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A Diffusion of Innovation Model Modified for Educational Technology Working with Coaches and Physical Education Teachers

by

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies, for acceptance, a thesis entitled "A Diffusion of Innovation Model Modified for Educational Technology Working with Coaches and Physical Education Teachers" submitted by Tsily Liebermann in partial fulfillment of the requirements for a degree of Doctor of Philosophy.

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Abstract

The investigation had two major goals. The first was to explore the status of the adoption of computerized technology in the fields of teaching and coaching volleyball. The motivation for conducting this research comes from the lack of studies exclusively carried out to explore the status of technology in the field of physical education and sport coaching.

The results showed that using computers for general purposes has already diffused almost completely. However, the picture is different with regard to the specific use of computers within physical education and sport, where more than half of the Late Majority and all the Laggards are still not using them. Additionally, the most popular applications used by teachers and coaches are general ones (e.g., word-processing, spreadsheets). Not many are using specific applications designed to assist teachers and coaches in carrying out unique assignments.

The second goal of the investigation was to study the process of the diffusion of innovation; and, more specifically, to learn about the role of several external factors within the diffusion of the innovation paradigm (Rogers, 1995). While in recent years many studies have focused on the input of perceived attributes of the innovation on the adoption process (e.g., Davis, Bagozzi & Warshaw, 1989), the research on the importance of an individuals' characteristics is relativity virgin. A modified model (based on the diffusion of innovation and technology acceptance models) has been developed and was used to test external factors that may affect one's decision to adopt or reject the innovation, as well as its implementation. The hypotheses related to the Technology Acceptance Model (TAM) and the relationship between innovation attributes and intention to adopt an innovation were supported. Additionally, specific attitude towards using computers within sports and physical education, professional innovativeness and formal education level were found to affect the characteristic of innovation and indirectly intention. Validation of the suggested model with a larger sample is recommended. This will allow exploration of more variables and their reciprocal relationships.

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Tsily Raz-Liebermann

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CHAPTER 1

INTRODUCTION

Technology profoundly affects many areas related to sport and physical education (Martens, 1997), from the development of new materials to be used in specific equipment (e.g., the pole in pole vault) through video demonstration for teaching a new skill, to biomechanical performance analysis. Technology can affect sport to such an extent that the advancements in equipment design may improve performance so much that it could even destroy the challenge in some sports (May, 2000).

The recent development in digital technology makes it possible for physical education teachers and coaches to gather efficiently and effectively, analyze, and integrate information and resources in order to improve teaching and training (Katz, 2001). As technology evolves it offers new and creative applications. However, in order for technological innovations to be used by teachers and coaches, those individuals need the technological background and the right attitude towards technology. In many cases however, there is a widening gap between changes and innovations that technology brings and the human capacity to adapt to them (Katz, 2001).

The level of diffusion of technology in coaching and teaching is still an open issue. Not much has been reported in the literature. Recently, Liebermann, Katz, and Morey-Sorrentino (2005) looked at senior coaches' attitudes toward technology. The results showed that advanced coaches seem to have a positive attitude towards the use of sport technology, but this attitude does not always translate into actual practice within the competitive environment.

The aim of this thesis was to study the diffusion of information technology among physical education teachers and coaches. Several questions about the level of diffusions have arisen. For example: to which categories of adopters (as defined by Rogers, 1995) has the computerized technology been diffused? This is a very important issue for sport related software developers and designers. As suggested by Norman (1998b), developing a tool for Early Adopters is very different from developing the same tool for the entire population in a specific social system, which includes Late Adopters and Laggards. For Laggards, the last individuals to adopt the innovation, technology is taken for granted and the tool has to be very 'user-friendly' in order to be adopted (Norman, 1998b).

The current study incorporated a modeling technique to try to identify the main external variables that affect an individual's intention to adopt a new technological tool such as the Interactive Volleyball CD-ROM, which was designed with this research in mind. The Diffusion of Innovation Model (Rogers, 1995) was validated in many different areas, such as hybrid-seed corn (Ryan & Gross, 1943), birth control (Freedman & Takeshita, 1969) and the Internet (Atkin, Jeffres, & Neuendorf, 1998). A more specific model, the technology acceptance model (TAM), which was developed by Davis, Bagozzi & Warshaw (1989) was suggested to explain diffusion of information technology (IT). These two models underlie the theoretical basis for the study.

The area of instructional technology implementation has been previously studied under the framework of Diffusion of Innovation. Several studies have also focused on the identification of the significant factors contributing to educational technology implementation (e.g., Anderson, Varnhagen, & Campell, 1998; Groves & Zemel, 2000; Liu & Johnson, 1998). Most studies however, have simply investigated one or two factors, focusing on either the psychological perspective or the environmental perspective of factors, and disregarding other relevant variables (Park, 2003).

However, the adoption and implementation of an innovation is a multifaceted process that is influenced by many factors. A complex interaction of social, economic, organizational, and individual factors can influence technologies that are adopted as well as the ways they are used after adoption (Park, 2003).

In the present study, three categories of variables were found in the literature to be related to the rate of diffusion. They were identified and studied using a modified model described in section 2.4. Subjects' self-efficacy, innovativeness, previous experience in using computers, as well as attitudes towards working with computers, are among the personal characteristics variables which have been collected and tested. Additionally, demographic variables, such as age and education were also measured. From the social point of view, the effect of the international context, or more specifically communication channels was also considered. Finally, two perceived attributes of innovation were monitored and introduced into the model: perceived relative advantage and perceived complexity.

Using multiple linear regression techniques the most profound variables, which affect the intention to adopt the CD-ROM, have been recognized. These variables were specific attitudes, professional innovativeness, education, perceived relative advantage and perceived complexity. While the regression model represents only direct effects, in reality, it was expected that some variables would also have indirectly affected one another through one or more intervening variables. Therefore, the structural equation modeling (SEM) was used. The hypothesized model of the study, which was validated using the data collected from physical education teachers and coaches, is described in Figure 1.1.

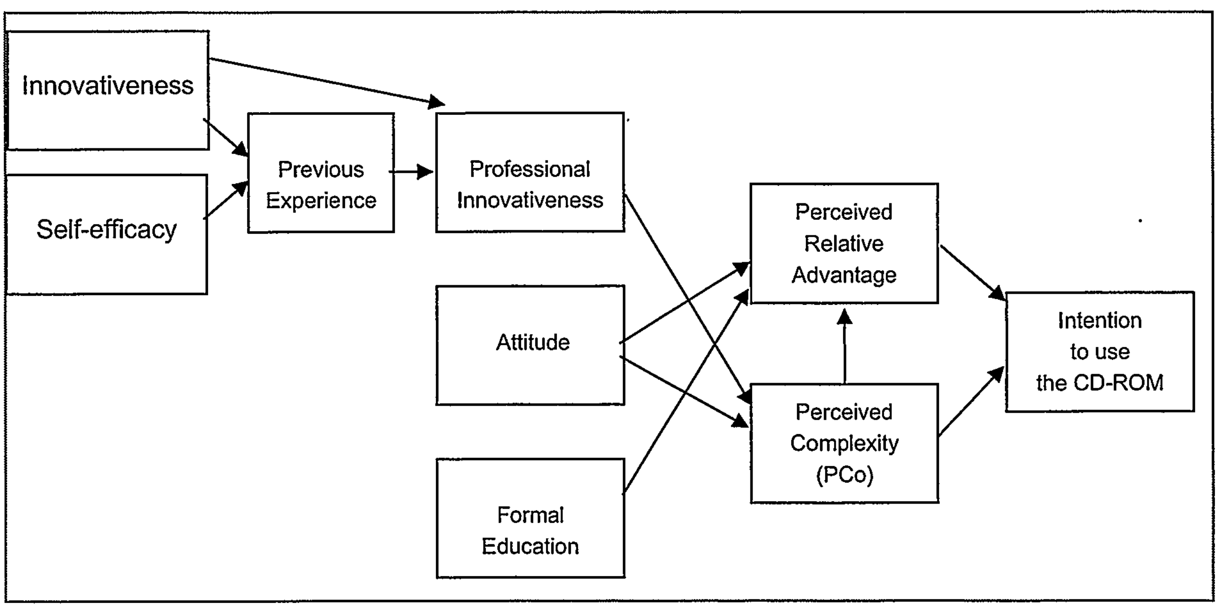


Figure 1.1. The modified model tested in the study.

1.1 Purposes of the Study

The current study had two major aims. The first was to study the relationships between instructional technology and physical education teachers and coaches. Subjects were asked about the technologies they used for general purposes and job-related tasks. They were also questioned on the duration of time they had been using digital technologies and their attitudes toward usage.

The second aim was to build a model that would help to predict the level of adoption of an innovation and to validate it with the data collected on teachers and coaches. The focus was the external variables and, therefore, several independent variables were identified and tested within the model. Understanding the reason people use or not use instructional technology seems very critical to instructional designers and developers. This is the primary reason why the field of adoption/diffusion of innovation should be studied.

1.2 Significance of the Study

Although there have been many studies of the adoption/diffusion of innovation, few have dealt with more than a limited number of external variables and their interrelationships (Park, 2003). In reality, it is assumed that a person will be influenced by different factors (e.g., psychological and environmental) for developing an intention to adopt or to utilize an innovation. The main concern of the innovation diffusion research is the way innovations are adopted and the reason innovations are adopted at different rates. Therefore, the development of the study model, which includes variables from different perspectives, and the empirical results generated, may add to the understanding of adoption and utilization processes of instructional technology especially, in physical education and sport.

This was a pioneering study in physical education and sport within the diffusion of innovations framework. As such, the result would also be helpful to instructional designers. Instructional technologists not only need to create well-designed products, but also to ensure the adoption of these products. When it comes to successful educational program design, the consideration of the characteristics of the target audience is essential to the analysis phase in most instructional design models (Norman, 1998a).

CHAPTER 2

LITERATURE REVIEW AND MODEL DEVELOPMENT

This chapter is divided into four main sections. The first section (2.1) introduces the use of computer-based technology in the fields of sports and physical education. In section 2.2 the diffusion of the innovation model (Rogers, 1995) is discussed. Section 2.3 presents applications of the diffusion model in the field of information technology, and introduces the TAM. The development of the model that was tested in the study is described in the last section (2.4).

2.1 Information Technology in Physical Education

The use of technology to enhance coaching and teaching has been recognized as an important factor (Katz, 2001). These days, computer-based technology influences many sport-related areas such as equipment design, performance evaluation, game statistics and analysis, measurements, and computerized training. However, technology especially designed for sport and physical education appears to be in the early stages of diffusion among coaches and physical educators. The impact on teaching physical education and coaching is usually less dominant compared to other disciplines.

The following are possible reasons for explaining the reason the use of computer-based technology in physical education has lagged behind:

1) *There is no "natural connection" between computers and physical education* - It is relatively difficult to incorporate computers in teaching physical education, compared to other disciplines such as mathematics or science (Raz-Liebermann, 2000).
2) *The teachers' attitudes* – Woodrow (1992) found that one of the necessary conditions for effective use of information technology in the classroom is a positive teacher attitude towards the use of computers. One reason for the relatively low level of technology adaptation in physical education and sports might be the level of implementation of technology in physical education colleges and university faculties. Since college students of today are the teachers of tomorrow, the use of technologies affects whether or not physical education teachers will incorporate computers into their teaching curricula. Consequently, the implementation of computers within the field of physical education should start in colleges and universities. This is expected to create a generation of teachers with more confidence and expertise in using computers and a higher awareness of the potential of the use of technology in teaching physical education (Raz-Liebermann, 2000).
3) *Physical education is a "practice subject"* – Traditionally, physical education has essentially been considered as a practice subject (Fox, 1992). According to this view, physical education topics can be learned primarily by active participation in physical activity. Under such an assumption,

cognitive processes take only a minor role and the possibilities of incorporating instructional software are limited.

4) *Availability of hardware and software* – While today many schools have computer laboratories, only few have computers in the gym, swimming pool, or on the athletics field. In the same vein, many math teachers in schools have personal computers at work, but this is not the case for physical education teachers. An additional problem is the availability of educational software that can be used in the class. Even though there is an abundance of sport-related software commercially available, only a small proportion is designed for educational purposes. This might be because such software is usually designed for entertainment, and thus, the motive underlying its development is economic (Raz-Liebermann, 2000). It seems that few, if any, of today's products are designed to meet actual educational needs (Flowers, 1998). The lack of accessibility of hardware in places where it is most needed by teachers, and the accompanying lack of software, are reasons for the limited use of computers in physical education.

However, in spite of the problems and concerns associated with the adoption of information technology in physical education, there are some unique advantages for recommending adoption of technology in this field:

1) *Visual and dynamic topic* – Important characteristics of physical education and sport are dynamics and visibility. It is relatively difficult to understand

performance features by written text alone. The use of computers can be very beneficial in visualizing sport performances, biomechanics principles, and muscle physiological processes. For example, in a physical education class, students can observe the performance of a long-jump in slow motion, with an overlaid animation illustrating the center of mass dynamics (force vectors and moments) and kinematics during the movement the jump (Raz-Liebermann, 2000). Many sport-related encyclopedias can be found where the user can see and/or hear video clips, sounds, pictures, and text. An advantage of digital playback technology is that the observer may get a better insight into fast and dynamic actions at his/her own pace since speed of replay is under his/her control. In addition, digital video technology enables a combination of video images and graphics.

2) *Improved performance* – A number of studies have shown the advantages of using instructional software for teaching physical education topics (Kerns, 1989; Skinsley & Brodie, 1990; Steffan & Hansen, 1987). For example, Skinsley and Brodie (1990) found that students who have experienced a computer-assisted instruction better understood and retained information as compared to students that were instructed using traditional methods.

3) *Multidisciplinary discipline* – Physical education is a multidisciplinary field, and as such, finding and focusing on relevant information may be problematic. Kinesiology, the field of study of theoretical and functional aspects of human movement, brought about a broad body of knowledge that

emerged in the last 30-40 years. It includes diverse scientific subtopics such as biomechanics, exercise physiology and sport psychology. Thus, Kinesiology could benefit from the use of information technologies (Fox, 1992) in a way similar to that used in other scientific integrative multidisciplinary areas of interest.

In addition, an essential requirement in many jobs today is the ability to locate information quickly. In multidisciplinary subjects such as physical education, this is further complicated since content materials are related to many other disciplines (Haggerty, 1999). When the data is in a digital form, it is relatively easier to find, filter, access, and present in effective and efficient ways by means of computer technology (Haggerty, 1999).

4) *Productivity tool* - One application of information technology in teaching physical education and coaching sports is the "productivity coaching tool." Fraser and Daniels (1980) predicted that computers would be the number one coaching tool of the eighties. However, they may have been overly optimistic as this is still an issue in 2005.

Even though currently available software can be used for recording and analyzing sport performances, in other aspects (e.g., in the evaluation of physical parameters, scheduling sport events and creating individual fitness programs) available software does not seem to meet coaches' and teachers' needs. According to Haggerty (1999), computers can help the coach/teacher in different administrative and analytical tasks (e.g., finding and selecting information, analyzing and visualizing results). This is an important benefit considering the information overload that people currently experience. Donald (1991) suggested that computers could be considered as "external extensions" of human biological memory. That is, the need for an external device such as a computer (Haggerty, 1999) stems from the limited information storage and processing capabilities of biological memory.

This section has summarized the major problems and advantages in adopting information technologies in the areas of sport and physical education. The next section presents the status of computer technology within these areas of study.

2.1.1 Brief History Review and Overview of the Status of Information Technology in Physical Education

Computers were initially introduced in sports mainly as a solution to data management problems (Franks, 1992). During the 1980's, many applications were designed for capturing, analyzing and evaluating sport performances. Computers were used as assistive tools for physical education teachers or coaches. The underlying principle of those pioneering applications was the availability of accurate and fast feedback of knowledge of results (KR), which was assumed to enhance and accelerate the motor learning process (Franks, 1992). In the 1990's, with the development of hypertext and multimedia, there were hopes that especially designed software would become a leading tool in the physical education classroom (Katz, 1992). However, hopes did not seem to realize.

Beside personal communications and experience, only a few studies have investigated the status of computer technology in physical education and/or sports. Skinsley and Brodie (1992) conducted a survey in England in which 372 physical education teachers were asked about their information technology awareness and experience. The authors concluded that there was a low level of computer awareness amongst physical education teachers. This was highlighted by the fact that only 29% of teachers reported using computers for any purpose, while only 9% used them on a regular basis. In addition, 13% of teachers reported that they used the computer when teaching, but mainly in administrative applications. These findings clearly showed that most physical education teachers had not benefited from the developments in information technology. Skinsley and Brodie (1992) pointed out that the reason for such phenomenon might be that "...unlike many other curriculum areas, the amount of subject specific software for physical education is still limited" (p. 18). Martens (1997) conducted a survey on 105 members of the American Academy of Kinesiology and Physical Education and found that even though many people used computers for word processing computers were not widely used as educational tools in the movement education sciences. The subjects Martens's study were also asked how well technology was used to advance the discipline of kinesiology. The results showed a mean score of 3.1, with a rate of 1 being "not well" and 5 being "very well." The results were even lower (mean score was 2.4) using the same scale when the same question was asked with regard to physical education (Martens, 1997).

However, from the literature, one cannot determine the status of computer implementation in sport teaching and coaching. The two studies previously reported in this chapter were carried out 11 and 8 years ago, respectively. It might be that physical education teachers and coaches are currently in the fast phase of the diffusion of the technology curve and, therefore, results of new studies may differ from those found a few years ago.

As a positive attitude towards using technology is a major factor in determining the adoption of the technology, it is important to study coaches' and teachers' attitudes towards computer usage. Previous studies (Huan, Compley, Williams, & Waxman, 1992; Padron, 1993) found that teachers did not always have positive attitudes towards technology. However, in recent years, Liebermann, Katz, and Morey-Sorrentino (2005) studied a group of 27 highly experienced and educated coaches. These researchers found that most of group participants not only believed that there is a role for technology in coaching (mean 4.54 on a 5-point scale) but also considered themselves to be relatively comfortable in using technologies (mean 4.33 on a 5-point scale). However, it should be emphasized that such a sample might not be representative of the general population of coaches, many of whom are less experienced. The sample size was also relatively small (n=27).

It is suggested that there is a need to study the current status of information technology and factors that might affect the diffusion of a technological innovation in physical education and sports.

2.2 Diffusion of Innovations Model – Rogers (1995)

Some new ideas or products are adopted very quickly, while others require lengthy periods before adoption. Additionally, the same innovation will be adopted at different rates by different individuals. The framework of diffusion of innovations (Rogers, 1995) could be used for explaining these phenomena. The model may be used to describe patterns and mechanisms of adoption, as well as assist in predicting whether an innovation will be successful and, if so, in what way (Clarke, 1999).

Diffusion is "the process by which an innovation is communicated through certain channels over time, among the members of a social system" (Rogers, 1995, p: 5). Therefore, the four main elements in the diffusion of a new idea or a product are: (1) the innovation, (2) the communication channels, (3) the time, and (4) the social system. An innovation can be "an idea, practice or object that is perceived as new by an individual or other unit of adoption" (Rogers 1995, p: 11).

The study of innovation diffusion is relatively new (Surry, 1997). It may be traced back to the study conducted by Ryan and Gross in 1943 on rural sociology in Iowa. These researchers investigated the rapid diffusion of hybrid corn to learn about aspects of this process that could be applied to other farming-related innovations. Since 1943, a number of researches (e.g., Tarde, 1969; Wellin, 1955; Rogers, 1995) have built on the work of Ryan and Gross (1943) and developed theories related to the diffusion of innovations. Researcher Everett M. Rogers is most responsible for establishing a "research tradition" in the field. His book *Diffusion of Innovations* was first published in 1960, and it is now in its fifth edition (2003). Rogers saw the similarities in all the studies carried out in the different disciplines and the potential for a general model. Rogers' diffusion of innovations model included three main theories: "the innovation-decision process," "attributes of innovations and their rate of adoption," and "innovativeness and adopter categories attributes" that are briefly described here.

2.2.1 The Innovation-Decision Process Theory

According to the diffusion of innovation model, diffusion of innovations is a process that takes place over time. The innovation-decision process has been defined by Rogers (1995) as the "process through which an individual (or other decision-making unit) passes from first knowledge of an innovation to forming an attitude towards the innovation, to a decision to adopt or to reject, to implementation of the new idea and the confirmation of this decision" (p. 20). Based on the theory, the process includes five distinct stages (Rogers, 1995) (see Figure 2.1).

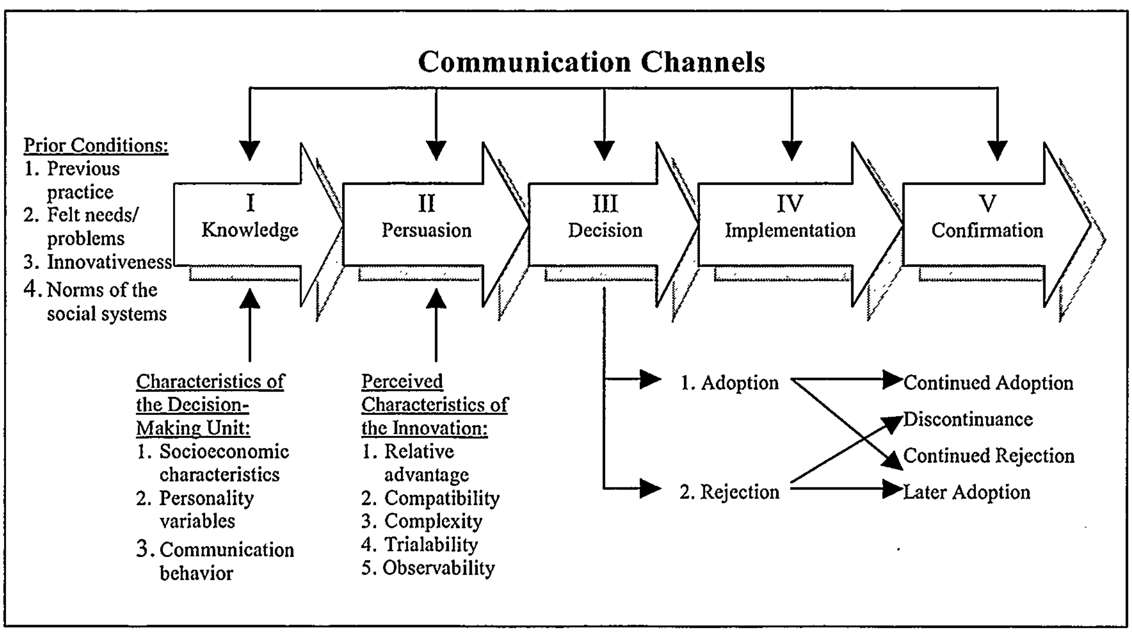


Figure 2.1. A model of stages in the innovation-decision process (Rogers, 1995, p: 163).

a) **Knowledge** – In this cognitive stage, the individual (or any other decision-making unit) gains basic information about the innovation. First, the individual has to find out that the innovation exists (awareness-knowledge). Then, he/she learns how to use the innovation properly (how-to knowledge), and finally, the individual needs to understand functioning principles underlying the way in which the innovation works (principles-knowledge). Characteristics that may influence this stage are socioeconomic status, personality variables and communication behavior.

b) **Persuasion** - Persuasion occurs when the individual is forming an attitude, either in favor or against the innovation. In order to do so, the individual have to become more involved with the innovation. He or she seeks information about advantages and disadvantages. There are five main characteristics of an innovation that might influence the individual attitude at this stage: relative advantage, compatibility, complexity, trialability, and observability (these are elaborated in section 2.2.2). The formation of a favorable or unfavorable attitude towards an innovation does not always result in adoption or rejection. In some cases, attitudes and actions are quite in contrast. This "knowledge-attitude-practice" discrepancy is called the "KAP-gap." Some individuals are more likely to have a KAP-gap than others are. One reason might be a low self-efficacy (i.e., the individual's belief that he/she cannot easily solve problems by him/herself).

c) **Decision** – During the decision stage, the individual engages in activities that lead to a selection between adopting and rejecting an innovation. In some cases, this decision is based on simple trial-error or some minor experience with the innovation. In some cases, the experience of peers might be sufficient.

d) **Implementation** – In the implementation stage, the individual uses the innovation. The first sign of a behavioral change can be seen at this stage. One issue is the decision about adopting an innovation, and another is the actual use of an innovation. The implementation stage ends when the innovation becomes an integral part of the adopter's behavior. In some cases, re-invention (i.e., an innovation change and its evolution) may take place at this stage.

e) **Confirmation** – The confirmation stage will not always occur for all individuals. At this stage, individuals might look for reinforcement of the innovation-decision process, or a reversal of the previous decision to use it.

2.2.2 Attributes of Innovations and their Rate of Adoption Theory

Researchers are able to plot "diffusion curves" using the number of adopters as a function of time. Innovation curves usually present normal, bell-shape profiles (Rogers, 1995). When “cumulative number of adopters” is used as the dependent variable, the result show an S-shaped curve (see Figure 2.2).

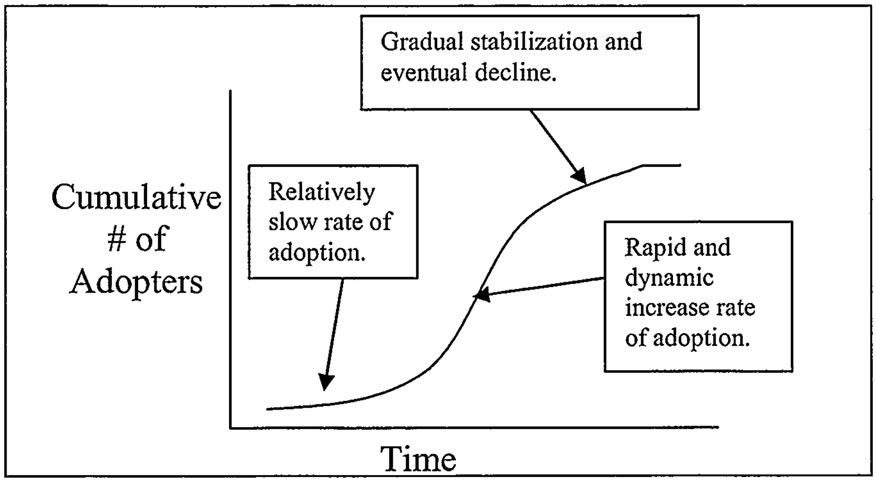


Figure 2.2. An S-shaped curve (based on Rogers, 1995).

This shape is a result of different diffusion rates at different stages. At the beginning of the process, the rate of adoption is positively accelerated but relatively slow. In the mid-stage of the diffusion process, a rapid increase is observed followed by a negatively accelerated rate of increase that may reach an asymptote (saturation) as time passes. The innovation’s rate of adoption may gradually stabilize and eventually decline.

Rogers (1995) has pointed out five variable-groups that may determine the rate of adoption: (1) Perceived Attributes of Innovations, (2) Type of Innovation-Decision (optional, collective or authority), (3) Communication Channels (e.g., mass media, interpersonal), (4) Nature of the Social System (e.g., it norms, degree of network interconnectedness) and (5) Extent of Change Agents’ Promotion Efforts.

The most dominant group of variables (one that was further tested in the present study) is the Perceived Attributes of the Innovation. Rogers and Scott (1997) have reported that 49-87% of the variance in the rate of adoption can be explained by the five perceived attributes of the innovation (relative advantage, compatibility, complexity, trialability, and observability). Innovations that are perceived by the individual as having high relative advantage, compatibility, observability and trialability, and less complexity, will demonstrate a faster rate of adoption compared to other innovations. The higher the innovation sums on each one of these characteristics, the faster the rate of adoption. An important point is that the innovation does not need to be better or easier to use than other products, but it should be perceived as such. The following is an explanation of each of the five perceived characteristics of the innovation.

Relative advantage – The relative advantage of an innovation is defined as "the degree to which an innovation is perceived as being better than the idea it supersedes" (Rogers, 1995, p: 212). Therefore, if using a personal computer (PC) is perceived as an easier way to write practice plans (compared to the traditional method of using pen and paper), then the computer is said to have a relative advantage. This will increase the likelihood of the PC (and the software) being adopted over traditional methods. In many studies, relative advantage (or usefulness) were reported as the strongest predictors of adoption and usage behavior (Adams, Nelson, & Todd, 1992; Agarwal & Prasad, 1997, Agarwal & Prasad, 1998).

Compatibility – Compatibility of an innovation is defined as "the degree to which an innovation is perceived as consistent with the existing values, past experience, and needs of potential adopters" (Rogers, 1995, p: 224). The more compatible the innovation, the more likely will be its adoption.

Complexity – The complexity of an innovation is defined as "the degree to which an innovation is perceived as relatively difficult to understand and use" (Rogers, 1995, p: 242). In other models, such as TAM (see next section), a characteristic of a similar innovation is called the "perceived ease-of-use." The rate of adoption of innovations that are perceived as being "difficult to use" will be slower than that of those that are perceived as being "easy to use."

Trialability – The trialability of an innovation is defined as "the degree to which an innovation may be experimented with on a limited basis" (Rogers, 1995, p: 243). An innovation that can be used on a trial basis before making the decision about its adoption represents less uncertainty for the individual (Rogers & Scott, 1997). Consequently, the rate of adoption of a trainable innovation will be higher compared to innovations that cannot be tried out.

Observability – The observability of an innovation is defined as "the degree to which the results of an innovation are visible to others" (Rogers, 1995, p: 244). In the case of new ideas, for example, the observability of the innovation might be zero. According to the theory, the easier it is for the individual to see the benefits of the innovation, the more likely he or she will adopt it.

2.2.3 Innovativeness and Adopter Categories Attributes Theory

It is very clear that different people adopt innovations at different rates. One of the main variables in diffusion research is innovativeness, which may explain the differences between individuals in the adoption of an innovation. Innovativeness is defined as "the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than other members of a system" (Rogers, 1995, p: 252). Based on their innovativeness at the onset of adoption of an innovation, individuals can be classified into five categories of adopters (see Figure 2.3): Innovators, Early Adopters (EA), Early Majority (EM), Late Majority (LM) and Laggards.

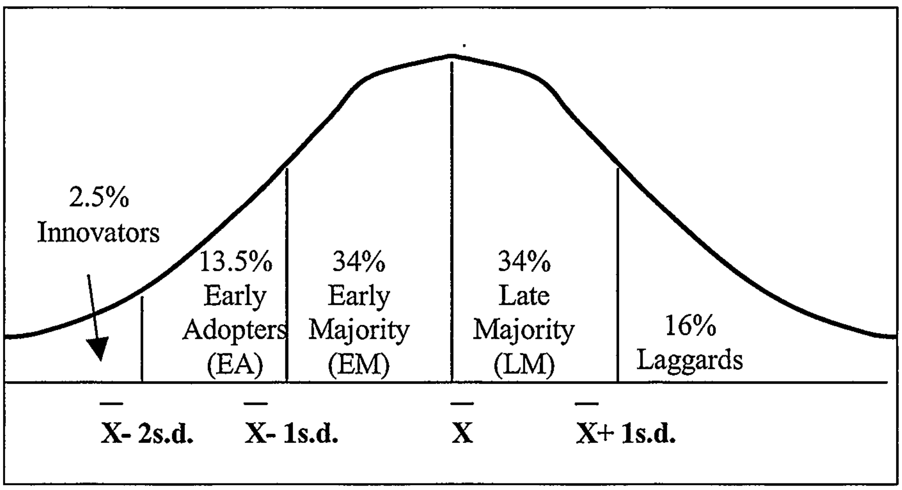


Figure 2.3. Adopter Categories based on innovativeness (Rogers, 1995, p: 262).

It is important to notice that innovativeness is a continuous variable that usually follows a normal distribution. The classification into the five categories is only to simplify the model and for illustration purposes. The categorization is based on the average of the innovativeness in the population and its standard deviation.

Innovators – Innovators are a small number of people (about 2.5% of the population) who are likely to be the first to adopt innovations. Usually, they are well educated, "risk takers," who may have a relatively high-income. In many cases, the innovators have a high ability to understand new technologies and are better able to cope with a high degree of uncertainty (Rogers & Scott, 1997).

Early Adopters – Early adopters comprise the next 13.5% of the individuals to adopt an innovation. According to Rogers and Scott (1997), those individuals are usually the opinion-leaders that serve as role models for the other members of the system.

Early Majority – The early majority represents the 34% of the individuals who choose to adopt an innovation just before the average member of the system (Rogers & Scott, 1997).

Late Majority – Late majority represents the next 34% of the population that adopt the innovation just after the average member of the system (Rogers & Scott, 1997).

Laggards – Laggards comprise the last 16% of the population that finally adopt an innovation. Usually laggards are skeptical of any changes or new ideas, are less educated and have limited resources.

In the present study, the innovativeness of the individuals is calculated based on the first time they started to adopt computer technologies for daily tasks. Thereafter, they are categorized into the above categories for future analyses. For the purposes of the statistical analysis, the Jacobsen (1998) method is adopted and only two major categories are used: 1) Early Adopters (16% which includes 2.5% Innovators + 13.5% Early Adopters) and 2)

Majority (which she called 'mainstream', include 84% of: 34% Early Majority + 34% Late Majority + 16% Laggards).

2.3 Diffusion of Innovation Research and Information Technology

This section discusses the ways in which the theories of innovation diffusion have been incorporated into the field of information technology (IT). An additional diffusion model that was specifically designed for the field of information technology – the TAM – is also presented.

The Diffusion of Innovation theoretical framework has been widely used in a variety of studies in different disciplines such as education, public health, communication, marketing, geography, general sociology and economics (Rogers & Scott, 1997). It has potential applications in the field of information technology, which is broad and diverse. At present, the information technology field is incorporating theories from areas such as communication, cognitive psychology, management, computer science and behavioral psychology (Surry & Fraquhar, 1997). Research in diffusion of innovations may help to understand the factors that influence the adoption of an innovation. Such understanding may help information technology designers to develop new tools that can enjoy rapid success.

Two of the most appealing characteristics of the diffusion of innovations model are its simplicity and its "generalizability." The model has been tested under different conditions and constraints, and has been found valid (i.e., Ryan & Gross, 1943, Atkin, Jeffres, & Neuendorf, 1998). According to the model, the diffusion of hybrid corn will present a similar process and characteristics as diffusion of the use of Internet. Rogers (1995) mentions only one unique feature of technological innovation – technology clustering. Elements of technology that are seen as being interrelated are referred to as technology clusters. In the mind of a potential adopter, one innovation might be perceived as related to another technology that he/she already used.

The same concept is also referred to as multi-product innovation (Mahajan & Peterson, 1985). This fact will influence a person's decision (i.e., to adopt or reject the innovation). This idea is very appealing for new technologies such as computer tools, and has already being studied in agriculture (Silverman & Baily, 1961). However, further research is required to analyze the influence of technological clusters on the rate of innovation diffusion. In this study, the "previous experience of working with computer in the field of coaching and teaching" (in short: previous experience) was incorporated into the model, as an external variable, and its influence on the intention to use the Interactive Volleyball CD-ROM was tested.

