PERCEIVED EFFECTIVENESS OF A COMPUTER BASED DRILL PROGRAM ON GRADUATE STUDENTS' SELECTION OF PRECISE STATISTICAL TECHNIQUE IN AN INTRODUCTORY RESEARCH METHOD COURSE: A CASE STUDY

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ABSTRACT

PERCEIVED EFFECTIVENESS OF A COMPUTER BASED DRILL PROGRAM ON GRADUATE STUDENTS' SELECTION OF PRECISE STATISTICAL TECHNIQUE IN AN INTRODUCTORY RESEARCH METHOD COURSE: A CASE STUDY

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The purpose of this research was to develop and examine the perceived effectiveness of a computer based drill program to provide help for students on selection of precise statistical technique in an introductory research method course. This program was administered to graduate students who completed the "selecting statistical technique for data analysis" chapter of the course.

This study was a descriptive study, which used data from 17 graduate students who enrolled in an introductory research methods class in the department of Computer Education and Instructional Technologies at the Middle East Technical University. Data on the effectiveness of the drill program was collected through a questionnaire that included both open and semi-open ended questions.

The analysis of data revealed that the students perceived the program effective and motivating on selection of precise statistical technique. The students perceived three of the four main segments of the program attractive and effective, however, one of the segments was rated questionable pertaining to its effectiveness on selecting precise statistical technique by the participants. Instructions and navigation used in the program satisfied most of the students' expectations. On the other hand, the participants reported that graphical user interface and "related items" segment of the program need to be improved.

Keywords: Instructional Technology, Computer Aided Instruction, Adult Learning Theory, Statistical Techniques, Statistics Anxiety.

ÖZ

LİSANS ÜSTÜ ÖĞRENCİLERİNİN ARAŞTIRMA METODLARINA GİRİŞ DERSİNDE UYGUN İSTATİSTİK TEKNİKLERİNİN SEÇİMİNE YARDIMCI OLMAK İÇİN GELİŞTİRİLMİŞ BİLGİSAYAR DESTEKLİ ALIŞTIRMA PROGRAMININ ETKİNLİĞİ: DURUM SAPTAMASI

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Bu çalışma, araştırma metodlarına giriş dersini alan lisansüstü öğrencilerine uygun istatistik tekniklerinin seçilmesi konusunda yardımcı olmayı amaçlayan bir bilgisayar programını geliştirmek ve bu programın etkinliliğini araştırmaktır. Bu program araştırma metodları dersinde "veri analizi için uygun istatistik tekniğinin seçilmesi" bölümünü tamamlamış kişilere uygulanmıştır.

Bu çalışma Orta Doğu Teknik Üniversitesi Bilgisayar ve Öğretim Teknolojileri Bölümünden 17 lisansüstü öğrenciden toplanan verileri kullanan betimleyici bir çalışmadır. Alıştırma programının etkinliği ile ilgili veriler açık ve yarı açık uçlu sorular içeren bir anket aracılığı ile toplanmıştır.

Verilerin analizi, öğrencilerin uygun istatistiksel teknik seçimi konusunda programı başarılı ve güdüleyici bulduklarını göstermiştir. Programın dört temel parçasından üçü etkin ve etkileyici olarak algılanırken bir parçasının doğru istatistiksel tekniği seçmedeki etkililiği tartışılır bulunmuştur. Programda yer alan bilgiler öğrencilerin beklentilerini karşılamıştır. Programın kullanıcı arayüzü ve ilişkili öğeler kısımlarının geliştirilmesi önerilmiştir.

Anahtar Kelimeler: Öğrenim Teknolojileri, Bilgisayar Destekli Eğitim, Yetişkin Eğitimi Teorisi, İstatistik Teknikleri, İstatistik Kaygısı.

To My Mother and Father

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CHAPTER 1

INTRODUCTION

1.1 Background of the Problem

Everyday, technology provides us with new improvements. As a result of this rapid improvement of the technology and the reducing costs, new technologies become more and more integrated to people's daily life. In this manner, computers and related applications are some of the most importance given technology branches. Today, computers have a wide variety of use in nearly every part of life. One of these areas of computer use is education.

Learning is a dynamic and complex process. To achieve an improvement in quality of learning or teaching, there are many dependent and independent factors to be focused on. Since computers have many suitable capabilities, they are valuable tools in order to use for educational purposes.

Educational technologies are not single technologies but complex combinations of hardware and software. Although many and several of them exist for educational purposes, searching for new methods, viewpoints and implementations seem to have no end because of the continuous changes appearing in hardware or software.

Computer aided instruction is a general term which is used to describe many types of applications used in learning process. There are many findings about the efficiency in learning with the use of computer. There is a well-known analogy between computer and mind. This analogy is known as "information processing model" and it is based on cognitive theory.

According to cognitive theory, knowledge is stored in schemata and propositional network. When a complex pattern of thinking is needed to work on a problem, expertness on the basic concepts and the relationships between these concepts would be helpful in order to reach the solution. This point of view brings the approaches like concept mapping and mind mapping.

Concept mapping is a process for representing concepts and their relationships in graphical form. It is used to organize and communicate what is known [1]. In a concept map there are concept labels connected with meaningful relationships. Two concept labels connected with a relationship forms a proposition, which is a meaningful unit that makes sense according to learner [2].

The Mind map is a formalised procedure for using associations to create a pictorial representation of one or more ideas [2]. In a mind map the subject is represented by a central image and the main themes of this subject radiate from the central image as main branches. Minor themes are linked to the main themes and all the branches are connected forming a nodal structure [3]. A concept map works with several or many ideas or concepts whereas a mind map focuses on one concept or idea [4].

A general fault is trying to solve problems by just dividing it into several simpler sub problems. Solving each of these simpler sub problems is usually seemed an effective way, but it has a great cost. After a while of these attempts, people begin to loose their ability of seeing the whole and later they begin to give up trying to see the whole [5]. Systems theory deals with the organization and structure of the entire organisms. So, system theory can open a way for solutions to the problems, which were resulted by focusing on the parts.

It is thought that guiding the students by using an approach, which is based on mind and concept mapping techniques and is strengthen with systems theory, will be effective to reinforce mastering the critical concepts.

Nowadays, the dominant factor shaping the world is information. In this information society, the number of completed researches and researches which are going on is exponentially increasing. Researches and conducting research become critical for existence in an information society.

Teaching of research methods to graduate students with humanities and social sciences background is a difficult task [6]. Considering researchers and research related courses; it can be observed that learners and researchers usually have problems about statistics and data analysis sections of these courses.

Data analysis is one of the critical sections of research process. It has a great role in the correctness of the research. The major purpose of this stage is analysing the problem statement and determining the precise statistical tests to reach meaningful information. In order to success this stage topics like "variables", "data types", "statistical tests" and "data categories" should be known.

While studying on a research question, path of thinking to select precise statistical test for data analysis is usually dependent to what the research question was. Although, two research questions look similar in number of groups and data types, the precise test could be different for some reasons like different sample size. When students face this varying nature, which has been found in data analysis phase, confusion and fear may appear.

Another reason of having problems with data analysis section is statistics anxiety. Statistics anxiety has been defined as an anxiety that occurs as a result of encountering statistics in any form and at any level [7]. There exists 6 components of statistics anxiety: worth of statistics, interpretation of anxiety, test and class anxiety, computational self concept, fear of asking for help and fear of statistics instructor [6].

When various thinking patterns are needed for complex structures, it is usually hard to master these structures. As a result, practicing appears to have importance as a strategy for studying these complex structures with varying characteristics. In education, practicing is usually studied with drilling. And the most studied type of computer-aided instruction (CAI) is drill and practice. Drill and practice programs are used for providing practice and they are not intended to teach.

People studying research methods in universities are adults. So, the characteristics of adults should be involved when a study involves them. For adult learners, there are some major differences from children's learning in some factors like self-directing, experience, readiness to learn and motivation.

Adult learners are autonomous and they need to participate to decisions about themselves and take responsibility. They have experience to share and they need to be shown respect. Adult learners are goal oriented and they need to have reason to learn something. They can be motivated intrinsically or as opposed to extrinsic forces. Since they are goal oriented, they are practical and serious. They have anxiety about their inefficiency and have fear of failure. [8] Because of all these characteristics of adult learners, an application for adult learners should pay attention to be goal oriented, motivational and time consuming. It should give the feeling of self-control to the adult learners.

1.2 Purpose of the Study

Based on the problems and findings described in the background of the problem section, it is aimed to develop an instructional software. The goal of this program will be helping students and researchers who need to learn how to decide which statistical technique is precise for data analysis stage of a research. This will be managed by practicing various examples, which are organized and presented in order to highlight critical concepts in the whole picture. Reminding the basic concepts, relating subjects and their relationships are also aimed to present by the help of appropriate explanations.

In addition to examples, concepts and brief explanations about the topics like "statistical tests", "variables and variable types" and "data types" will also be organized and involved in order to respond the need of reminding. A constraint in developing this program will be the need for dynamic structure, which will be important to respond presentation of sample research problems with different kinds. After development of program, perceptions and the opinions of the students about this program will be obtained and analysed.

1.3 Significance of the Study

During the courses related to research methods given in the universities, there is a lack of practicing for students. Although there can be found exercises, most of

the students can have problems in practicing. Usually lack of time decreases the practicing activity. As a result, students usually become confused and need to find some answers to their questions. Adding their anxiety of statistics and research methods, students can give up practicing to become experts. The importance of this program will be "motivating the students" and "giving chance to practicing" with relevant explanations.

Another important part of the program will be its design, which is specifically designed according to the needs of adult learners, since it is known that the effects of design can change according to the goals and user types.

Concept mapping and mind mapping are graphical representations of what is known. Mind mapping approach focuses to one idea whereas concept mapping shows many ideas together. In concept mapping the relationships are labelled where it is not generally done in mind mapping. And also connections with other main themes are usually not shown. Usually, these tools are used for writing and extracting one's own knowledge. In the program, a hybrid design will be supported. The concepts will be designed with a structure like mind mapping with sub branches but there will be related items like in the concept mapping. Additionally, relevant explanation support will give the chance of transfer of knowledge.

Since it will be required to satisfy the need of presenting different research questions that have different paths of thinking, the program should be designed to work dynamically. This will also give the flexible use of program in different areas.

After treatment, the perceptions and opinions of the students about such a tool will be obtained as results of this study. These results could be helpful in decisions about the design of alternatives or evaluated versions of this tool.

1.4 Overview of goals and objectives

The primary goals and objectives of this study are explained below.

An instructional program will be developed. Well-designed examples will be chosen and they will be organized in order to practice selection of statistical techniques for data analysis phase of a research problem.

The program will be used by the university students who were registered or completed the introductory research methods course. After the treatment, a questionnaire will be given to obtain perceptions and opinions of the students.

The results of the questionnaire will be analysed and efficiency of the program will be driven. In addition, opinions of the students will be analysed in order to take into account for future studies.

1.5 Definition of Terms

The terms generally used in the study were explained below.

Item: Item has two meanings changed according to the content of the item. One of them refers to main concepts like "variable types", "data types", "statistical tests" etc. The other meaning refers to examples to practice on. Both are organized and placed in the same elaborated structure of the content.

Subitem: Parallel to item's meaning, subitem refers to sub-concepts of the concepts like "variable types", "data types", "statistical tests" etc. At the other side, subitem refers to explanation specific to the examples. This may be seen as a sub-question before the selection and a description after the selection of subitem.

Selected item: Item which has been selected to work on while navigation.

Related item: Item which has some relationship with the selected item.

CHAPTER 2

LITERATURE REVIEW

In the previous chapter, the problem and the background of the problem were introduced. In order to have an opinion about the previous studies related to the problem, this chapter provides a review of literature about the following topics: Computer aided instruction, adult learning theory, cognitive theory, concept and mind mapping, anchored instruction, hypertext learning environments, anxiety about statistics.

2.1 Computer Aided Instruction (CAI)

Computer aided instruction can be defined as "the system of individualized instruction that uses a computer program as the learning medium" or generally "the process of teaching by computer" [9].

