact that the utilization of technology can have its drawbacks along with its many positive effects. Concrete examples are provided particularly indicating that the use of technology badly affects the thinking, interpreting, decision-making, and reacting

capabilities of people. The sixth cluster expresses the negative effects of technology utilization on individuals clearly through a single statement and is "*a category that questions the relation between technology and the human memory".*

REFERENCES

Anderberg, M. R. (1973). Cluster Analysis for Applications, Academic Press, Inc. New York.

Becker, K., H. and Maunsaiyat, S. (2002). Thai Students' Attitudes and Concepts of Technology, Journal of Technology Education, 13(2), 6-19.

Brownell, K. (1997). Technology in Teacher Education: Where Are We and Where Do We Go From Here?, Journal of Technology and Teacher Education, 5(2/3), 227-240.

Campbell, K. and Yong, Z., (1996). Refining Knowledge In A Virtual Community: A Case-Based Collaborative Project for Pre-service Teachers, Journal of Technology and Teacher Education, 4(3/4), 263-280.

Christensen, R. and Knezek, (2000). Internal Consistency Reliabilities for 14 Computer Attitude Scales, Journal of Technology and Teacher Education, 8(4), 327-336.

Ferry, B., Hedberg, J. and Harper, B. (1996). Investigating ways of supporting teacher use of interactive multimedia, Journal of Technology and Teacher Education, 4(3/4), 197-210.

Fisher, M. M. (1997). The Voice of Experience: In-service Teacher Technology Competency Recommendations for Pre-service Teacher Preparation Programs", Journal of Technology and Teacher Education, 5(2/3), 88-97.

Frantom, C. G., Gren, K. E. and Hoffman, E. R. (2002). Measure Development: The Children's Attitudes Toward Technology Scale (CATS), Journal of Educational Computing Research, 26(3), 249-263.

Gabriel, M. A. and MacDonald, C. J. (1996). Pre-service Teacher Education Students and Computers: How Does Intervention Affect Attitudes? Journal of Technology and Teacher Education, 4(2), 91-116.

Hawkridge, D. (1983). New Information Technology in Education, Croom Helm. London

Hizal, A. (1989). An Evaluation of Teacher Opinions on Computer Education and Computer Aided Instruction", Anadolu University Press. Eskişehir.

Isman, A. and Dabaj, F. (2004). Attitudes of Students Towards Internet, Turkish Online Journal of Distance Education, 5(4), http://tojde.anadolu.edu.tr/tojde16/index.htm

Lambdin, D. V., Thomas M. D. and Moore, J. A. (1997). Using an interactive information system to expand pre-service teachers' visions of effective mathematics teaching, Journal of Technology and Teacher Education, 5(2/3), 277-290.

Norton, P. and Sprague, D. (1997). On-Line collaborative lesson planning: An experiment in teacher education, Journal of Technology and Teacher Education, 5(2/3), 280-297.

OTA (1995) Teachers and Technology, www.wws.princeton.edu/~ota/ns20/year_f.html

Percival, F. and Ellington, H. (1988). A Handbook of Educational Technology, Kogan Page, London.

Schrum, L. (1996). Rural telecommunications for educational professional development and instructional improvement, Journal of Technology and Teacher Education, 4(3/4), 247-263.

Schrum, L. and Dehoney, J. (1998). Meeting the future: A teacher education program joins the information age, Journal of Technology and Teacher Education, 6(1), 23-38.

Sheffield, C. J. (1998). A trend analysis of computer literacy skills of pre-service teachers during six academic years, Journal of Technology and Teacher Education, 6(2/3), 105-115.

Slough, S. and Zoubi, M. R. (1996). Getting technology reluctant teachers published on the world wide web, Journal of Technology and Teacher Education, 4(3/4), 215-232.

Tanguma, J. M., Sylvia S. and Crawford, C. M., (2002). Higher Education and Technology Integration in to the Learning Environment: Results of a Survey of teacher Preparation Faculty, Proceedings of SITE 2002: Society for Information Technology and Teacher Education International Conference, 13th, Nachville, TN, March 18-23, 7p.

Tsai, C., Lin, C. and Tsai, C.C. (2001). Developing an Internet Attitude Scale for High school Students, Computers and Education, 37(1), 41-51.

White, B. Y. and Frederiksen, J. R. (1989). Causal models as intelligent learning environments for science and engineering education, Applied Artificial Intelligence, 3(2-3), 83-106.

White, C. (1996). Relevant social studies education: Technology and constructivism, Journal of Technology and Teacher Education, 4(1), 69-83.

Yavuz, S (2005). Developing a Technology Attitude Scale for Pre-Service Chemistry Teachers, TOJET, Accepted Publication, In Press.

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