Adaptation of the general model of innovation diffusion to the field of information technology might include adaptation of the perceived characteristics of the innovation. Moore and Benbasat (1991) attempted to do this by extending the model and adding two perceived characteristics of the innovation (image and voluntariness of use) to the basic five suggested by Rogers (1995). Image, which Rogers included as part of the relative advantage, was defined as "the extent to which using the innovation was perceived to enhance one's image or status in the organization" (Compeau & Meister, 1997, p: 2).

Voluntariness was "the degree to which use of an innovation is perceived as being voluntary, or of free will" (Moore & Benbasat, 1991, p: 195).

In order to test empirically the seven perceived innovation characteristics, Moore and Benbasat (1991) developed seven scales and conducted an experiment with three groups of potential adopters of personal workstations. Based on factor analysis, they suggested that: a) relative advantage and compatibility were empirically indistinguishable, b) observability was made up of two distinctly different dimensions (results demonstrability and visibility), and c) trialability is confused with voluntariness.

In order to test further the reliability of the scales developed by Moore and Benbaset (1991), Compeau and Meister (1997) collected data in three different settings with different versions of the same scales. They concluded that while the scale for measuring relative advantage, compatibility, image and ease-of-use, are reliable across changes in context, the reminding scales are not.

2.3.1 Technology Acceptance Model

A review of relevant literature shows that there are additional models although the diffusion of innovations model is popular for describing and explaining the acceptance of information technology. For example, an alternative model that is useful for predicting technological innovation, the TAM, was proposed by Davis, Bagozzi, and Warshaw (1989). The basis of this model is the theory of reasoned action (TRA) (Fishbein & Ajzen, 1975), which suggests that an individual's attitudes influence behavior and performance.

This theory was widely tested and accepted for a wide range of behaviors (Davis et al., 1989).

TAM was specially designed to explain computer usage. It proposes casual relationships between the two key beliefs of the users (perceived usefulness and perceived ease-of-use) and their intention and actual usage, which are mediated by individual attitude towards using computers (see Figure 2.4).

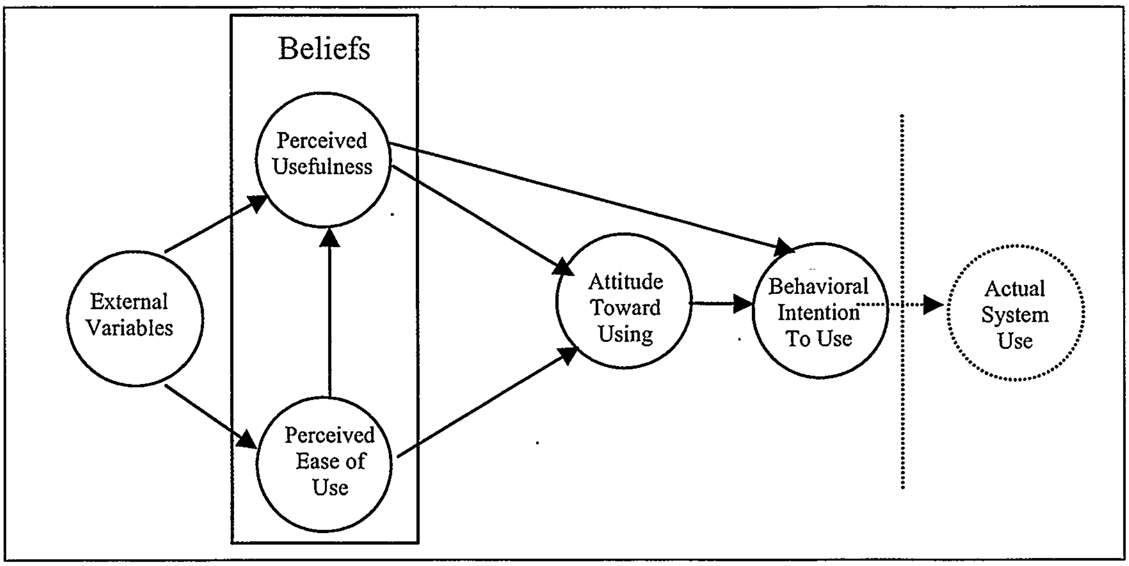


Figure 2.4. Technology Acceptance Model (Davis & Venkatesh, 1996, p: 20).

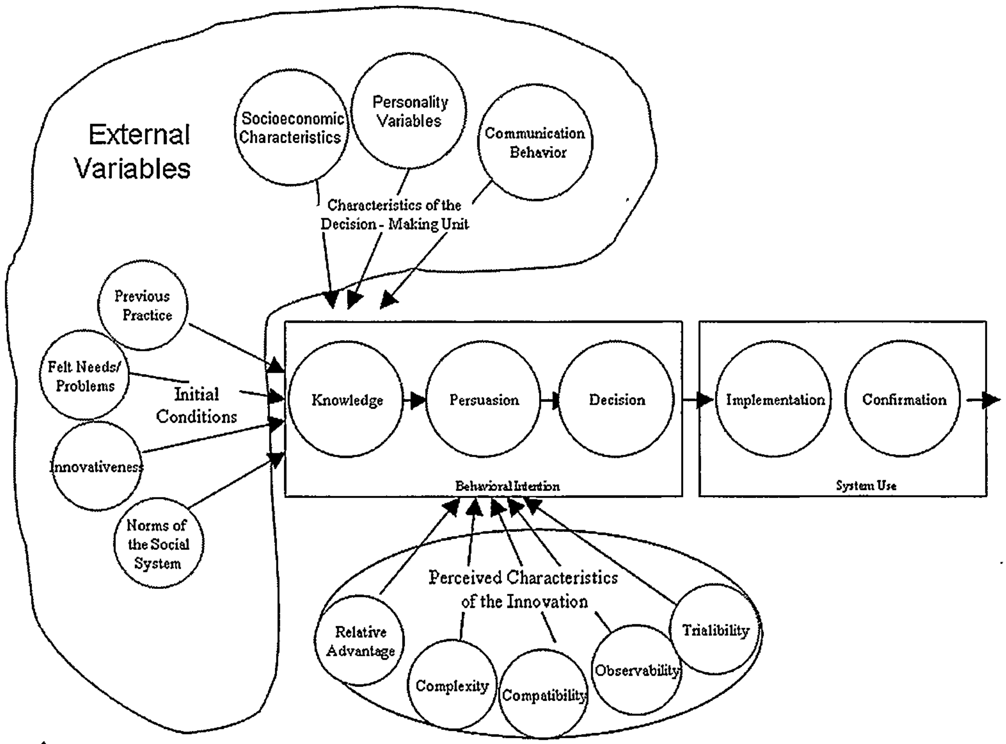
The model suggests that peoples' attitude and (indirectly) performance are influenced by two main "beliefs": perceived usefulness, and perceived ease-of-use of the innovation (Davis et al., 1989). These authors tested more than 100 students to assess, empirically, the ability of TAM to predict and explain users' acceptance of word-processing software. The results showed that perceived usefulness strongly influences the individuals' intention to use computers, while the perceived ease-of-use is a significant secondary determinant.

Adams, Nelson and Todd (1992) have replicated the previous study using electronic and voice mail. Based on their results, the investigators suggested that a variety of other factors should be added to the model in order to obtain better predictions.

2.4 The Development of the Model

As already mentioned, the major concern of the present study is to test the role played by external variables in the innovation adoption process. Although diffusion of innovation research has evolved for a number of years and is consistent with the importance of the perceived attributes of an innovation on its adoption, the treatment of differences among individuals is still inconsistent (Vishwanath, 2005). Based on the review of the literature, a modified model is developed that incorporates variables that are hypothesized to affect the adoption of the Interactive Volleyball CD-ROM by teachers and coaches.

The proposed model is based on the two models previously discussed in the chapter: Diffusion of Innovation Model (Rogers, 1995) and Technology Acceptance Model (Davis et al., 1989). The first step in the development of the new model is to find similarities and dissimilarities between the two previous models. In order to visualize these similarities and differences, flow diagrams of the two models are presented in Figure 2.5.



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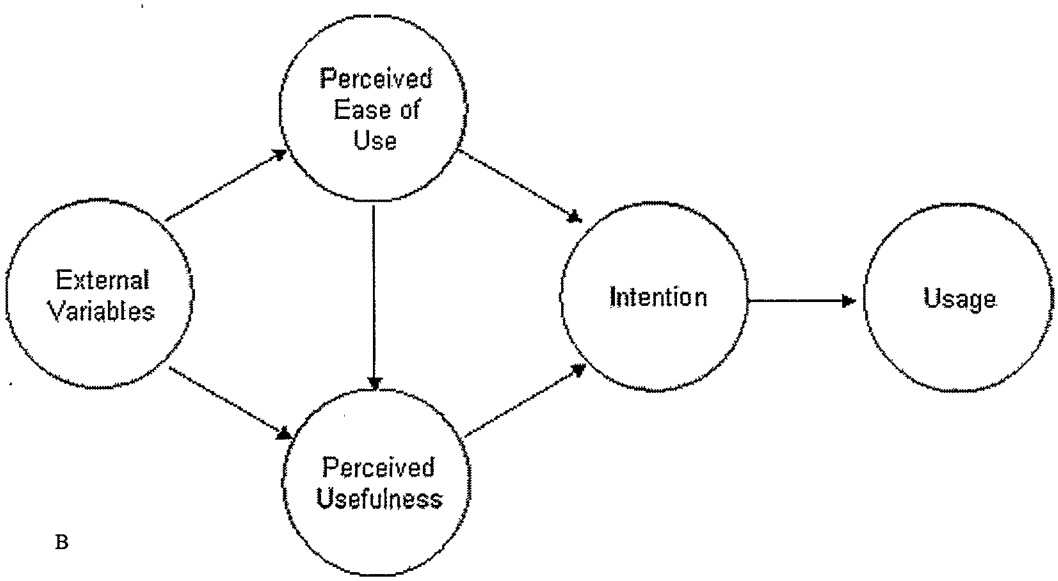


B

Figure 2.5. Schematic representation of the two models: A. - Diffusion of Innovation Model (Based on Rogers, 1995. p: 163), and B. - the Technology Acceptance Model (Based on Davis, et al. 1989).

Minor modifications to the diffusion of innovation model include:

1) A collapse of prior conditions needed for the innovation-decision process together with characteristics of the decision–making unit (to-be-considered as external variables).
2) A division of the five stages of the process into two major stages: a Behavioral Intention phase and a System Usage phase.
3) Exclusion of the Adoption/Rejection Attributes, which are assumed to affect the decision stage, from the model.

The extraction of the component 'Attitudes towards using technology', which was not measured in this study, is the only modification made to TAM.

The next step was to merge together components of the two models that share similarities, into one single factor. Both models suggest that attributes of the innovation (specifically: how the individual perceived the innovation's characteristics) are important and influence the diffusion. Both models also suggest that similar qualities of the innovation affect its diffusion.

Perceived Relative Advantage was defined by Rogers (1995) as "the degree to which an innovation is perceived as being better than the idea it supersedes" (p. 212). The perceived usefulness was defined by Davis and his colleagues (Davis et al., 1989) as "the users' subjective probability that using a specific application system will increase his/her job performance within an organizational context" (p. 985). The underlying assumption in both cases is that the more an innovation is perceived as having a higher relative advantage compared to the methods currently used, the greater the rate of adoption of the innovation.

Due to the similarity of these two definitions, the model incorporated here collapsed both factors together into one named, "Perceived Relative Advantage."

Perceived Complexity was defined by Rogers (1995) as "the degree to which an innovation is perceived as relatively difficult to understand and use" (p. 242). According to Davis et al. (1989) ease-of-use is the degree to which a potential adopter views the usage of the target system to be relatively free of effort. Again, due to the similarity of the two characteristics, they are incorporated into a single perceived complexity component. In fact, Davis (1989) already hinted to such a possibility in suggesting that "complexity parallels perceived ease-of-use quite closely" (p. 322).

A major difference between the two models can be found in the influence of external variables on adoption of technology. According to diffusion of innovation, external variables such as systems characteristics and users' previous experience may influence the decision process *directly*. On the other hand, TAM suggests that their influence is *indirect*, mediated by the individuals' beliefs.

Based on the evidence for such indirect relationships (i.e., Davis et al, 1989, Davis, 1989), the model proposed in the present study follows TAM, and suggests that the influence of the external variables is mediated by the users' perceptions about the characteristics of the innovation, particularly the innovative technology usefulness and ease-of-use.

External factors of interest are also incorporated into the present model. The following variables, assumed to contribute to predicting and explaining individual behavior, are tested: generalized self-efficacy, innovativeness, professional innovativeness, formal education, coaching education, coaching experience, volleyball coaching experience, previous experience using computer software, age, gender, international context, and attitudes towards working with computers. The hypothesized model is presented in Figure 2.6. Its components and interrelationships are explained in the following sections.

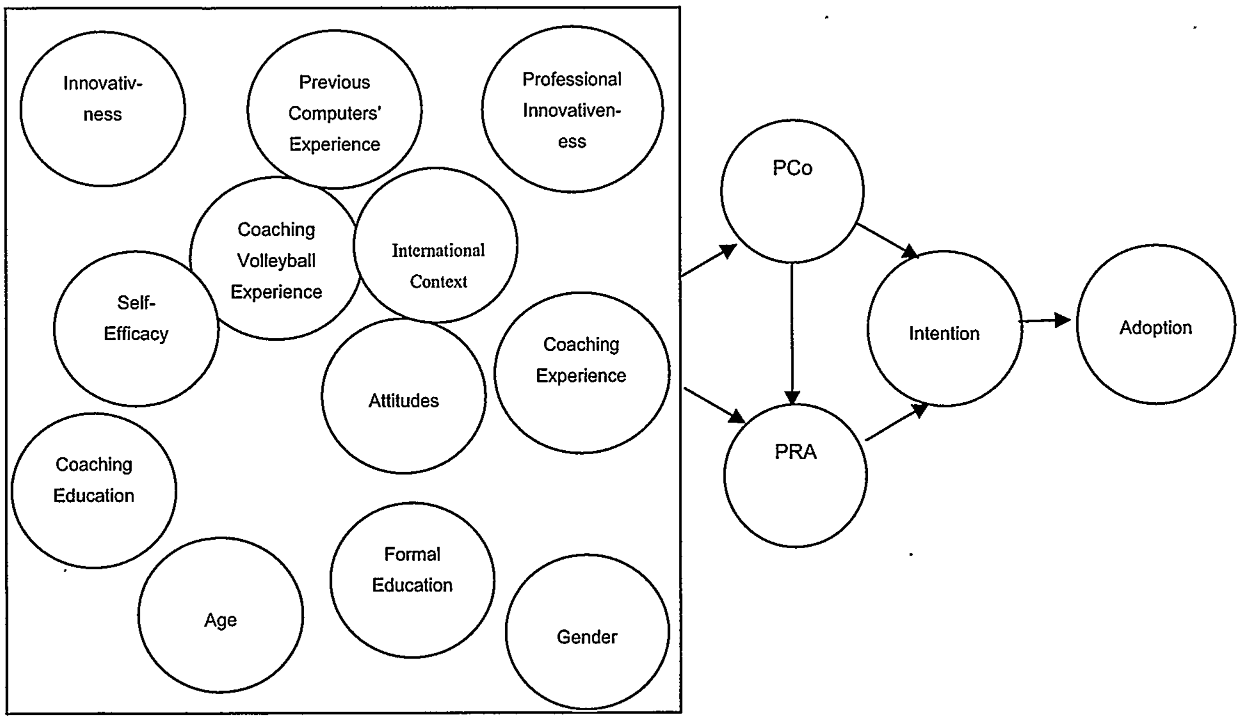
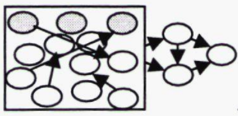


Figure 2.6. The proposed model.

2.4.1 Model Components:

The first component in the proposed model involves the identification and assessment of external variables that influence the diffusion outcome. In the current study, those external variables are used in the model as independent variables. Following, is a brief explanation of the introduction of each of the variables into the model.



2.4.1.1. Innovativeness, Professional innovativeness and Previous Experience

In the diffusion of innovation model of Rogers, there are few conditions that precede the innovation decision process, and that are suggested to affect the process of diffusion. These preconditions are previous practice, needs/problems, innovativeness and norms of the social systems.

In the proposed model, two of the four previous conditions are tested directly: previous practice and innovativeness, while norms of the social system are tested indirectly by comparing subjects from different countries. In addition, another innovativeness factor that assumes to be a content-specific was included (*professional innovativeness*).

Even though the innovation that is tested for acceptance/rejection is the Interactive Volleyball CD-ROM, it is argued here that its diffusion cannot be studied in isolation, without taking previous experience and innovativeness of computers applications and hardware into consideration. This assumption stems from Rogers' (1995) notion of *cluster technology, which has been defined* to consist "…of one or more distinguishable elements of technology that are perceived as being interrelated" (1995, p: 235). Koontz (1976) also pointed out that elements comprising an innovation may be tightly or loosely bundled together. In cases where the elements are more closely linked, it is difficult to adopt one element without adopting the others. This is an accurate assumption concerning the use of information technology. It is suggested that computer hardware and applications are tied together, and thus, the adoption of one tool (such as the Interactive Volleyball CD-ROM) cannot be studied in isolation of the other (i.e., software and computers hardware or associated tools cannot be studied separately).

Therefore, the study of software innovations, without considering the context of the associated technological innovations, is likely to result in arguments and lack of proper understanding of the process (Mahajan & Peterson, 1985).

Experience and innovativeness are conceptually close variables and, therefore, it is difficult to distinguish between them and measuring each one independently. In a previously reported investigation, Jacobsen (1998) suggested that for users to develop an "extensive" expertise with a particular tool, an earlier adoption of innovation should have preceded, as compared to users who perceives his/her expertise as a "little." Therefore, Jacobsen (1998) included in her questionnaires an item that asked users to rate their level of experience with each of a list of 44 computer applications and tools on Likert scale from 0 to 4. Thereafter, a composite score was calculated for *innovativeness* by summing the level of expertise on each of the tools. Similarly, Wei (2001) reported measuring *innovativeness* among cellular phone adopters by testing ownership in a cluster list of telecommunication.

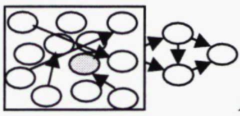
However, in the current study, an attempt was made to measure each of these variables (previous experience and innovativeness) separately, stressing the fact that innovativeness is time dependent and should be measured on a time-line.

Previous Experience – It is assumed that the individuals' previous experience in using computer software influences their decision on whether or not to adopt new software. This idea is also based on Rogers' concept of "technology cluster" (1995). As a result, subjects' previous knowledge and experience in working with computers was added to the model and assumed to correlate with the behavioral intention to adopt an innovation.

Innovativeness and Professional innovativeness – As mentioned, innovativeness, which is the degree to which an individual is relatively earlier to adopt an innovation, is a major component in Rogers' (1995) theory. The current model suggests making a distinction between general innovativeness (how fast subjects adopt an information technology) and professional innovativeness (how early they adopt it for coaching and teaching assignments). This dichotomy resembles the concepts of global and context-specific innovativeness of Vishwanath (2005).

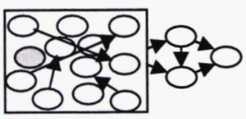
Innovativeness assumes a personality characteristic and, as such, it cannot be directly measured. In the current study, innovativeness is assessed with a procedure similar to that used in Jacobsen (1998) and Muller and Jacobsen (1997). Accordingly, subjects were provided with a list of tools and applications and asked to recall the year they first started using them. This result was used in the current study to measure subjects' innovativeness and to split the subjects into adopters' categories, while in the previously reported studies the composite score of previous experience was used. It seems to be more appropriate because it includes a temporal dimension, as suggested by Rogers (1995). In addition, participants were to recall the year they first started using the tool for their teaching/coaching purposes. This is a measure of professional innovativeness.

2.4.1.2. Other External Variables



Attitudes towards Working with Computers – The influence of individual attitudes on behavior is extensively addressed. Teachers' attitudes towards information technology and its influence on usage has been a much-debated research topic (Akaba & Krunbacak, 1998; Pardon, 1993). Successful use of computers is closely related to teachers' attitudes towards computers (Lawton & Gerschner, 1982). Stevens (1980, as cited by Violato, Marini, & Hunter, 1989) identified teachers' attitudes and expertise in using computers as major factors in the adoption of computers in the classroom. A positive attitude towards computers is widely recognized as a pre-condition for an effective use of information technologies in the classroom (Woodrow, 1992).

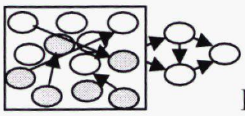
In this study, two scales are used to measure subjects' attitudes towards working with computers. The CAS (computer attitude scale) served to measure Anxiety, Liking, Confidence, and Usefulness, both separately and collapsed into a global attitude score. A newly developed scale is also incorporated to measure specific attitudes towards using computers within the field of coaching and teaching physical education. The scale is used to determine general attitudes as well as specific attitudes.



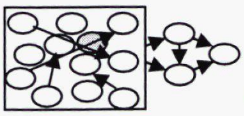
Self-Efficacy – Self-efficacy has been identified as a factor that may contribute to success in completing a task (Cassidy & Eachus, 1999). Concerning computer usage, Compeau and Higgins (1995) reported that individuals with high self-efficacy employed computers more frequently, enjoyed utilizing them more and experienced less computer-related anxiety. The importance of self-efficacy in explaining the use of computers was also demonstrated by Hill, Smith, and Mann (1987). They found that computer "self-efficacy beliefs" affected the choice of individuals to utilize or reject computers, irrespective of their beliefs about the value of doing so. These researchers have reported that self-efficacy influences the rate of class registration in computer courses at university level (Hill, et al., 1987). Similar results were found when "performance" in software training was measured as a dependent variable (Gist, Schwoerer, & Rosen,1989).

Self-efficacy is being recognized as an important factor in the field of information technology and, therefore, Compeau and Higgins (1995) have developed a specific tool for measuring *computer self-efficacy*. Their findings suggest that computer self-efficacy influenced the individuals' actual computer-use among other variables.

It is possible to find justification for testing the effect of self-efficacy on diffusion in Rogers' diffusion theory as well. Rogers (1995) pointed out that personality variables (traits) that are associated with innovativeness have not yet been studied enough. He listed several personality factors that might differentiate between Early Adopters and Late Adopters of an innovation. Rogers (1995) mentioned for example: empathy, dogmatism, ability to deal with abstraction, rationality, intelligence, favorable attitude towards change, ability to cope with uncertainty and risks, favorable attitude towards science, fatalism, and aspiring to a goal (Rogers, 1995). Jacobsen's (1998) study denoted the diffusion of innovation paradigm and the findings supported the hypothesis that there are significant differences in self-efficacy between Early and Late Adopters. Based on these findings, self-efficacy was added to the model to assess its influence on the intention to use an innovation and the interaction with other external variables.



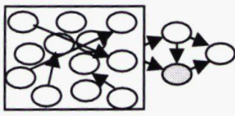
Demographics variables – Formal education, coaching education, coaching experience, volleyball coaching experience, age, and gender were collected in the study and their relationship to other components of the model is tested.



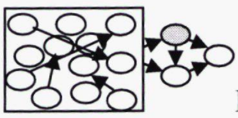
International context – Because the experimental data was collected in Canada and in Israel, an international aspect of the model could also be tested. Although the international context can also be included in the previous demographic item, it is investigated in a separate analysis by comparing Israeli physical education teachers and coaches to their Canadian counterparts.

2.4.1.3. Innovation Perceived Attributes

In addition, the model included two mediated variables related to perceived attributes of the innovations: *Perceived Relative Advantage* and *Perceived Complexity*.



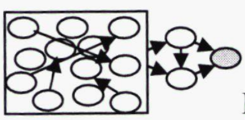
Perceived Relative Advantage (Perceived Usefulness) – Relative advantage was found to be one of the best predictors of an innovation rate of adoption (Rogers, 1995). Based on previous investigations, Rogers formulated a generalization in that "the relative advantage of an innovation, as perceived by members of a social system, is positively related to the rate of adoption." (1995, p: 216). This hypothesis is congruent with the TAM proposed by Davis et al. (1989).



Perceived Complexity (Perceived Ease-of-Use) – The generalization formulated by Rogers (1995, p: 242) suggested that "The complexity of an innovation, as perceived by members of a social system, is negatively related to its rate of adoption." Similarly, TAM suggests the innovation perceived ease-of-use as an important factor in determining an individual's intention to use an innovation (Davis et al., 1989).

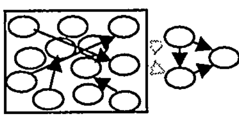
The dependent variables of the model (the results of the process) are outcome measures of the innovation's rate of adoption. The two suggested variables in the literature to measure the process outcome are intention to adopt an innovation, and actual adoption.

2.4.1.4. Dependent Variables

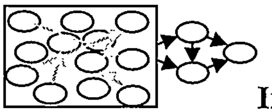


Behavioral Intention (BI) (and System Use) – In this study, the behavioral intention to use the Interactive Volleyball CD-ROM was tested using the following question: "Please rank your intention to actually take and use this tool for your teaching/coaching related tasks." A behavioral intention score in a 5-point Likert scale is used as a representative dependent variable instead of the actual usage of the CD-ROM because there was a low return rate of the follow-up questionnaires within some time constraints of the present study. This precluded the possibility of including "actual system use" into the model. Nevertheless, in future studies, it is strongly recommended to measure the actual usage of an innovation by follow-up questionnaires.

2.4.2 Model Relationships



External Variables → Perceived Relative Advantage and External Variables → Perceived Complexity – In the tested model, the influence of different external variables on the decision of whether or not to adopt technological innovation was tested. Both original models suggest that external variables (Davis et al, 1989), or prior conditions (Rogers, 1995), have an impact on individuals' intention on using the technology. According to Rogers' model (1995), there is a direct causal relationship between conditions that exist prior to the innovation-decision process and the outcome of the process. On the other hand, TAM proposes an indirect relationship mediated by the individuals' beliefs about the innovation.

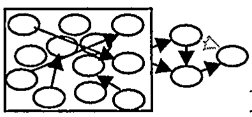


Interrelationships among the external variables – Different relationships might exist among the different external variables. For example, Loyd and Gressard (1986) showed that positive attitudes towards computers are positively correlated with teachers' previous experiences. Familiarity with computers tend to decrease anxieties and fears and to the enhance confidence and liking towards computers.

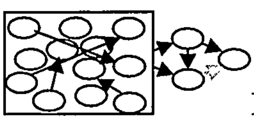
A major line of investigation within diffusion of innovation is to study the relationship between innovativeness and demographic variables such as age, gender, income, and others. Jacobsen (1998), for example, found a difference between Early Adopters and Majority in self-rated computer expertise and total adoption of technology for teaching and learning. In other investigations, tendencies for Innovators to have higher income, higher education, and younger age, compared to the Majority were found (Atkin, Jeffres, & Neuendorf, 1998).

Rogers (1995), however, noted that variables related to personality traits, which can be associated with innovativeness, have not yet been a focus of attention of in IT research. Based on theoretical aspects his model, Rogers suggested that differences between Early Adopters and Late Adopters should be further investigated. More specifically, he listed some fundamental personality characteristics that differentiate Early Adopters from Late Adopters of innovations. Early Adopters, for example, are empathetic, less dogmatic, have a greater ability to deal with abstractions, are rational, intelligent, and better able to cope with uncertainty. They also possess a more favorable attitude towards science, are less fatalistic, and have higher aspirations compared to Late Adopters. In the current study, two personality variables are selected from this list:

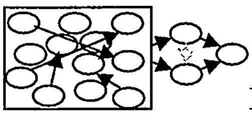
1. Generalized self-efficacy, which may be associated with Rogers' idea that Early Adopters are better able to cope with uncertainty and better adapted to the digital technology field.
2. Attitudes towards working with computers, which is also adapted from Rogers' personality list of variables, which suggests that Early Adopters have a more favorable attitude towards science.



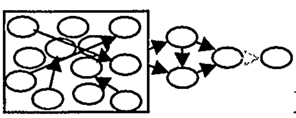
Perceived Relative Advantage → Behavioral Intention – TAM assumes that two major beliefs, usefulness and ease-of-use, are of major relevance in the acceptance behavior towards computer technologies. The model suggests usefulness (or relative advantage) as a direct effect on the behavioral intention (Davis et al., 1989).



Perceived Complexity → Behavioral Intention – In accordance with the previous relationship, TAM proposes that ease-of-use (or, alternatively, its complexity) also has significant influence on the individual's attitudes and intentions to use an innovation. According to TAM, the perceived complexity effect on the intention to use an innovation or the actual use of it, happens in two distinguishable paths. Firstly, as a direct relationship, and secondly, indirectly, by influencing Perceived Relative Advantage. The direct relationship, in most cases (e.g., Davis, 1993), comes second to the effect of the perceived relative advantage but it still contributes significantly to explaining the variance of the intention to use an innovation.



Perceived Complexity → Perceived Relative Advantage – According to Davis et al.'s (1989) TAM, the perceived usefulness is affected by the degree to which the potential users expect a system to be "effort free," that is, it should be highly rated in perceived ease-of-use.



Behavioral Intention → System Use – Different studies show a positive relationship between the intention to use an innovation and the actual use of it. Davis et al. (1989), for example, found a significant correlation between the behavioral intention to use the system and its actual use. They concluded that behavioral intention is a major determinant of users' actual behavior while other factors influence users' behavior indirectly by affecting the behavior at the intention stage.

CHAPTER 3

THE DEVELOPMENT OF THE INTERACTIVE VOLLEYBALL CD-ROM

This study has been designed to gain additional knowledge about the adoption of computerized innovation in the field of coaching and teaching volleyball. The innovation that was used to study the topic was a newly developed multimedia tool for enhancing volleyball coaching. The CD-ROM *Interactive Volleyball: For the Virtual Coach and Teacher* was designed to provide physical education and coaches teachers with a useful time-saving tool to carry out work.

Chapter 3 describes the theoretical concepts underlying the development of the CD-ROM (section 3.1). Thereafter (section 3.2), these issues are translated into the practical ideas that were implemented into the CD-ROM.

3.1 Theoretical Concepts

Many variables need to be considered for the development of instructional materials. For example, availability of hardware, attitude towards technology and budget are of major importance. However, a theoretical approach to the development process is of fundamental importance even though, in many cases, the theoretical framework is neglected.

Two theoretical backgrounds underlie the development of the Interactive Volleyball CD-ROM are the constructivism philosophy and the user-centered approach (Norman, 1993). The influence of a learning theory on the software development process is presented in section 3.1.1. This is followed by a discussion on a user-centered approach and the possible outcomes of such an approach.

3.1.1 Learning Theories (with Focus on Constructivism)

Learning theories offer important insights into the functions that need to be considered by anyone designing instructional materials (Schiffman, 1995). This study suggests that constructivism should provide the philosophical framework for a theory of learning. Constructivism in learning emphasizes the active role of the learner in learning and understanding (Grabe & Grabe, 1996). On the other hand, behaviorism is a psychological theory and practice that views the learner as passive with respect to the responses to external stimuli. It focuses on observable behavioral changes by means of operant conditioning and reinforcement of behavior. It has evolved into an appropriate theory of learning when a machine-centered approach is adopted (Van den Aardweg & Van den Aardweg,1993).

Constructivism and behaviorism vary in their conception of learning and knowledge. While they are fundamentally different theories about the nature of learning, they have had a significant influence on the development of educational technology.

According to the website of "A Collaborative Term Paper Project in Pedagogical Information Science" (1998), the behaviorist theory is based only on observable changes. It suggests that when a new behavioral pattern is repeated it has become automatic, and thus, it may be assumed to be "learned" behavior. Based on this idea, "drill and practices" as well as "computer tutorials," were developed and introduced into the learning environments

(Jonasson, 1994). These tools were designed to provide users with all the information needed as well as appropriate feedback. It is assumed that, behavior may be modified until it becomes an automatic response when required upon enough repetition.

The constructivist approach, on the other hand, anchors its premises in the basic philosophy that humans build all their knowledge in their minds (Fosnot, 1996). Learning happens when individuals construct new information with their own unique version of the knowledge, colored by his/her background, experiences and aptitude (Willis, 1995). In order for learning to occur, learners need to be active. Constructivism attempts to guide students to see the relevance of what they have learned and the direct relationship of the material to the real world.

The constructivist principles co-exist with user-centered approaches in that they prioritize users and the tasks they perform. Thus, according to this view, an educational process should be learner-centered. Students should have control over the pace and the order of the process and should be encouraged to make decisions. Within such an approach, it is also important to stress that learning experience should be in authentic and meaningful situations, with direct applications of the learned material to daily life (Vygotsky, 1986). Adopting constructivism for developing technology-based learning tools implies that the major premises of the user-centered approach should be adopted.

3.1.2 User-centered Approach

Human-computer interaction is an area of inter-disciplinary knowledge based mainly on the combination of psychology and computer technology (van der Veer, Green, Hoc, &

Murray, 1988). A main concern of HCI research is to determine the affects of physical, cognitive, and effective human characteristics on the interaction between users and computers (Computer Science and Telecommunications Board, 1997). The need for understanding such theoretical issues underlies the fact that digital technologies are usually complex compared to traditional tools (e.g., a typewriter). This is mainly due to the fact that digital technologies incorporate added functions. An e-mail system, for example, serves many functions (sorting, tracing, and forwarding) and, thus, it is more complicated to use compared to conventional mail. The result of such complexity often results in cluttered user-interfaces.

The theoretical issues that are studied in the field of HCI are important for the development of any computer application. Early research in HCI focused primarily on the designing of the machine and the computer application. The interface design, for example, was one of the major topics that had been traditionally studied (Fischer, 1998). However, lately, there has been a shift from a machine-centered approach to a human-centered approach. Fischer criticizes the fact that most HCI research has been concerned mainly with system interfaces, and warns that if changes take place only at the level of the interface, the influence of such HCI research will become only a "scratch on the surface" (Computer Science and Telecommunications Board, 1997).

Focusing on the users' needs and tasks is not a new proposition. "Know the user" was the first principle in Hansen's (1971) list of design engineering principles. However, after a short examination of the instructional software available today, one should ask if such principle has been really adopted by designers. Developments that focused mainly on the technology or the machine itself rather than on the needs and the tasks of the end-users, have been criticized by many researchers. For example, Norman (1993) states: "We need to reverse the machine-centered point of view and turn it into a person-centered point of view. Technology should serve us." (Preface, p: XI). Norman (1998a) also pointed out that an inappropriate machine-centered approach might result in frustration and inefficiency for the end-users. Fischer (1998) is in apparent agreement with such statements and points out that the adoption of a machine-centered approach is responsible for the perception that computers are “unfriendly,” “uncooperative,” and “time consuming.”