The computer environment has a great potential use of delivering instruction to the learner. For this reason, beginning from 1950s, there was variety of studies on

CAI. There are different terms that were used to describe computer applications in education like CBI (Computer based instruction), CBL (Computer based learning), CBE (Computer based education), CAL (Computer assisted learning) [10].

Researches on CAI have indicated that, in general, students can learn effectively from computers and that in some cases, computer work improves student achievement and attitude toward subject matter [10].

2.1.1 General advantages of CAI

Some of the main advantages of CAI are described below. [9]

Self-Pacing: Each student can proceed their learning activity at their own pace. Pacing can be controlled by the student or by the program. Usually, for most learners, self-pacing is better than program controlled pacing.

Active learning: Compared to passively listening and watching the teacher, CAI is designed to bring up active student involvement in the learning process. Usually, it requires frequent responses from the learner.

Variety: Within the CAI, multi-sensory presentation techniques and variety of feedback messages become possible to be added into instruction. By this way, getting the message to the learner and maintaining the attention of learner were ensured.

Record keeping: Storing data property provides the learner and teacher with reports of learner's progress and responses. By this way determination of level of the students, amount of time spent by the student and specific concepts that have been difficulty for students becomes possible.

Flexibility: Sequence of content can be changed by skipping according to the ability of learner. In addition content learned can be marked to remember for the next time the program started. This flexibility of CAI gives the user a feeling of control and customizes the learning to fit the learner.

Timeliness: Computers are always present and ready for studying without getting bored or taking breaks.

2.1.2 General Disadvantages of CAI

Some of the main disadvantages of CAI are described below. [9]

Lack of human qualities: It is claimed that spending too much time with computers can inhibit social development and ability to interact with people. This may be true when a large amount of time was spent with the computer.

Restricted text displays: Computer's monitor present restricted amount of text at one time. Despite the power of graphics or sound, lessons with extensive amount of textual explanation could cause problems for accessing and moving around.

Cost: Although the prices of computers and programs were reduced, usually they are not enough for access of all students in a school. In addition, benefits of CAI must be measured in terms of improvement in learning, time saving and etc. Besides prices of computers and applications needed, time to create a CAI program is prohibitive. A non-interactive CAI can take 20 hours to create where it is delivered in 1 hour. And since different content requires different techniques, the time and human resource cost can be completely different for different programs [11].

Correlation to the curriculum: Even if the computers and software were successful, they may be meaningless when they are not sharing the aims of the teacher. So, CAI should be carefully integrated with the curriculum and teaching strategies.

Lack of software: There are lots of CAI programs, which are poor in quality. Most of them are criticised for being boring, missing important learning objectives, being hard to use, having poor documentation. Additionally, a detailed and patient search is needed to reach a successful program.

2.1.3 What CAI is not

Programs used in education can be categorized into different groups. Distinction between tool applications and CAI programs is important since these tools can be used frequently in education.

Tool applications are used such as a pen, a ruler or a calculator is used. In this manner, use of word processors to prepare papers or reports, use of database programs to organize and retrieve information, use of spreadsheet programs for computing, use of desktop publishing and graphics programs to create printed materials and programs which are originally produced for personal use are not included in CAI.

2.1.4 Brief History of CAI

A brief history of CAI was given below according to Robert V. Price [9].

CAI was first used in education and training during the 1950s. The early efforts were depending on Skinner's behavioural analysis. It was believed that principles of stimulus and reward, characterized by immediate reinforcement, could bring about learning. First, some programmed instructions were developed which is followed by teaching machines. Norman Crowder incorporated multiple-choice questions into programmed instruction. Although, programmed instruction worked, it never achieved popularity.

In late 1950s and early 1960s, some efforts to use computers in instruction took place. After unexpected launching of soviet satellite Sputnik in 1957, education system is questioned. US government wanted to determine the possible effectiveness of computer-assisted instruction. At the beginning most CAI efforts involved teaching of programming and few of them involved educational programs for

students. In 1960s a movement to individualized instruction began, which promoted CAI as a tool for individualizing instruction.

From 1965 to 1970, students began to use computers as problem solving tools and teachers began to see computers as instructor's aide rather than a substitute teacher. The application that is known as computer-managed instruction (CMI) emerged. Computer Managed Instruction included properties like record keeping, diagnosis and prescription or computerized testing.

In 1970s the computer revolution began. Major changes were, developing and marketing of minicomputers because of the reduced cost, invention of microcomputers which were small, inexpensive and relatively powerful, increase in variety and amount of educational software. Most of CAI of this period was poorly produced.

From 1980s, computer revolution gained momentum. Apple II line dominated the schools, especially in CAI applications. In 1980, by an agenda for action, which was released by The National Council of Teachers of Mathematics, the importance and use of computers in education and responsibility about development of high quality instructional software were declared. Parallel to these studies, some advancement like use of mouse, use of graphics oriented user interfaces and use of animations, make development of more sophisticated software programs possible.

At the last, hypertext and hypermedia emerged. The term hypertext describes the electronic representation of text that takes advantage of the random access capabilities of computers. By this way, sequential medium of print on paper become overcame. Hypermedia extends to the non-linear representation and access to graphics, sound, animation and full-motion video. Nature of hypermedia environment is interactive, exploratory and constructivist.

2.1.5 Types of CAI Programs

The traditional method for classifying the educational use of computers involves categorizing the computer applications by the type of software. This categorization includes 4 types of computer-aided instruction. These types are drill and practice programs, tutorials, simulations and educational games.

Drill and Practice is the most known type of CAI. These programs are used to help learner by providing practice of instructional materials. It is assumed that the skill or knowledge has already been introduced, so the aim is to strengthen the knowledge of the learner. It is not designed to teach new skills or introduce new content. It is an effective technique for teaching factual information and it can be used extensively at all educational levels.

Tutorial is an instructional methodology that is frequently used to accomplish presenting information and guiding the learner. It is emphasized from question-and-answer and dialogue type learning in the traditional tutor [12]. Tutorials are

appropriate for presenting factual information, for learning rules and for learning problem solving strategies in almost every subject area.

Simulation is a technique that teaches about some aspects of the world by representation of a phenomenon or the elements of some real-life or imaginary event. Simulations may be used in any phase of the learning for initial presentation of the content, guiding the learner, practice, assessing learning, and any combination of these [13]. The learner is allowed to experiment with simulation environment to learn the consequences of possible actions.

An educational game is a decision-making activity that usually includes rules, goals to reach, conditions introduced by chance, competition, strategy or pattern to be taken by players, feedback system and a winning team or player. Although they are mostly produced for entertainment purposes, when associated by good instruction it is an important type of CAI. This is because of some valuable characteristics of learning by play like high motivation, active participation, etc.

2.2 Adult Learning Theory (Andragogy)

Most studies of adult learning are based on the work of Malcolm Knowles, who introduced the term andragogy to describe the art and science of helping adults to learn.

Kearsley summarizes andragogy to instructors in practical terms: "Andragogy means that instruction for adults' needs to focus more on the process and less on the content being taught. Strategies such as case studies, role-playing, simulations, and self-evaluations are most useful. Instructors adopt a role of facilitator or resource rather than lecturer or grader (1996)." [14]

Knowles contrasted andragogy to the more traditional pedagogy. He argued that pedagogy is not always appropriate for teaching adults on the basis of 4 essential assumptions about the characteristics of adult learners, which are different from the assumptions about the child characteristics. [15]

The first assumption is about self-directing. Adults are autonomous and self-directing. They need to be free to direct themselves. Participation in the learning process, giving responsibility for presentations and group leadership, guiding them to their own knowledge rather than supplying them with facts are critical for efficiency in adult learning.

The second assumption is about experience. Adults have a rich reservoir of experience that can serve as a resource for learning. They need to connect learning to this knowledge/experience base, which may include work-related activities, family responsibilities and previous education. As all learners, adults need to be shown respect and acknowledging the wealth of experiences of adult learners becomes important to facilitate drawing out these experiences.

The third assumption is about readiness to learn. Adults tend to have a life-, task-, or problem-centered orientation to learning as contrasted to a subject-matter orientation. They appreciate educational programs, which are organized and have well defined elements, since they are goal-oriented. Additionally, adults are relevancy-oriented and they must see a reason for learning something. Learning is valuable for them when it is applicable to their work or other responsibilities. They are practical, so they focus on the aspects of a lesson most useful to them in their work. They are not interested in knowledge for its own sake.

The fourth assumption is about motivation. Adults are generally motivated to learn due to internal or intrinsic factors and as opposed to external or extrinsic forces. Social relationships, external expectations or recommendations of someone, social welfare, personal advancement, escape or stimulation to relieve boredom or to provide a break in the routine of life, and cognitive interest are some motivations different from the motivations for children's learning.

There are some additional characteristics of adult learners, which are critical to reach effective adult learning. These characteristics are;

- Adult learners need to take responsibility.
- Adult learners are generally serious on the topics they study.
- For adult learners, learning is not for future use opposite to children for whom learning is for future use.
- Efficiency is important for adult learners so there occur anxiety about the ability to meet expectations.

- Enjoyment is important for adult learners.
- Adults vote with their feet. If the learning situation does not suit their needs and interests, they will simply stop their involvement.

Cross, presented the Characteristics of Adults as Learners (CAL) model in the context of her analysis of lifelong learning programs. The CAL model consists of two classes of variables: personal characteristics and situational characteristics. Personal characteristics include: aging, life phases, and developmental stages. Situational characteristics consist of part-time versus full-time learning, and voluntary versus compulsory learning [16].

It has been found that learning must actively engage the individual in the learning process. In particular, adults have been found to learn more effectively by doing or experiencing. Adult learning specialist, David Kolb, has described this learning process as a four-phase cycle in which "the learner: (1) does something concrete or has a specific experience which provides a basis for (2) the learner's observation and reflection on the experience and their own response to it. These observations are then (3) assimilated into a conceptual framework or related to other concepts in the learner's past experience and knowledge from which implications for action can be derived; and (4) tested and applied in different situations." [17]

From another point of view, it was found that physiologically, learning is the formation of cell assemblies and phase sequences. Children learn by building these assemblies and sequences. Where adults spend more time for making new

arrangements than forming new sequences. Adults' experience and background allow them to learn new concepts. [18]

2.3 Cognitive Learning Theory

Cognitive theory relates to "how we gain information from the world, how such information is represented and transformed as knowledge, how it is stored and how that knowledge is used to direct our attention and behaviour" [19].

In the cognitive view, outcome of the learning is knowledge. Changes in learned knowledge make changes in behaviour possible. More then being an end product of learning, it also guides new learning. Jerome Bruner, proposed that much of the behaviour depends on how we structure knowledge about ourselves and the world around us.

So, according to cognitive approach, a good basis of knowledge can be more important than good learning strategies in understanding and remembering.

2.3.1 General principles

There are a few basic principles that most cognitive psychologists agree with [20]. These principles are described differently in the following paragraphs.

The assumption of a limited capacity of the mental system is the first principle. This means that the amount of information that can be processed by the system is constrained in some very important ways.

The second principle is that a control mechanism is required to oversee the encoding, transformation, processing, storage, retrieval and utilization of information. That is, when one is learning a new task or is confronted with a new environment, the executive function requires more processing power than when one is doing a routine task or is in a familiar environment.

The third principle is that there is a two-way flow of information as we try to make sense of the world around us. We constantly use information that we gather through the senses (often referred to as bottom-up processing) and information we have stored in memory (often called top-down processing) in a dynamic process as we construct meaning about our environment and our relations to it.

The fourth principle is that the human organism has been genetically prepared to process and organize information in specific ways. For example, language development is similar in all human infants regardless of language spoken by adults or the area in which they live. All human infants with normal hearing babble and coo, generate first words, begin the use of telegraphic speech (e.g., ball gone), and over generalize at approximately the same ages.

2.3.2 Kinds of Knowledge

Cognitive theory makes several distinctions about kinds of knowledge. One of the categorizations includes "general knowledge" and "domain-specific knowledge" where the other categorization includes "declarative knowledge", "procedural knowledge" and "conditional knowledge" [21]. These different kinds of knowledge require different teaching approaches.

General knowledge refers to information that is useful in many different kinds of tasks; they can be applied to many situations. And domain-specific knowledge refers to information that is useful in a particular situation.

According to other classification, declarative knowledge is "knowing that" something is the case. Verbal information and facts are this kind of knowledge. Procedural knowledge is "knowing how" to do something. It is important that knowledge which is demonstrated when a task is performed is procedural although knowledge needed to state the task without demonstration was declarative. Conditional knowledge is "knowing when and why" to apply existing declarative and procedural knowledge.

Knowledge can be stored in memory in a variety of forms. It can be stored isolated and in a disconnected manner which is often the result of rote memorization. Contrary, knowledge can be organized into large interconnected bodies [22]. For these subjects, information-processing model is one of the most used and accepted

models. Processing and storing of the information in mind is generally explained by the use of this model.

2.3.3 Information Processing Model

Information processing model is a cognitive model of structure and processes based on the analogy between the mind and the computer.

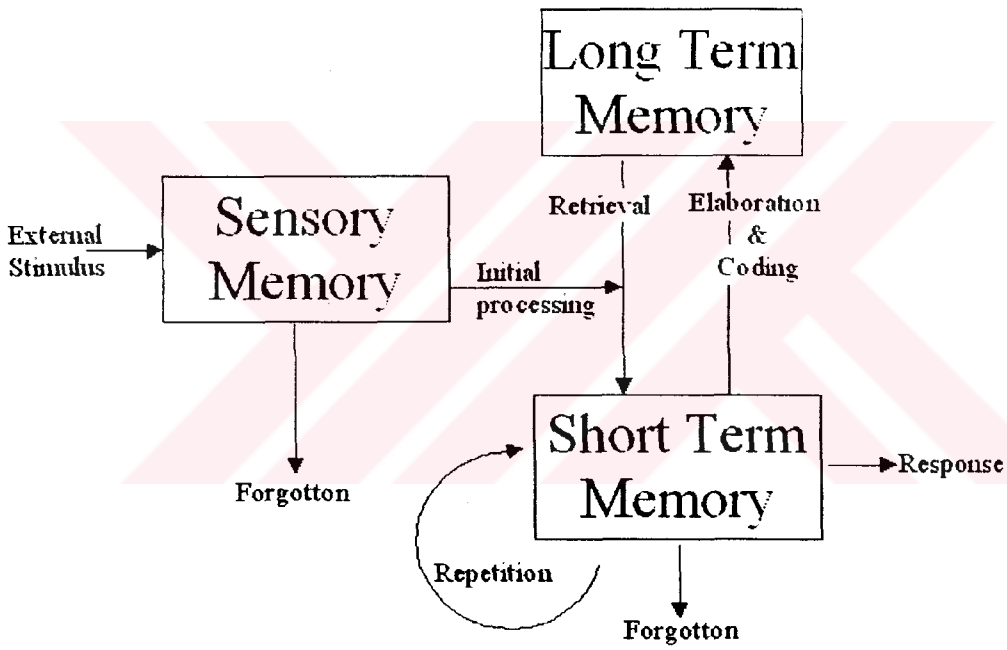

Figure 2.1: Information Processing Model

As seen in the Figure 2.1, this model proposes that information is processed and stored in 3 stages. This view was also named as "stage theory" and is based on the work of Atkinson and Shiffrin (1968) [20].

2.3.3.1 Sensory Memory

Sensory memory is the first stage in the information-processing model. Some external stimulus is perceived by senses (seeing, hearing, tasting, smelling and feeling). This sensory information is hold by sensory memory. Although the capacity of sensory memory is very large, duration of the sensory information is between 1 and 3 seconds. The content of the sensory memory are sensations from the original stimulus. Visual sensations are coded briefly as images and auditory sensations are coded as sound patterns. In this stage, perception is very critical because the perceived information becomes transformed into patterns or codes and than these coded information enters the short-term memory system.

2.3.3.2 Short Term Memory

Short-term memory is the second stage in the information-processing model. Short-term memory is also known as working memory. Information can be kept activated through repetition or transferred into long-term memory by being connected with information in long-term memory. The capacity of short-term memory is very limited. It appears that, in short term memory only 5 to 9 separate items can be held at one time. Duration of information in short-term memory is about 20 to 30 seconds at most. This time can be longer only if the information is activated. The content of short time memory is activated information, which refers what person

was thinking at that moment. Activated information can be knowledge from long-term memory or something new.

2.3.3.3 Long Term Memory

Long-term memory is the third stage in the information-processing model. Since long term memory holds the knowledge that is learned, it is also known as storing memory. The capacity and duration of long-term memory is practically unlimited. The content of the long-term memory is formed of propositional network and schema which are structures used for organizing and connecting the data.

Long-term memory has three types. These are Semantic memory, episodic memory and procedural memory.

2.3.3.3.1 Semantic Memory

Semantic memory is the memory used for meaning. It is like a dictionary containing the meaning of all of the words, sounds, images the person knows. Information is stored in semantic memory as propositions, networks and schemata. A proposition is the smallest unit of information that can be judged true or false. A propositional network is set of interconnected concepts and relationships in which long term knowledge is held. All or most of the information can be stored and represented by propositional networks. Schemata are needed to hold and represent

more complex tasks. Schemata refer to basic structures for organizing information. Singular form of schemata is schema, which is a pattern to guide for understanding an event, a concept or a skill. Schema tells typical features of a category.

2.3.3.3.2 Episodic Memory

Episodic memory is the long-term memory holding the information tied to a particular time and place. Especially this information is the memories of the events in a person's life. Episodic memory keeps track of the order of things. By this way the concepts in semantic memory can be put together in particular ways.

2.3.3.3.3 Procedural Memory

Long-term memory used for holding how to do things is known as procedural memory. Procedural information is stored as condition-action rules in this type of memory. These condition-action rules, called productions, tell what actions to take when certain conditions occur. It takes longer time to create a procedural memory compared to other types of memories.

2.4 Concept Mapping

A concept map is a graphical representation where nodes represent concepts, and links represent the relationships between concepts. The concepts, and sometimes

the links, are labeled on the concept map. The links between the concepts can be one-way, two-way, or non-directional. The concepts and the links may be categorized. The concept map may show temporal or causal relationships between concepts. [23]

Concept maps can be used to generate ideas, to design a complex structure, to communicate complex ideas, to aid learning by explicitly integrating new and old knowledge, and to assess understanding or diagnose misunderstanding. [24]

There are 3 types of concept maps each representing different type of content structure. These are spider maps, chain maps and hierarchy maps. The relationships can also be categorized as "is a", "enables", "causes" relationships [25].

Concept mapping has advantages of visual representation: visual symbols are quickly and easily recognized, minimum use of text makes it easy to scan for a word, phrase, or the general idea, and visual representation allows for development of a holistic understanding that words alone cannot convey [23].

Two of the most important applications of concept mapping in learning are increasing the potential for recall and maximizing the usefulness of knowledge where awareness of the big picture occurs.

It is important to be aware of abilities of concept mapping. Although concept mapping is a powerful method for assisting learning at the conceptual level, it is not very effective at improving the recall of details.

Concept mapping is usually associated with Joseph Novak. His work was based on the theories of David Ausubel, who stressed the importance of prior knowledge in being able to learn about new concepts [23].

2.5 Mind Mapping

Mind mapping is a cognitive mapping technique like concept mapping. The Mind Map is a formalised procedure for using associations to create a pictorial representation of one or more ideas. This technique relies on brainstorming [2].

Mind Mapping is invented (and copyrighted) by Tony Buzan. He describes mind maps as: "a mind map consists of a central word or concept, around the central word you draw the 5 to 10 main ideas that relate to that word. You then take each of those child words and again draw the 5 to 10 main ideas that relate to each of those words." [24]

The difference between concept maps and mind maps is that a mind map has only one main concept, while a concept map may have several. This comes down to the point that a mind map can be represented as a tree, while a concept map may need a network representation. Another critical distinction between concept map and mind map is about the connection of the nodes. In concept map connections of different nodes can show various relationships and they can be represented and labelled differently. In mind mapping the connection show usually just the connection between the nodes.

2.6 Anchored Instruction

Generative learning environments were developed to assist students in the generation of relevant sub-problems, arguments and explanations in problem-solving situations. This is accomplished through anchoring or situating instruction in meaningful problem-solving contexts. [26]

Anchored instruction is a model of curriculum integration combined with inquiry learning that builds prior knowledge and engages students in the relevant application.

The term anchor refers to an informational text or well-crafted video that is used to build a common core of understanding among participants. The ultimate goal is to help students develop the confidence, skill, and necessary knowledge to solve problems and become independent thinkers and learners. [27]

For anchored instruction, selection of anchor is critical. An anchor that has many components related to the core, enables constructing new knowledge and relationships. An anchor that has attractive utilities increases motivation and improves retention.

Becoming better problem solvers and thinkers, and becoming more literate and more capable of working collaboratively can be expected from the use of anchored instruction. [27]

2.7 Hypermedia Learning Environment

Hypermedia is one of the most recent tools for education. Generally speaking, hypermedia offers a multimedia information environment, supports non-linear access to information, provides interaction communication, and integrates the various information formats.

Hypermedia can be defined as a classification of software programs that consist of networks of related text, graphics, audio files, and video clips through users navigated by browser [28].

The nature of hypermedia is interactive, exploratory, and constructivist. Such an environment requires the input or action of the user, and the user directs his/her own path through the environment [10].

Hypermedia offers the potential of altering the roles of teachers and learners and the interactions between them. The nature of the hypermedia environments grants more control to the learner and encourages the teacher to become a facilitator rather than a deliverer of information.

2.7.1 The Characteristics of Hypermedia

There are 4 main characteristics of hypermedia.

First, hypermedia offers a multimedia information environment. The information in the hypermedia system can be simultaneously represented in any combination of media format, such as text, image, graphic, sound, and animation.

Second, hypermedia supports non-linear access to information. Hypermedia is a loose term for presentations containing more complex arrangements than the traditional linear text and is already widely acknowledged to be a promising teaching and learning tool.

Third, hypermedia supports interactive communication. Generally, users of hypermedia have full control over the learning situation. This high level of interaction gives users dynamic control of information.

Fourth, hypermedia integrates the information format. The multiple mixed-media nodes in a hypermedia system can be instantly called up in a consistent manner, irrespective of the structure of the information or resources.

2.8 Statistics Anxiety

Statistics is for many students in all faculties a major obstacle. It is demotivating, both for students and teachers. Moreover, the teaching load is increased by the many students who must repeat the courses. [29]

According to Lovett and Greenhouse [30], There are five principles of learning, derived from cognitive theory and applied to statistics education. These principles are briefly:

1. Students learn best what they practice and perform on their own.

2. Knowledge tends to be specific to the context in which it is learned.

3. Learning is more efficient when students receive real-time feedback.

4. Learning involves integrating new knowledge with existing knowledge.

5. Learning becomes less efficient as the mental load students must carry increases.

Many teachers of statistics are likely to focus on transmitting knowledge but many students are likely to have trouble with statistics due to non-cognitive factors, such as negative attitudes or beliefs towards statistics [31].

Courses in research methods, statistics, or some combination thereof, cause much anxiety among students. Statistics anxiety is "an anxiety which occurs as a result of encountering statistics in any form and at any level" and which "appears to involve a complex array of emotional reactions which have the propensity to debilitate learning" [6].

According to Onwuegbuzie, who had studied about statistics anxiety, there are six components of statistics anxiety: Worth of statistics, Interpretation anxiety, Test and class anxiety, Computational self-concept, Fear of asking for help, Fear of statistics instructor.