The user-centered (or human-centered) approach to the development of instructional (or other) tools suggests that: “a process of product development that starts with users and their needs rather than technology” (Norman, 1998a, p: 185). In order to do this, Norman (1998a) suggests that the development of any new tools should start by studying and observing workers at their workplace. The goal of the user-centered approach is to design technologies that are “invisible” to the users. This is very important because many of end-users of tools are individuals who are not computer engineers but use computers only for specific tasks. This was not the case twenty or even ten years ago, but it is the case today. The changes in the population of potential users should be accompanied by a shift in the designing philosophy.

An immediate result of the assumption that the use of information technology is at a “mature stage” is that Late Adopters are already part of the target audience. These users need to be taken into consideration in the development of information technology and educational tools. A similar assumption holds valid for tools designed for coaching sports.

Therefore, it is suggested here that designers and developers of digital tools for teachers and coaches should adopt a user-centered development approach.

3.1.2.1 Users' Needs

In accordance with the suggestion that the users' needs are of major importance when designing digital tools, the first step in the development of the CD-ROM included identifying the target population and its needs. Identifying the common tasks that coaches actually perform in their work was the underlying drive for developing a generic model for development of computerized tools for coaching and teaching games. The model is discussed in section 3.2.

3.1.2.2 User Diversity

Whenever the emphasis of the development process moves towards the users and their tasks, the diversity within the users' population becomes a major factor. Users of information systems interact with a computer in order to accomplish the information-handling tasks necessary to get their jobs done. It is suggested here that such diversity should be considered when developing an instructional tool. The diversity of human motor and perceptual abilities is a challenge to every designer (Shneiderman, 1987). It is difficult to design a tool that satisfied *all* users in *all* situations. However, understanding the cognitive and perceptual abilities of the users is a vital foundation for designing interactive systems (Wickens, 1984).

A user-centered approach to designing that recognizes users and their profiles may help in achieving this goal. A clear understanding of the target population has proven to be helpful in designing tools for a specific group of workers (Shneiderman, 1987). Users differ from each other in background experience, level of knowledge, personality, cognitive abilities, training, and job experience. All these variations are important and should be considered when developing tools for educational uses. One very important factor is the diversity of the target population regarding their previous experience with computers. Rogers (1995) used a different term to describe a similar characteristic. He coined the term "level of innovativeness," which he defined as "the degree to which an individual or other unit of adoption, is relatively earlier in adopting new ideas than other members of a system" (p. 252).

It is argued here that the level of innovativeness is one of the main factors to be considered when developing a digital product aimed at improving the productivity of (sport) practitioners.

The target population, in most cases, is defined by a common task and not by background and experience. Users may be keenly concerned with task performance, but may have little knowledge of (or interest in) the computers themselves. Therefore, the differences found within the population may be enormous.

The level of innovativeness of the potential users should be determined prior to the development of any software. Individuals can be viewed on a continuum ranging from those who have no experience working with computers to others with a great deal of experience. For the purpose of simplicity, Shneiderman (1987) suggests that users may be categorized according to their computer experience (or innovativeness, in Rogers' words) into three main categories: novice users, knowledgeable-intermediate users, and frequent users. Rogers (1995) suggests a similar categorization of individuals into five adopter categories based on their level of innovativeness.

Computer experience is only one example of diversity among individuals. Similar analysis and consideration could be done on any personality trait or experience of interest. Section 3.2 describes how the diversity of the population was taken into account while developing the Interactive Volleyball CD-ROM.

3.1.2.3 Software Flexibility

The suggestion that computer applications should be flexible is the result of adopting a user-centered approach as well as constructivism as a learning theoretical framework. If the users are the prime focus of the designed system, and if knowledge is to be actively built by the users, factors such as flexibility of the system become important. The application's flexibility also fits well with focusing on users' needs while considering diversity and adopting constructivism as a philosophy. In the constructivist view applied to the development of an electronic tool, it may be most important to enhance learning that allows users to create and generate new knowledge-based schemes. This can be attributed to constructivism, which suggests that learning happens when learners construct new knowledge based on prior knowledge (Piaget, 1926).

Several authors share the idea that new tools and applications should be designed with built-in flexibility, allowing for further manipulation of the information. However, different terms have been used to describe this feature. Illich (1973), for example, pointed out the need for "convivial tools," which he characterized as tools that allow users to invest the world with their meaning, and to use them for the accomplishment of a purpose they have chosen. Fischer (1998) shares this view by suggesting that one of the biggest challenges of the HCI community is to understand the fundamental differences between printed and digital media. One such a difference is that digital tools can be further developed and manipulated by the users. In view of that difference, Fischer (1998) suggests that the tools of today should consider users as "designers" rather than only as "consumers" of knowledge. Similarly, Shneiderman (1999) suggests that one of the future challenges for HCI research is the design of interfaces in the information technology domain that uses and enhances the creativity of users in building their own schemes.

Additional support for the suggestion that computer applications should be flexible and allow the incorporation of the potential user's creativity can be found in the diffusion of innovations model (Rogers, 1995). Rogers (1995) coined the term "re-invention," which he defined as "the degree to which an innovation is changed or modified by a user in the process of its adoption and implementation" (p. 174). Re-invention is often beneficial to the adopters of an innovation. According to a national survey on innovation in public schools (Berman & Pauley, 1975) when educational innovation was re-invented by the school, its adoption was more likely to continue. That is, a more flexible innovation that can be changed and re-invented by its users has a greater chance of being adopted compared to those that are designed as so-called "closed systems." Closed and open systems are alternative terms that can be used to describe the flexibility of the systems. Closed systems refer to computer applications that cannot be manipulated by the users. That is, systems for which their "essential functionality is anticipated and designed at the design time" (Fischer, 1998, p: 3). Fischer (1998) suggests that closed systems are inadequate to cope with the knowledge and the situation of real-world problems, and calls for the development of "open systems."

3.1.2.4 Software Usability

Adopting a user-centered approach with emphasis on user needs and diversity also results in attempting to design a user-friendly software interface. Different terms have been used to describe such a characteristic of the software: complexity and usability.

As explained previously, perceived usefulness and perceived ease-of-use are important perceptions determining information technology adoption, according to TAM (Davis, 1989; Davis et al., 1989). The model predicts that perception of technology as easy to use increases the likelihood of its adoption.

In the diffusion of innovations model (Roger, 1995), the term "complexity" is used as a factor which affects users' "persuasion" to adopt the system. The complexity of an innovation is defined as "the degree to which an innovation is perceived as relatively difficult to understand and use" (Rogers, 1995, p: 242) and it is assumed to be in a negative relationship with the adoption level.

Usability seems to be a wider term compared to ease-of-use and complexity. It was defined by Nielsen (1998) as the measure of the quality of the experience users have when interacting with a website, a traditional software application, or some other device. That is, usability is a general property of the tools and systems that people deploy.

Based on Nielsen (1998) and Shneiderman (1987), usability can be measured using the following five characteristics:

- How fast can a user, who has never seen the user interface before, learn it sufficiently well to accomplish basic tasks? "Ease-of-learning" according to Nielsen (1998) or "time-to-learn" according to Shneiderman (1987).
- How fast can an experienced user accomplish tasks? This factor was called "Efficiency-of-use" by Nielsen (1998) and "speed-of-performance" by Shneiderman (1987).
- How much more effectively does an experienced user remember to how to use it the next time? "Memorability" (Nielsen, 1998) or "retention-over-time" (Shneiderman, 1987).
- How often does a user make errors while using the system, how serious are these errors, and how easy is it to recover from them? "Error frequency and severity" (Nielsen, 1998), or "rate-of-errors" (Shneiderman, 1987).
- How much does the user like using the system? That is, subjective satisfaction.

The overall suggestion from different models presented here is that information technology should be easy to use and present a lower level of complexity and a higher level of usability in order to be widely adopted.

3.2 The Model

Based on all the previously noted theoretical concepts, a model for developing a computerized tool for sport game coaching has been developed.

The projected was initiated by grouping together a development group which used to meet together on a weekly base. The group included volleyball coaches, physical education teachers, volleyball players, instructional designers and a graphical designer. The first step in the development process was identifying the target population and specific needs. The target audience was defined as volleyball physical education teachers and coaches from beginners to intermediate levels. Thereafter, the needs of the target audience were recognized by the development group. The underlying assumption was that physical education teachers and coaches were in need of electronic tools that were aimed at helping them carry out their job.

According to the Australian Coaching Council (available on-line) the main goal of the sport coach is "…to assist athletes in developing to their full potential." The primary task of the coach is to carry out practices. The major part of the practice should be devoted to drills that are used to teach and practice different aspects of the game. Additionally, coaches are in need of background information in coaching-related topics (e.g., components of the practice, principles of drill selection, key-coaching points).

Bearing this in mind, the following figure (Figure 3.1) is the result of the discussions that took place in the needs-assessment stage of the Interactive Volleyball CD-ROM. It should be noted that the proposed model is a generic one, which may serve as a prototype for any sport games such as soccer or basketball.

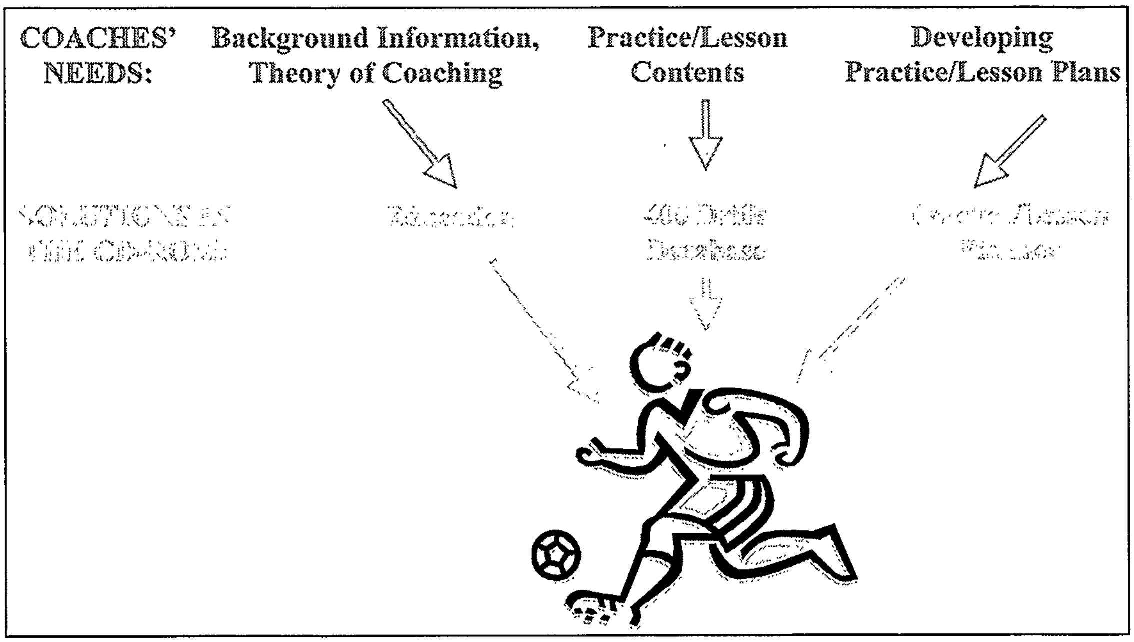


Figure 3.1. A generic model for development of electronic tools for coaching and teaching sport games.

The model recognizes three main needs of teachers and coaches and provides a solution for each of them. The first need is the basic requirement of a coach/teacher to have a theoretical background in different teaching/coaching areas (e.g., steps in planning the practice). The solution for this need is presented in the CD-ROM as an educational section that consists of video-clips and textual information about coaching theory and tips. The drills database is the solution for coachs' need for content material to develop the practices. It supplies drills (which are the main content of the practices and lessons) that can be further manipulated and changed. A re-thinking of the database brought changes in the searchable criteria, which required re-building the database. The practice/lesson planner in the CD-ROM fulfils the third need. This planner is a valuable tool that allows educators to design their own practices (or lessons) easily and effectively. In addition, coaches may use the tool to keep track of practices or lessons over a period by saving the plans into the database.

Using an electronic tool such as the Interactive Volleyball CD-ROM provides teachers and coaches with the means for performing their common tasks (i.e., designing drills and writing practice plans) as well as with the means for acquiring knowledge. In addition, information from digital storage can be easily accessed and shared by any number of users (e.g., several coaches in the same club or users over the Internet). In this way, the Interactive Volleyball CD-ROM meets several goals, as suggested by Leighton (1995). Firstly, it provides the tools for learning and generating some training performance scheme whenever required. Secondly, it enables users of the CD-ROM to be productive. Finally, it allows for the organization of daily work, while building a knowledge-base that can be used in the future (by creating and saving new drills and new practice plans).

3.2.1 Implementation of the Theoretical Concepts into the Model

The development process of the CD-ROM started with the identification of its target population and user needs. The content of the CD-ROM was chosen as result of the development team discussion about the requirements of teachers and coaches in the field. Each idea raised in such meetings was examined with regard to the coach/teacher needs. Additionally, the team included two volleyball players and four coaches/physical education teachers. The former were asked to talk to their colleagues and identify their "wish lists." In order to improve the product, it has been presented to different audiences at different stages. The main question at the end of the presentations was: "is there anything else that can be done to help you to carry out your tasks." Even now (after the CD-ROM has been published), we are still looking for possible improvements and there are two major suggestions that will be introduced to future versions: 1) another chapter with game analysis, and 2) developing a website to support the CD-ROM.

The underlying assumption of user diversity was also incorporated into the CD-ROM. Whenever multiple classes (such as level of innovativeness) were identified and accommodated in one system, the basic approach was to promote a level-structure sometimes called the layered or spiral approach (Shneiderman, 1987). This approach was taken during the development of the Interactive Volleyball CD-ROM. The lack of published information about the level of innovativeness among teachers and coaches, led to the assumption adopted here that the target population has already passed the point of transition, and that the potential users of the system include Late Adopters as well as Early Adopters. Therefore, a level-structure was used, for instance, by incorporating different mechanisms for user-interaction with the software. For novice users, the basic interaction can take place by simply clicking relevant buttons available on the screen. An example from the Education chapter is presented in Figure 3.2. For experienced users, functions that are more complicated were introduced and made available via different menus. An example can be seen in Figure 3.3, which was taken from the drills database design option in the Interactive Volleyball CD-ROM.

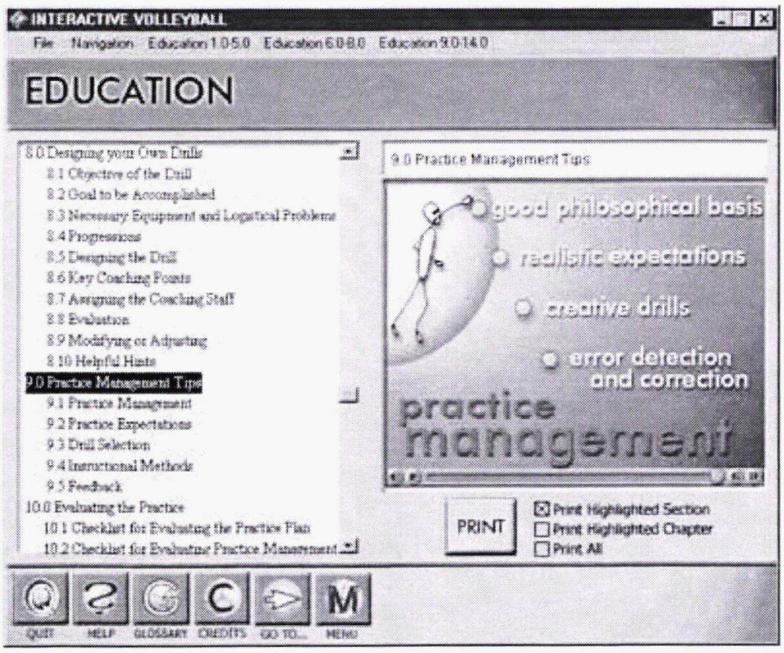


Figure 3.2. A screen-shot from the Education chapter of the Interactive Volleyball CD-ROM.

The concept of software flexibility was implemented in the Interactive Volleyball CD-ROM by allowing the coach to create and modify drills as well as practice/lesson plans to fit his/her own goals. The information in the Interactive Volleyball CD-ROM can be further manipulated, developed, and changed by the users to meet their own objectives. This is accomplished through the operation of two databases. The CD-ROM includes f 400 volleyball drills. This is an open database, which allows users to modify the existing drills and to add new ones. The following screen shot was taken from the drills database design page, where users can create a new drill, or modify an old one to suit their own purposes (Figure 3.3).

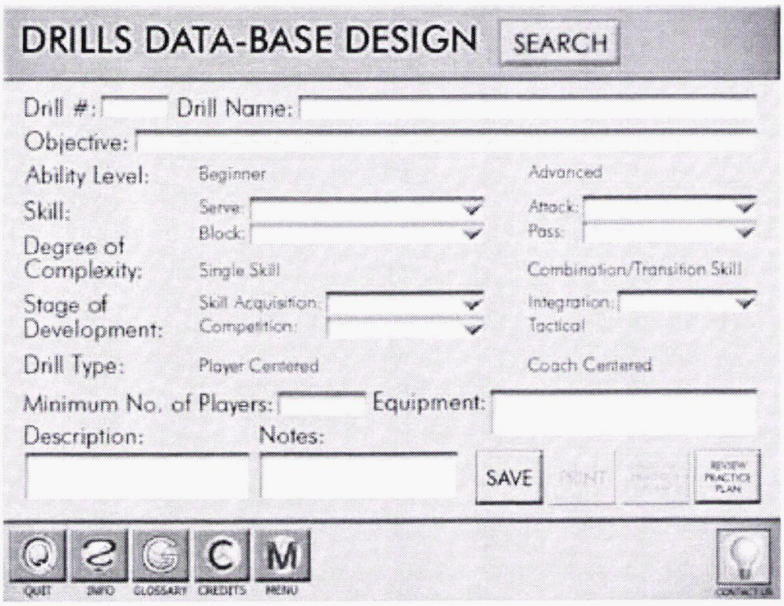


Figure 3.3. A screen-shot of the Drills' Database Design page of the Interactive Volleyball CD-ROM.

Similarly, the CD-ROM includes a practice/lesson plan database that can be user-manipulated (see Figure 3.4). The ultimate goal is that the each user will have two databases, one for drills and another for plans. Both databases can be manipulated according personal needs. With the use of the accompanying website, users are able to download additional drills and adjust them accordingly.

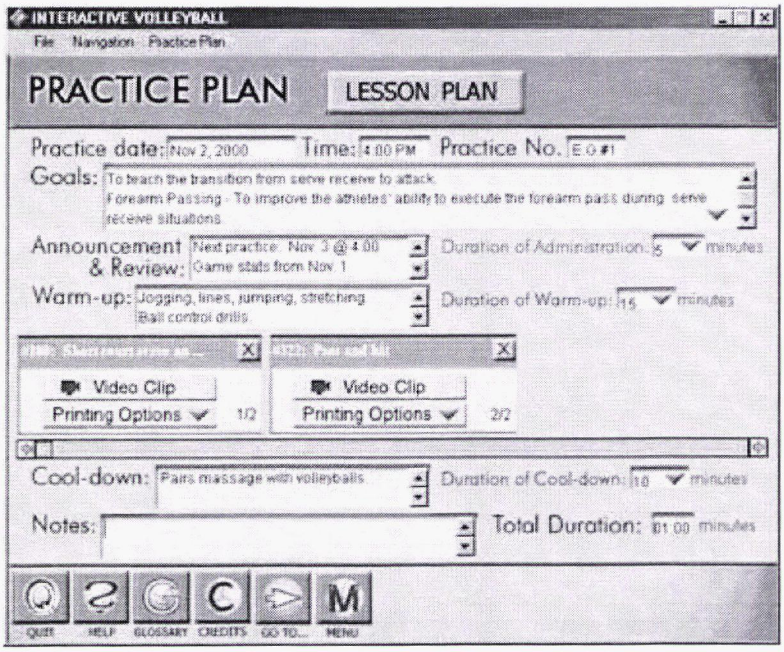


Figure 3.4. A screen-shot of the Practice Plan page of the Interactive Volleyball CD-ROM

Additionally, in the view of constructivism, the act of developing practice/lesson plans or designing a new drill can be regarded as an act of problem-solving that takes place while using the CD-ROM. In implementing the constructivistic conceptual framework users should also be faced with a meaningful and authentic task. This is employed in the CD-ROM, were subjects need to develop a practice/lesson plan based on different conditions such as the level of expertise of the players, number of players, or/and the goal of the practice/lesson.

CHAPTER 4

METHODOLOGY

4.1 Research Questions and Hypotheses

The proposed study is designed to gain further knowledge about the way volleyball physical education teachers and coaches implement computerized technology.

The data collected from the sample were used for two main purposes: a) to learn about the status of information technology in the fields of coaching and physical education, and b) to validate different aspects of a model which were based on the diffusion of innovations (Rogers, 1995) and technology acceptance models (Davis, Bagozzi, & Warshaw, 1989). The data of the survey was further subdivided into the points of interest described in the next paragraphs.

4.1.1 Survey Questions

In order to learn about the status of information technology in the fields of coaching and teaching physical education, data concerned with the following eight points were collected:

1. **What are the categories of adopters (as defined by Rogers, 1995) to which computerized technology has been diffused?** Within Rogers' theoretical model, time is a major factor in determining the diffusion of innovation. Determining the use of different tools and software in a temporal perspective

should provide information on the innovativeness level of the teachers and volleyball coaches. This allowed for a categorization of the subjects into "adoption categories." The "Pattern of Computer Technology Scale" (Appendix B) was used to collect this data. Each coach was asked to provide data about the time he/she first used computers for personal tasks.

2. **What are the categories of adopters to which computerized technology been diffused for performing teaching/coaching tasks?** Subjects were also asked to recall the year they first used computers in teaching or coaching-related tasks. This variable was used to calculate the subjects' professional innovativeness (i.e., how early were they in adopting the technology for fulfilling job-related tasks). Again, the "Pattern of Computer Technology Scale" (Appendix B) was used to collect this data.
3. **What is the time-gap between the adoption of a technology for personal uses and its adoption for professional purposes?** Previous studies (Jacobsen, 1998) have found that the gap between adopting a computerized tool for personal tasks and using it for teaching-related tasks is 10 years on average (among university faculty members). In this study, teachers and coaches provided the information that enabled the calculation of this time gap.
4. **What is the current level of experience in computer usage of physical education teachers and coaches, and what are the trends in using computers?** Data from three different sources were used to learn about subjects' previous experience levels on computers adoption. Subjects were

asked about their perceived level of expertise with a list of different tools and software, in the "Computer Experience" questionnaire (Appendix C). The total level of expertise for different items was then derived together with the average number of tools used. The "Stages of Adoption of Technology" was also used to assess the overall perceived stage that best described individuals' technology adoption (Appendix D). Finally, in a one single question on the "Patterns of Use of Computer Technology" Scale subjects were asked to report their level of experience with computers on a 5-point Likert scale (Appendix B).

5. **What are the computerized tools and software that are used by physical education teachers and coaches?** An answer to this concern was obtained from a "Computer Experience" questionnaire, which provided an overview of tools and software applications that are related to teaching or coaching (Appendix C).
6. **What are the major requests (needs) of physical education teachers and coaches with regard to computerized tools?** Learning about the subjects' needs concerning digital technology is a very important first step in developing computerized tools. Subjects were thus, asked in open questions about the kind of tools they currently use and the ones they would like to have "Computer Technology for Physical Education and Coaches" Scale (Appendix F).
7. **What are the major trends among physical education teachers and coaches in relation to the acquisition of computerized tools?** Information about the way in which teachers and coaches purchase their computers and other market-

related issues was collected using a "Patterns of Use of Computer Technology" Scale (Appendix B).

8. **What are possible barriers in implementing the Interactive Volleyball CD-ROM?** The Follow-up scale was used to gather information about the percentage of teachers and coaches that have adopted the software, the different ways in which it was used, the evaluation of the software, and possible difficulties that coaches may have encountered while using it (Appendix J).

4.1.2 Hypotheses of the Research

A modified model (Figure 2.6) that could explain the relationship among different factors was developed under the assumption that they influence the teachers and coaches' decisions on using the Interactive Volleyball CD-ROM, as described in section 2.4.

In order to validate the model, the following predictions were tested (the predictions were directly based on the previously reported findings discussed in the literature review):

1. Perceived Relative Advantage would be negatively[1] correlated to Behavioral Intention.
2. Perceived Complexity would be negatively[1] correlated to Behavioral Intention.
3. Perceived Complexity would be positively[2] correlated to Perceived Relative Advantage.
4. External variables would be correlated to Perceived Relative Advantage.

[1] A negative relationship is expected because the direction of the intention is opposite and ranking 1 on the scale suggestion high intention to use the CD-ROM.

[2] A positive relationship is expected because the direction of complexity was measured in the same direction as perceived relative advantage, when high score = less complexity of the CD-ROM.

5. External variables would be correlated to Perceived Complexity.

Some of the relationships among the external variables were also tested. More specifically, innovativeness and its influence on the following selected variables:

6. Early Adopters are Younger compared to Majority.
7. Early Adopters are mainly Males while Late Adopters are Females.
8. Early Adopters have more Education compared to Majority.
9. Early Adopters have more Coaching Experience compared to Majority.
10. Early Adopters have higher Professional Innovativeness compared to Majority.
11. Early Adopters have higher Level of Expertise with computer technology compared to Majority.
12. Early Adopters have higher Self-efficacy compared to Majority.
13. Early Adopters have more positive Attitudes towards computers compared to Majority.
14. Early Adopters have higher Perceived Relative Advantage on a newly introduced digital technology (such as the Interactive Volleyball CD-ROM) compared to Majority.
15. Early Adopters have lower Perceived Complexity on a newly introduced digital technology (such as the Interactive Volleyball CD-ROM) compared to Majority.
16. Early Adopters have higher Intention to use a newly introduced digital technology (such as the Interactive Volleyball CD-ROM) compared to Majority.

17. Early Adopters Adopt and Use the Interactive Volleyball CD-ROM more than the Majority.

Time and its effect are also of major interest in the present study. The following hypothesis were tested with that regard:

18. Subjects' Level of Expertise in pre-workshop is significantly lower as compared to their level during the follow-up questionnaire.
19. There is significant positive relationship between subjects' Level of Expertise in the pre-workshop and in the follow-up questionnaire.
20. Subjects' positive Attitudes towards working with computers in the pre-workshop are significantly lower as compared to their level during the follow-up questionnaire.
21. There is significant positive relationship between subjects' Attitudes towards working with computers in the pre-workshop and in the follow-up questionnaire.
22. There is a significant positive relationship between subjects' Self-efficacy scores in the pre-workshop and their scores in the follow-up questionnaire.
23. Subjects' Innovativeness is significantly lower as compared to their Professional Innovativeness ("adoption gap").
24. There is a significant positive relationship between subjects' Innovativeness and their Professional Innovativeness.

One hypothesis tests the assumption that innovativeness and previous experience in using computers are synonyms. It is hypothesized that:

25. There are significant relationship between innovativeness and previous experience in using computers.

The last group of hypotheses is intended to assess the role played by the international context in the adoption of technology. Data obtained from the Canadian sample of practitioners collected as part of the pilot stage of the study is compared to the Israeli sample of sport practitioners to test any similarities and dissimilarities in the patterns of the intention-decision process about an innovation within information technologies. Thus, it is hypothesized that:

26. There is a significant difference between Israelis and Canadians in level of expertise.
27. There is a significant difference between Israelis and Canadians in innovativeness.
28. There is a significant difference between Israelis and Canadians in professional innovativeness.

4.2 The Sample

The sample consisted of 125 physical education teachers and volleyball coaches that agreed to participate in the study. Thirty-five were from the Calgary district of Alberta, Canada, while the other 90 participants were Israelis. The data from the Canadian subjects was used for the pilot study and for testing the model, and the data from the Israelis was used for the actual study.

A letter of consent and an explanation sheet were sent to the list of fifty teachers and volleyball coaches in Canada and 118 teachers and coaches in Israel. Teachers and coaches that agreed to participate in the study were asked to participate in a workshop (University of Calgary and Zinman College of Physical Education and Sport), in Canada and Israel respectively.

4.3 Tools

4.3.1 The Innovation: The Volleyball Interactive CD-ROM

This study was designed to gain knowledge about the adoption of computerized innovations in the field of coaching and teaching. The present innovation was the newly developed multimedia tool for enhancing volleyball coaching and teaching. The CD-ROM was developed by the Sport Technology Research Laboratory (STRL) of the Faculty of Kinesiology at the University of Calgary, and included three main sections, which answered three different needs of teachers and coaches.

The Educational section covers theoretical aspects of coaching and practice tips. The second section includes a database that consists of 400 drills covering every skill at different levels of expertise[3]. Text, graphics and video clips illustrate the drills, which can be browsed according to different criteria. The user may also modify or add new drills to the database. The third section is a practice/lesson planner that enables users to develop a

[3] The drills were designed by volleyball experts and are based on *400 Plus Volleyball Drills and Ideas* (Bratton & Kilb, 1985).

personalized training/teaching plan. It may be printed out in different formats or presented using a computer in the gym.

The basic assumption of the present research is that the CD-ROM helps and enhances the process of teaching and coaching volleyball. Appendix M shows examples of the different screens in the CD-ROM while more information on the CD-ROM development process can be found in chapter 3.

The Interactive Volleyball CD-ROM is based on two previously published media. The first is the *400 PLUS: Volleyball Drills & Ideas* (Bratton & Kilb, 1985). The book was designed as a "cookbook" that included descriptions and images of 400 drills. The drills were organized into four major categories: beginners, skill development, intermediate and advanced level, and transition drills.

A laserdisc based on the book was published in 1992. The two major add-ins of the laserdisc were: a) A video-clip for each of the 400 drills, and b) the organization of the drills into a searchable database. The laserdisc was developed using the HyperCard Programming tool in a Macintosh platform compatible with a laserdisc player.

The CD-ROM developed for the present study became the third version (published in 2000) of the original project. It uses previously available materials (drills information and video-clips) and scanned images of the book in one database. The art images are used mainly in the printing option. Based on the model (described in section 3.2), two new chapters have been added to the CD-ROM, as previously described: a Practice/Lesson planner and an Education section. The CD-ROM is a hybrid version which can be played in both Macintosh and Windows platforms. It has been developed using Macromedia Director (version 7.5), with an addition of database plug-ins. A computer with a compatible CD-player is required to run the CD-ROM.

4.3.2 Research Instruments: Scales and Forms

Users were asked to complete ten different scales in three stages along the study. All scales were written originally in English. Translation of the scales into Hebrew was done by using the back-translate method (Campbell & Werner, 1970). After translation into Hebrew, they were translated to English by a different person. If major differences were found between the original scale and the translated version, the process was repeated. A brief description and sources of the scales is provided here, while more detailed descriptions and the scales are provided in appendices A-J.

4.3.2.1 General Information Form

This form consisted of 17 items that collected nominal and ordinal data about the subjects' backgrounds (see Appendix A for more details and the scale itself). Results allowed for correlations among the different demographic factors such as *age, gender, level of education, and coaching experience.* In addition, the data from this scale were used to present the demographic profile of the sample population, which allowed a comparison to the population profile.

4.3.2.2 Patterns of Computer Technology Use

This 18-item scale was adapted from Jacobsen (1998) study. The data collected by this questionnaire include information regarding the patterns of computer use, the type of computer purchased, access to computers, professional-related software use, and computer training and support. The purpose of the scale was to gain knowledge about the way physical education teachers and coaches use computers for personal and professional purposes (see Appendix B for an explanation of the scale adaptation process, as well as for the scale itself).

4.3.2.3 Computer Experience

This scale was modified from Jacobsen's (1998) study. The alpha coefficient reported by Jacobsen (1998) was 0.93, which is indicative of a relatively high internal consistency. The modified scale includes a list of computerized software applications[4]. This scale can be seen in Appendix C along with an explanation about the adaptations made to the original scale.

The results from this scale were used to calculate a previous experience score and the level of innovativeness. Based on this computation, subjects were divided into "adopter categories" (Rogers, 1995), which are a "classification of members of a social system on the basis of innovativeness" (Rogers, 1995, p: 279) to test the influence of innovativeness on other variables.

[4] 46 tools and applications were used in the Canadian sample, while this number was reduced to 41 for their Israeli counterparts in this study. This is explained in the Pilot Study section.

4.3.2.4 Stages of Adoption of Technology Instrument

This is a self-assessment tool of a teacher's level of adoption of technology. It was developed by Christensen (1997) based on Russell's (1995) learning-stages. According to Russell (1995), the process involved in learning a new technology includes six main stages: a) awareness, b) learning the process, c) understanding and application of the process, d) familiarity and confidence, e) adaptation to other contexts and f) creative applications to new contexts.

Users were asked to choose the stage they believed best describeds the momentary status of their level of adoption of technology (see Appendix D). Using this scale, the variable for the Previous Experience (working with computers) was defined.

Since the Stages of Adoption of Technology instrument is a single item survey, internal consistency reliability measures cannot be calculated for data gathered through it. However, a high test-retest reliability estimate (.91) was reported by Knezek et al (2000).

4.3.2.5 Computer Attitudes Scale (CAS)

In order to learn about the attitudes of physical education teachers and volleyball coaches towards computers, the Computer Attitude scale (CAS) originally developed by Loyd and Gressard (1984), was used. The purpose of the scale is to gather information about people's attitudes towards learning about and working with computers (Appendix E). The reported internal consistency for the four sub-scales was as follows (Christensen, 1998): Anxiety– α=0.91, Confidence– α =0.81, Liking– α =0.89 and Usefulness– α =0.85.

4.3.2.6 Computer technology for physical education teachers and coaches

This questionnaire was specially designed to measure the attitude towards information technology, and the level of awareness on the use of technologies among physical education teachers and coaches. It consists of 28 items divided in three sub-scales: general questions, coaching and teaching-related questions, and open questions (see Appendix F).

4.3.2.7 Generalized Self-efficacy

In order to measure the self-efficacy of the users participating in the study, a self-efficacy scale was used. The scale was originally developed by Jerusalem and Schwarzer (1981, reported in Schwarzer, 1992). Recently, Schwarzer and Jerusalem (1995) reported that the Generalized Self-efficacy scale yields relatively high internal consistency with alpha ranging 0.82 - 0.93. Jacobsen (1998) found the internal consistency of the scale to be 0.91, and confirmed the "unidimensionality" of the scale. The tool is a 10-item psychometric scale that was designed to assess "optimistic" self-beliefs used to cope with a variety of difficult task demands in life. Users were asked to indicate on a 4-point scale how well they felt that each statement described their optimism (1 =not at all true, 2 =sometimes true, 3 = often true and 4 = almost always true) (see Appendix G).