In addition to these, Onwuegbuzie investigated whether a two-dimensional construct of hope can be used to predict statistics anxiety. Hope consists of agency and pathways. Agency is the perception of a successful meeting of goals in the past and the present, and a projection of this into a successful future determination. The pathways element of hope is the awareness of one's cognitive ability to identify and overcome obstacles by developing successful goal-achievement strategies. In other words, agency is a continuing fact-based but emotional "aura" or self-image of goal achievement success, while the pathways component is the intellectual component of that success [6].

CHAPTER 3

METHOD

In the previous chapters, the need for this study was investigated and related literature review was given. In this chapter, the main purpose and research questions of this study, the design of the study, subjects, instruments, treatment and data collection, data analysis, limitations and the assumptions of the study are presented.

3.1 Main Purpose

The main purpose of this study is to develop a drill and practice program to provide help for users on selection of precise statistical technique for data analysis of a given research problem.

The second purpose is to investigate the perceptions and opinions of the students about the developed program in order to see the advantageous and disadvantageous sides.

3.2 Research Questions

In this section the research questions and the sub-questions were presented.

Question 1: What are the students' perceptions about the navigation used in the program?

Sub-question 1.1: What are the perceptions of students regarding to the elaboration of the subject matter?

Sub-question 1.2: What are the perceptions of students about effectiveness of the navigation through the program?

Sub-question 1.3: Does the navigation among items help students see the dynamics of the items?

Question 2: What are the perceptions of the students for the segments of the program?

Sub-question 2.1: What are the perceptions of students for "Active window" segment of the program?

Sub-question 2.2: What are the perceptions of students for "Explanation window" segment of the program?

Sub-question 2.3: What are the perceptions of students for "Subitems list" segment of the program?

Sub-question 2.4: What are the perceptions of students for "Related items list" segment of the program?

Question 3: What are the opinions and perceptions of the students about the overall of the program and its effectiveness?

Sub-question 3.1: What are the perceptions of students about motivation to use this program?

Sub-question 3.2: What are the perceptions of students about the effects of using this program?

Sub-question 3.3: What are the opinions of students about the potential situations for effective usage of the program?

Sub-question 3.4: What are the students' selections about the four segments of the program?

Sub-question 3.5: What are the students' preferences about the segments of the program?

Sub-question 3.6: What are the opinions of students about the program?

Sub-question 3.7: What are the critiques and suggestions of students to improve the programs' effectiveness?

3.3 Design of The Study

The study is a descriptive study. It is based on a qualitative study and a survey. It is completed in three major steps:

First, a computer based drill and practice program was developed and implemented according to nature of the problem and learner needs.

Second, elaboration of the instruction and the practicing examples were prepared in a structured way in order to use during the application.

Third, the program was implemented to the graduate students, who were registered to research methods course at Computer Education and Instructional Technologies department (CEIT) of the Middle East Technical University (METU). Perceptions and opinions of these students were obtained by an open-ended questionnaire.

3.4 Population and Subjects

This study used data from 17 graduate students who enrolled in an introductory research methods class in the department of Computer Education and Instructional Technologies at the Middle East Technical University.

Participants' age ranged between 22 and 28. The mean age of the participants was 23.65.

Demographic characteristics of the subjects are presented in Table 3.1.

Table 3.1: Demographic Characteristics of the Students

	N	%
Sex		
Female	5	29.4
Male	12	70.6
Previously Taken Research Methods Courses		
Yes	2	11.8
No	15	88.2
Expected Achievement Level in Research Methods Course		
Very Good	4	25
Good	8	50
Average	4	25
Bad	0	0
Very Bad	0	0

3.5 Instruments

3.5.1 Open-Ended Questionnaire

Open-ended questionnaire was developed by the researcher with the help of content experts. It was distributed to students all together. There are 40 questions in the questionnaire. This questionnaire was consisted of 7 structured, 31 semi-structured and 2 unstructured (open-ended) questions.

The questionnaire was structured in accordance with the functional segments of the program. It was divided into separate headings. The headings, which were evaluated, were;

1. Demographics of the students.
2. Students' interpretations of the general flow of instruction.
3. Effectiveness of the navigation.
4. Perceptions and opinions of students on visual and cognitive functionality of the "active window segment" of the program.
5. Perceptions and opinions of students on visual and cognitive functionality of the "explanation window segment" of the program.
6. Perceptions and opinions of students on visual and cognitive functionality of the "subitems list segment" of the program.
7. Perceptions and opinions of students on visual and cognitive functionality of the "related items list segment" of the program.

8. Perceptions and opinions of students on visual and cognitive functionality of the program in general manner.

3.5.2 Instructional Software "Critical Highlight"

The instructional software is a drill and practice program which aims to guide and practice selection of precise statistical test for data analysis of a given research question. To achieve these goals the program uses examples supported by explanations. These explanations can be specific to examples or about the related subjects or concepts.

The program was prepared by Delphi programming language. Database tables were used to support dynamic infrastructure.

Generally hypertext learning, adult learning theory, cognitive learning theory and concept and mind mapping approaches were influential on the design of the program.

A detailed view of this program can be presented in two sections. "Content and the elaborated structure of the content" will be described first, and then "visual and functional properties of the program" will be described.

3.5.2.1 Content and the elaborated structure of content

Since the program was exposed to graduate students who took research methods course. The content is limited by the curriculum of this course.

The topics included were "variables and classifications of variables", "data categories", "data and scale types", and "statistical tests" (t-test, ANOVA, MANOVA, Pearson–r Correlation, Chi-square).

There are 15 research questions to practice in the program. At least two research questions for each type of statistical tests are selected in order to present the similarities.

The content is organized like mind mapping and concept mapping with some additional properties. There is only one level depth of details from the central nodes. The connection between central node and details was set regarding the type of relationship. Additionally, subitems and relations between items can be ordered. The structure can be examined from Figure 3.1

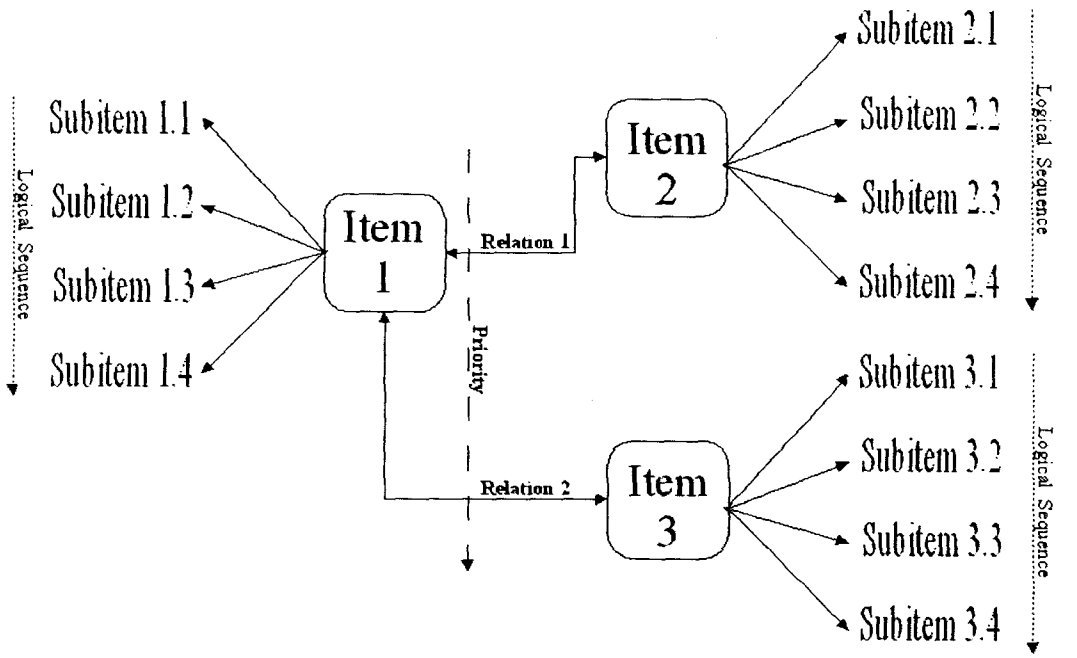

Figure 3.1: The Elaborated Structure of Content.

As seen in the figure 3.1, the content is divided into items and subitems. Concepts, facts, examples, flowcharts that can be focused separately are stated as "item". Furthermore, "subitem" refers to sub-questions, critical points to be aware of, and knowledge that are specific to the selected item. In this structure, one level depth of detail is preferred in order to provide simplicity. By this way, it is tried to avoid from confusion and getting lost.

In addition to identifying the subitems, the order of subitems are determined, if the sequence of these subitems was critical and has some other meaning.

In the elaboration of content, this kind of structuring is far from being content specific because of the variety of cases and research problems. By this general and

dynamic structure, all various kinds of research problems, cases, concepts and other types of knowledge were tried to be supported.

For selection of statistical test for data analysis, "item" sometimes refers to sample research problems and sometimes refers to concepts related to data analysis and statistical tests. At the other side, "subitem" sometimes refers to sub-questions needed for selection and sometimes refers to item specific explanations.

After determining the items and subitems, connections between the related items are set. By this way navigation between the related items become possible. Expectancy from having this connection is reminding the existing knowledge which is related to the selected item, completing the missing knowledge needed and showing similar items to aid finding out common arguments.

The critical difference between related item and subitem is that related item of a selected item could also be included in another items' "related item list" whereas subitem of a selected item is specific to the selected item. By this way, dynamic structure needed to satisfy requirements which have varying characteristics is satisfied by the "subitems list" and need for hypertext and integration is satisfied by the "related items list".

Explanation of each item or subitem is another critical part of the content design. General strategy for determining the explanation is based on adult learning theory. The explanations are tried to be shorten. While shortening, it is also tried to

have clear explanations, which are focused on issues that directly concern the item. The important phrases and phrases that are needed to be emphasized in the explanations are written in different colours. This style is preferred because it is thought that coloured phrases could help retention by the students, who were adult learners and had existing knowledge about the content. Other purpose of using coloured text is to be task oriented and to give the feeling of effective use of time.

3.5.2.2 Visual and Functional Characteristics of the Program

The elaborated structure of content (Figure 3.1) shows that there are items, subitems, related items and their explanations to be taken into consideration for an effective program to achieve the goals. In addition, when the number of items increase, the problem of navigation occurs. To support all these arguments, the program has 2 screens; Main screen and a supporting screen, which includes the "content list" and "action history". Below, the screenshot of the main window is given in figure 3.2.

There are 6 main functional parts of the main screen, which are;

1. Navigation
2. Header
3. Active window (upper left)
4. Explanation window (upper right)
5. Subitems list (right bottom)
6. Related items list (left bottom)

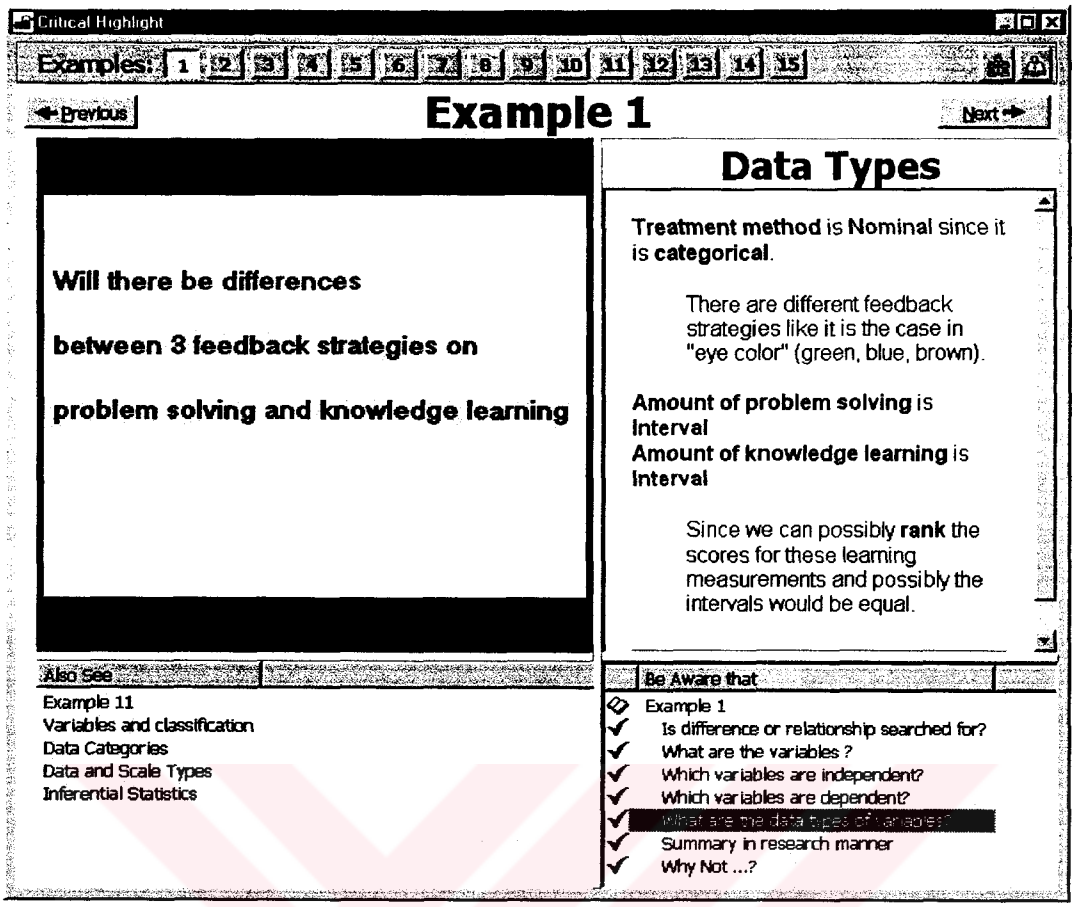

Figure 3.2: Screenshot of the Main Screen

3.5.2.2.1 Colouring strategy

Before the explanation of different windows of the program, which have different functions, understanding the colouring strategy can be critical. Colours are used in 3 different parts of screen to provide integrity.

Background colour is used to distinguish belonging to item or subitem. Items' background colour is light grey whereas subitems' background colour was light

yellow. For example background colour of "explanation window" is light yellow when a subitem is selected whereas it is light grey when an item is selected. Although, the selection of item or subitem does not change the background colour of some windows, the same strategy is applied to these windows in order to provide consistency. For example since the "related items list" shows the items related to the selected item (not subitem), its background colour is always light grey. In addition, a light grey connection on the left side of the screen is used to integrate the header and "related item list".

Colouring the text in the "explanation window" is another use of colours. In the explanations of items and subitems, important and emphasized phrases or sentences are predefined. Furthermore, there can be need for sub-headings in the explanation. Distinguishing the sub-heading is from its font size and its being bold. Important phrases have higher priority so they are written in red and bold. Emphasized phrases have lower priority that they are written in bold. Number of colours or styles is selected to be 2 because of the thought that if the number of colours increases, the aim of gaining attention can be totally lost.

Colour of the highlighting effect is the last use of colours in the program. The purpose of colouring the highlighting effect is distinguishing and combining different positions of the clues. For example in a research problem some part of clue can be found in the first line of the research problem while the other part was in the fourth line, these parts are highlighted by blue, where a distinct clue at the first line is highlighted by red at the same time. The colour of highlighting effect is selected

from dull colours in order not to attract much more attention than needed. And by the use of transparency, keeping attention of the students on the problem is aimed.

3.5.2.2.2 Navigation

The navigation through items and subitems depends on the elaborated content structure. Having different types of navigation, in order to navigate through the arrow lines in the elaborated content structure figure (Figure 3.1) is the general strategy. This is the cause of avoiding the hyperlinks, although hypertext mark-up language (html) was used in the "explanation window". Hyperlinks in "explanation window" would mean connection between subitem 1.1 and item 2 which would be improper to elaborated content structure. 4 different types of navigation are supported in the program. These are searching from content list, using the examples menu, using the next - previous buttons and selecting an item from the lists.

The "content list" includes all items and subitems in a tree structure which can be searched by item or subitem name. To improve navigation, icons are used to distinguish the visited and unvisited items or subitems.

Menu is formed of 15 menu items where each menu item corresponds to a different example. Examples can be reached immediately, by the selection of adult learner. Since adult learners need to control their learning, supporting the selection of adult learners is critical.

Navigation by next and previous buttons is used to support practicing the examples in a serial way. This type of navigation and navigation from menu is complementary. Selected example can be seen from the menu while navigating by next and previous buttons. It is expected that this type of navigation will be helpful for especially the first use of the program.

Selecting from the list is another type of navigation through items and subitems. Selection from the "related items list" takes the user to another item and selection from "subitems list" takes the user to a subitem. Selection from "related item list" is by double clicking on the list item whereas selection from "subitems list" is just by clicking on the list item. There is such a difference because changing the selected item effects the whole screen whereas changing the selected subitem effects only the "explanation" and "active window" without loosing the focus. By this way it is expected that by double clicking, the message "There will be a move to a new and probably independent subject or example which is also related the currently selected one. So there can be a need to focusing and orientation", will be given to the learner.

3.5.2.2.3 Headers

The main function of the headers in the screen is to show the selected item. Selection of item and subitem can have different effects on appearance and functions of the screen. In order not to get lost and to be aware of the relationship between the item and subitem, two headers are needed in the screen: "Primary Header" and "Secondary Header".

In order to understand use of headers, it should be clarified that each item and subitem has name and caption properties. Names are used for indicating the item or subitem and captions are used as headings or directions. For example the name of a subitem can be "Why not ... ?". This name can be seen before selection. On the other hand, the caption of the same subitem can be "Why not ANOVA?" which can be seen after it is selected. Other uses can be illustrated as "Data Types – Nominal data", "Example 1 – Ask and try to answer", "Data categories – Data categories". In the last illustration, both name and caption are same. This means the explanation is about what "Data Categories" mean and there is no need for any other direction or heading.

Names are used in the "primary header" and in the lists like "subitems list", "related item list" or "content list". And captions are used in the "secondary header" when the item or subitem is selected.

Primary header is on the top of the screen in order to remind which item was selected. Everything seen in 4 main windows (Active window, explanation window, subitems list, related item list) are related to the selected item and primary header.

Secondary header is placed above of the "explanation window" and below the "primary header". This is because of the varying nature of secondary heading according to selection of item or subitem and according to the similarity between the primary and secondary header. This varying nature includes change in background colour and change in visibility of the secondary header to provide consistency.

Background colour of secondary header changes as described in the colouring strategy. Visibility of the secondary header depends on the similarity of primary and secondary headings. If the primary and secondary headers are same, the secondary header becomes invisible in order to avoid repetition (like the case "Data categories – Data categories"). This case occurs probably when an item is selected.

3.5.2.2.4 Active Window

There are two main functions of "active window" changing according to the selection of item or subitem. When an item is selected, if it is needed, an image related to the item appears in this window. When a subitem is selected, if it is needed, a blinking like effect highlights some areas on the item image.

The function of image is visualizing or setting the scope of the selected item whereas the function of highlighting effect is positioning or giving clue about the critical components related to the selected subitem.

The "active window" uses just images for attracting the attention of the user by visualization or by showing the scope of the item selected, because people tend to remember visual information much more than verbal information. Since research questions can be in various kinds with various solutions, image is thought to be a common way of presenting them. The positioning and highlighting effect is also another reason for using image. This image can contain different types of data such as a problem statement to work on, a screenshot to describe, a flowchart to

investigate or a sample diagram. In the program, each item can only have 1 image or not. If there is a need for more images this means there is probably a need for another item related to the selected one.

The place of "active window" is on the top left part of the screen, because this functional area is thought to be the most attractive area for learners. So, showing the item and its critical parts in this area should be effective for learners. When there is no image related to the selected item, this area shrinks in order to make learners pay more attention to the "explanation window".

Highlighting effect can occur when a subitem is selected. As the subitems and their descriptions present some parts of the item, this highlighting effect aims to highlight the important components of the item and present the place of it in the whole picture of the item. In order to attract learner's attention it has a blinking property in it and, in order not to lose the whole picture it has a transparency property.

Distinguishing and combining the related parts for highlight effect is managed by using different colours as described in colouring strategy.

3.5.2.2.5 Explanation Window

"Explanation window" presents verbal information for the selected item or subitem. The only visual difference between the selection of item or subitem is the

change in background colour. The general functions and properties, which are described in "colouring strategy" and in "elaborated structure of content" sections, are same for both.

The place of the "explanation window" is at the top right part of the screen. This area is strategically important because of having neighbourhood with both "active window" and "subitems list". By the help of background colours, "active window" and "explanation window" seem related which is true when an item is selected. Furthermore, "subitems list", "explanation window" and "highlighting effect" seem related which is true when a subitem is selected.

3.5.2.2.6. Subitems List

The main function of this window is presenting the subitems of the selected item which learners should be aware of. When a subitem in the list is selected, related explanation appears in the "explanation window" while the position of the related part on the item image blinks to highlight in the "active window".

The "subitems list" is placed at the bottom right part of the screen. This place is selected because this area of the screen is the area, which attracts the user's attention most after top left area of the screen.

At the top of the list, selected item is placed in order to give chance for selection of item again after selection of a subitem. The difference between selected

item and its subitems is given by indented format and by the use of different icons. A book image is used for item and a question mark is used for subitem to be aware of. When the item or subitem is selected in the list icons can change to an open book image or a to check mark image in order to distinguish the visited and unvisited items.

If there is a sequence provided for subitems, they are ordered top down in the list. When there is a sequence, selection of subitems in the recommended order is not forced. Learners can decide which subitem to select by themselves.

The difference between name and caption of subitem has critical use for this list. In the application, the names of subitems are usually questions defined according to the path for selection of statistical test where the captions act as heading of the answers. For example the caption of the subitem can be "The variables" where name of subitem was "What are the variables?". Learners were expected to answer or think by themselves before selection of subitem. In addition to questions, some additional information like why the decision was not another test which is similar or what the meaning of an unknown word was, were given at the end of sequence of questions.

3.5.2.2.7. Related Items List

The main function of the "related items list" is to navigate through the related items. While working on a research question or a subject, some other related concepts or subjects could be needed to remember or learn. Furthermore, there can

be need for suggesting some subjects or concepts to have opinion about. One of the main expectations is to provide all knowledge, which can be needed.

The second main expectation from the "related items list" is to help learners to derive the common characteristics of items, which are similar to the selected item. For instance chi-square is studied in examples 2, 8, and 14. When example-2 is selected, example 8 and 14 will be included in the "related items list".

The "related items list" is placed at the left bottom part of the screen. Being beneath the "active window" shows the relationship between the item and being near to the "subitems list" is critical for similar characteristics for selection.

3.5.2.2.8. Content list and Action history screen

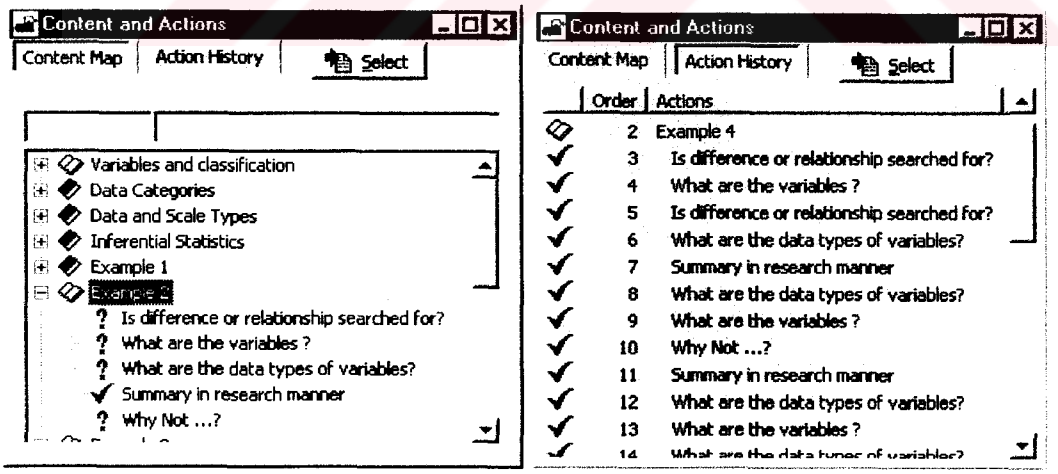

Figure 3.3: The Screenshot of Content list and Action History Screen

The second screen in the program includes a content list and action history. As seen from the figure 3.3, the objective of this screen is to help learner to position himself by showing the visited items and unvisited items in two structured ways.