4.3.2.8 Perceived Relative Advantage.

In order to measure the perceived relative advantage of the Interactive Volleyball CD-ROM, six items from the perceived relative advantage scale were used (Moore & Benbasat, 1991). The six items were made up from the five recommended by Moore and Benbasat

(1991) to be used in the short version of the scale, plus the item that tests the perceived productivity of the innovation. This short version was made up of five items and the reliability that was reported was 0.90 (Moore & Benbasat, 1991). All items were tested on a 7-point Likert scale, ranging from "strongly disagree" to "strongly agree" (Questions 1-6 in Appendix H).

4.3.2.9 Perceived Complexity

The short version of the perceived ease-of-use was used to measure the perception of the coaches about the complexity of the Interactive Volleyball CD-ROM. The version included four items with a reliability of 0.84 (Moore & Benbasat, 1991). All items were tested on a 7-point Likert scale, ranging from "strongly disagree" to "strongly agree" (Questions 7-10 in Appendix H).

4.3.2.10 Intention to Use the Interactive Volleyball CD-ROM

The last scale of the post-workshop questionnaire includes an intention to use the CD-ROM assessment. Subjects were asked to rank their intention to use the CD from "I will certainly use it (1)" to "I will certainly NOT use it (7)." The Hebrew version of the scale also included two questions regarding subjects' English level and whether they think it will affect their decision to adopt the CD-ROM. The scale also includes an open question on factors which may affect subjects' intention to use, or not to use the CD-ROM (See Appendix I for the scale).

4.3.2.11 Follow-up Scale

After a period of time (after 6 months in Calgary and 18 months in Israel), teachers and coaches were requested to fill out the Follow-up scale. The later was especially designed for studying whether subjects used the software, the purpose of utilization, the overall evaluation of the software, and possible barriers encountered while using the CD-ROM (see Appendix J).

4.4 Procedure

Subjects that agreed to participate in the study were asked to sign a consent form after reading the cover letter (Appendices K and L). They were then provided with schedules and invited to a workshop, which took place at the respective institutions in the target countries (Canada and Israel) by the same person (the author of the present thesis work). The duration of such a training session was approximately two hours. A schematic representation of the Procedures of the present study is shown in Figure 4.1.

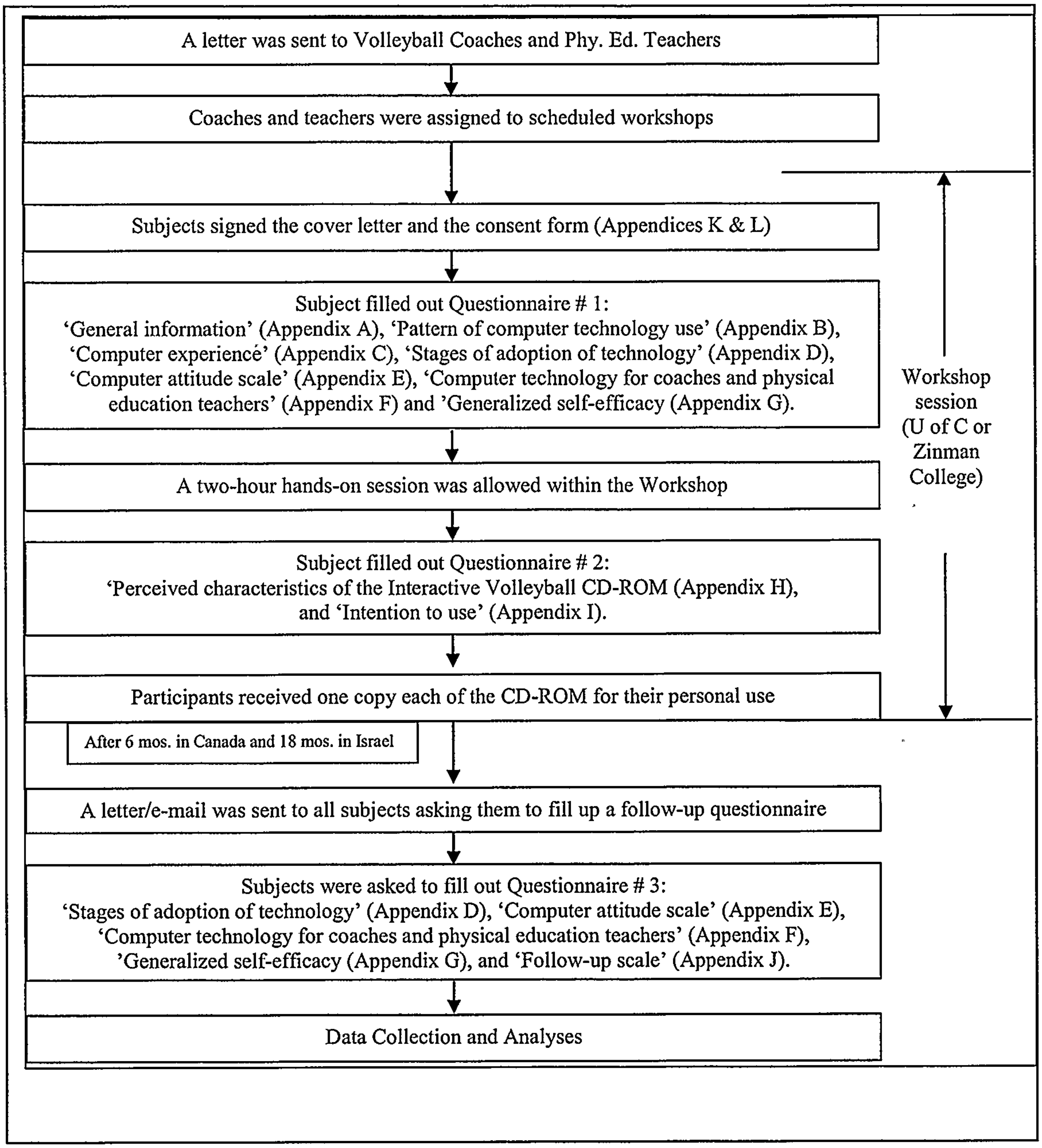


Figure 4.1. Schematic representation of the study procedure

Participants started by completing the first questionnaire. It included General Information, Pattern of Computer Technology Use, Computer Experience, Stages of

Adoption of Technology, Computer Attitude Scale, Computer Technology for Physical education teachers and coaches and Generalized Self-Efficacy. This first pre-workshop questionnaire was designed mainly to obtain demographic variables, information about the subjects' innovativeness, previous experience, attitudes and self-efficacy.

Thereafter, subjects received a copy of the Volleyball Interactive CD-ROM. Each coach/teacher was assigned to a computer. Subjects started the hands-on sessions. These workshops included a short demonstration of the software and a hands-on teaching session given by a volleyball coach. The session curriculum dealt with ways teachers and coaches could use the software. At the end of the workshops, subjects were asked to complete the second post-workshop questionnaire (Perceived Relative Advantage, Perceived Complexity, and Intention to use).

Once completed, the testing session concluded. Teachers and coaches were instructed to take the CD-ROM for their personal use.

After a period of 6 months (in Canada) or 18 months (in Israel), a letter or an E-mail was sent to all the teachers and coaches who participated in the workshop requesting them to fill out the follow-up questionnaire.

The follow-up questionnaire included the following scales: Stages of adoption of technology, Computer attitude, Computer technology for physical education teachers and coaches, Generalized self-efficacy and the Follow-up scale.

4.5 Research Design and Data Analysis

This study was comprised of two parts. The first part was designed as a survey and as such it was used to collect data by means of the questionnaires. The survey was designed to answer questions regarding the characteristics and frequency of technology-related implementation into coaching and teaching. The second part included several statistical procedures, such as model fitness, a quasi-experimental design and a comparison between the Israeli and Canadian samples.

The first phase of the data analysis included a description of the results from the 14 different scales. Thereafter, the study major variables were calculated. Correlations and reliability tests were used to find the best way to describe the variable, wherever multiple data was collected to describe a similar variable.

A structural equation modeling technique was used to test the goodness of fit between the collected data and the modified model described previously in section 2.4. Other aspects of the Diffusion of Innovation model were observed, while testing the study 28 hypotheses. Early Adopters were compared to Majority using a series of one-way independent t-tests and chi-square tests. The influence of time of the diffusion process was studied using dependent t-tests and Pearson's correlation coefficient that compared the data collected in the pre-workshop questionnaire with the data collected 18 months later. The hypothesis that Level of Expertise is related to Innovativeness was tested using Pearson's correlation coefficient. Finally, data collected in the pilot study on a Canadian sample was compared to the data of the Israeli sample using t-tests.

CHAPTER 5

THE PILOT STUDY

A pilot study was conducted in order to investigate the status of the diffusion of computerized tools within the population of physical education teachers and coaches in Canada. The purpose was to evaluate the overall experimental procedure, including scales and measurements that were used as part of the actual study. This chapter includes the descriptive analysis and results of the pilot study concerning these two goals.

It is important to mention that statistically it might be inappropriate to draw conclusions based on the small sample size used for this pilot study (n=35). Furthermore, the tests of normality carried out on several variables did not present a bell-shaped Gaussian distribution suggesting that non-parametric tests should be used. However, considering that the goals of the statistical analysis on the pilot data were only to survey the population and to test the relevance of to-be-used procedures and variables within the actual study, the present information was deemed particularly important for a transparent set of inclusion-exclusion criteria. Therefore, it may occasionally seem to the reader, that data may have been ignored and the chosen statistical procedure might not have been appropriate because of violations of the normality assumption. However, such cases sometimes fulfilled the goal of knowing more about factors which should be included in posterior analyses.

The pilot study was also used to assess a newly developed Interactive Volleyball CD-ROM in real life, with a suitable target population (physical education teachers and volleyball coaches). After briefly using the CD-ROM at the end of the workshop, teachers and coaches were asked to provide feedback and suggestions.

In general, no major problems were reported in the operation of the CD-ROM. The feedback from subjects included mainly suggestions for future development. For example, they suggested more specific practice/lesson plans that could be incorporated in the application. They suggested adding seasonal planning tools and statistical information. The most relevant of these suggestions regarding the CD-ROM were gathered, and in the future will be integrated in the construction of a newer version of the CD-ROM.

The pilot study was completed at the University of Calgary. It followed the tools and procedures described previously in sections 4.3 and 4.4. A letter was sent to about 50 teachers and coaches, and thirty-five of them volunteered to participate in the two-hour workshop. Before the workshop started, after signing the consent form, subjects were asked to fill out a pre-workshop questionnaire that included seven different scales (see Appendixes A - G). Thereafter, the workshop was composed of a demonstration of the CD-ROM by a volleyball expert, followed by a practice session with the CD-ROM under the supervision of computer experts. At the end of the workshop, subjects were asked to complete the post-workshop questionnaires (see Appendixes E[5], H and I). All participants in the workshop were given a copy of the Interactive Volleyball CD-ROM for personal use.

[5] This Computer Attitude Scale was administrated to subjects in the post-workshop questionnaire only in the Pilot study.

Six months later, subjects were contacted and asked to fill out another questionnaire (the Follow-up questionnaire, see Appendices D, E, F, G and J).

The data collected in these three questionnaires was entered into MS-Excel workbooks (Office, Microsoft Inc., USA), and analyzed using MS-Excel function tools and SPSS (SPPS Inc., USA). The following three major sections of chapter 5 correspond with the goals of the pilot study, namely: Presentation of the survey data (5.1), Description of the external variables (5.2), and Evaluation of the procedures and tools (5.3).

5.1 The Survey

The first goal of the pilot study was to explore the status of computer applications with physical education teachers and coaches in Alberta, Canada. The descriptive statistic of the different variables is reported in the next sub-sections (5.1.1-5.1.7 pre-workshop questionnaire, 5.1.8-5.1.10 post-workshop questionnaire and 5.1.11-5.1.15 follow-up questionnaire), presented by the order of scales given to the subjects.

5.1.1 Scale # 1: General Information (Pre-workshop Questionnaire)

The present sub-section (5.1.1) shows descriptive statistics of the data collected using the General Information Form administrated to the subjects within the pre-workshop questionnaire. The scale includes demographic data as well as teaching/coaching background information.

Table 5.1

Descriptive Statistics from the General Information Form Completed by Subjects Prior to the Workshop

Q#	Variable	Sample Composition
6	Age	Mean = 35 years SD = 8.19 years Range = 28 years (from 23 to 51)
7	Gender	Men = 57% (20/35) Women = 43% (15/35)
8	Educational Level Attained	Bachelor Degree: 97%. (34/35) Coaching Certificate: 63% (22/35) Coaching Levels: Level 1: 59% (13/22) Level 2: 27% (6/22) Level 3: 14% (3/22) Level 4: 0% Master Degree: 6% (2/35) Doctorate Degree: 0%
9	Profession	Teachers: 91% (32/35) Phys. Ed. Teachers: 60% (21/35), 66% of the total number of teachers (21/32) Other teachers: 34% (12/35), 38% of the total number of teachers (12/32) Coaches: 86% (30/35)

		Elementary School Coach: 0% J.H. School Coach: 23% (8/35), 27% of the total number of coaches (8/30) H. School Coach: 77% (27/35), 90% of the total coaches (27/30) College Coach: 0% University Coach: 0% Other (clubs, provincial, regional): 11% (4/35), 13% of the total number of coaches (27/30) Other professions: 3% (Engineer) (1/35)
10	Total No. of Years Teaching/Coaching Volleyball	Mean = 9.83 years SD.= 7.79 years Range = 24 years (from 2 to 26)
11	Teaching/Coaching Other Sports	Yes: 83% (29/35) No: 17% (6/35)
13	Age of Population Teaching/Coaching	Children, 6-12 years old: 43% (15/35) Adolescents, 13-17 years old: 100% (35/35) Mature Athletes, 18-30 years old: 31% (11/35) Mid-Ages, 31-40 years old: 11% (4/35) Seniors, 41-63 years old: 6% (2/35) Elderly, 64 years old on: 0%
14	Average No. of Volleyball Practice/Lesson	Mean = 3.01 plans SD = 0.93 plans Range = 4 plans (from 1 to 5)

	Plans Written Weekly (during the season)	
15	Time spent preparing a Practice/Lesson plan (see also Figure 5.1)	Not at all: 11 % (4/35) Less than 1 hour: 9% (3/35) 1-2 hours: 80% (28/35) 2-4 hours: 0% More than 5 hours: 0%

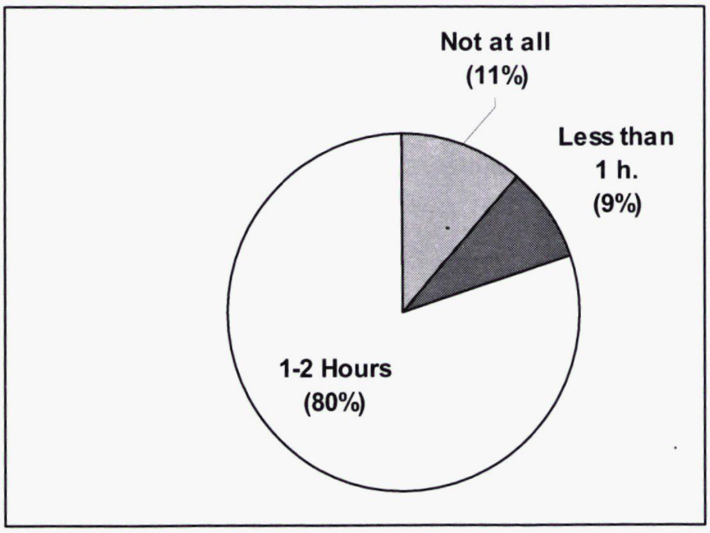


Figure 5.1. Distribution of time spent to prepare a practice/lesson plan

16	Availability of Coaching Assistance	Yes: 51% (18/35) No: 49% (17/35)
17	Factors that Affect the Decision to Select a Computer Software	An advertisement in the media: 11% (4/35) A colleague recommendation: 57% (20/35) Availability of software: 63% (22/35) District policies and procedures: 9% (3/35) Other (ease of use, cost, easy access to help,

		quality, notice sent to our school, and more): 29% (10/35)

From the demographic variables, it may be noticed that the sample chosen for the pilot study was quite diverse in the Age variable (23-51 years old). Similarly, teaching/coaching Volleyball experience varied from 2 to 26 years of experience.

Most of the subjects (97%) had a Bachelor's degree, and 63% had a coaching certificate. Two subjects had a Master's degree and none held a Ph.D.

Ninety-one percent of the sample officially worked as teachers, and 86% worked as coaches, suggesting that many of the subjects were physical education teachers while coaching at the same time. Taking into consideration that only 63% of the sample had a coaching certificate, while 86% actually reported being engaged in coaching activities, it may be concluded that some may coach sports without a certificate.

The majority of the subjects taught or coached at high-school level (77%) and 23% at junior-high. When asked about the age of the target populations they coached/taught, it was found that all subjects (100%) coached or taught adolescents (13-17 years old), 43% - children (6-12 years old), 31% - adult athletes (18-30 years old), 11% - mid-ages (31-40 years old) and 6% - senior citizens (41-63 years old).

One of the main assumed advantages of the Interactive Volleyball CD-ROM is the reduction of the time needed for creating and managing practice/lesson plans. Therefore, subjects were specifically asked about the average number of practice/lesson plans they wrote weekly. The average number was found to be about 3 (3.01) plans a week. When they were asked about the average time spent writing one plan, 80% of them reported 1-2 hours. Thus, it may be conclude that on average, a teacher or a coach spends 4.5 hours (1.5 h. times 3 plans) writing practice/lesson plans weekly. Using the CD-ROM may help to save time by allowing the users to choose existing drills from the database and to use the same plans over and over again.

The last question inquired about factors that had the most affect on the subjects' decision in selecting computer software. This was asked to determine and plan a more appropriate marketing strategy for distributing sport-related applications. The results show that 63% were affected mostly by the availability of the software, 57% by a colleague's recommendation, and only 11% by an advertisement. Therefore, it may be suggested that marketing money for such a software might be better spent by disseminating the name and knowledge of the software among peers rather than by placing advertisements.

Finally, subjects also mentioned other factors that may affect their decisions. Among these additional factors, easy to operate, easy help access, quality, and cost are the most important.

5.1.2 Scale # 2: Patterns of Computer Technology Use (Pre-workshop Questionnaire)

The second scale that subjects were asked to complete before the workshop, was aimed at gathering information about individual computer use patterns. In addition to the questions on the form, four variables were calculated: number of years that subjects used a computer for *daily* tasks, the number of years that subjects used a computer for *professional* tasks, the age at which subjects started to use a computer, and the age at which subjects started to use a computer for *professional* tasks.

The first two were calculated by subtracting the year the subjects started to use computers, or started to use computers for professional use, from the current year (i.e., 2000 – the year the questionnaires were completed). The other two variables were calculated by subtracting the results of these two new variables from the subject's age. The descriptive results of the scale are presented in Table 5.2.

Table 5.2

Descriptive Statistics from the Patterns of Computer Technology Use Form Completed by Subjects Prior to the Workshop

Q#	Variable	Sample Composition
1	The first year a computer was used for *personal* tasks (see also Figures 5.3 & 5.4)	1980: 6% (2/35) 1984: 6% (2/35) 1985: 11% (4/35) 1986: 3% (1/35) 1988: 11% (4/35) 1989: 11% (4/35) 1990: 23% (8/35) 1992: 9% (3/35) 1994: 3% (1/35) 1997: 3% (1/35) 1998: 9% (3/35) Not yet: 6% (2/35)

New (Calculated)	No. of years of using the computer for *personal* tasks (Excluding missing data) (see also Figure 5.11)	Mean: 10.82 SD: 4.52 Range: 18 (from 2 to 20)
New (Calculated)	Age first used computer for *personal* tasks (see also Figure 5.13)	Mean: 24.70 SD: 8.23 Range: 28 (from 14 to 42)
2	The first year a computer was used for *professional* tasks (see also Figure 5.5 & 5.6)	1984: 3% (1/35) 1985: 6% (2/35) 1987: 3% (1/35) 1988: 3% (1/35) 1989: 3% (1/35) 1993: 9% (3/35) 1994: 11% (4/35) 1995: 11% (4/35) 1996: 6% (2/35) 1997: 6% (2/35) 1998: 9% (3/35) 1999: 9% (3/35) Not yet: 23% (8/35)

New (Calculated)	No. of years of using the computer for *professional* tasks (Excluding missing data) (see also Figure 5.12)	Mean: 6.30 SD: 4.50 Range: 15 (from 1 to 16)
New (Calculated)	Age first used computers for *professional* tasks (see also Figure 5.14)	Mean: 28.33 SD: 6.77 Range: 26 (from 17 to 43)
3	The first year a computer was bought for *personal* use (see also Figures 5.7 and 5.8)	1980: 3% (1/35) 1981: 3% (1/35) 1982: 6% (2/35) 1985: 9% (3/35) 1989: 3% (1/35) 1990: 11% (4/35) 1994: 11% (4/35) 1995: 3% (1/35) 1996: 14% (5/35) 1997: 11% (4/35) 1998: 9% (3/35) 1999: 6% (2/35) 2000: 6% (2/35) Not yet: 6% (2/35)

4	The first year a computer was bought for *professional* (teaching/coaching) tasks (see also Figures 5.9 and 5.10)	1976: 3% (1/35) 1984: 3% (1/35) 1990: 9% (3/35) 1993: 3% (1/35) 1994: 9% (3/35) 1995: 3% (1/35) 1996: 14% (5/35) 1997: 6% (2/35) 1998: 6% (2/35) 1999: 6% (2/35) 2000: 3% (1/35) Not yet: 37% (13/35)
5	No. of computers owned (see also Figure 5.2)	None: 20% (7/35) 1 computer: 37% (13/35) 2 computers: 20% (7/35) 3 computers: 11% (4/35) 4 computers: 11% (4/35)

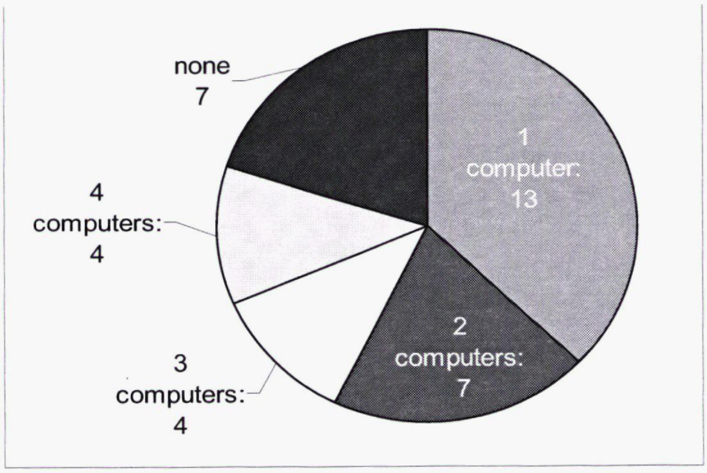


Figure 5.2. Distribution of the number of computers owned

6	Access to a computer for personal use	Yes: 77% (27/35) Sometimes: 17% (16/35) No: 6% (2/35)
7	Access to computers, software and needed equipment for teaching/coaching tasks	Yes: 63% (22/35) Sometimes: 26% (9/35) No: 11% (4/35)
8	Satisfaction from computer-related teaching/coaching tasks support	Very satisfied (+2): 9% (3/35) Satisfied (+1): 37% (13/35) Neutral (0): 26% (9/35) Unsatisfied (-1): 29% (10/35) Very unsatisfied (-2): 0% Mean: 0.26 SD: 0.98 Range: 3 (from -1, Unsatisfied to +2, Very satisfied)
9	Satisfaction from the training available to you for computer-related teaching/coaching tasks	Very satisfied (+2): 9% (3/35) Satisfied (+1): 31% (11/35) Neutral (0): 26% (9/35) Unsatisfied (-1): 34% (12/35) Very unsatisfied (-2): 0% Mean: 0.14

		SD: 1.00 Range: 3 (from -1, Unsatisfied to +2, Very satisfied)
10	Acquisition of initial computer skills	Self taught: 57% (20/35) Formal course: 46% (16/35) From a peer: 54% (19/35) From a player/student: 3% (1/35) From support staff: 17% (6/35) Other (parent): 3% (1/35)
11	Range of computer knowledge and skills are primarily the result of:	Self-teaching: 86% (30/35) Formal course: 26% (9/35) Peer teaching and support: 43% (15/35) Support staff assistant: 11% (4/35) Other (university, husband): 6% (2/35)
12	No. of hours spent weekly using a computer	Less than 1 hour: 6% (2/35) 1 to 3 hours: 20% (7/35) 3 to 5 hours: 34% (12/35) More than 5 hours: 40% (14/35)
13	No. of hours spent weekly using the Internet	Less than 1 hour: 40% (14/35) 1 to 3 hours: 23% (8/35) 3 to 5 hours: 23% (8/35) More than 5 hours: 14% (5/35)
14	Experience with computer technologies	Very Experienced: 17% (6/35) Good: 43% (15/35) Fair: 31% (11/35) Poor: 9% (3/35) None: 0%

15	Participation in courses/workshops for using computer technologies	Yes: 83% (29/35) No: 17% (6/35)
16	Typing skills	Non-existent: 3% (1/35) Poor: 11% (4/35) Good: 74% (26/35) Excellent: 11% (4/35)
17	Methods used to update knowledge about educational uses of computers	Computer magazines or journals: 11% (4/35) Computer courses: 37% (13/35) User groups: 20% (7/35) Workshops: 83% (29/35) Other (Peer instruction, Self-Teaching using the Internet, Practice): 14% (5/35)
18	Experience with other computer-based instruction software	Yes, quite a few : 17% (6/35) Yes, only one or two: 46% (16/35) No: 31% (11/35) Missing Answer: 6% (2/31)

The purpose of the scale was to learn about ways physical education teachers and coaches use computer technology. The first question related to the first year of usage. This variable was later applied to calculate subjects' *innovativeness* (i.e., how early they started using computers). Similarly, they were asked about professional uses concerning their teaching or coaching tasks and their *professional innovativeness* was also estimated. This procedure was used to learn about the time gap between adopting a technology for daily uses and adopting it for work related purposes, is discuss later.

Subjects were also questioned about when they bought their first computer for personal and professional tasks. Only two subjects never bought computers for personal use while 13 (37%) never acquired computers for work related purposes. However, these results should be viewed with caution because it was noticed from the responses that subjects, in many cases, bought computers for family members (mainly children) and not for personal use in the sense meant within the present context.

Several questions were designed to learn about the availability of training in basic computer skills, availability of computer hardware, and feasibility of related technical support. All three are important factors that determine the success of the adoption of any technology (even the most attractive software is unlikely to be used by teachers and coaches without appropriate hardware, training, and support). The results of this part of the study showed that only 63% had access for their professional task goals, while 77% of the subjects had access to computers for personal tasks. Forty-six (9%+37%) percent of subjects believed that the support received at the time of the study for coaching and teaching computer-related tasks was satisfactory or very satisfactory, while 29% were not satisfied. A similar trend was observed in reply to the question about training satisfaction. This information is important to educational leaders, who would like to distribute technology into schools and clubs. That is, they should take into consideration that one-third of users might not be fully satisfied with the support and training on information technologies.

Subjects were also asked about ways they acquired initial computer skills. The most common replies were: self-taught (57%), via peers (54%), and through formal courses (46%). It stems from the data that a combination of more than one method is chosen as a mean for acquiring computer skills. When asked: "Overall, your range of computer knowledge and skills are primarily the result of...," a 86% reported that mainly self-teaching is the way they acquired computer skills, which suggests that life-long learning skills are very important for keeping updated with computer knowledge. Again, this might have an impact on the way applications are designed.

Subjects were also asked about the number of hours they spent (on average) per week on a computer. Forty percent reported that they used the computer more than five hours a week. When asked about amount of time spent per week using the Internet, a substantial number of individuals (40%) suggested that they used it for less than an hour. Therefore, it may be concluded that the subjects were using computers for assignments other than surfing the Internet.

In Question 14, subjects were asked to rate their experience with computer technologies, on a 5-point Likert scale. The results of this question were later used to obtain the subjects *level of expertise* in using computers. It should be noted that all subjects reported having some sort of computer experience. Nine percent reported they had poor experience, 31% believed their experience was fair, 43% that it was good, and 17% thought they were very experienced in using computers.

Some of the results can be better seen in a graphical format. Figures 5.3 and 5.4 show the distributions of the answers to the first question: "In which year did you first use a computer for your *personal* tasks?." Figure 5.3 presents a typical histogram, while Figure 5.4 demonstrates the accumulative frequency of the same results. This representation of the data is with accordance to the Diffusion of Innovations model (Rogers, 1995), which suggests that the resulting distribution has an S-shape, when the accumulative sum of the number of individuals adopting a new idea is plotted over time. Even though the pilot study was based on a relatively small number of subjects (n=35), the overall shape of the curve can be observed in most of the graphs.

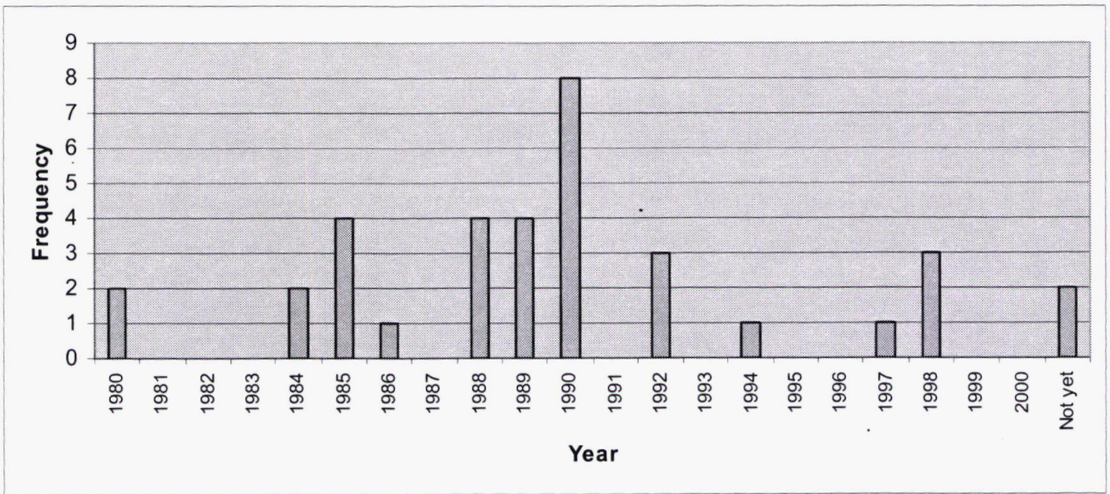


Figure 5.3. Frequency distribution of the year subjects started to use computer for *personal* tasks.

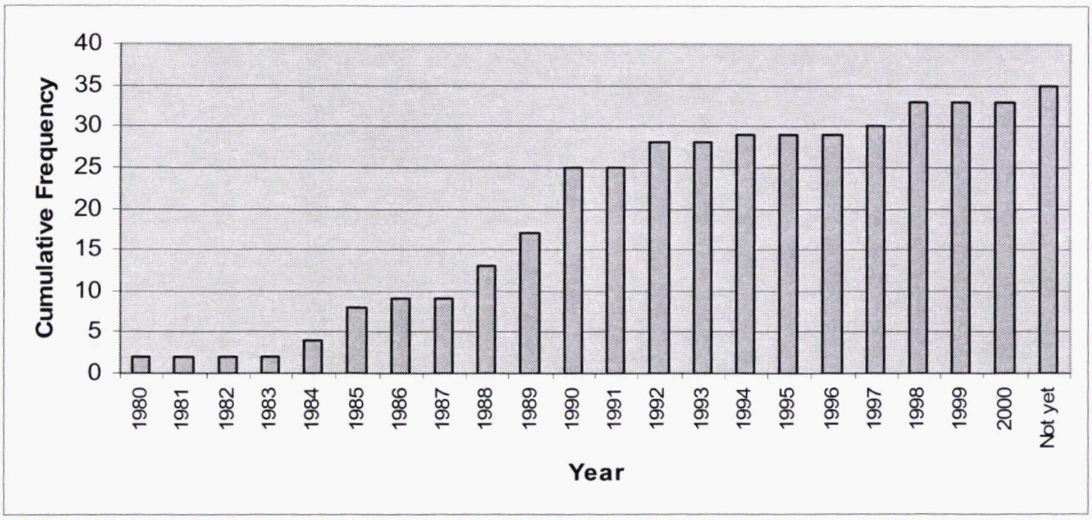


Figure 5.4. Cumulative frequency of the year subjects started to use computer for *personal* tasks.

Similarly, Figures 5.5 and 5.6 present the distributions of the answers to the second question: "In which year did you first use a computer for *professional teaching/coaching* tasks?"

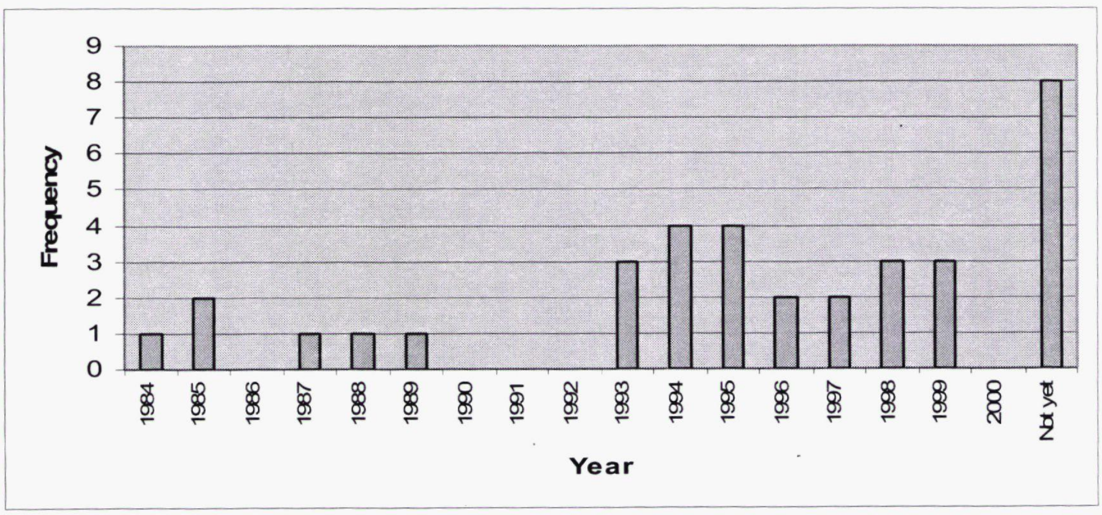


Figure 5.5. Frequency distribution of the year subjects started to use computer for *professional* tasks.

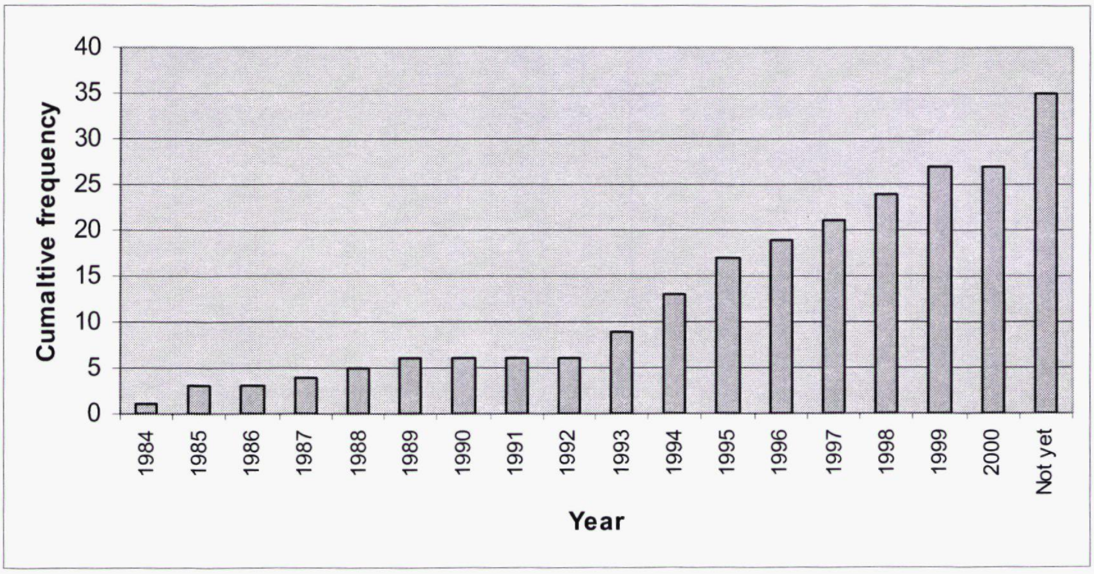


Figure 5.6. Cumulative frequency of the year subjects started to use computer for *professional* tasks.

The answers for questions # 3 (the first year a computer was bought for *personal* use) and # 4 (the same for *professional* tasks) are represented in Figures 5.7, 5.8, 5.9 and 5.10.

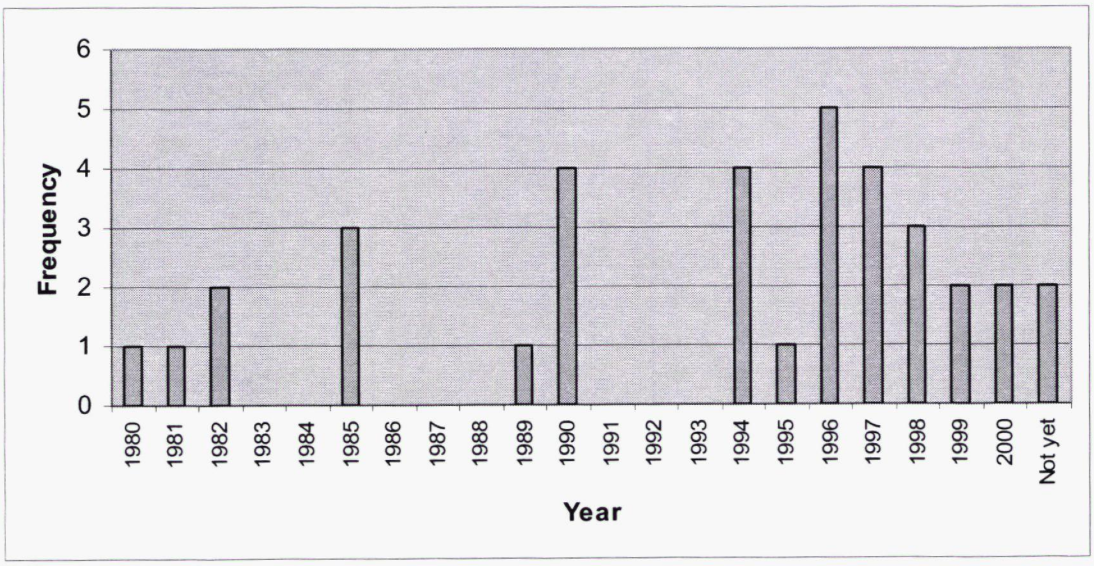


Figure 5.7. Frequency distribution of the year subjects bought their first computer for *home/personal* use.

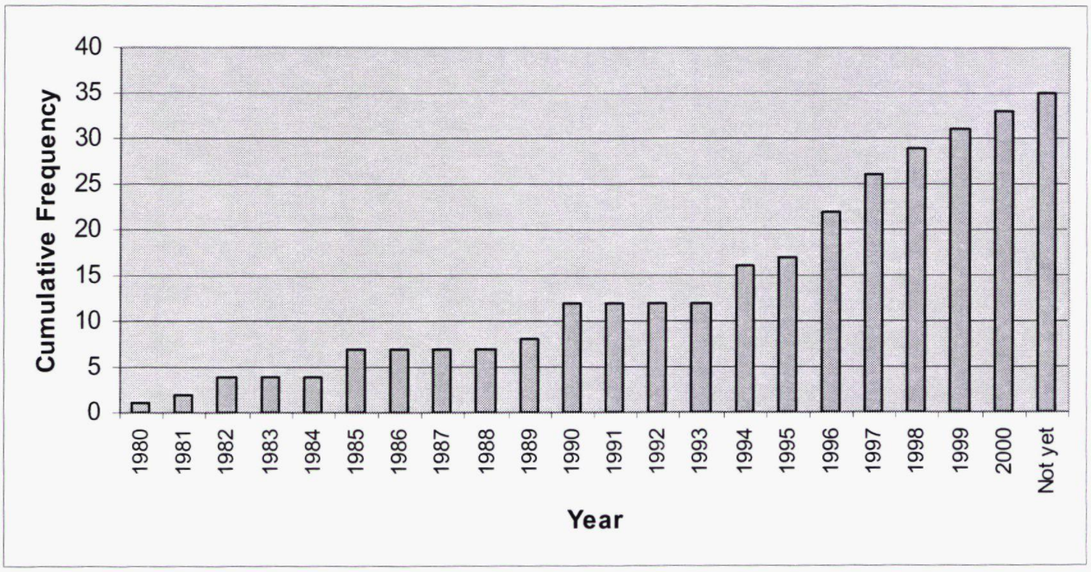


Figure 5.8. Cumulative frequency of the year subjects bought their first computer for *home/personal* use.

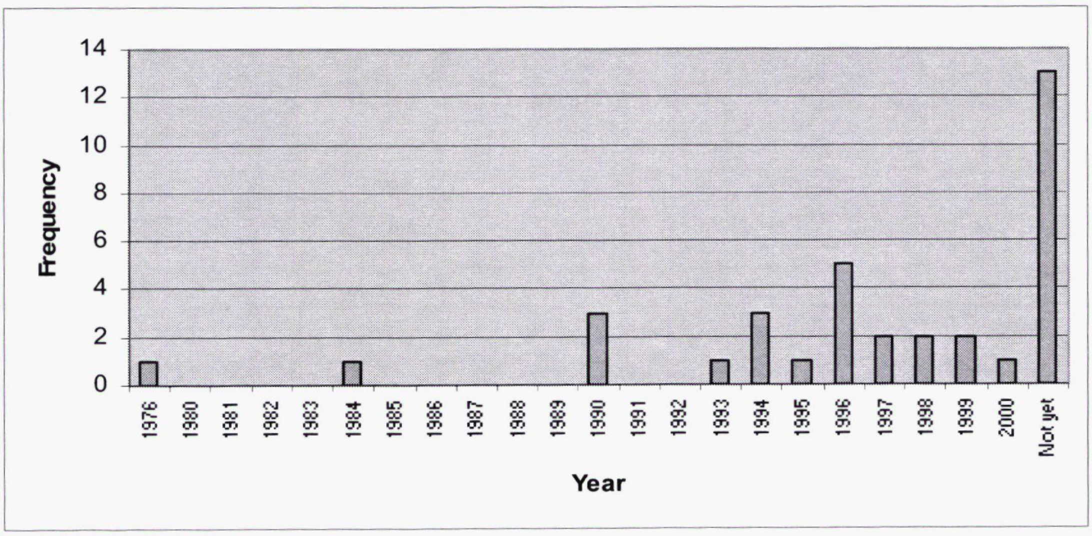


Figure 5.9. Frequency distribution of the year subjects bought their first computer for *professional* use.

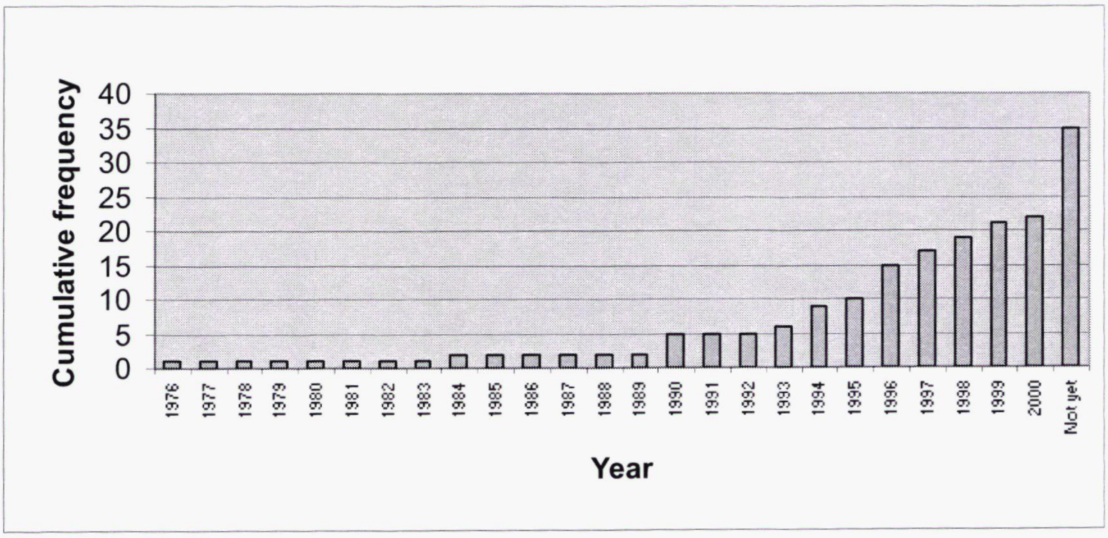


Figure 5.10. Cumulative frequency of the year subjects bought their first computer for *professional* use.

As mentioned previously, four additional variables have been calculated from the data. Figures 5.11 and 5.12 show the distributions of the number of years subjects used the computer *personally* and *professionally*, while Figures 5.13 and 5.14 the distribution of the subjects' age when they started to use computers for *personal* and *professional* uses.

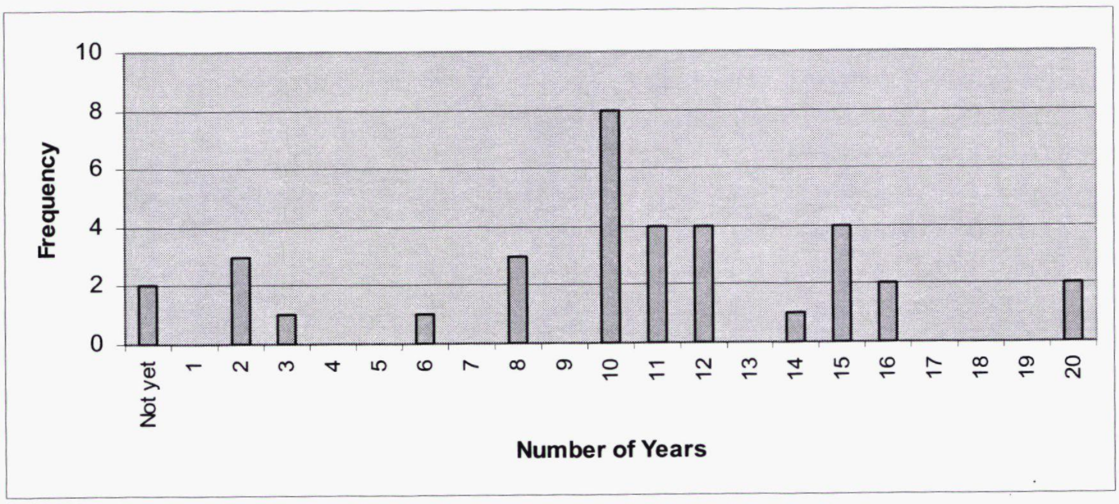


Figure 5.11. Frequency distribution of the number of years subjects used computers for *personal* tasks.

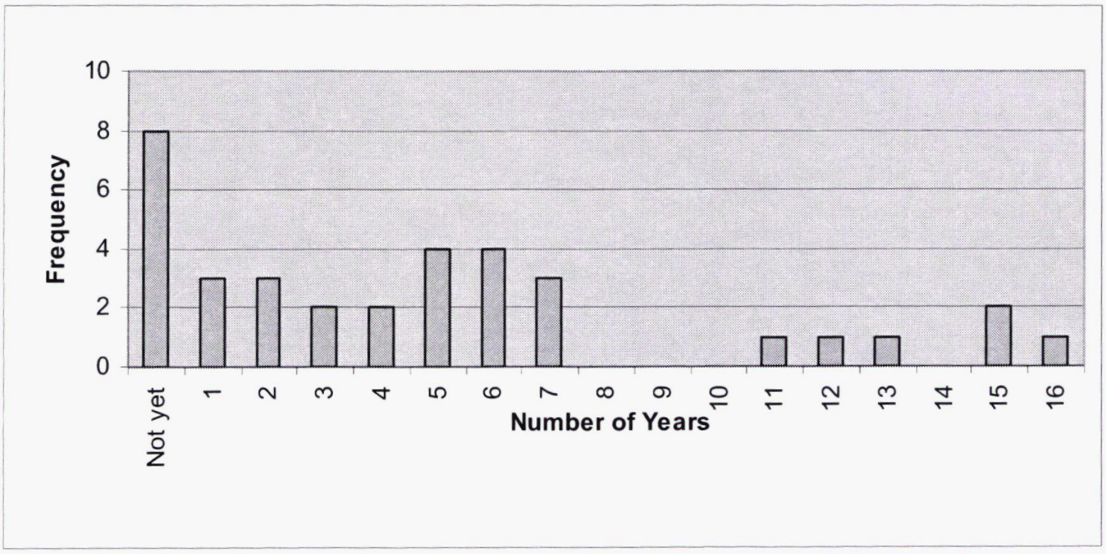


Figure 5.12. Frequency distribution of the number of years subjects used computers for *professional* tasks.

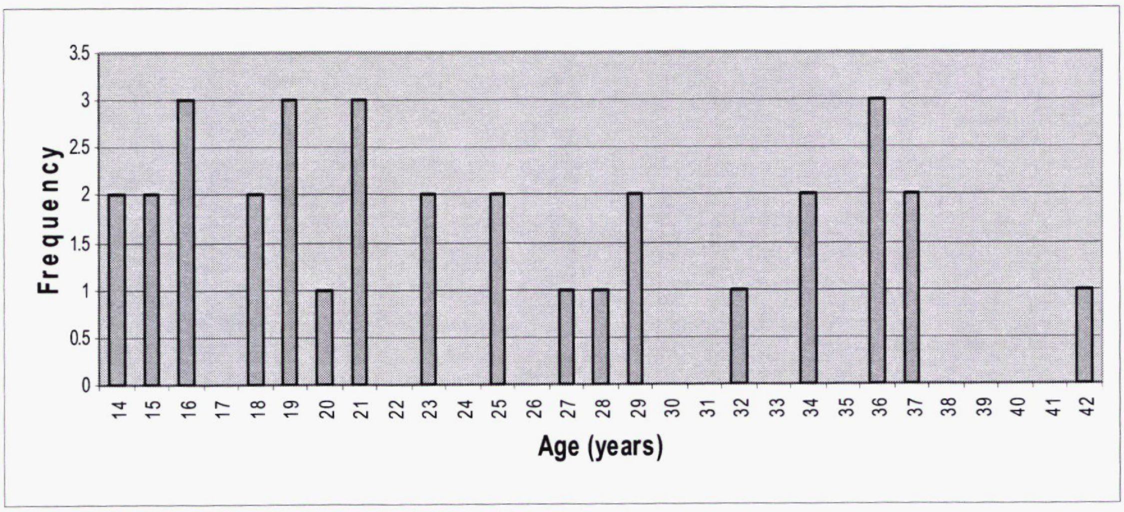


Figure 5.13. Frequency distribution of the age in which subjects first used computers.

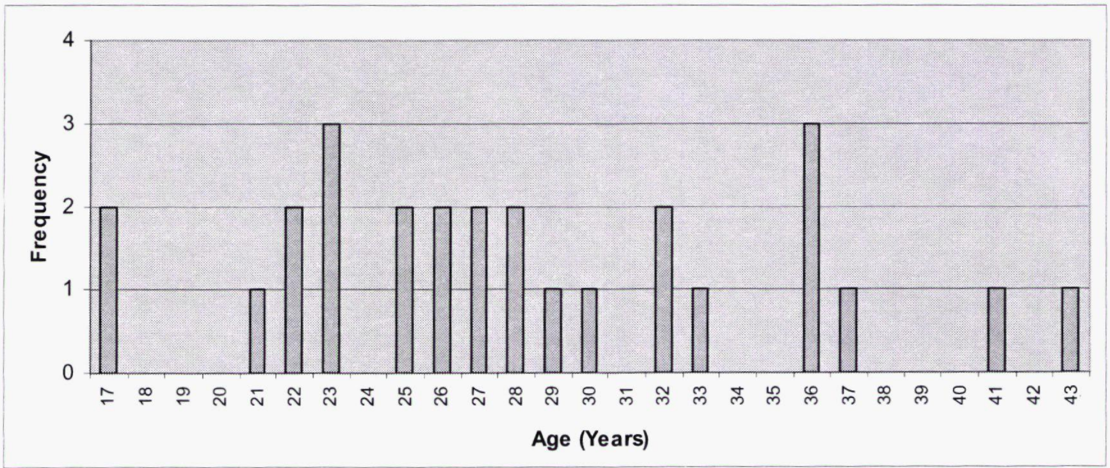


Figure 5.14. Frequency distribution of the age in which subjects first used computers for *professional* tasks.

As is evident from the results presented in this section, some of the data collected using the Patterns of Computer Technology Use Scale is based on the time dimension. Time is one of the important variables of the Diffusion of Innovations Model (Rogers, 1995). While in other behavioral sciences the time dimension is ignored, Rogers (1995) believes that the "inclusion of time as a variable in diffusion research is one of its strengths" (p. 20). However, it should be taken into consideration that subjects may not recall details precisely. Asking subjects to recall different dates from their past might also be one of the method's weak points, as their recall may be limited by their memory abilities.

The next scale, Computer Experience, was also designed to collect information using the time dimension. This scale is the basis for calculating the *innovativeness* and the *level* *of expertise* variables which is used in the actual study to test the fitness of the proposed model.

5.1.3 Scale # 3: Computer Experience (Pre-workshop Questionnaire)

The third form completed by subjects prior to the workshop included a list of 46 examples of computer software and tools under six different categories. They were asked to state (1) their current level of expertise (None (0), A little (1), Fair (2), Substantial (3) or Extensive (4)), (2) the year in which they first used this software/tool (if ever) and (3) the year they first used this software/tool (if ever) for teaching/coaching related tasks. The results from this scale were used to determine the adoption level of the different technology tools.

The following figures (5.15-5.24) show the distribution curves of selected computerized tools: windows operating systems, word processing, spreadsheets, e-mail, and the Internet.

Windows 95, 98 Operating System

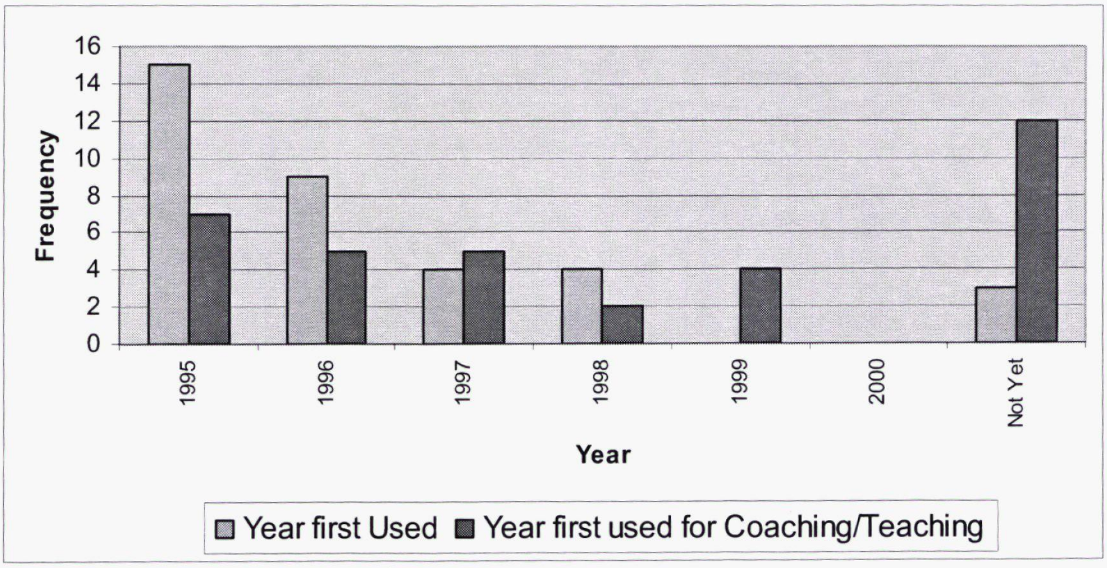


Figure 5.15. Frequency distribution of subjects along the year they first started to use the Windows 95, 98 Operating System.

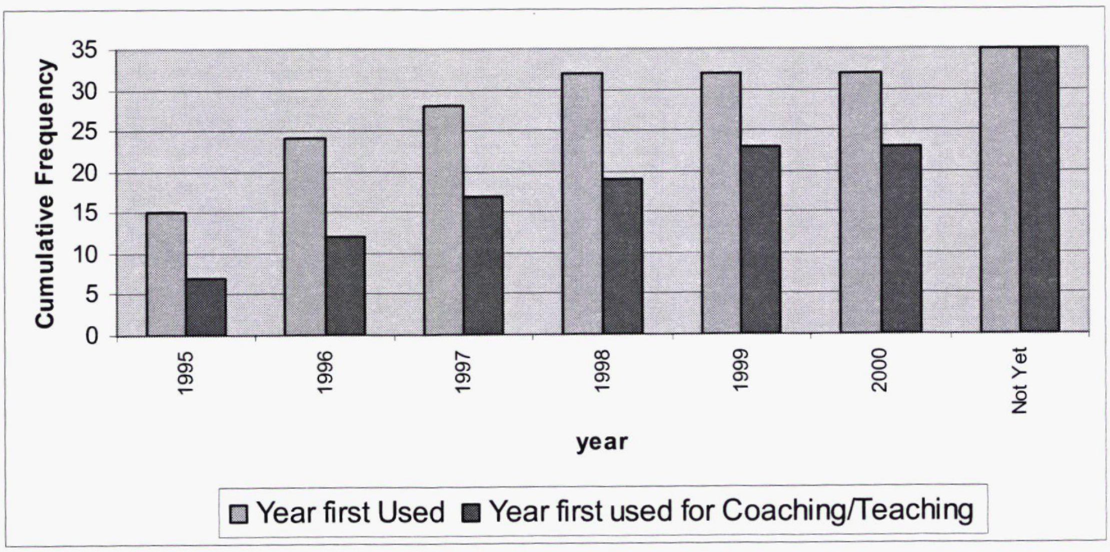


Figure 5.16. Cumulative frequency of the number of subjects along the year they first started to use the Windows 95, 98 Operating System.

Word Processing

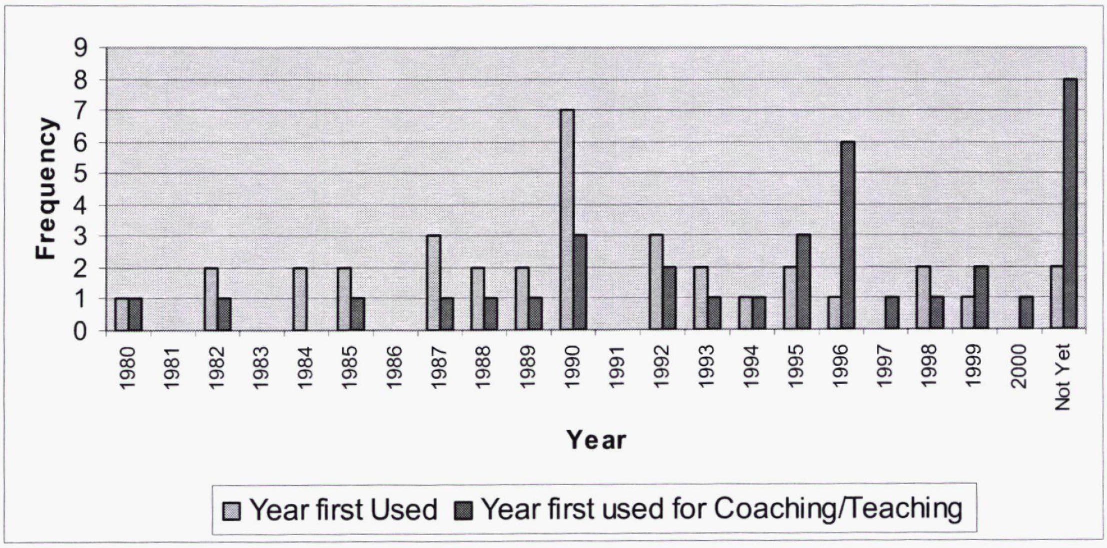


Figure 5.17. Frequency distribution of subjects along the year they first started to use word processing

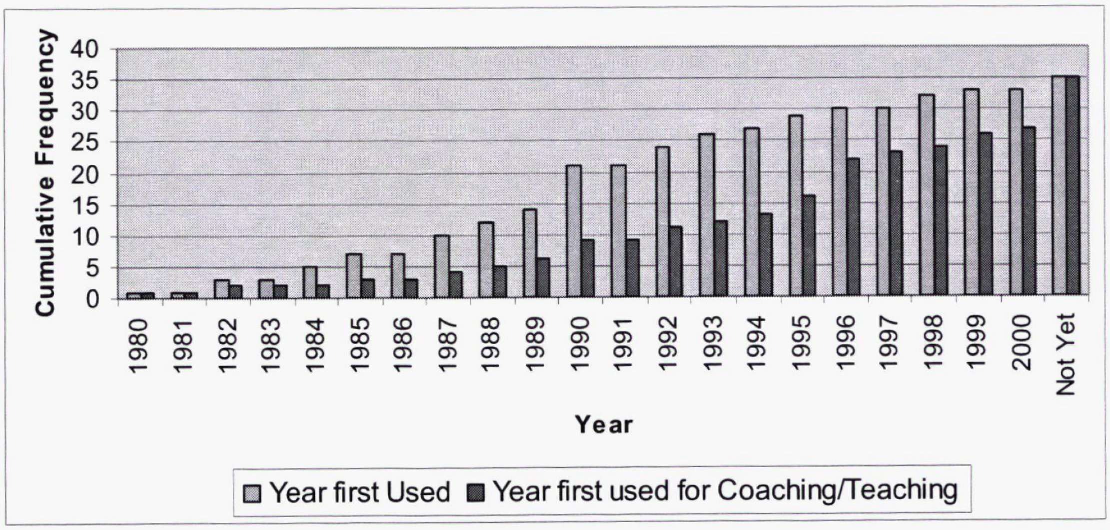


Figure 5.18. Cumulative frequency of the number of subjects along the year they first started to use word processing.

Spreadsheets

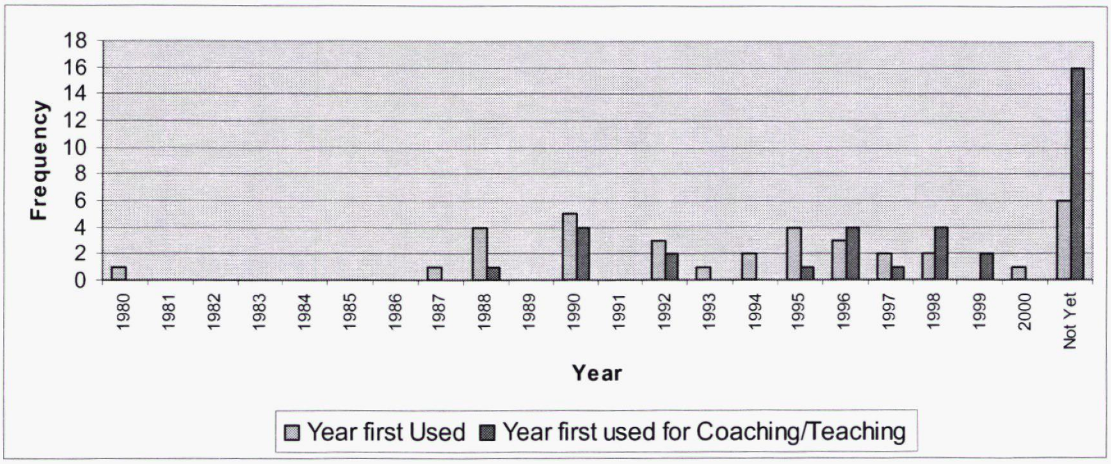


Figure 5.19. Frequency distribution of subjects along the year they first started to use spreadsheets.

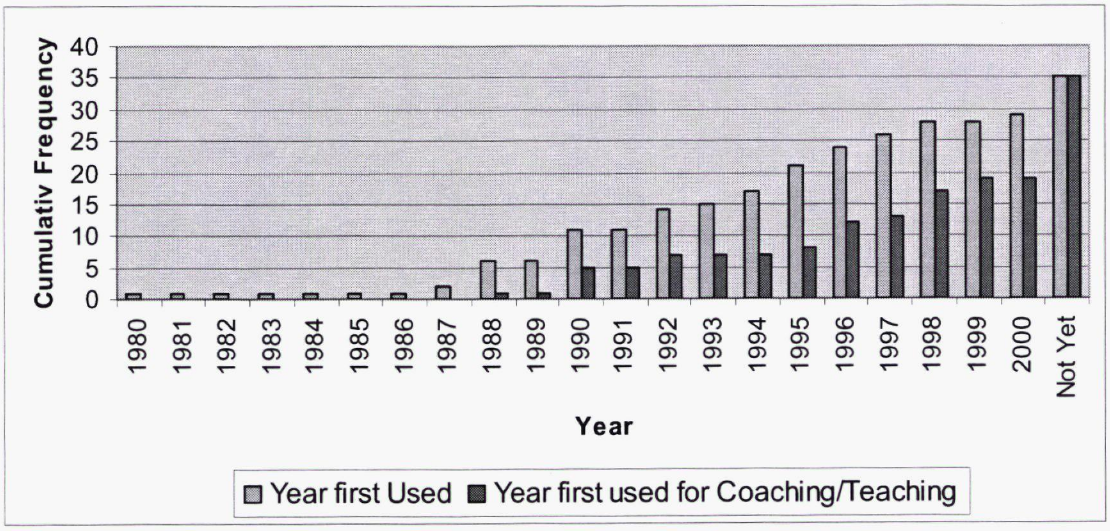


Figure 5.20. Cumulative frequency of the number of subjects along the year they first started to use spreadsheets.

E-mails

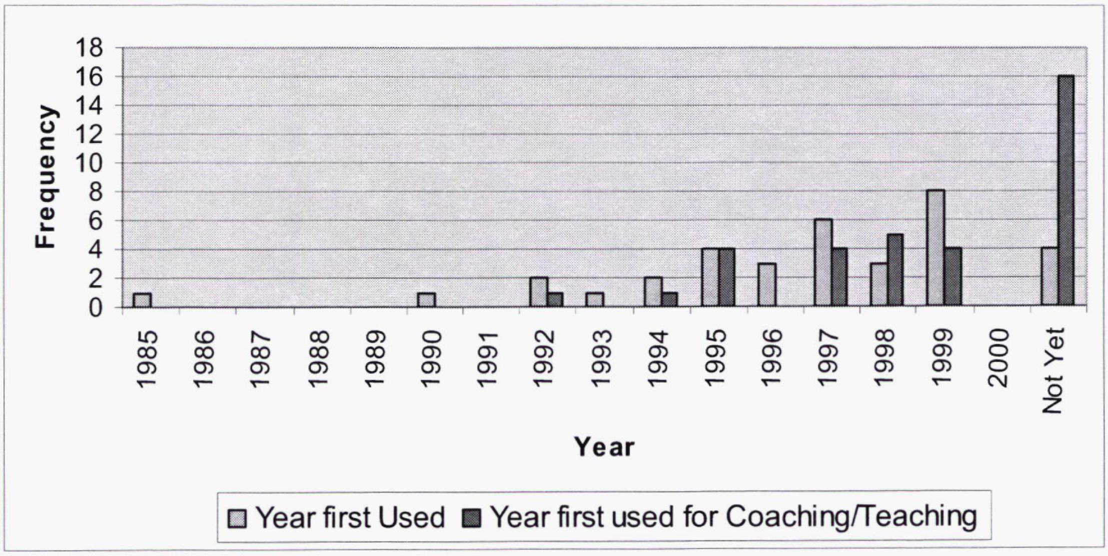


Figure 5.21. Frequency distribution of subjects along the year they first started to use electronic mail.

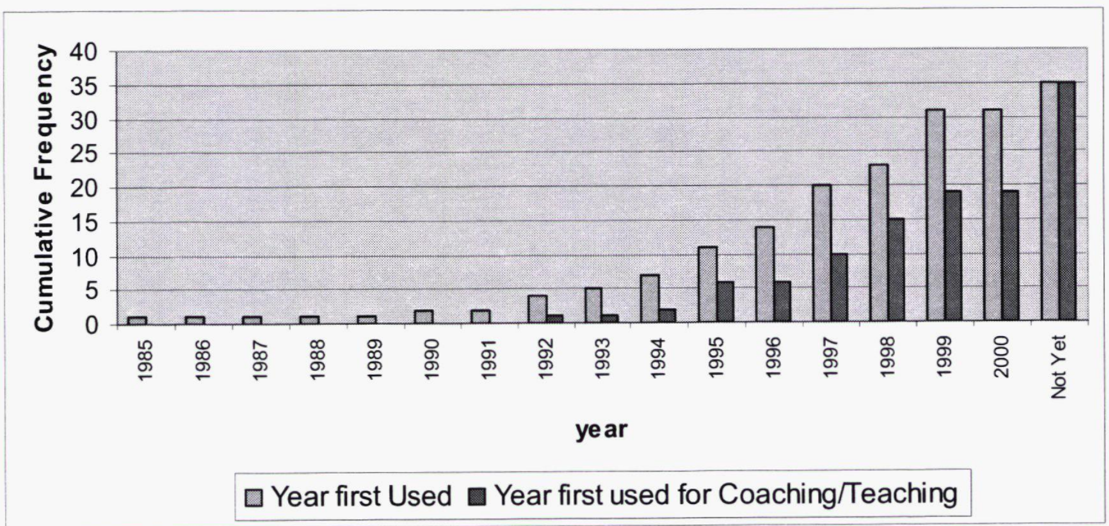


Figure 5.22. Cumulative frequency of the number of subjects along the year they first started to use electronic mail.