The first structure is the "content list". In this section, there is a tree-structured list including all items and subitems. This list is strengthened by keyword search. Items and subitems are distinguished by different icons, which also change according to the state of being visited or unvisited. Expectation from this list is to inform the learner about the unvisited items.

The second structure is an action history. In this section, the visited items and subitems are listed in an historical order. The expectation from this list is to remind the list of visited items.

3.6 Treatment

Before the treatment, the instructional software called "Critical highlight" was installed to the computers in a computer laboratory. All the students received an explanation in advance to the use of the program. The students were requested not to start application before the instruments were distributed. In the explanation rational of the study, aims and objectives of the study and the questionnaire, why this treatment was at the end of the semester, what was expected from the students, were made clear to the students. Since introductory screens were also questioned, explanation about the use of application is given in a broad manner.

During the treatment, the students use the instructional software and they provided their answers to the questionnaire. There was no time limitation for the treatment.

3.7 Data Analysis

Data analysis method used in this study has consisted of three simultaneous activity; namely data reduction, data display, and conclusion drawing. Firstly, the raw data obtained was simplified and categorized. Data display included organization of the reduced data to enable conclusion drawing. Finally, conclusions were drawn from specific to a more generalized.

Since this study is a descriptive study, there were no comparison groups. The data obtained from the questionnaire were in nominal and open-ended types. The nominal data was analysed by using frequency and percentiles distribution. Nominal data was in terms of "agreement", "disagreement", and "undecided".

The nominal data was strengthened by open-ended questions. Opinions were given parallel to the "disagreement" and "undecided". In addition, the answers given to open-ended questions were analysed in a qualitative manner.

Qualitative approach was preferred since in-depth expression of participants had been important. By this way, it became possible to obtain data of perceptions, preferences and opinions of the students about the program and its effects.

3.8 Assumptions for the study

For this study, the following assumptions were made.

- All subjects are computer literate.
- All subjects have prior knowledge about research methods or statistical tests.
- All subjects responded accurately to the instrument used in the study.
- The data were accurately recorded and analysed.

3.9 Limitations of the study

- The sample size in this study is limited by the number of students registered to the research methods in education course at CEIT department of METU at Spring 2001 semester.
- Validity is limited to the honesty of the subjects' responses.
- The application developed was limited to the basic statistical tests (t-test, Pearson correlation, ANOVA, MANOVA, Chi-Square).

CHAPTER 4

RESULTS AND CONCLUSIONS

The sub-questions presented in chapter 3 were analysed through frequency distribution, which was carried out by SPSS (Statistical Package for Social Sciences). In this chapter, the results of the frequency distributions and related opinions of the subjects are presented.

In addition to frequency distributions given, if exists, some comments and opinions of the students were added below these results. It is observed that, mostly the students who had chosen the "disagreement" option or "undecided" options as their answers gave these opinions and comments.

4.1 Results

The results of sub-question 1.1:

The perceptions of students regarding to the elaboration of the subject matter was the first sub-question of research question 1. To obtain relevant data three

questions were asked. The questions and answers with frequencies were given in Table 4.1.

Table 4.1: Perceptions about the elaboration of the subject matter

	N	%
I liked the flow of instruction		
Yes	12	80
No	1	6,7
Undecided	2	13,3
Instructions included in the program were sufficient		
Yes	10	71,4
No	1	7,1
Undecided	3	21,4
The number of examples was sufficient		
Yes	12	85,7
No	1	7,1
Undecided	1	7,1

Three of the students mentioned that the order of examples could be different. Two of them suggested that the order of examples should be based on the complexity of statistical tests (for example; from T-test to MANOVA). Another comment was about the flow of subject. One of the students suggested that explanation of subject and descriptions of concepts should be given before examples.

Results show that the elaborated structure and implementation of the subject is mostly perceived sufficient. The examples were ordered randomly in order not to cause expectation about the solution, since the main purpose of the program had been practicing. Suggestions "elaboration according to complexity" and "topics before examples" show that some students' expectations conflict with the program's goal.

The results of sub-question 1.2:

The perceptions of students about the effectiveness of navigation through the program were the second sub-question of research question 1. To obtain relevant data 3 questions were asked. The questions and answers with frequencies were given in Table 4.2.

Table 4.2: Perceptions about the effectiveness of navigation through the program

	N	%
Which navigation type did you used generally in the program?		
Use of Menu Items	7	41,2
Use of Next and Previous buttons	7	41,2
Selection from the "Related Items List"	3	17,6
Selection from the "Content List"	0	0
During navigation did you loose your way and focus?		
Yes	0	0
No	15	88,2
Undecided	2	11,8
Did you get trouble in navigation through content?		
Yes	0	0
No	16	94,1
Undecided	1	5,9

One of the students mentioned that at the beginning the navigation was confusing and frightening because of having 4 separate windows and many buttons in the main screen. Another student pointed out a difficulty in coming back to the focused item after navigation by the use of the "related items list".

Results show that navigation by menu items and next and previous buttons were mostly preferred. None of the students preferred navigation by the content list. It was pointed that the problems occurred at the beginning of the treatment had

disappeared in a short time. Since navigation by the "related items list" was used by 17.6% of the students, difficulty of one student in navigating back was noticeable.

The results of sub-question 1.3:

Helpfulness of the navigation for seeing the dynamics between related items was the third sub-question of research question 1. The answers with frequencies were given in Table 4.3.

Table 4.3: Helpfulness of navigation, on relating the items.

	N	%
Navigation through the "related items list" helped me relating items and seeing the similarities.		
Yes	8	47,1
No	4	23,5
Undecided	5	29,4

Most of the students who had chosen the "Undecided" option mentioned that they had not needed to use this kind of navigation where some mentioned that it could be helpful.

Results show that no clear thought can be driven on this item. Not having a need for this type of navigation could be a result of recently taken research course.

The results of sub-question 2.1:

The perceptions of students for "active window segment" of the program

were the first sub-question of research question 2. This problem was investigated by 4 questions. The questions and answers with frequencies were given in Table 4.4.

Table 4.4: The perceptions of students about "active window segment".

	N	%
The colourful highlighting effect was helpful for seeing the clues.		
Yes	17	100
No	0	0
Undecided	0	0
The colourful highlighting effect disturbed me and makes it harder to read explanations.		
Yes	0	0
No	14	82,4
Undecided	3	17,6
Use of different highlighting colours effects better facilitate the use of program.		
Yes	13	81,3
No	1	6,3
Undecided	2	12,5
Selection of highlighted phrases was appropriate.		
Yes	16	100
No	0	0
Undecided	0	0

One of the students mentioned that highlighting effect was disturbing due to its blinking characteristic and suggested that in a short period of blinking time this property should be fixed to a steady state of colour. Another student recommended that highlighting would be sufficient also without blinking characteristic.

Results show that none or just a few of the students perceived "active window segment" inefficient. Opinions of these few students were only about the blinking characteristics of the highlighting effect.

The results of sub-question 2.2:

The perceptions of students for "explanation window segment" of the program were the second sub-question of the research question 2. This problem was investigated by 5 questions. The questions and answers with frequencies were given in Table 4.5.

Table 4.5: The perceptions of students about "explanation window segment".

	N	%
The explanations related to sample research problems and concepts were sufficient.		
Yes	15	93,8
No	1	6,3
Undecided	0	0
I have read entire text of explanations.		
Yes	9	56,3
No	1	6,3
Undecided	6	37,5
Use of different colours for text in the explanations made it easier to keep up with.		
Yes	16	94,1
No	1	5,9
Undecided	0	0
Having different coloured text in the explanations is useful.		
Yes	14	82,4
No	1	5,9
Undecided	2	11,8
Use of different coloured text in the explanations prevented me from reading the entire explanation.		
Yes	1	5,9
No	15	88,2
Undecided	1	5,9

Some of the students who read explanation texts partially mentioned that they read entire text when they are not sure about the answers. Students, who thought having different coloured text in the explanations is somewhat useful, recommended

that this effect could be destructive when it is used excessively although they were not affected during the treatment.

Results showed that most of the students perceived the "explanation window" as helpful and effective. From the beginning, partial reading of text was expected since the students were adult learners.

The results of sub-question 2.3:

The perceptions of students for "subitems list segment" of the program were the third sub-question of research question 2. This problem was investigated by 5 questions. The questions and answers with frequencies were given in Table 4.6.

One of the students mentioned that questions included in the "subitems list" should be sequenced according to their complexity. Two of students felt that they were not adequate to comment on usefulness of sequencing the questions included in the "subitems list" although it was not seemed problematic for them.

Results show that students' perceptions about this segment were generally positive.

Table 4.6: The perceptions of students about "subitems list segment".

	N	%
I have tried to answer the questions by myself before seeing related explanation.		
Yes	15	88,2
No	2	11,8
Undecided	0	0
I have followed the questions found in the subitems list in provided order.		
Yes	13	76,5
No	3	17,6
Undecided	1	5,9
Sequence of questions included in subitems list was correct.		
Yes	12	70,6
No	2	11,8
Undecided	3	17,6
Sequence of questions included in subitems list was useful.		
Yes	15	88,2
No	0	0
Undecided	2	11,8
Icons "✓" and "?" located in the front of subitems were helpful.		
Yes	16	100
No	0	0
Undecided	0	0

The results of sub-question 2.4:

The perceptions of students for "related items list" segment of the program were the fourth sub-question of the research question 2. This problem was investigated by 3 questions. The answers with frequencies were given in Table 4.7.

Some of the students mentioned that they could not test helpfulness of using similar items in the "related items list" since they had no need during treatment. But they believed that it would be helpful if they had used. One of the students suggested that the items in this list could have been presented in concept map style in order to see the subitems of the items in this list directly.

Table 4.7: The perceptions of students about "related items list segment".

	N	%
I reached all information that I need in the related items list.		
Yes	10	58,8
No	2	11,8
Undecided	5	29,4
I used similar research questions presented in the related items list.		
Yes	6	37,5
No	8	50,0
Undecided	2	12,5
Inclusion of similar research questions in the related items list is helpful for learning.		
Yes	12	70,6
No	0	0
Undecided	5	29,4

Results show that this segment of program is not used much, although it was believed to be useful. Suggestion about the concept map style can be considered as tree-structure. This suggestion can be questionable because of the strategy of navigation.

The results of sub-question 3.1:

The perceptions of the students about the motivation to use the program developed were the first sub-question of the research question 3. This problem was investigated by 3 questions. The questions and their answers with frequencies were given in Table 4.8.

Table 4.8: The perceptions of students about motivation to use the program.

	N	%
I have found boring to study this subject by using this program.		
Yes	1	5,9
No	15	88,2
Undecided	1	5,9
Use of such a tool motivates more than searching from help files		
Yes	8	57,1
No	3	21,4
Undecided	3	21,4
Would you prefer to use such a program when you are studying other subjects?		
Yes	12	70,6
No	1	5,9
Undecided	4	23,5

Some of the students suggested that it would be more motivational especially when studying a subject alone. One of the students mentioned that by this way to get help is easier and faster than searching in help files. Some of students suggested that it would be appropriate in some studies especially while using comparison and examples but it is not appropriate for all subjects.

Results show that students are motivated or at least not resistant to use this program while studying.