Surfing the Internet

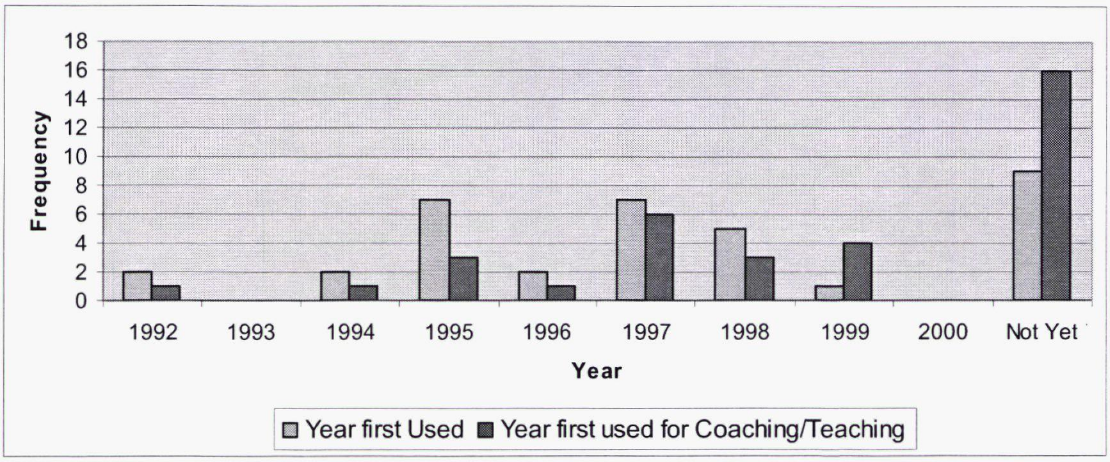


Figure 5.23. Frequency distribution of subjects along the year they first started to use the Internet.

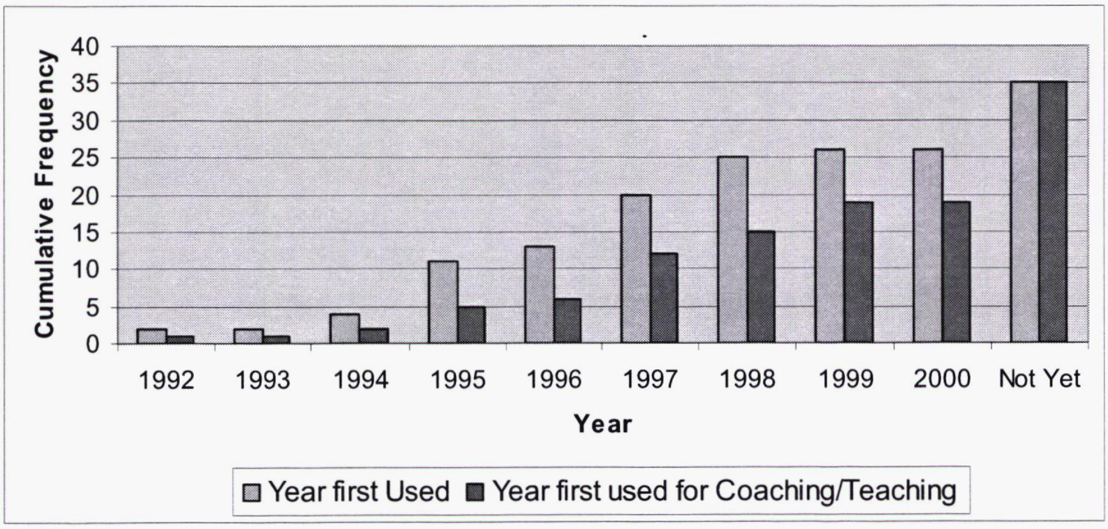


Figure 5.24. Cumulative sum of the number of subjects along the year they first started to use the Internet.

Table 5.3 was designed in order to better learn about the different computer tools and applications mentioned in the scale. The table presents all the tools and applications mentioned, with their cumulative percentage of adoption for *personal* and *professional* uses at the time the information was gathered (August, 2000). The table is sorted by the cumulative percentage of adoption of *personal* tasks.

Table 5.3

Summary of the Cumulative Percentage of Adoption for Personal and Professional Uses, August, 2000

Computer Tool/Application	Cumulative percentage of adoption: Personal tasks		Cumulative percentage of adoption: Professional tasks
Word-processing	94.29%	**Laggards**	77.14%
World Wide Web browsing, searching	94.29%	⇧	62.86%
Win 95, 98	91.43%	⇩	65.71%
Electronic mail	88.57%	**Laggards**	54.29%
Spreadsheets	82.86%	**L.M.**	54.29%
Grading package	80.00%	⇧	57.14%
Graphics program	77.14%		54.29%
Surfing the Internet	74.29%		54.29%
Macintosh	71.43%		45.71%
Apple	60.00%		11.43%
On-line video, audio	60.00%		25.71%
Database	57.14%		37.14%
Charting-graphing	54.29%		20.00%
On-line databases	54.29%		20.00%
PC-DOS	51.43%	⇩	11.43%
Presentation package	51.43%	**L.M.**	34.29%
Win 3.x, NT	48.57%	**E.M.**	22.86%
FTP	45.71%	⇧	17.14%
Tutorials	37.14%		28.57%
Games	37.14%		17.14%
Desktop publishing	34.29%		20.00%
Newsgroups	31.43%		5.71%
WWW page creation/editing	31.43%		8.57%
Drill & Practice	31.43%		28.57%
Programming language experience	29.41%		2.86%
Authoring	28.57%		11.43%
Listservs, BBS	20.00%		5.71%

Time and Scheduling software	20.00%	⇩	20.00%
Videodisk	17.14%	**E.M.**	5.71%
Gopher	14.29%	**E.A.**	2.86%
Statistics package	14.29%	⇧	5.71%
Simulations	11.43%		5.71%
Designing and Creating practice/lesson plans software	11.43%		8.57%
Virtual Reality	11.43%		0.00%
UNIX	8.57%		0.00%
Measurements of performance related software	8.57%		2.86%
Game analysis related software	8.57%		5.71%
Integrated Learning System	5.71%	⇩	2.86%
Sun	2.86%	**E.A.**	0.00%
Robotics	0.00%	**Innovators**	0.00%

One of the conclusions from the table is that only four tools and applications (Word-processing, World Wide Web browsing and searching, Windows 95, 98 and Electronic Mail) are adopted by the majority, and starting to diffuse and be used by subjects that are considered to be Laggards. On the other hand, tools and applications, which are used only by less than 16% of the population (Statistics, Simulations, Virtual Reality), are probably used only by those subjects, which are considered Early Adopters and Innovators only.

It can also be seen that there is an adoption *time-gap* between personal and professional tasks. The cumulative percentage of adoption for the former is always higher than for professional ones. That is, teachers and coaches tend to develop a level of personal expertise with a particular technology before attempting to integrate it into their profession. This phenomenon is similar to that found by Jacobsen (1998) concerning the decade between the adoption of the computer for professional and research tasks and adoption for teaching tasks by university faculty. This time-gap can also be seen in the following figure

(5.25) where the cumulative percentage of the subjects that adopted computers for personal and professional tasks is plotted over time.

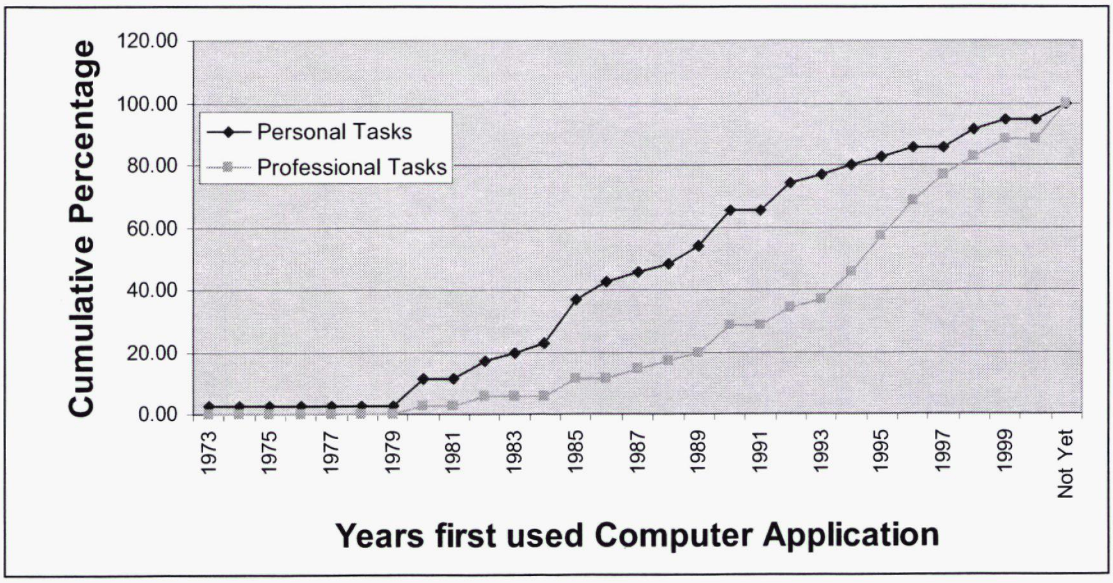


Figure 5.25. Cumulative percentage of the number of subjects along the year they first started to use any computer application for personal and professional tasks.

The Computer Experience Scale was also used to calculate external variables used in the proposed model. *Innovativeness*, a major factor in the diffusion of innovations model (Rogers, 1995), was obtained by finding the first year a computer application was used by each subject. *Professional Innovativeness* was calculated similarly, using the first time a subject used an application professionally. *Level of Expertise* was calculated by summing up the level of expertise of each coach/teacher (from none (0) to extensive (4)) in all the different tools and applications mentioned in the scale.

As already mentioned, the 46 items were divided into six categories: Operating Systems, Tool Application, Communication Software, Software and Tools, Teaching/coaching Related Software, and Variety. The last item in each category was always an open question asking the subject to note any other tool, and the specific category was not mentioned. In five of the six open categories, no other tool was recorded; therefore, the level of expertise has been calculated using a total of 41 items. The mean level of expertise was 37.49 with standard deviation of 22.55. The range of the results was 98 (8 to 106) out of maximum possible range of 164 (0 to 41*4).

The proposed model suggests that these two variables (*Innovativeness* and *Level of Expertise*) are among the external variables which may affect the decision whether or not to adopt an innovation. Elaboration on these two external variables, and others, will take place in section 5.2.

5.1.4 Scale # 4: Stages of Adoption of Technology (Pre-workshop Questionnaire)

Another scale that measured the level of technology adoption was used. On the Stages of Adoption of Technology Scale, subjects indicated the stage that best described their level of technology adoption out of six possible stages, each described in the scale (see Appendix D). One of the reasons for this scale was to validate some of the specifically developed scales used in the study. This, however, was done only with the actual study data.

The mean response for the perceived stage of adoption of technology was 4.56 with a standard deviation of 1.33. Only one subject perceived their adoption stage to be at the first stage (i.e., 3% of the sample). Two subjects (6%) considered themselves in Stage # 2, four (11%) in Stage # 3, six (17%) in Stage # 4, twelve (34%) in Stage # 5, and nine (26%) in Stage # 6. The distribution of the subjects at the different stages is presented in Figure 5.26.

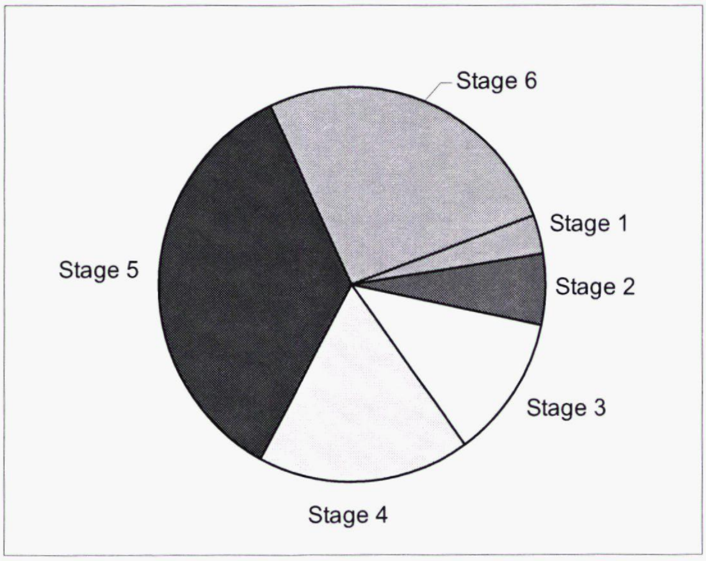


Figure 5.26. Distribution of the perceived stage of technology adoption.

5.1.5 Scale # 5: Computer Attitude Scale (Pre-workshop Questionnaire)

The Computer Attitude Scale was made up of four different sub-scales: Anxiety, Confidence, Liking, and Usefulness. Each factor was calculated as a sum of 10 items. Table 5.4 shows the statistics of the different factors.

Table 5.4

Description Statistics of the Computer Attitude Sub-Scales Collected with the Pre-Workshop Questionnaire

Factor	Statistics of the sample
Anxiety (10 items)	Mean: 44.14 Standard Deviation: 5.15 Range: 22 (from 28 to 50)

Confidence (10 items)	Mean: 41.23 Standard Deviation: 4.99 Range: 24 (from 26 to 50)
Liking (10 items)	Mean: 38.51 Standard Deviation: 5.45 Range: 25 (from 25 to 50)
Usefulness (10 items)	Mean: 43.97 Standard Deviation: 3.66 Range: 13 (from 37 to 50)

5.1.6 Scale # 6: Computer Technology for Physical education teachers and coaches (Pre-workshop Questionnaire)

A newly developed scale was used to gather information specifically on the attitude of the physical education teachers and coaches towards the use of technology in sport and physical education. The scale was made-up of 3 parts: 1) General attitude, 2) Attitude towards specific teaching/coaching tools, and 3) Open questions. The results of the first two scales are presented in Table 5.5. The qualitative data collected by the open questions is described thereafter.

Table 5.5

Descriptive Statistics of Variables Collected with the Computer Technology for Physical education teachers and coaches Scale (Pre-Workshop Questionnaire)

Factor	Statistics of the sample
General Attitude (12 items)	Mean: 49.34 Standard Deviation: 4.25 Range: 15 (41 to 56)
Attitude towards Teaching/coaching Tools (12 items)	Mean: 51.63 Standard Deviation: 5.39 Range: 20 (40 TO 60)

The purpose of the open questions was to shed more light on the computer applications and tools that physical education teachers and coaches use for carrying out their job-related tasks. Subjects were to list computer tools they currently used for fulfilling teaching or coaching tasks. The most common reply was word processing, which was claimed by sixteen subjects (43%). Twelve subjects (34%) indicated the use of the Internet, nine subjects (26%) used grading and marking applications, and eight (23%) were using spreadsheet software. Other applications reported, but less commonly so, were: e-mails, databases, presentation software, and games.

In the following question, subjects were asked if they would like to use computer tools and applications in filling their teaching/coaching tasks. The majority (34 subjects, i.e., 97%) of the sample was affirmative. The most common explanation for the reason was: easy access to information, time-saver, visual aid for demonstration, organizational possibilities, and the recognition that we are in the technology revolution period. When asked about tools and applications they would like to use, ten subjects mentioned data-bank of drills and skills. Other suggestions were: lesson/practice plans, schedule making, coaching ideas, motion analysis, simulation, and game statistics. It is important to notice that seven subjects replied that they could not answer the question as they believed they did not have enough knowledge in the area. Furthermore, they explained that they came to the workshop in order to learn more about the possibilities in the area.

5.1.7 Scale # 7: Generalized Self-efficacy (Pre-workshop Questionnaire)

Ten items were used to measure the subjects' generalized self-efficacy. The scale was taken, with permission, from Schwarzer and Jerusalem (1995). The score of the scale was calculated by adding up the ten items. The mean of the sample generalized self-efficacy was 31.37 with a standard deviation of 5.20. The results ranged from low of 21 to max of 40 (out of a possible score of 40 which describes a person with a very high generalized self-efficacy).

Once the seven scales of the pre-workshop questionnaire were concluded, subjects participated in the workshop and were introduced to the Interactive Volleyball CD-ROM. At the end of the workshop, they completed the post-workshop questionnaire. The data of the three scales of the post-workshop questionnaire is presented in sub-sections 5.1.8-5.1.10.

5.1.8 Scale # 8: Perceived Characteristics of the Interactive Volleyball CD-ROM (Post-workshop Questionnaire)

On the first form of the post-workshop questionnaire, subjects were to evaluate the Interactive Volleyball CD-ROM on ten different items using a seven-point Likert scale (ranging from "strongly disagree" to "strongly agree"). The scale was made up of two sub-scales: The Perceived Relative Advantage (items 1-6) and the Perceived Complexity (items 7-10). The results are presented in Table 5.6. It is apparent that, on average, subjects considered the CD-ROM to have a relative advantage compared to other, more traditional methods (mean score of 36.06 out of 42 maximum score) and that the CD-ROM was easy to operate (mean score of 24.64 out of 28 maximum score).

Table 5.6

Descriptive Statistics of the Variables Collected by the Perceived Characteristics of the Interactive Volleyball CD-ROM Scale (Post-Workshop Questionnaire)

Factor	Statistics of the sample
Perceived Relative Advantage	Mean: 36.06 Standard Deviation: 4.44 Range: 13 (from 29 to 42)
Perceived Complexity	Mean: 24.64 Standard Deviation: 3.49 Range: 12 (from 16 to 28)

5.1.9 Scale # 9: Computer Attitude Scale (Post-workshop Questionnaire)

Subjects completed the same Computer Attitude Scale they had before, after the workshop was over. The reason was to test if practice with a relatively easy-to-use computerized tool might change individuals' attitude towards computers, especially of those who had not used computers extensively before. These assumptions were rejected (discussed in section 5.3.1) and, therefore, the Computer Attitude Scale was not included in the post-workshop questionnaire of the actual study. Table 5.7 shows the descriptive statistics of the attitude variables collected at the post-workshop.

Table 5.7

Descriptive Statistics of the Attitude Variables Collected by the Computer Attitude Scale (Post-Workshop Questionnaire)

Factor	Statistics of the sample
Anxiety	Mean: 44.15 Standard Deviation: 4.76 Range: 18 (from 32 to 50)
Confidence	Mean: 41.52 Standard Deviation: 5.61 Range: 20 (from 30 to 50)
Liking	Mean: 39.52 Standard Deviation: 5.52 Range: 23 (from 27 to 50)
Usefulness	Mean: 43.39 Standard Deviation: 4.38 Range: 18 (from 32 to 50)

5.1.10 Scale # 10: Intention to Use the Interactive Volleyball CD-ROM (Post-workshop Questionnaire)

In the final scale of the post-workshop questionnaire, subjects were to rank their intention to actually take and use the Interactive Volleyball CD-ROM for their teaching/coaching tasks. This was measured using a 7-point Likert scale (ranging from 1="I will certainty use it" to 7="I will certainty NOT use it"). The average score of the scale was 1.48 with a standard deviation of 0.67. The results ranged only from 1 to 3. All subjects believed that they would use the CD-ROM. Sixty-one percent said they would certainly use it, 30% were a little bit less sure (2) that they would use it, and another 9%, even-though they thought they would use it, were not as sure (3). The distribution of the replies can be observed in Figure 5.27.

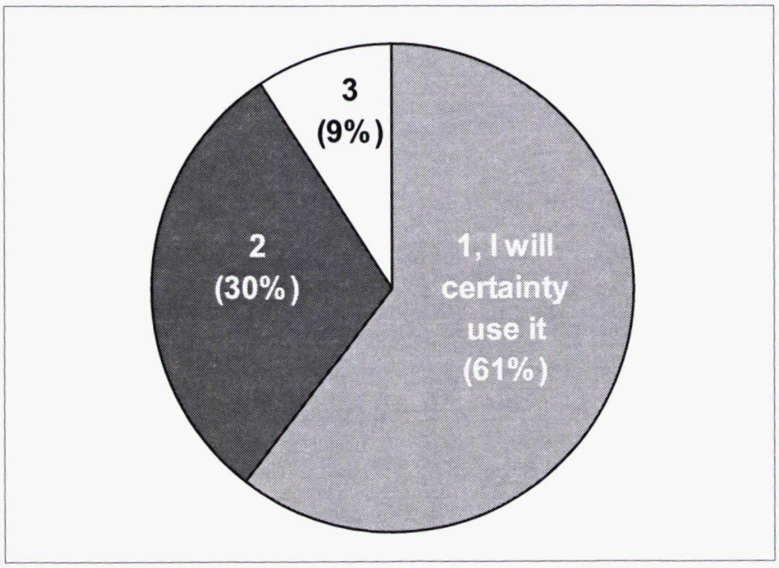


Figure 5.27. Distribution of the intention to use the Interactive Volleyball CD-ROM.

Subjects were to explain "the reason they chose the previously described option as an open answer. The most common responses were: time saver (29% of the sample), friendliness and easy operation (26%), source of information for drills and coaching tips (26%), video and visual demonstration (23%), and organization features (11%).

The following five scales (sections 5.1.11-5.1.15) were sent to subjects approximately six months after the workshop. The follow-up questionnaire gathered data using the scales: Follow-up, Computer Attitude, Generalized Self-efficacy, Stages of Technology Adoption, and Computer Technology for Physical education teachers and coaches. The response rate was about 66% (23/35).

5.1.11 Scale # 11: Follow-Up Scale (Follow-up Questionnaire)

The main propose of the follow-up scale was to learn about the adoption process of an innovation. In addition, information about the pattern of usage of the Interactive Volleyball CD-ROM, as well as any changes in users' attitude that may be associated with it, was collected. In the first question, subjects were to choose if they never used the CD-ROM (0), used it for few times (1), used it many times (2) or used it on a regular basis (3). The distribution of the responses is presented in Figure 5.28.

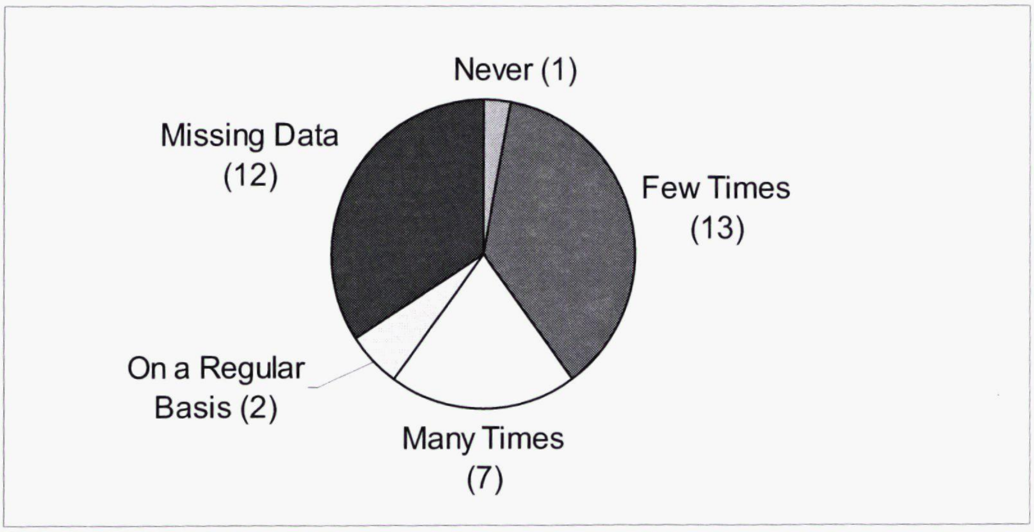


Figure 5.28. Distribution of the responses for the frequency use of the Interactive Volleyball CD-ROM, when the missing data is included.

When excluding the missing data the results indicate that 4% of the reported data (one subject) never used the CD-ROM. The majority of the subjects (13) used the CD-ROM few times, while seven subjects used it many times, and two on a regular basis. These results are presented in the Figure 5.29.

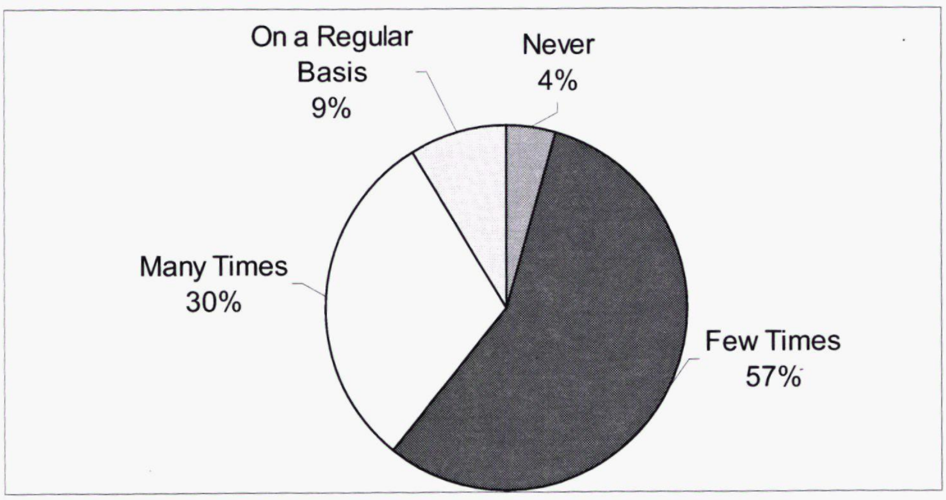


Figure 5.29. Distribution of the responses for the frequency use of the Interactive Volleyball CD-ROM, when the missing data is excluded.

In the second question, subjects stated the type of work they did with the CD-ROM. They were to check any of the following options: reading and watching the educational content, looking for drills, modifying and creating new drills, creating lesson/practice plans, or using it in the gym with their students. They could also add any other uses. The results show that 11 subjects used to CD-ROM to read and watch the educational content, 22 looked for drills; nine used it to modify or create new drills, while 14 used it to create lesson/practice plans. Additionally, three coaches/teachers used the CD-ROM in the gym, to present its content to their students. Two subjects reported on a usage that was not listed on the form. They used the CD-ROM to share information with other coaches in the school.

Questions 3 and 4 were designed to shed more light on ways the CD-ROM was used. Subjects were to report the number of new drills (Question 3) and the number of practice/lesson plans they had added to the databases (Question 4). Six subjects reported on saving new drills to the drills database. The numbers of new drills reported were: 1, 5, 6, 11, 197, and 200. This is somewhat different from the number of subjects that reported using the CD-ROM for creating new drills (9 subjects on Question 2). One explanation (that was given by one of the subjects) is that drills were created using the CD-ROM and were printed out, but were not saved for future use. Ten subjects reported a number of practice/lesson plans added to the database. The number of new practice/lesson plans created with the CD-ROM ranged from 1 to 23.

The next five questions (5 to 9) addressed information about the overall impression subjects had about the CD-ROM. The five topics were: usefulness, designing, problems, relevance to teaching/coaching tasks, and effectiveness/efficiency compared to other methods. The questions were presented on a 5-point Likert scale ranging from Strongly Agree (+2) to Strongly Disagree (-2). The results of the five questions are presented in Table 5.8 where they are ordered by the total score calculated by summing up the multiplication of the number of subjects in each category by the category constant.

Table 5.8

Descriptive Statistics of the Follow-up Scale (Follow-up Questionnaire)

Topic	**Strongly Agree (2)**	**Agree (1)**	**Neutral (0)**	**Disagree (-1)**	**Strongly Disagree (-2)**	**n**	**Total Score**
Designing	4	18	1	0	0	23	26
Usefulness	6	12	5	0	0	23	24
Relevance	4	15	4	0	0	23	23
Bugs	3	13	3	4	1	23	13
Effectiveness/ Efficiency	2	12	5	4	0	23	12

All the topics in the scale had a positive score, suggesting that overall, subjects believed the CD-ROM was good for all topics mentioned. The strongest point of the CD-ROM, according to subjects, is its design. Four subjects (15%) strongly agreed that it was very well designed. An additional 18 subjects agreed, one did not have an opinion (Neutral), and no one disagreed or strongly disagreed. The CD-ROM got only positive marks on 2 additional topics: usefulness ("Overall, I find that the CD-ROM can help me carry out my teaching/coaching related-tasks") and relevance ("I think that this program meets the relevant needs of coaches/teachers"). On the other 2 topics (bugs - "I found the CD-ROM to work as expected, and to be without bugs" and Effectiveness/Efficiency - "I believe that the CD-ROM is more effective/efficient than other methods") even though the overall marks were positive, a few subjects disagreed and one even strongly disagreed with the written statements.

The second part of the follow-up scale included ten "closed" and one "open" questions. All were concerned with any barriers subjects may have encountered while using, or trying to use, the Interactive Volleyball CD-ROM. The ten "closed" questions suggested ten possible barriers and subjects were asked to rate their opinion from "strongly agree, a major barrier" (-2) to "strongly disagree, not a barrier" (+2), on a 5-point Likert scale. The results are presented in Table 5.9, ordered by the score of each barrier, calculated by summing up the multiplication of the numbers of subjects in each category and the category constant.

Table 5.9

Descriptive Statistics of the Barriers Information Collected by the Follow-up Scale (Follow-up Questionnaire)

Topic	**Strongly Agree, a major barrier (-2)**	**Agree (-1)**	**Neutral (0)**	**Disagree (+1)**	**Strongly Disagree, not a barrier (+2)**	**n**	**Score**
Lack of time	8	11	2	2	0	23	-25

Inadequate financial support	1	10	1	5	6	23	5
Unavailable hardware	3	6	4	2	8	23	6
Manual inadequate and unhelpful	0	1	9	5	3	18	10
No interest from peers	1	3	3	15	1	23	12
Personal preference to pen and paper	0	1	5	14	2	22	17
Unstable hardware	0	1	8	7	7	23	20
Not an advantage to work	0	0	2	17	4	23	25
Insufficient personal knowledge	0	1	2	12	8	23	27
The CD-ROM is too difficult to operate	0	0	1	12	10	23	32

From the table it may be observed that the major barrier for using the CD-ROM was the lack of time. It was also the only one that actually got a negative score, suggesting more subjects found it to be a barrier than not. All other scores were positives; however, two more barriers should be taken into account as they got a relatively low score: Inadequate Financial Support (scored 5) and Unavailable Hardware (scored 6). At the other end of the scale, several barriers seem not to be considered as such by most of the sample. Subjects disagreed with the following statements:

- The CD-ROM is not an advantage to work.
- Insufficient personal knowledge on ways to use and to integrate the CD-ROM in work was a problem (excluding one subject).
- The CD-ROM was difficult to operate.

In an open question, subjects stated about any additional barriers that may prevent teachers and coaches from using and/or integrating the Interactive Volleyball CD-ROM in their work. Three subjects re-mentioned time, one mentioned cost (even thought they got the CD-ROM for free) and another one mentioned the availability of hardware.

5.1.12 Scale # 12: Computer Attitude Scale (Follow-up Questionnaire)

Subjects were to complete the Computer Attitude Scale once again to explore if their attitudes towards working with computers had changed, during the time elapsed since the workshop (6 months) (the results are in Table 5.10).

Table 5.10

Descriptive Statistics of the Computer Attitude Scale (Follow-up Questionnaire)

Factor	Statistics of the sample
Anxiety (10 items)	Mean: 42.27 Standard Deviation: 4.67 Range: 16 (from 34 to 50)
Confidence (10 items)	Mean: 42.59 Standard Deviation: 4.23 Range: 15 (from 35 to 50)
Liking (10 items)	Mean: 38.41 Standard Deviation: 5.12 Range: 21 (from 25 to 46)
Usefulness (10 items)	Mean: 43.91 Standard Deviation: 3.58 Range: 12 (from 37 to 49)

A comparison of these results to those collected previously with the same scale at the pre- and post-workshop questionnaires are discussed in section 5.3.1.

5.1.13 Scale # 13: Generalized Self-efficacy (Follow-up Questionnaire)

The follow-up questionnaire also included the Generalized Self-efficacy Scale. The average score was 33.74 with a standard deviation of 4.44. The responses ranged from 25 to 40.

5.1.14 Scale # 14: Stages of Adoption of Technology (Follow-up Questionnaire)

In order to notice any changes in subjects' level of computer usage, the follow-up questionnaire also included the Stages of Adoption of Technology Scale, concluded in the pre-workshop questionnaire. The results show a mean of 5.30 with a standard deviation of 0.88. The distribution of the results is graphically represented in Figure 5.30.

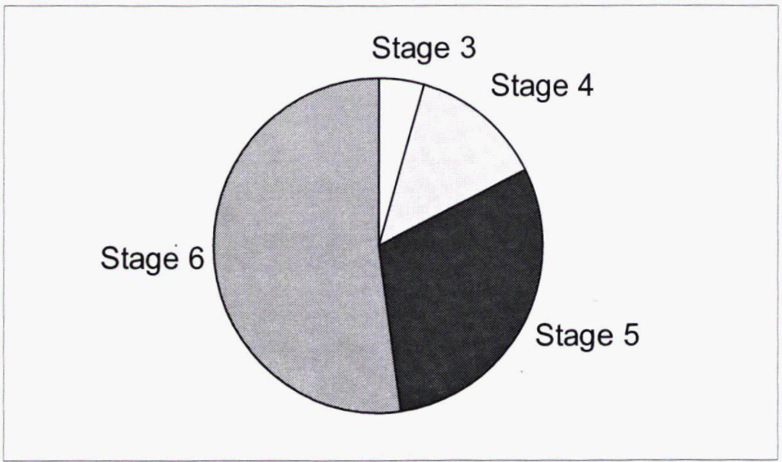


Figure 5.30. Distribution the perceived stage of subjects at the follow-up questionnaire.

5.1.15 Scale 15: Computer Technology for Physical Education Teachers and Coaches (Follow-up Questionnaire)

In the last scale of the study, subjects were asked to complete the Computer Technology for Physical Education Teachers and Coaches Form, already answered in the pre-workshop questionnaire six months prior. The results are in Table 5.11.

Table 5.11

Descriptive Statistics of the Variables Collected by the Computer Technology for Physical education teachers and coaches Scale (Follow-Up Questionnaire)

Factor	**Statistics of the sample**
General (12 items)	Mean: 49.83 Standard Deviation: 4.30 Range: 17 (from 42 to 59)
Teaching/coaching tools (12 items)	Mean: 50.65 Standard Deviation: 4.97 Range: 18 (from 42 to 60)

This concludes the descriptive statistics of the row data collected with the three questionnaires. In the next section (5.2), the external variables, which in the actual study are used to test the proposed model goodness of fit, are discussed.

5.2 External Variables

Many of the variables collected in the pilot study served as a survey for the technology level of adoption among physical education teachers and coaches in Alberta, Canada. These are described in the previous section (5.1). Several other variables were collected to test the study hypothesis and the proposed model goodness of fit (described in section 2.4) using the data collected in the actual study that took place in Israel. These variables are described and discussed in the following sub-sections. It is important to note that all these external variables, were collected with the pre-workshop questionnaire.

5.2.1 Level of Expertise

The proposed model suggests that the *level of expertise* in using similar tools or applications might affect our decision whether or not to adopt an innovation. In this study, the subjects' previous level of expertise in other computer applications was evaluated in three ways. In the Patterns of Computer Technology Use form, subjects were to rank their *experience with computer technology* on a scale from 0 (none) to 4 (very experienced). The level of expertise working with computers was also measured with the *Stage of Adoption Technology Scale* in which subjects were to choose the one that best described their level of adoption of technology on a 1-6 scale. The third variable, *total level of expertise* was calculated from the Computer Experience Scale, by summing up the level of expertise (from none (0) to extensive (4)) on all mentioned computer applications.

Prior to the data analysis, the Kolmogorov-Smirnov One-sample Test was used to determine the normality distribution of different variables in the study. The null hypotheses for the procedure stated that the distributions were normally distributed. Due to the relatively small sample size and the type of scale (0-4 and 1-6) *Experience with computer technology* and *Stage of adoption technology* variables seemed not to be distributed normally. This was also one of the reasons the model was not tested using the pilot study data only. The next Table (5.12) presents the normality data for the level of expertise variables.

Table 5.12

Results of the Kolmogorov-Smirnov One-Sample Tests for Normally Distribution Of The Level Of Expertise Variables.

Variable Name	K-S score	Probability	Scale	Normality
Experience with computer technology	0.300	0.000	0-4	Not Normal D.*
Stage of adoption technology	0.273	0.002	1-6	Not Normal D.*
Total level of expertise	0.187	0.138	1-164	Normal D.*

* At α level=0.05

In order to learn about the relationships among the level of expertise variables, the Pearson Correlation Test was carried out. The correlations are presented in Table 5.13, where all relationships were found to be significant at α level of 0.01. However, the strength of the relationship was in medium levels (0.567-0.758) only.

Table 5.13

Correlation Coefficients and Their Significant Levels Among Variables Which Measured Subjects' Level of Expertise Working With Computers

	Experience with computer technology	**Stage of adoption technology**	**Total level of expertise**
Experience with computer technology	--		
Stage of adoption technology	0.695 ** (n=34)	--	
Total level of expertise	0.758 ** (n=35)	0.567 ** (n=34)	--

** Significant at α level = 0.01

5.2.2 Innovativeness

Innovativeness was defined by Rogers (1995) as "the degree to which an individual, or other unit of adoption, is relatively earlier in adopting new ideas compared to other members of the system" (p. 22). Based on the Innovativeness characteristic, the diffusion of Innovations model (Rogers, 1995) categorized the system's members into five adopters' categories: Innovators, Early Adopters (EA), Early Majority (EM), Late Majority (LM) and Laggards. In previous studies (Anderson, Varnhagen, & Campbell, 1998; Jacobsen, 1998) an assumption was made that members, who developed an "extensive" expertise with a particular tool, did so by starting the adoption relatively early. Therefore, *innovativeness* and *level of expertise* were considered synonymous, and the innovativeness score was calculated by summing up the level of expertise on the Computer Experience Scale. However, in the current study, these two variables were measured separately: the *level of expertise* by its magnitude, as described previously and *innovativeness* on the time dimension.

The innovativeness score was calculated by four time-related variables: two measured the early time subjects tended to adopt innovation and the other two their *professional innovativeness* with regard to job-related applications. The repetition was carried out to establish validity of the variables, especially since they were based on subjects' recall ability.

In the Pattern of Computer Technology Use Scale, subjects were to report *the year they first used the computer* for personal tasks. Additionally, subjects were to report *the first year* they used the computer for *professional tasks*. On the Computer Experience Form, subjects had to indicate their experience with 46 computer applications. From that scale, "*total first time*" subjects reported using a computer and the "*total first time*" they used it for *professional tasks*, was obtained.

The Kolmogorov-Smirnov One-sample Test was used to test the normality distribution of the *innovativeness* variables. Table 5.14 presents the description statistics as well as the normality data.

Table 5.14

Descriptive Statistics and the Results of the Kolmogorov-Smirnov One-Sample Tests for Normal Distribution of the Innovativeness Variables

Variable Name	**Mean (s.d.)**	**Range**	**K-S score**	**Probability**	**Normality**
The year they first used the computer	1989.18 (4.52)	18 (1980-1998)	0.194	0.111	Normal D.*
The year they first used the computer *professionally*	1993.70 (4.50)	15 (1984-1999)	0.198	0.094	Normal D.*
Total first time used a computer application	1987.97 (5.98)	26 (1973-1999)	0.171	0.200	Normal D.*
Total first time used a *professional* application	1992.71 (4.99)	19 (1980-1999)	0.233	0.020	Not Normal D.*

* At α level=0.05

The correlations between the variables of the innovativeness which were collected at the pre-workshop questionnaire are presented in Table 5.15 where it is clear that all the innovativeness variables present a relatively high correlation (from 0.566-0.782) with significancy (at α level=0.01).

Table 5.15

Correlation Coefficients and Their Significant Levels Among Variables Which Measured the Subjects' Innovativeness

	The year they first used the computer	The year they first used the computer *professionally*	Total first time used a computer application	Total first time used a *professional* application
The year they first used the computer	--			
The year they first used the computer *professionally*	0.606 ** (n=27)	--		
Total first time used a computer application	0.697 ** (n=32)	0.566 ** (n=26)	--	
Total first time used a *professional* application	0.708 ** (n=30)	0.782 ** (n=25)	0.614 ** (n=31)	--

** Significant at α level = 0.01

5.2.3 Self-efficacy

Self-efficacy was measured using the Schartzer and Jerusalem (1995) Generalized Self-efficacy Scale. The distribution of the self-efficacy score is presented in Figure 5.31.

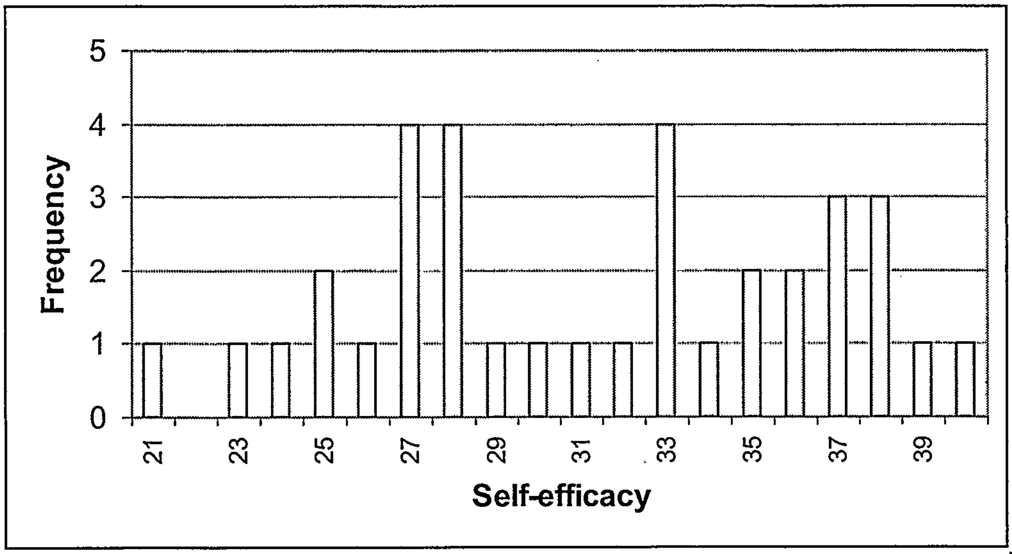


Figure 5.31. Distribution the self-efficacy of the subjects.

The Kolmogorov-Smirnov Normality Test of the self-efficacy distribution (0.209; p=0.059) suggests that subjects' self efficacy is distributed normally at α=0.05.

5.2.4 Attitude

The subjects' attitudes towards working with computers were measured with two different scales. The Computer Attitude Scale (CAS) was developed by Loyd and Gressard (1986) to measure four separated attitude variables (anxiety, confidence, liking, and usefulness). It was designed for teachers because positive attitudes teachers towards computers are widely recognized as a necessary condition for affective use of computer technology in schools (Woodrow, 1992). The second scale was especially designed for the purpose of this study for measuring the attitude of physical education teachers and coaches towards computer technology.

The normality distribution of the attitude variables was done with the Kolmogorov-Smirnov One-Sample Test as shown in Table 5.16.

Table 5.16

Results of the Kolmogorov-Smirnov One-Sample Tests for Normal Distribution of the Attitude Variables (Collected During the Pre-Workshop Questionnaire)

Variable Name	K-S score	Probability	Normality
Anxiety	0.254	0.007	Not Normal D.*
Confidence	0.154	0.200	Normal D.*
Liking	0.186	0.143	Normal D.*
Usefulness	0.187	0.139	Normal D.*
General Attitude	0.159	0.200	Normal D.*
Attitude towards Coaching/ Teaching Tools	0.155	0.200	Normal D.*

* At α level=0.05

The correlation coefficients of the six variables that measured subjects' attitudes during the pre-workshop questionnaire are reported in Table 5.17. It is clear that all attitude variables present significant interrelationships at α level of 0.05 and most of them also at α level of 0.01. The relationships of the newly developed variables (General Attitude and

Attitude towards Coaching/ Teaching Tools) are relatively weaker compared to the variables collected with the Computer Attitude Scale (Loyd & Gressard, 1984).

Table 5.17

Correlations Coefficients and Their Significant Levels Among Attitude Variables Collected at the Pre-Workshop Questionnaire.

	Anxiety	Confidence	Liking	Usefulness	General Attitude
Anxiety	--				
Confidence	0.788 ** (n=35)	--			
Liking	0.753 ** (n=35)	0.712 ** (n=35)	--		
Usefulness	0.808 ** (n=35)	0.671 ** (n=35)	0.686 ** (n=35)	--	
General Attitude	0.658 ** (n=35)	0.550 ** (n=35)	0.549 ** (n=35)	0.473 ** (n=35)	--
Attitude towards Coaching/ Teaching Tools	0.516 ** (n=35)	0.347 * (n=35)	0.369 * (n=35)	0.480 ** (n=35)	0.582 ** (n=35)

* Significant level α=0.05
** Significant level α=0.01

5.2.5 Age

The subjects' age might also be considered as an external variable that influences thier adopting level. The normality test for the age distribution (Kolmogorov-Smirnov =

0.229; p=0.024) suggests that subjects' ages are not distributed normally at α=0.05. The distribution of the subjects' ages is presented in Figure 5.32.

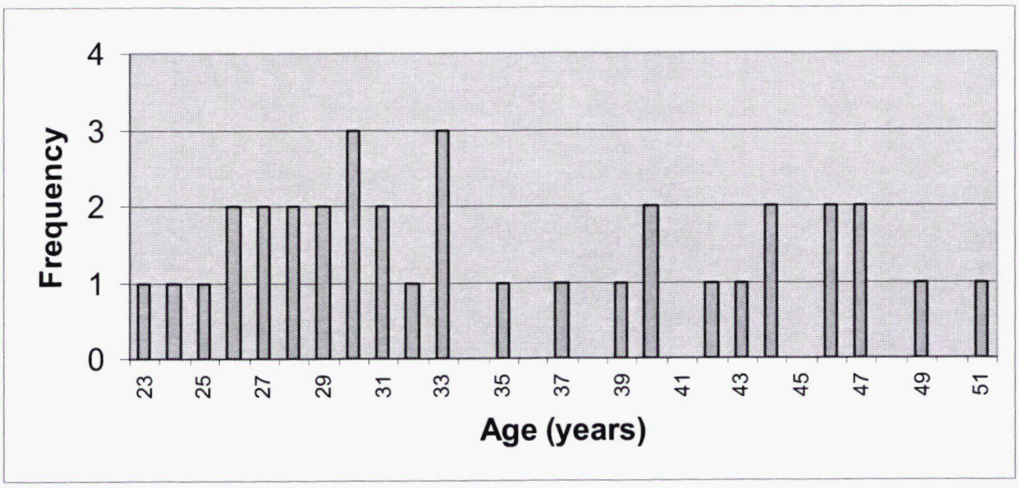


Figure 5.32. Distribution the subjects' age.

5.2.6 Coaching Experience

Another variable that might affect subjects' decisions weather or not to adopt an innovation might be their coaching experience. The normality test (Kolmogorov-Smirnov=0.197; p=0.099) suggests that the coaching experience is distributed normally at α=0.05. The coaching experience distribution is presented in Figure 5.33.

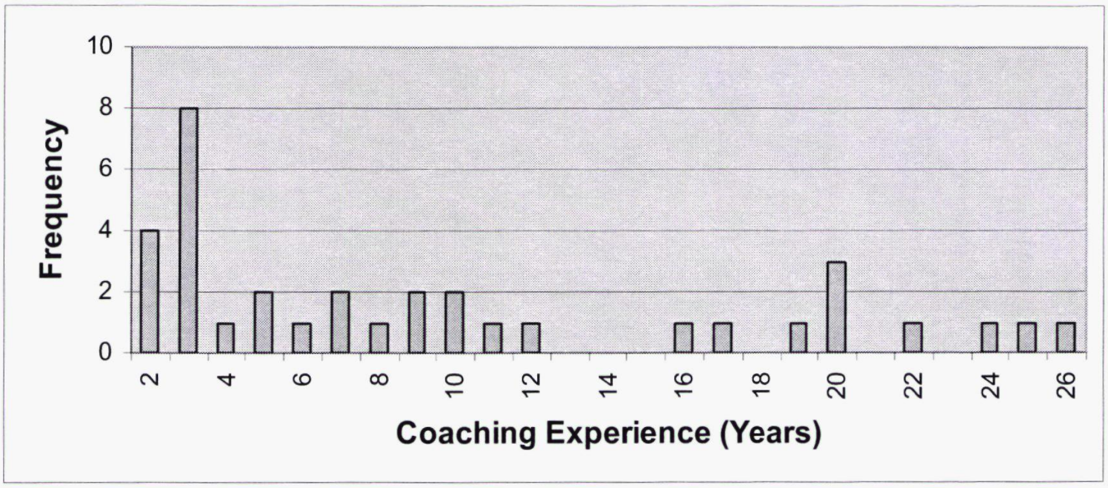


Figure 5.33. Distribution of subjects' coaching experience.

The six external variables discussed hereby (sections 5.2.1-5.2.6) should be tested within the study's proposed model. However, due to the relatively small sample size of the pilot study (n=35), it is statistically incorrect to test the model goodness of fit. Therefore, the model was tested together with the data of the main study, as described in section 6.3.

5.3 Evaluation of the Procedure and the Tools

5.3.1 The Questionnaires

As described previously, one of the reasons for conducting the pilot study was to pre-test questionnaires selected for inherent in the study. Overall, it was found that too many scales were administered to subjects. Therefore, a closer look at the scales and their purpose was taken.

The first examination included the repeated administration of the Computer Attitude Scale. The reason for repetition was that participating in a computer-workshop while using a friendly and easy-to-use application, might change subjects' attitude toward computers, due to increase in self-confidence and recognition of the advantages of computer applications. However, a 2-hours workshop might be too short to have any significant effect. Additionally, the level of experience of subjects with working with computers was unknown before the study took place. Their previous experience level might play an important roll. Changing subjects' attitude as a results of a short workshop may mainly be true to computer novice subjects. Therefore, the following four hypotheses to suggest changes in subjects' attitudes due to participating in a two-hour workshop were formulated:

- There is a decrease in subject's Anxiety between the pre-workshop and the post-workshop.
- There is an increase in subject's Confidence between the pre-workshop and the post-workshop.
- There is an increase in subject's Liking between the pre-workshop and the post-workshop.
- There is an increase in subject's Usefulness between the pre-workshop and the post-workshop.

A series of one-tailed t-tests was conducted to compare the means of the four attitude variables in the pre-workshop and the post-workshop questionnaires. The results are presented in Table 5.18.

Table 5.18

Difference between Attitude Variables Collected at the Pre-workshop and the Post-workshop Questionnaires.

	Pre	**Post**	**t-test**	**One-tailed probability**
Anxiety	44.14 (±5.15)	44.15 (±4.76)	t=0.076 (d.f.=32)	Not Sig*
Confidence	41.23 (±4.99)	41.52 (±5.61)	t=0.00 (d.f.=32)	Not Sig*
Liking	38.51 (±5.45)	39.52 (±5.52)	t=1.67 (d.f.=32)	Not Sig*
Usefulness	43.97 (±3.66)	43.39 (±4.38)	t=1.23 (d.f.=32)	Not Sig*

As evidently, we failed to reject all four null hypotheses and it was concluded that subjects' attitude towards computers, most likely to be built up over a long period of experience, can not be altered in a two-hour workshop. The results of that analysis and the intent to find ways to shorten the number of scales submitted to subjects, brought about the withdraw of the Computer Attitude Scale from the post-workshop questionnaire in the actual study.

Based on the pilot study, the following changes were made to the questionnaires:

- In Question 15 in the General Information scale: "How much time do you usually spend in preparing a practice/lesson plan?" - The option "Less than an hour" was added.
- In Questions 6 & 7 in Patterns of Computer Technology Use - The order of the answer-options have been reordered to be "Yes," "Sometimes," and "No."

- In the Computer Experience Scale, subjects were asked to add computer tools/applications, which have not been mentioned, under six different categories. Only one suggestion was provide, and therefore, the “Commodore” option was added to the operating System category. All other "open" items within a specific category were deleted (items # 16, 25, 29 & 42). The last item was left to include any other tool/software used by subjects and was not mentioned in the scale. Additionally, item #22 (World Wide Web browsing, searching) was deleted due to similarity with item #44 (surfing the Internet). Items #43 (Robotics) and #45 (Virtual Reality) were moved to the teaching/coaching related software, and category of Variety was been deleted. As a result, the number of items was reduced to forty-one (see Appendix C for the two versions of the Computer Experience Scale).

Since the CD-ROM was developed in the English language but was used in the actual study with Hebrew speaking subjects, an additional two questions were added to the Intention to Use the Interactive Volleyball CD-ROM Scale administered in the post-workshop questionnaire. Subjects were asked to rank their English level from 1 (excellent) to 7 (almost none), and were to indicate if they believed that the CD-ROM written in English was affecting their intention of use, or non-use.

The questionnaires were translated into Hebrew using the back-translation method (Campbell & Werner, 1970) where original questionnaires were translated into Hebrew and then back into English by different persons, each fluent in both languages. In places where this type of translation differs significantly from the original version, adaptations were made in the Hebrew translation.

Lastly, a few minor changes were applied to scales in order to make them understandable to Israeli coaches. For example: Coaching Levels 1, 2, 3 & 4 were changed to “coaching certificate” and “advance coaching certificate.”

5.3.2 The Procedure

The experimental procedure tested in the pilot study included mainly the organization of the workshop, administration of the questionnaires, and data analysis. The only major problem from the testing procedure was the length of the questionnaires. It took about 30 minutes to complete the pre-workshop questionnaire. Besides shortening the questionnaires, as described previously, it was decided to distribute the pre-workshop questionnaire to subjects together with the workshop invitation, and to have them return questionnaires fully completed to the workshop. This increased the available time in the workshop for demonstrating the CD-ROM rather than spending it on the questionnaires.

The next chapter includes data analysis and results of the actual study, conducted in Israel.

CHAPTER 6

DATA-ANALYSIS AND RESULTS

The main study was conducted in Israel during 2001-2003. It followed the tools and procedures described previously in sections 4.3 and 4.4. The data was collected in three workshops, in July, 2001, May, 2002, and March, 2003. The workshops took place in the computer lab at the Zinman College located at Wingate Institute in the center of Israel. A letter was sent to about 120 teachers and coaches, and 90 volunteered to participate in the two-hour workshop.

As a lesson from the pilot study, subjects received the pre-workshop questionnaires (see Appendixes A - G) in the mail, and were asked to bring them to the workshop already filled up. Each workshop started by subjects signing the consent form. Thereafter, the workshops included a demonstration of the CD-ROM by a volleyball expert, and a practice session. At the end of the workshop, subjects completed the post-workshop questionnaires (see Appendixes E, H and I). All teachers and coaches were given a copy of the Interactive Volleyball CD-ROM for personal use. Follow-up questionnaires (appendices D, E, F, G and J) were sent to subjects approximately 18 months after the workshops. Based on the data, the study was composed of five main statistical procedures. The first was a *survey*, which included descriptive statistics of the questionnaires (completed by 90 physical education teachers and coaches). The second was a *quasi-experiment* obtained by analyzing the questionnaire data and comparing among groups within the sample. The third part included a *time-comparison;* while the fourth was a comparison between the *two countries*, Israel and Canada. The last part tested the goodness of fit of the proposed *mode using the collected data.*

6.1 The Survey

As mentioned previously, the main purpose of the survey was to learn about the level of technology adoption among physical education teachers and coaches in Israel. The survey data was collected from a total of 90 subjects. The descriptive statistics of the variables collected with three questionnaires (pre-workshop, post-workshop and follow-up) is given here in the same order as the scales presented in the questionnaires.

6.1.1 Scale # 1: General Information (Pre-workshop Questionnaire)

Table 6.1 shows the descriptive statistics of the General Information Form administrated to subjects in the pre-workshop questionnaire. It includes demographic variables as well as teaching/coaching background information. Questions 1-5 included personal data such as name, telephone number, and address and, therefore, are not listed in the table.

Table 6.1

Descriptive Statistics from the General Information Form Completed by Subjects Prior to the Workshop

Q#	Variable	Sample Composition
6	Age (see also Figure 6.1)	n = 88 Mean = 36.94 years Std. Dev.= 9.56 years Range = 41 years (21 from to 62)

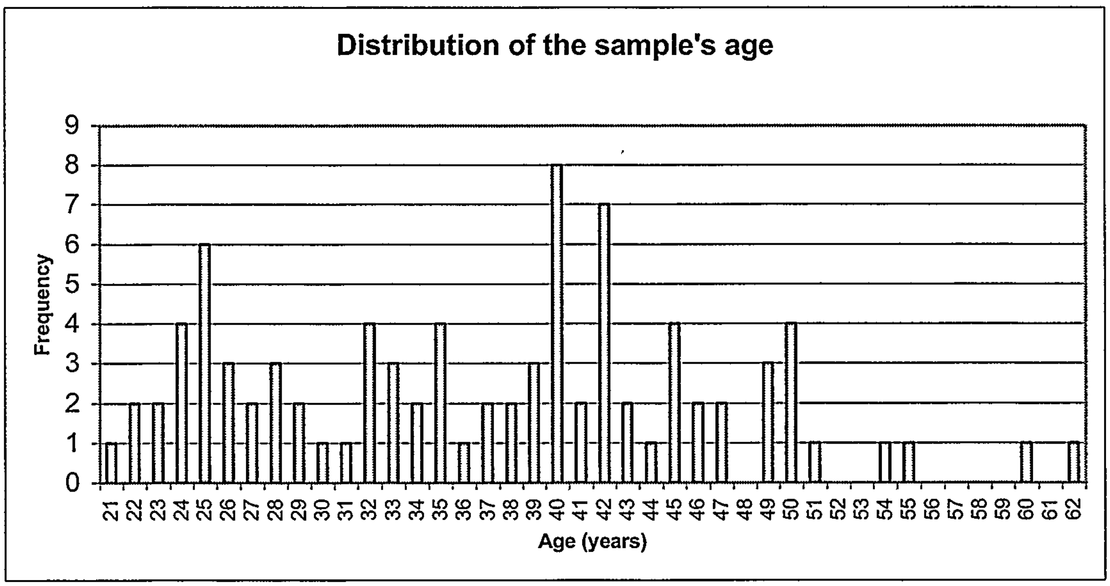


Figure 6.1. Distribution of the sample's age

7	Gender	Men = 49 % (44/90) Women = 51% (46/90)
8	Educational Level Attained	Students in the Physical Education Program: 20% (18/89) Bachelor Degree: 72%. (64/89) Physical Education:

		91% (58/64) Other: 9% (6/64) Master Degree: 25% (22/89) Doctorate Degree: 3% (3/89) Instructor Certificate: 27% (24/89) Coaching Certificate: 45% (40/89) Senior Coaching Certificate: 22% (20/89) Physical Education Teaching Diploma: 62% (55/89)
9	Profession	Students in the Physical Education Program: 20% (18/89) Teachers: 74% (66/89) Phys. Ed. Teachers: 73% (65/89), 98% of the total teaches (65/66) Other Teachers: 7% (6/89), 9% of the total teachers (6/66) Coaches: 57% (51/89) Elementary School Coach: 28% (25/89), 49% of the total coaches (25/51) J.H. & H. School Coach: 28%

		(25/89), 49% of the total coaches (25/51) National Team level: 16% (14/89), 27% of the total coaches (14/51) Other: 2% (2/89), 4% of the total coaches (2/51) Other profession: 6% (Lawyer, Player, Team manager, Sailor) (5/89)
10	Total No. of Years Teaching/Coaching *Volleyball*	n = 79 Mean = 10.56 years Std. Dev.= 9.45 years Range = 40 years (from 0 to 40)
11	Teaching/Coaching other Sports	Yes: 68% (54/79) No: 32% (25/79)
New (Calculated based on 12)	Total No. of Years Teaching/Coaching *any sports*	n =79 Mean = 12.99 years Std. Dev.= 9.18 years Range = 40 years (from 0 to 40)
13	Age of Population Teaching/Coaching	Children (6-12 years old): 62% (42/68) Adolescents (13-17 years old): 72% (49/68) Mature Athletes (18-30 years old):

		34% (23/68) Mid-Ages (31-40 years old): 22% (15/68) Seniors (41-63 years old): 6% (4/68) Aged population (64 years old on): 1% (1/68)
14	Average No. of Volleyball Practice/Lesson Plans Written Weekly (during the season)	n=77 Mean = 5.09 plans Std. Dev.= 5.09 plans Range = 28 plans (from 0 to 28)
15	Time Spend Preparing a Practice/Lesson plan (see also Figure 6.2)	Not at all: 22 % (17/77) Less than 1 hour: 5% (4/77) About 1.5 hours: 70% (54/77) About 3 hours: 3% (2/77)

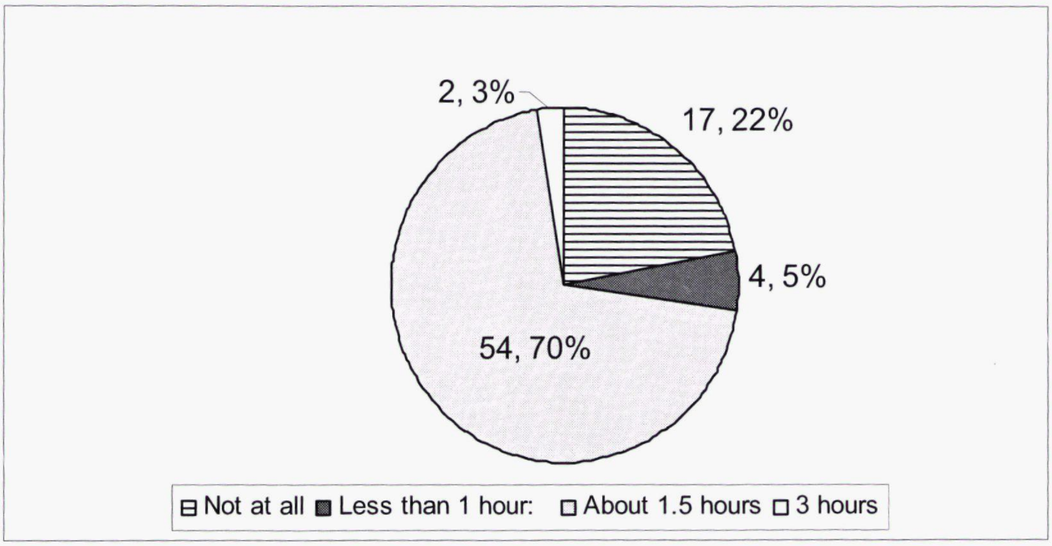


Figure 6.2. Distribution of time spent to prepare a practice/lesson plan

16	Availability of Coach Assistance	Yes: 9% (7/77) No: 91% (70/77)
17	Factors most Affect the Decision to Select a Computer Software	An advertisement in the media: 23% (19/83) A colleague recommendation: 76% (63/83) Availability of software: 35% (29/83) District policies and procedures: 28% (23/83) Other (cost, quality, husband/friend recommendation and more): 18% (15/83)

From the demographic variables presented in Table 6.1, it is evident that the sample chosen for the study was very diverse in many variables. For example, subjects' ages ranged from 21 to 62 years, while teaching/coaching experience varied from 0 to 40 years.

With respect to education, seven subjects did not have a bachelor's degree (8%), 20% of the sample (18 subjects) were students within the physical education program and 72% (64 subjects) had already graduated. Among the ones with a first degree, the majority (91%) had a degree in Physical Education and 9% had a bachelor's degree in other fields. Four subjects had two bachelor's degrees in Physical Education Twenty-five percent of subjects had a master's degree and three additional subjects (3%) had acquired a PhD degree as well. In relationship to coaching education, there are three different courses which can be taken in Israel. An instructional course, which is the basic course, was taken by 27% of the sample. Forty subjects (45%) took a coaching certificate class and 20 subjects (22%) took the highest level of coaching course, a senior coaching certificate.

In Question 9, subjects were to state about their current profession. In accordance with the education distribution presented in the previous question, there were students (20%), teachers (74%) or coaches (57%). Some were doing two at a time, such as coaching and teaching, or studying and coaching. Only 6% were in other occupations such as a professional player, team manager, sailing, or a lawyer. It is important to take into account that 65 reported that they actually taught physical education, while only 55 subjects reported that they had a physical education teaching diploma (in Question 8).

Ninety-eight percent (i.e., all but one) of teachers taught physical education, but six subjects taught other topics (in most cases, in addition to physical education). Among the coaches, a similar number of subjects (28% or 25 subjects) did so at the elementary-school level, junior-high level, and high-school level. An additional 16% (14 subjects), coached professional teams, and two subjects coached a group of adult players.

In reference to the age of those they taught/coached, subjects reported that (72%) taught or coached adolescents (13-17 years old), 62% taught or coached children (6-12 years old), 34% mature athletes (18-30 years old), 22% mid-ages (31-40 years old), 6% senior citizens (41-63 years old), and 1% coached an aged population (over 63 years old).

Another variable, which may be of importance to the study, is subjects' teaching/coaching experience. In Question 10, subjects were to state the number of years they had been teaching or coaching volleyball. Then, they were to indicate whether they coach/teach other sports and, if so, the number of years. A new variable was calculated by taking the larger number, to represent *total number of years for teaching/coaching sports*. The results are in Figure 6.3.

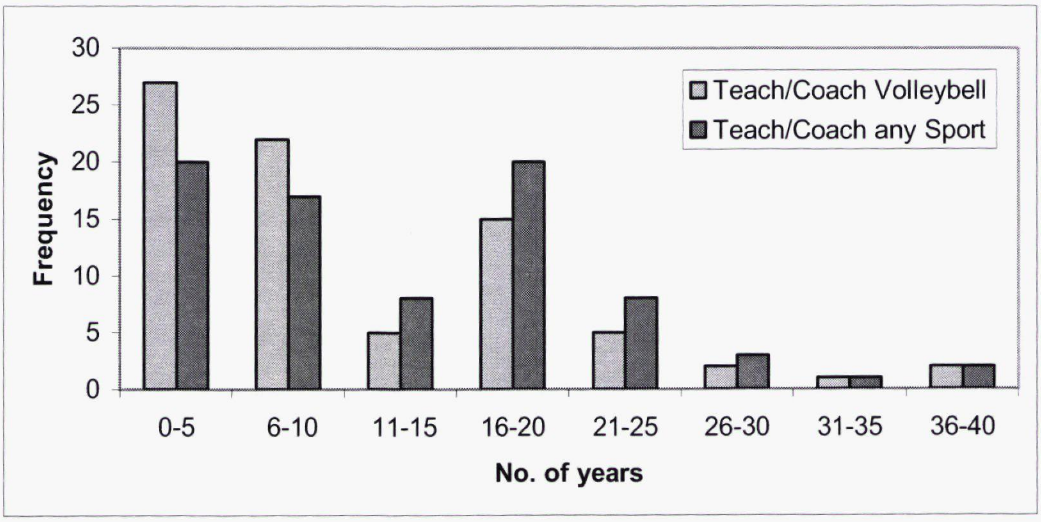


Figure 6.3. Distribution of time spent to prepare a practice/lesson plan.

6.1.2 Scale # 2: Patterns of Computer Technology Use (Pre-workshop Questionnaire)

One of the main purposes of the study was to learn about individual computer usage patterns, previously and currently. In order to do so, the Patterns of Computer Technology Use Scale was developed and administrated to the subjects. Using this form, it was also possible to compare the patterns of *home/personal* computer use with those of *professional (teaching/coaching)* usage. The descriptive results of that scale are presented in Table 6.2.