The results of sub-question 3.2:

The perceptions of the students about the effects of using the program were the second sub-question of the research question 3. This problem was investigated by 2 questions. The questions and answers with frequencies were given in Table 4.9.

Table 4.9: The perceptions of students about the effects of using the program.

	N	%
I believe that this tool will accelerate my studies.		
Yes	14	82,4
No	0	0
Undecided	3	17,6
I believe that this tool make it faster to reach conclusion while studying.		
Yes	12	70,6
No	1	5,9
Undecided	4	23,5

Some of the students thought that this tool could accelerate their study. One of them explained that acceleration in study occurs since bringing out the relationships between items was time consuming. One of the students added that acceleration in study would occur especially while studying alone. And another student mentioned that reaching to conclusion faster would be a result of visualization.

Results show that acceleration while studying and reaching to conclusions were expected by the most of the student.

The results of sub-question 3.3:

The opinions of the students about the potential situations for effective usage of the program were the third sub-question of the research question 3. This problem was investigated by 1 question, which has 7 options. The options and answers with frequencies were given in Table 4.10.

Table 4.10: The opinions about the potential areas for effective usage.

	N	%
While learning a new subject	6	35,3
While practicing after having knowledge about subject	14	82,4
As a supporting tool while teaching a subject	11	64,7
Only for definite subjects	2	11,8
As a supporting tool during an application	10	58,8
Should not be used anywhere	0	0
Others	2	11,8

Two students who marked "only for definite subjects", suggested the use of subjects from science courses and subjects in which practicing is highly needed. Students, who marked "others", suggested using in order to remember after learning occurred. Another suggestion was using for courses, which have a linear structure, and for courses, which include comparison of different methods.

The results did not conflict with the potential area aimed while developing program. The most suitable area was practicing after having knowledge about the subject matter. The second tendency was using it as a support tool while teaching or studying on a subject.

The results of sub-question 3.4:

The selection of students about the four segments of the program was the fourth sub-question of the research question 3. This problem was investigated by 1 question with 4 options. The segments and answers with frequencies were given in Table 4.11.

Table 4.11: The selections about the four segments of the program.

	N	%
Active window		
Used most	0	0
Used more	6	35,3
Used less	7	41,2
Used least	4	23,5
Explanation window		
Used most	8	47,1
Used more	5	29,4
Used less	3	17,6
Used least	1	5,9
Subitems list		
Used most	6	35,3
Used more	5	29,4
Used less	5	29,4
Used least	1	5,9
Related items list		
Used most	3	17,6
Used more	1	5,9
Used less	2	11,8
Used least	11	64,7

The results were examined according to the groups of ranking of selection and according to the groups of windows. Results show that "related item list" was the least used segment of the program. "Active window", "explanation window", and "subitems list" were used interchangeably, where "active window" was not used in the highest ranking. In this interchangeable usage, "explanation window" has the highest tendency to use where the "subitems list" follows the "explanation window".

The results of sub-question 3.5:

The preferences of students about the segments of the program were the fifth sub-question of the research question 3. This problem was investigated by 1 question, which has 5 options. The results with frequencies were given in Table 4.12.

Table 4.12: The preferences about the segments of the program.

	N	%
Active window		
Preferred in the 1st order	1	5,9
Preferred in the 2nd order	4	23,5
Preferred in the 3rd order	7	41,2
Preferred in the 4th order	2	11,8
Preferred in the 5th order	3	17,6
Explanation window		
Preferred in the 1st order	3	17,6
Preferred in the 2nd order	6	35,3
Preferred in the 3rd order	5	29,4
Preferred in the 4th order	3	17,6
Preferred in the 5th order	0	0,0
Subitems list		
Preferred in the 1st order	6	35,3
Preferred in the 2nd order	5	29,4
Preferred in the 3rd order	4	23,5
Preferred in the 4th order	1	5,9
Preferred in the 5th order	1	5,9
Related items list		
Preferred in the 1st order	5	29,4
Preferred in the 2nd order	2	11,8
Preferred in the 3rd order	0	0,0
Preferred in the 4th order	3	17,6
Preferred in the 5th order	7	41,2
Navigation		
Preferred in the 1st order	2	11,8
Preferred in the 2nd order	0	0,0
Preferred in the 3rd order	1	5,9
Preferred in the 4th order	8	47,1
Preferred in the 5th order	6	35,3

The results were examined according to the groups of ranking of preference and according to the segments of the program. Results show that the order of preference according to the groups of ranking from the highest to the lowest was; "subitems list", "explanation window", "active window", "related items list" and "navigation". Most of the students preferred "subitems list segment". It was remarkable that, according to the segments of the program, "related items list" is

mostly preferred by the 29.4 percent of the students whereas it was least preferred by the 41,2 percent of the students.

The results of sub-question 3.6:

The opinions of the students about the program were the sixth sub-question of the research question 3. This problem was investigated by 1 open-ended question, which requested students to provide a brief description about the program. All students provided responses to this question. The responses were evaluated according to some topics found in the descriptions. These topics were "subject and goals of the program", "target user group", "how program achieves its goals" and additional characteristics emphasized.

Most of the students mentioned statistical tests, statistical methods, related concepts, and place of using these arguments as subject of the program. One of the students mentioned that any subject could be practiced by this program.

The program was mostly perceived as a practicing or supplementary tool whereas a few students mentioned that it was a teaching or learning tool. Practicing is emphasized more than supporting as a goal. Generally, practicing was focused on reminding the basic concepts and distinguishing the situations needed for different types of statistical tests or methods. Students who perceived the program as supplementary tool focused on deciding the precise statistical technique, feedback and simplicity and practical use of program.

Three students mentioned target user group of the program as a student who has a research question, people who have prior knowledge on statistics and students who have different learning styles.

Most of the students perceived that the program attains its goals by the use of examples and related explanations, which were presented step by step in a detailed manner. Appropriate and immediate feedback, simplicity of using, having different types of navigation, and short and basic content were other arguments perceived additionally.

Some students needed to point out some characteristics of the program and emphasized specially. According to these students, the program was well designed, has ability to reach its goals effectively in a short time, has ability to direct questioning, and helps constructing concepts. Additionally, it is mentioned that the connections between similar examples, which enables comparison, and questions like "Why Not...?" in the examples were attractive and gratifying.

The results of sub-question 3.7:

The critiques and suggestions of students about the program were the seventh sub-question of the research question 3. This problem was investigated by 1 open-ended question. All students answered this question. Below, the criticisms and suggestions of the students were given in groups.

Before the first use of program, students should be directed to help files and a simple animation about the use of program was suggested. One of the students mentioned that the program seemed and frightening at the beginning because of the crowded seeming controls (buttons, windows).

Most of the critiques were about content and elaborated structure of content. 3 students suggested increase in number of examples, and statistical test types. One of the students critiqued that definitions and explanation of topics should be presented before the examples whereas another student critiqued that starting with MANOVA example was inappropriate. Another critique of a student about content and elaborated structure of content was about the set of questions, which gives clue about the selection of statistical test. It is mentioned that according to what questions were asked, the students can predict that the selection should be One of chi-square or Pearson product correlation or not.

One of the students cited a need of evaluation test before exiting the program in order to test themselves about what they master or not. Another suggestion was writing the answers before reading the solutions while navigating through the "subitems list".

One of the students mentioned that he did not use the "related items list" since he did not need because of the already given explanations on selection of each subitem.

Other critiques and suggestions were about graphical user interface. 2 students just pointed out the need of improvement in interface where one of them thought that other features were satisfactory. 2 students suggest navigating through hyperlinks, which were placed on the "explanation window", especially when explaining the decision of selection.

The "related items list" is one of the most criticised segments of the program. It is suggested that the items in this list can be presented like concept mapping and subitems of these items can become visible by this way. It is also suggested that the "related items list" can be designed as a popup menu, which can be opened when needed. Another suggestion about the "related items list" is carrying the items about the description of topics (like variable types, data types, test types) to the upper part of screen where they can be seen regarding which item was selected and separate from the related examples.

In addition to all these suggestions, one of the students perceived "active window", "explanation window" and "subitems list" were very attractive. And some mentioned that they did not see any missing or erroneous parts adding that they expect some need for improvements as it is used.

4.2 Summary of Findings

Based on the data analysis and results, which were presented, in the previous sections, the following findings could be summarized.

- "Active window", "explanation window" and "subitems list" were perceived attractive and effective where effectiveness of "related items list" was still questionable by the participants.

- "Related items list" was perceived to be helpful.

- "Related items list" needs improvement in structure and interface.

- Navigation was not problematic for most of the students and most preferred types of navigation found in the program were navigation through previous and next buttons and through menu items.

- Helpfulness of navigation through "related items list" was unclear and it needs improvement especially in going back to previous item.

- There was not a need for the content list.

- Instructions included in the program satisfied most of the students' expectations, whereas some students preferred some changes in the content order and required increased number of examples.

- Highlighting effect of the "active window" was perceived helpful and effective where its blinking characteristics would need improvement.

- Use of brief and coloured explanations was perceived useful.

- The program was perceived motivating and believed to accelerate the students' studies.

- The program was perceived suitable for using as a practicing or as a supplementary tool.

- Introducing for the first use of the program should be improved.

- Evaluation test or entrance of students' answers for feedback could be added.

- Graphical user interface of the program should be improved.

CHAPTER 5

DISCUSSION, IMPLICATIONS AND RECOMMENDATIONS

5.1 Discussion

The purpose of this study was to develop the effectiveness of the computer based drill and practice program called as "Critical Highlight" which was developed in order to help students in selection of precise statistical technique for data analysis of a given research problem.

Analysis of results revealed that the most attractive segments of the program were "explanation window", "subitems list" and "active window". These 3 segments of the program were the segments, which were designed for presenting the selected subject and its logical divisions. The other segments were designed for navigation and relating the items. This result was parallel to the expectations related to the adult learning theory. [8] [15]

In addition to these components, "related items list" was the other important segment of the program. "Related items list" was not used and preferred much as the other segments, although some critical functions were expected from it. For most of the students (64,7%) this segment was the least preferable, contrary to the next greatest group of students (29,4%), who have perceived this segment as the most preferable. Additionally, results and comments showed that the students who didn't use this feature also perceived this segment as effective and important. This could be because of the assumption that the students already had prior knowledge of the subject.

There were some suggestions about the user interface and structure of "related items list". These suggestions were presenting the "related items list" as a concept map or as a pop-up menu. And the suggestion of having hyperlinks in the "explanation window" should be considered with these suggestions. At the design stage of the program's development, hyperlinks in the "explanation window" was avoided in order to help distinguishing the related items and subitems of the selected item, but probably because of the habits or familiarity with web pages, students expected to find links at "explanation window". The place of "related items list" could be changed according to these expectations.

Suggestion of concept map structure for "related items list" could be simply managed by a tree structure but there are some potential problems. When an item was selected, information in any format has a direct relationship with selected item, but a subitem of a related item of the selected item can be meaningless for the

selected item. Thus, presenting these subitems will be inconsistent to the strategy and the infrastructure. At the other side, if the subitems, which were meaningless for the selected item, become hidden, the "subitems list" before and after navigating to the related item will be different. Hiding the irrelevant subitems can cause missing the presentation of knowledge about some of the subitems, since it will affect the decision of navigating to the related item or not. All these can be confusing for the learner.

The navigation was critiqued by the students that, it needed modifications for a better use. Results showed that navigation was not problematic for most of the students and most of the students navigated through next and previous buttons and menu items. Carrying some of the related items, which were general and related to all of the items, to the upper part of screen can improve navigation, if it can be avoided from having a crowded and frightening screen.

Content and its elaborated structure were perceived satisfactory by most of the students. Some of the students required reordering of the examples from the easiest to more complex ones, and some required presenting the topics before the examples. Since the program was designed as a drill tool, the topics were presented when a need existed. Reordering examples from the easiest statistical techniques to the more complex ones will probably cause expectations and prevent student's cognitive process from deciding the precise technique. These results were expected according to the studies about CAI [9] and cognitive learning theory. [19] [20]

Highlighting effect, use of colours in highlighting effect, "explanation window" and using brief explanations were all seem to be satisfactory for the students. The only criticism, which was given by 2 students, was about blinking characteristic of the highlighting effect. These features of the program were based on the characteristics of adult learners.

The program was perceived as a motivating one and it fasters students' practices. In addition, the program was rated as simple and clear. And also it was evaluated to be suitable for practicing and as a supplementary material. This feature of the program would yield a lower anxiety level among students while studying statistics.

Some of the students did not perceive the explanations given by selection of subitems as a feedback mechanism and requested writing the answers to be checked. This may be because of not trying to answer before selecting the subitems, or because of the need for being approved. This type of feedback (with checking students answers and giving correct ones) was not handled because the answers could be hidden in some phrases or words of the examples. So the answers could be stated in different ways that checking for correction can be hard to manage.

Although some of the students mentioned that they had some problems at the beginning of the treatment, they pointed out that these problems were disappeared in a short time. So, introduction for the first usage was considered as weak.

5.2 Implications

Practicing the selection of statistical technique by using the program called "Critical Highlight" can save time for instructors and students. This practicing does not only save time but also make learning more effective.

At the other side, this program could help students overcome their anxiety of statistics, which will also be valuable for the instructors. Since fear for asking a question to statistics instructor was one of the major sources of statistics anxiety, using this program can also be helpful for overcoming this barrier.

Selection of statistical test can be an anchor for learning the basic concepts of data analysis. Appropriate examples can improve the quality of learning in "data analysis".

Since the program can reduce statistics anxiety, and uses statistics tests as anchors it could also be used in statistics courses, beside research methods courses.

As a conclusion, it is clear that using the program called "Critical Highlight" helped students in selecting precise statistical techniques, shorten their learning time, better motivated them, and helped them lower their statistics anxiety.

5.3 Recommendations

There is a continuous need for research in effectiveness of teaching and learning with appropriate tools and techniques. In the light of this study, some recommendations are listed below to those who want to make further research in similar topics.

1. Perceptions of the instructors for the use of program can be studied to add new features to satisfy the different expectations of the instructors.

2. Sample size can be increased to obtain more reliable results. Samples can also include students registered to statistics courses.

3. Development of other programs can be achieved in the light of the results of this study.

4. Further developments could include some additional features and different approaches. Some of these may be:
   - Since the Internet becomes an important medium of instruction, this program can be adapted to the Internet environment.
   - Number and types of examples and subject matter can be increased.
   - Sample problems can be chosen from real life cases.
   - Subjects other than "selection of precise statistical tests for research problems" can be chosen to study by the use of program called

"Critical Highlight". While selecting these subjects some questions could be asked like;

i. Could the subject be elaborated into critical concepts or steps to reach a conclusion?

ii. Does the sub items of the subject matter require to be positioned in the whole picture of the subject?

iii. Does the subject have case based examples to simulate the step-by-step deciding process?

- Some artificial intelligence features can be added to the program. For example program can decide the next example by considering the answers of the students.

5. Further research studies depending on this research and the program developed could be:

- The effects of the program on achievement levels of the students. This problem could be studied by adding control group to the design of the study.
- Comparison of the effectiveness of the program for different learning styles.
- Whether the program help instructors' giving instruction

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APPENDIX

GELİŞTİRİLEN "CRITICAL HIGHLIGHT" İSİMLİ
ÖĞRETİM ARACININ
DEĞERLENDİRME ÇALIŞMASI

İlgililere

Bu anket, bir araştırma için gerekli istatistik testinin seçimine yönelik adımların öğretimi amacı ile geliştirilmiş olan bir bilgisayar programının etkinliğine yönelik araştırma yapmak üzere bulgu edinmek için hazırlanmıştır.

Ankete isminizi yazmanıza gerek yoktur.

İlginiz ve yardımlarınız için teşekkür ederim.

Adres:
ODTÜ Fen Bilimleri Enstitüsü
Bilgisayar ve Öğretim Teknolojileri Eğitimi Bölümü

Saygılarımla
Can Kültür

*Lütfen aşağıdaki soruların tamamını yanıtlayınız. * işareti konulan cevapları işaretlediyseniz neden ya da nasıl olduğu ile ilgili açıklama yazmanız çok yararlı olacaktır. Soruların ilgisiz olduğunu düşünüyorsanız ilgisiz olduğuna dair not düşebilirsiniz. Yardımlarınız için teşekkür ederiz.*

A. Kişisel Sorular

1. Yaş: _____

2. Cinsiyet: _____

3. Daha önce "Araştırma Metodları" dersi aldım. [ ] Evet [ ] Hayır

4. Bu dönem "Araştırma Metodları" dersinde beklediğim başarı düzeyi

[ ] Çok iyi [ ] İyi [ ] Orta [ ] Kötü [ ] Çok kötü

B. Konunun işlenişi ile ilgili sorular

1. Programda işlenen konunun akış sırasını beğendim.

[ ] Evet [ ] Hayır [ ] Kısmen* _____

2. Programda işlenen konu ile ilgili bilgileri yeterli buldum.

[ ] Evet [ ] Hayır [ ] Kısmen* _____

3. Programda işlenen konu ile ilgili örnek soruların sayısını yeterli buldum.

[ ] Evet [ ] Hayır [ ] Kısmen* _____

C. "Konu ve sorular arasında ilerleme (Navigation)" ile ilgili sorular.

1. Programdaki konu ve sorular arasında ilerlerken en çok kullandığım yöntem

[ ] Üstteki soru butonlarından seçmek [ ] "Next-Previous" butonlarını kullanmak

[ ] "Also See" listesinden seçmek [ ] Content-map ekranından seçmek

2. "Also See" ekranı üzerinden ilerlemek, konular arası ilişkileri, benzerlikleri, farklılıkları yakalamamda ve ilişki kurmamda yardımcı oldu.

[ ] Evet [ ] Hayır [ ] Kısmen* _____

3. Konular arasında ilerlerken (navigation) konumdan uzaklaşıp yolumu kaybedebildim.

[ ] Evet [ ] Hayır [ ] Kısmen* _____

4. Konular arasında ilerlerken (navigation) zorlandım.

[ ] Evet [ ] Hayır [ ] Kısmen* _____

D. Sol üstteki "Görsel" kısım ile ilgili sorular.

1. Renkli yanıp sönme etkisi, ipuçlarını görmemde yardımcı oldu

[ ] Evet [ ] Hayır [ ] Kısmen* _____

2. Renkli yanıp sönme etkisi, dikkatimi dağıtıp açıklamaları okumamı zorlaştırdı.

[ ] Evet [ ] Hayır [ ] Kısmen* _____

3. Aynı anda farklı renklerde yanıp sönme etkileri olabilmesi kullanımı kolaylaştırıyor.

[ ] Evet [ ] Hayır [ ] Kısmen* _____

4. Yanıp sönme etkisi verilen kısımlar uygun seçilmiş

[ ] Evet [ ] Hayır [ ] Kısmen* _____

E. Sağ üstteki "Açıklama" kısmı ile ilgili sorular.

1. Örnek sorular ve ilgili konulara yönelik verilen açıklamalar yeterlidir.

[ ] Evet [ ] Hayır [ ] Kısmen* _____

2. Açıklamaların hepsini okudum.

[ ] Evet [ ] Hayır* _____

[ ] Kısmen* _____

3. Açıklamalar kısmında farklı renk yazı kullanımı, takip etmemi kolaylaştırdı.

[ ] Evet [ ] Hayır [ ] Kısmen* _____

4. Açıklamalar kısmında farklı renk yazı kullanımı yararlıdır.

[ ] Evet [ ] Hayır [ ] Kısmen* _____

5. Açıklamalar kısmında renk kullanılması, metnin bütününü okumamı engelledi.

[ ] Evet [ ] Hayır [ ] Kısmen* _____

F. Sağ alttaki "Be Aware That" listesi ile ilgili sorular

1. Uygulama sırasında cevapları görmeden önce soruları kendim yanıtlamaya çalıştım

[ ] Evet [ ] Hayır [ ] Kısmen* _____

2. Bu kısımda yer alan soruları, listelendiği sıra ile takip ettim.

[ ] Evet [ ] Hayır [ ] Kısmen* _____

3. Bu kısımda yer alan soruların sıralandırması hatasızdır.

[ ] Evet [ ] Hayır [ ] Kısmen* _____

4. Bu kısımda yer alan soruların sıralandırması yararlıdır..

[ ] Evet [ ] Hayır [ ] Kısmen* _____

5. Soruların başlarındaki "?", ve "□" işaretlerini faydalı buldum.

[ ] Evet [ ] Hayır [ ] Kısmen* _____

G. Sol alttaki "Also See" listesi ile ilgili sorular

1. "Also See" listesinde ihtiyaç duyduğum bütün bilgilere ulaştım

[ ] Evet [ ] Hayır [ ] Kısmen* _____

2. "Also See" listesinde bulunan benzer soruları kullandım.

[ ] Evet [ ] Hayır [ ] Kısmen* _____

3. "Also See" listesinde benzer soruların listelenmesi öğrenme için etkilidir.

[ ] Evet [ ] Hayır [ ] Kısmen* _____

H. Genel sorular

1. Bir konuyu bu şekilde çalışmayı sıkıcı buldum.

[ ] Evet [ ] Hayır [ ] Kısmen* _____

2. Bu aracın çalışmamı hızlandıracağını düşünüyorum.

[ ] Evet [ ] Hayır [ ] Kısmen* _____

3. Çalışırken, bu aracı kullanmanın sonuca gitmeyi hızlandıracağını düşünüyorum.

[ ] Evet [ ] Hayır [ ] Kısmen* _____

(Aşağıdaki soruda birden çok seçeneği işaretleyebilirsiniz)

4. Bu mantıkla hazırlanmış programlar daha çok şu alanlarda kullanılmalı.

[ ] Yeni bir konuyu öğrenirken.

[ ] Konu hakkında bilgi veya fikir sahibi olduktan sonra alıştırma yaparken.

[ ] Bir konuyu öğretirken yardımcı araç olarak.

[ ] Sadece belirli konularda * _____

[ ] Uygulama yaparken, yardımcı araç olarak.

[ ] Hiçbir yerde kullanmamalı.* _____

[ ] Diğer* _____

5. Genelde yardım dosyalarını okurum.

[ ] Evet [ ] Hayır [ ] Bazen* _____

6. Böyle bir araç yardım dosyalarını okumaya ve cevap aramaya göre daha güdüleyicidir.

[ ] Evet [ ] Hayır [ ] Kısmen* _____

7. Programın kullanımını anlatan "Welcome" ve "Use of program" sayfaları yeterlidir.

[ ] Evet [ ] Hayır [ ] Kısmen* _____

8. Programın aşağıdaki kısımlarını en çok kullanığınızdan en az kullandığınıza doğru sıralar mısınız? *(1: En çok, 4: En az)*

Görsel kısım (Yanıp sönme etkisi) : _____

Açıklama kısmı : _____

"Be Aware That" listesi (Sağ alt) : _____

"Also see" listesi (Sol Alt) : _____

9. Programın aşağıdaki kısımlarını en çok beğendiğinizden en az beğendiğinize doğru sıralar mısınız? *(1: En çok, 5: En az)*

Görsel kısım (Yanıp sönme etkisi) : _____

Açıklama kısmı : _____

"Be Aware That" listesi (Sağ alt) : _____

"Also see" listesi (Sol Alt) : _____

Konular arasında ilerleme (Navigation) : _____

10. Çalıştığınız konuların bu şekilde düzenlenmiş olmasını tercih eder miydiniz?

[ ] Evet [ ] Hayır [ ] Kısmen* _____

11. Programı görmeyen bir kişiye programın amacını ve temel özelliklerini kısaca nasıl anlatırdınız?

_____

_____

_____

12. Program ile ilgili eksik ya da hatalı bulduğunuz noktalar ya da eklemek istediğiniz noktalar nelerdir?

_____

_____

_____

_____