Table 6.2

Descriptive Statistics from the Patterns of Computer Technology Use Form, Completed by Subjects prior to the Workshop

Q#	Variable	Sample Composition
1	The first year a computer was used for *personal* tasks (see also Figures 6.4 & 6.5)	10% of the subjects (9/89) did not used computers at the time of the workshop 90% of the subjects (80/89) used computers, as follow: 1980: 1% (1/89) 1982: 1% (1/89) 1983: 1% (1/89) 1984: 1% (1/89) 1985: 1% (1/89) 1986: 1% (1/89) 1987: 3% (3/89) 1988: 3% (3/89) 1989: 2% (2/89) 1990: 9% (8/89) 1991: 1% (1/89) 1992: 3% (3/89) 1993: 3% (3/89) 1994: 6% (5/89) 1995: 8% (7/89) 1996: 6% (5/89) 1997: 3% (3/89) 1998: 9% (8/89) 1999: 7% (6/89) 2000: 16% (14/89) 2001: 2% (2/89)

		2002: 1% (1/89)

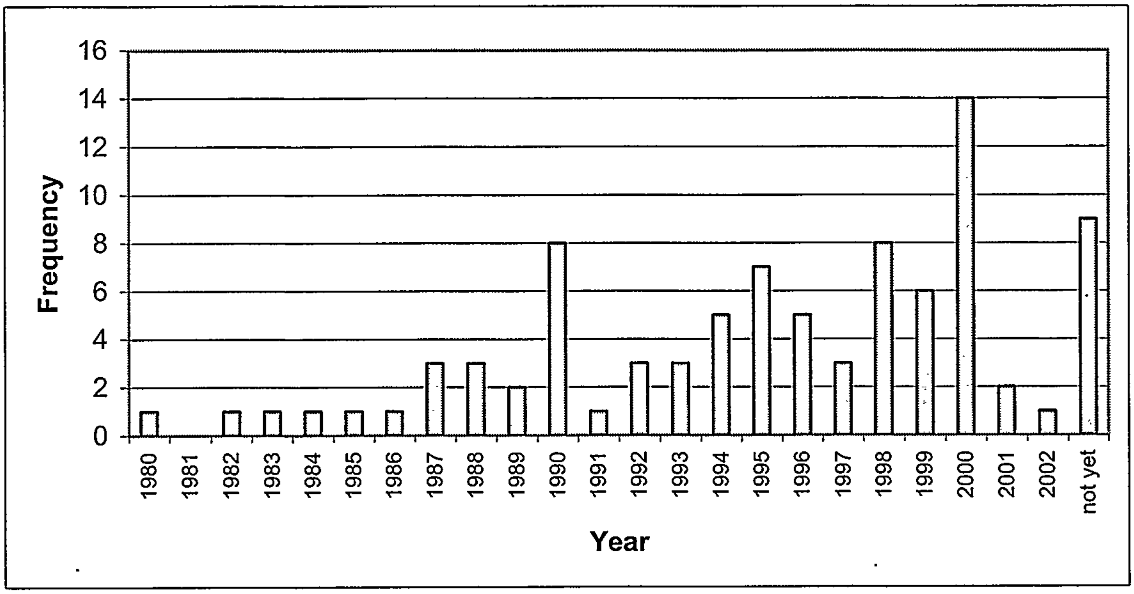


Figure 6.4. Frequency distribution of the year subjects started to use computers for personal tasks.

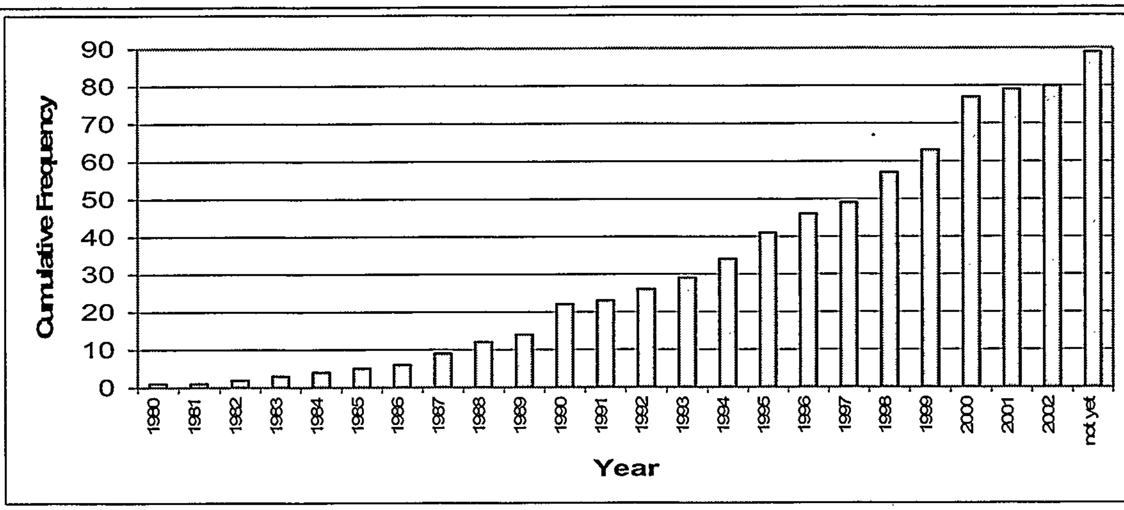


Figure 6.5. Cumulative frequency of the year subjects started to use computers for personal tasks.

New (Calculated)	No. of years of using the computer	n=85 Mean: 9.08

	for *personal* tasks (see also Figure 6.6)	SD: 5.52 Range: 24 (from 0 to 24)

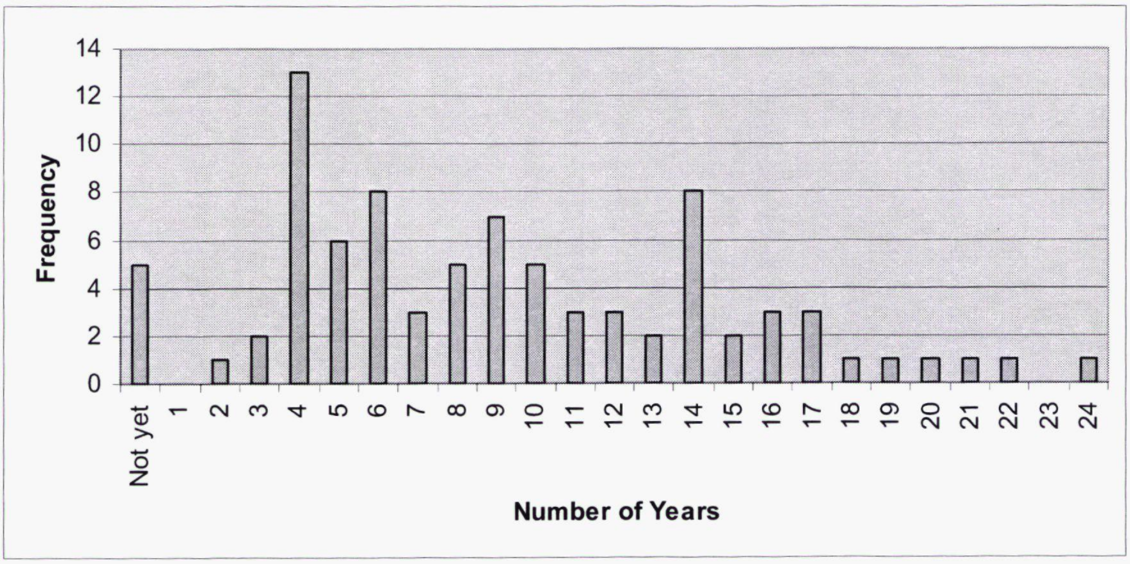


Figure 6.6. Frequency distribution of the number of years subjects used computers for personal tasks.

New (Calculated)	Age first used computer for *personal* tasks (see also Figure 6.7)	n = 79 Mean: 26.54 SD: 11.01 Range: 49 (from 6 to 55)

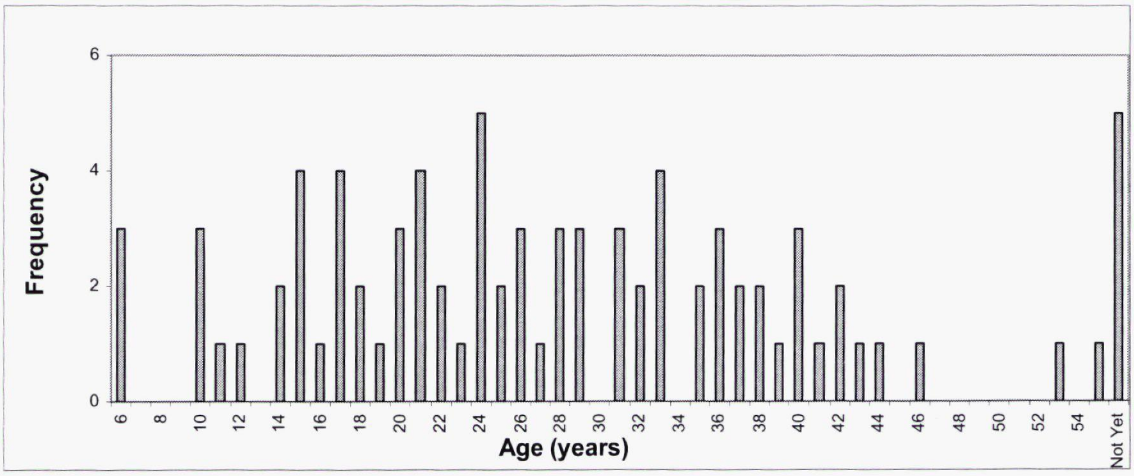


Figure 6.7. Frequency distribution of the age in which subjects first used computers for personal tasks.

2	The first year a computer was used for *professional* tasks (see also Figure 6.8 & 6.9)	36% of the subjects (32/89) did not used computers for professional tasks at the time of the workshop 64% of the subjects (57/89) used computers, as follow: 1986: 1% (1/89) 1990: 2% (2/89) 1991: 1% (1/89) 1993: 2% (2/89) 1994: 1% (1/89) 1995: 11% (10/89) 1996: 6% (5/89) 1997: 4% (4/89) 1998: 10% (9/89) 1999: 7% (6/89) 2000: 11% (10/89) 2001: 3% (3/89) 2002: 3% (3/89)

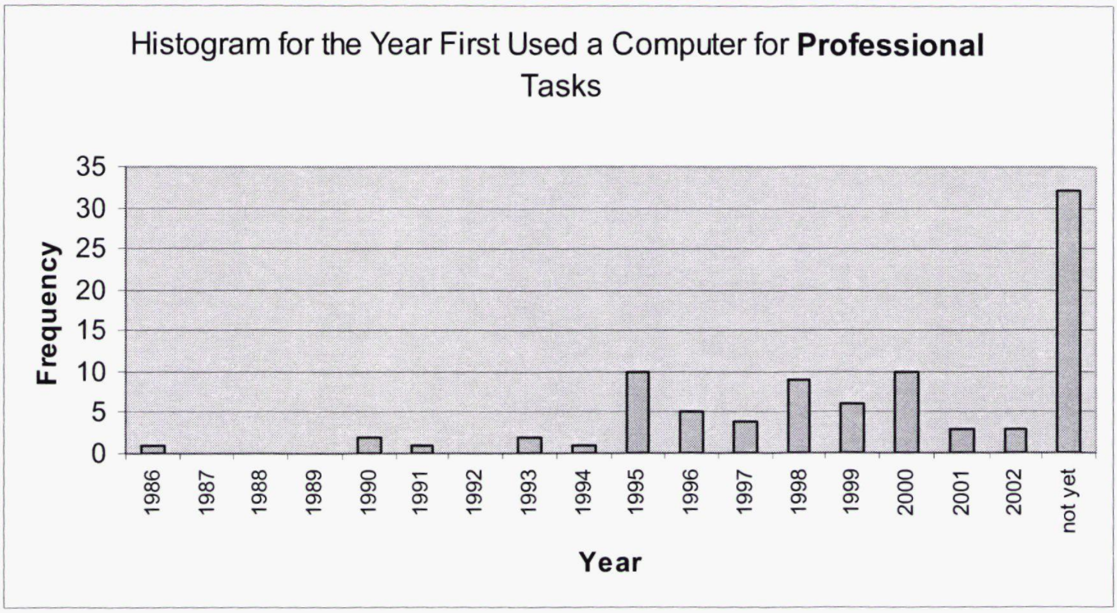


Figure 6.8. Frequency distribution of the year subjects started to use computers for professional tasks.

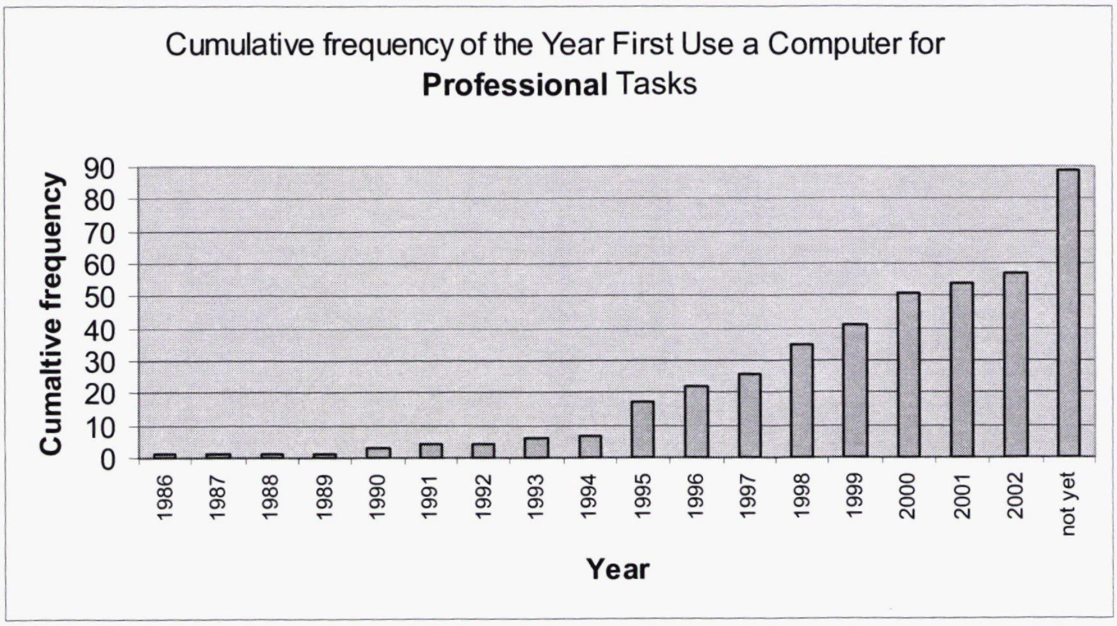


Figure 6.9. Cumulative frequency of the year subjects started to use computers for professional tasks.

New (Calculated)	No. of years of using the computer for *professional* tasks (see also Figure 6.10)	n = 87 Mean: 4.46 SD: 4.17 Range: 18 (from 0 to 18)

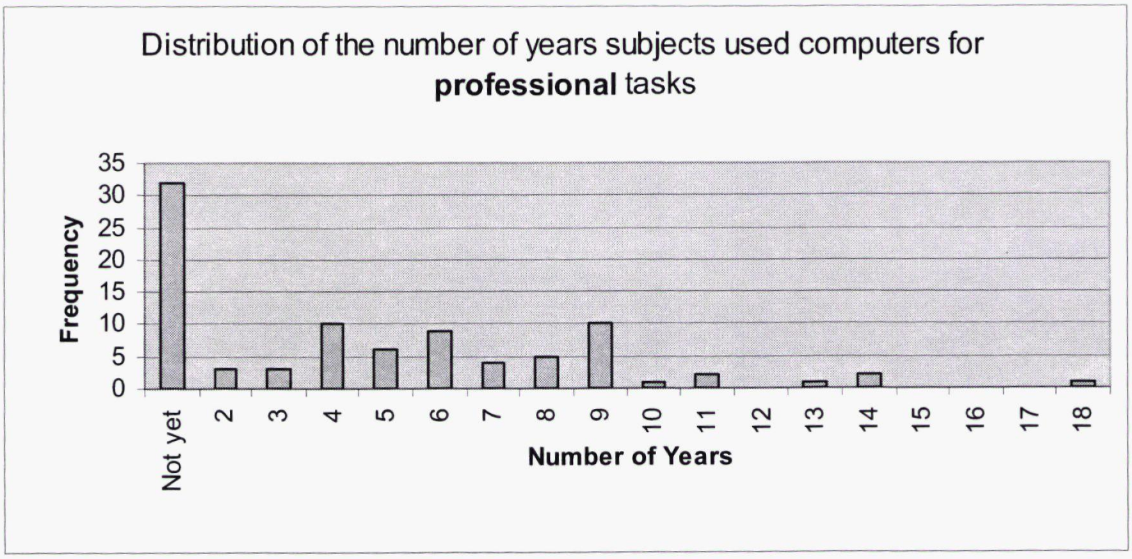


Figure 6.10. Frequency distribution of the number of years subjects used computers for professional tasks.

New (Calculated)	Age first used computers for *professional* tasks (see also Figure 6.11)	n = 56 Mean: 28.30 SD: 9. 66 Range: 42 (from 15 to 57)

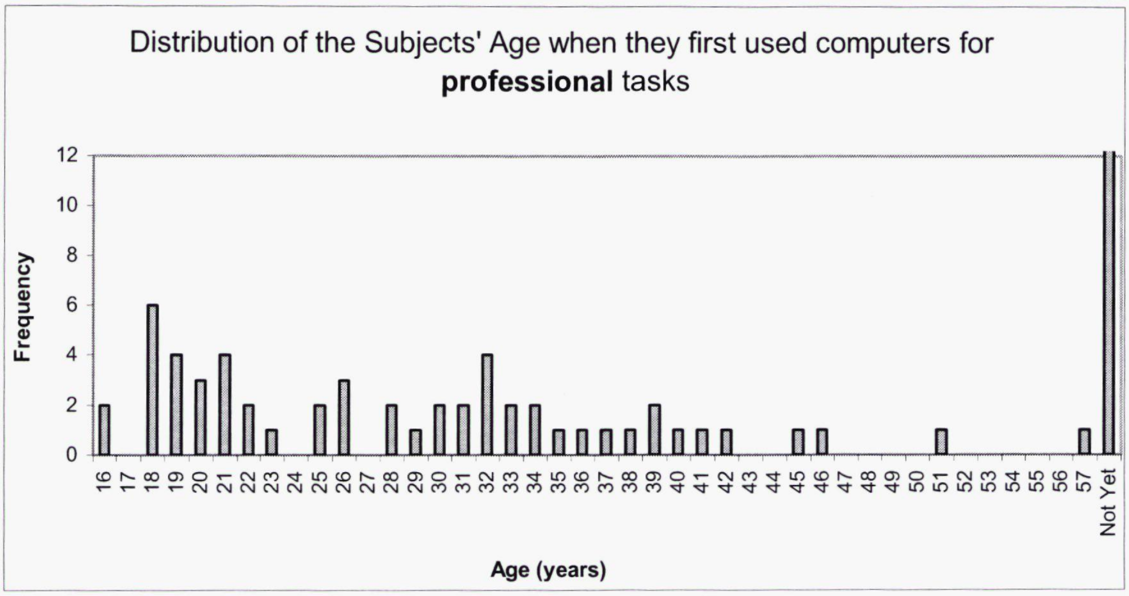


Figure 6.11. Frequency distribution of the age in which subjects first used computers for professional tasks.

3	The first year a computer was bought for *personal* use (see also Figures 6.12 and 6.13)	15% of the subjects (13/89) did not buy computers at the time of the workshop 85% of the subjects (76/89) bought computers, as follow: 1981: 1% (1/89) 1983: 1% (1/89) 1985: 1% (1/89) 1988: 2% (2/89) 1989: 2% (2/89) 1990: 19% (17/89) 1992: 6% (5/89) 1993: 2% (2/89) 1994: 10% (9/89) 1995: 4% (4/89) 1996: 9% (8/89) 1997: 6% (5/89) 1998: 9% (8/89)

		1999: 3% (3/89) 2000: 6% (5/89) 2001: 3% (3/89)

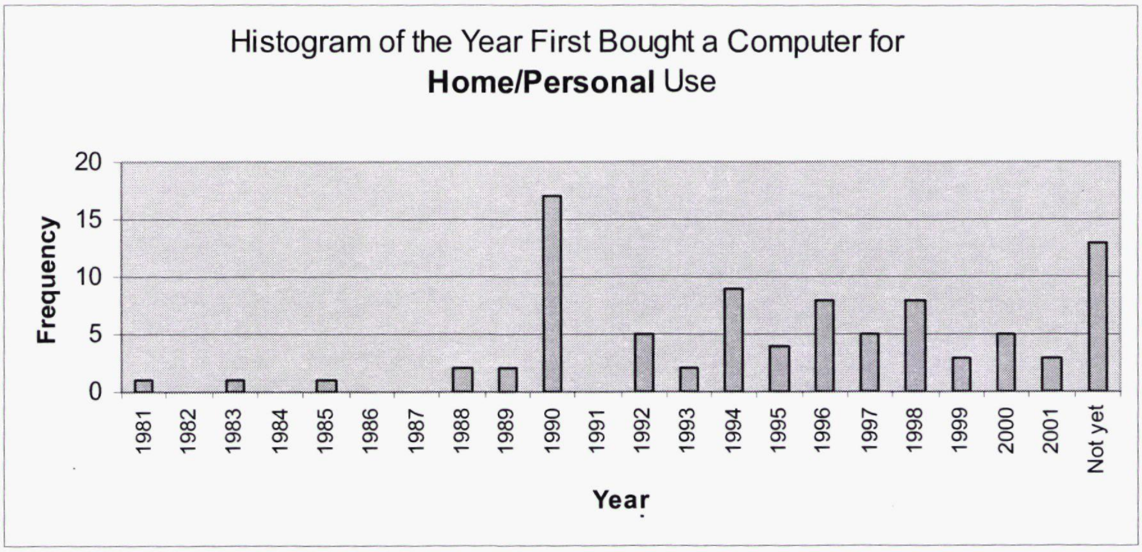


Figure 6.12. Frequency distribution of the year subjects bought their first computer for home/personal use.

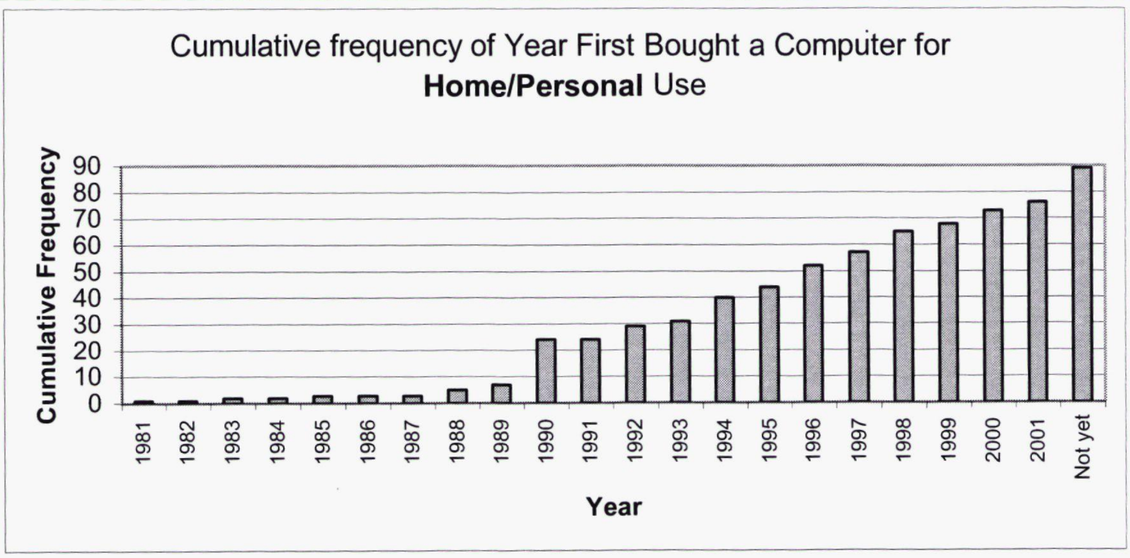


Figure 6.13. Cumulative frequency of the year subjects bought their first computer for home/personal use.

4	The first year a computer was bought for *professional* (teaching/coaching) tasks (see also Figures 6.14 and 6.15)	76% of the subjects (68/89) did not buy computers at the time of the workshop 24% of the subjects (21/89) bought computers, as follow: 1985: 1% (1/89) 1990: 1% (1/89) 1992: 1% (1/89) 1994: 3% (3/89) 1995: 3% (3/89) 1997: 3% (3/89) 1998: 2% (2/89) 2000: 7% (6/89) 2001: 1% (1/89)

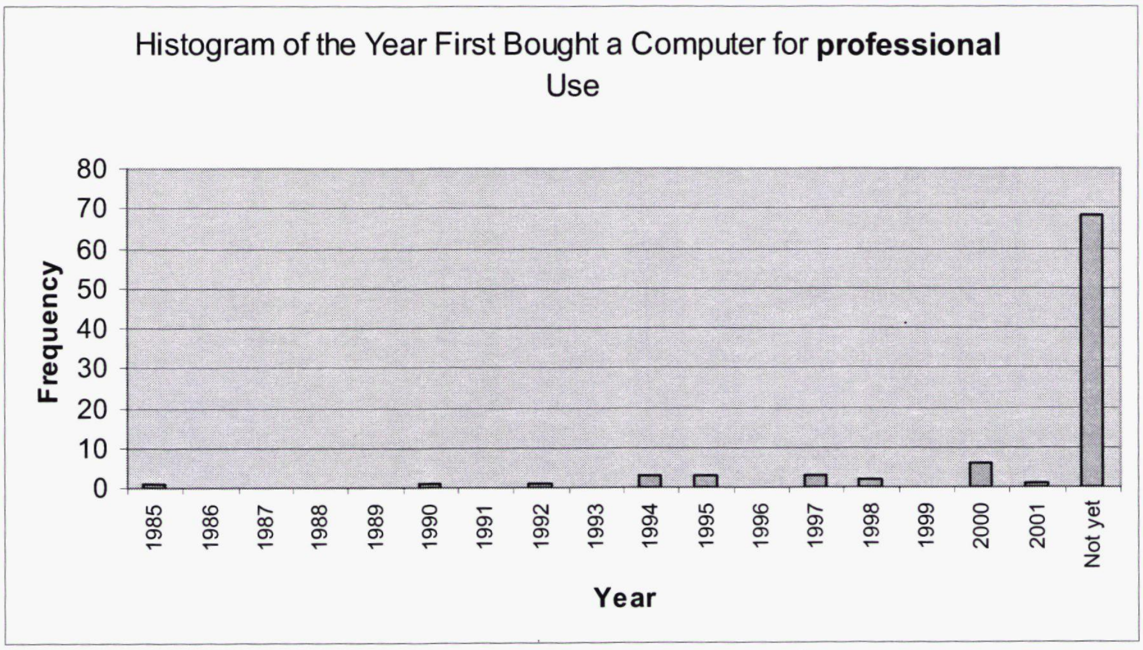


Figure 6.14. Frequency distribution of the year subjects bought their first computer for professional use.

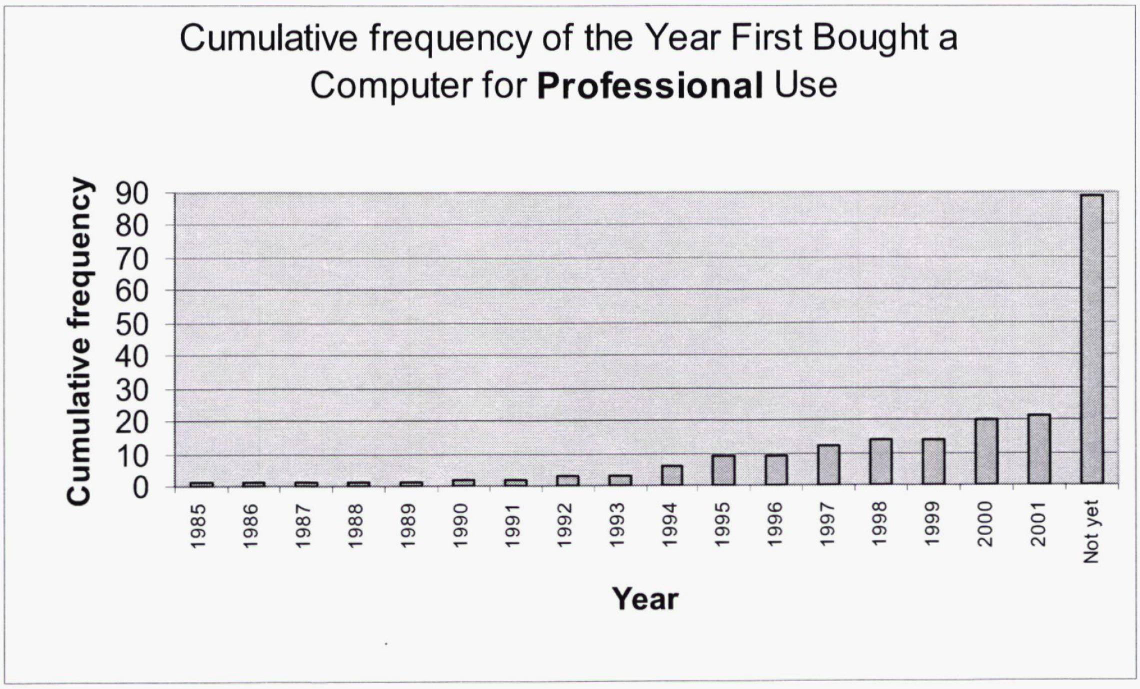


Figure 6.15. Cumulative frequency of the year subjects bought their first computer for professional use.

5	No. of computers owned (see also Figure 6.16)	None: 10% (7/68) 1 computer: 22% (15/68) 2 computers: 25% (17/68) 3 computers: 28% (19/68) 4 computers: 9% (6/68) 5 computers: 6% (4/68) Missing data: 22 subjects

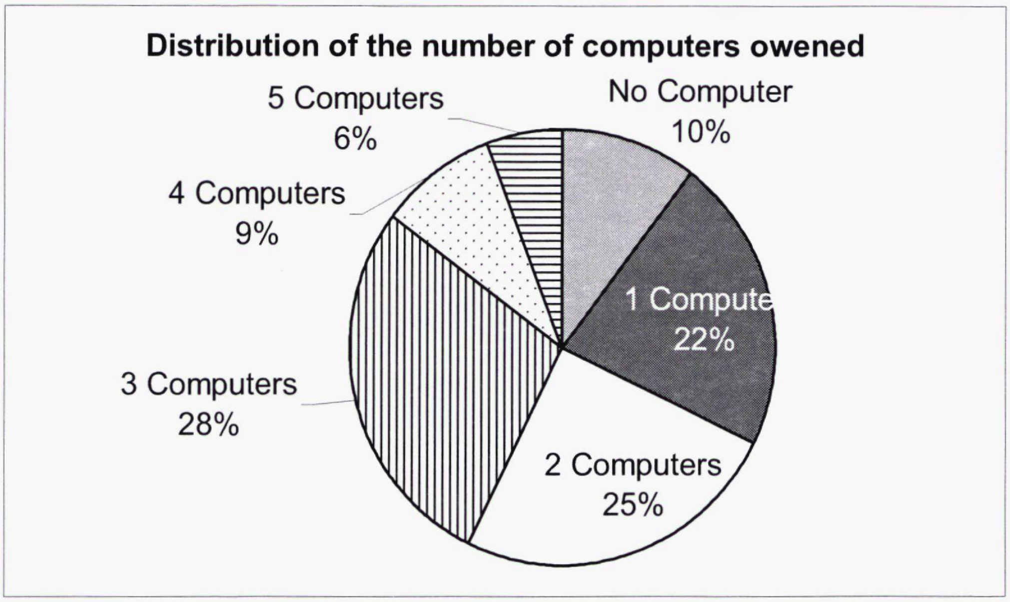


Figure 6.16. Distribution of the number of computers owned.

6	Access to a computer for *personal* use	Yes: 89% (79/89) Sometimes: 11% (10/89)
7	Access to computers, software and needed equipment for *teaching/coaching* tasks	Yes: 53% (47/89) Sometimes: 29% (26/89) No: 18% (16/89)
8	Satisfaction from computer-related teaching/coaching tasks *support*	Very satisfied (+2): 3% (2/78) Satisfied (+1): 14% (11/78) Neutral (0): 41% (32/78) Unsatisfied (-1): 29% (23/78) Very unsatisfied (-2): 13% (10/78)

		Mean: -0.36 SD: 0.97 Range: 4 (from -2, Very Unsatisfied to 2, Very satisfied)
9	Satisfaction from the *training* available to you for computer-related teaching/coaching tasks	Very satisfied (+2): 4% (3/72) Satisfied (+1): 11% (8/72) Neutral (0): 38% (27/72) Unsatisfied (-1): 38% (27/72) Very unsatisfied (-2): 10% (7/72) Mean: -0.38 SD: 0.96 Range: 4 (from -2, Unsatisfied to +2, Very satisfied)
10	Acquisition of *initial* computer skills	Self taught: 51% (45/89) Formal course: 33% (29/89) From a peer: 34% (30/89) From a player/student: 8% (7/89) From support staff: 1% (1/89) Other (big brother, wife): 2% (2/89) Missing data: 1 subjects
11	Range of *computer knowledge and skills* are primarily the result of:	Self-teaching: 80% (67/84) Formal course: 55% (46/84) Peer teaching and support: 11% (9/84) Support staff assistant: 2% (2/84) Other (brother, husband): 6% (3/84)

		Missing data: 6 subjects
12	No. of hours spent weekly using a computer	Less than 1 hour: 19% (16/85) 1 to 3 hours: 26% (22/85) 3 to 5 hours: 25% (21/85) More than 5 hours: 31% (26/85) Missing data: 5 subjects
13	No. of hours spent weekly using the Internet	Less than 1 hour: 34% (29/85) 1 to 3 hours: 34% (29/85) 3 to 5 hours: 14% (12/85) More than 5 hours: 18% (15/85) Missing data: 5 subjects
14	Experience with computer technologies	Very Experienced: 12% (10/86) Good: 21% (18/86) Fair: 42% (36/86) Poor: 22% (19/86) None: 3% (3/86) Missing data: 4 subjects
15	Participation in courses/workshops for using computer technologies	Yes: 82% (71/87) No: 18% (16/87) Missing data: 3 subjects
16	Typing skills	Non-existent: 2% (2/87) Poor: 38% (33/87)

		Good: 45% (39/87) Excellent: 15% (13/87) Missing data: 3 subjects
17	Methods used to update knowledge of educational computer	Computer magazines or journals: 22% (14/63) Computer courses: 27% (17/63) User groups: 6% (4/63) Workshops: 11% (7/63) Other (Friends, self-teaching using the Internet, books, self-teaching, family members): 49% (31/63)
18	Experience with other computer-based instruction software	Yes, quite a few : 14% (12/87) Yes, only one or two: 44% (38/87) No: 43% (37/87) Missing answer: 3 subjects
19	Currently using computer applications in physical education and sport	Yes: 19% (16/86) No: 81% (70/86) Missing answer: 4 subjects

The purpose of the second scale in the pre-workshop questionnaire was to gather information about ways computer technology is used by physical education teachers and coaches currently and in the past.

In the first question, subjects were asked to report the first year they used a computer for *personal* tasks. A similar question was posed regarding using the computer for *professional*-related tasks. These variables were used to calculate the subjects' *innovativeness*, or the time frame of their usage. These two variables are also utilized to learn more about the time-gap between adopting technology for daily usage and adoption for job-related purposes (discussed later). The distributions of the results are shown in figures 6.4, 6.5, 6.8 & 6.9.

An additional four variables were calculated from the replies to the first two questions: the number of years that subjects used computers for *personal* tasks, the number of years that subjects used computers for *professional* tasks, the age subjects started to use computers, and the age they started to use computers for *professional* tasks. The first two were calculated by subtracting the year subjects started to use computers, or use them for professional purposes, from the current year (i.e., 2004). The other two variables were calculated by subtracting the results of these two new variables from subject's age. It is evident that only 64% were using them to complete teaching and coaching related missions, while 90% of the sample was using computers at the time of the workshops for personal tasks. The detailed distribution was presented in the previous Table (6.2) and in figures 6.6, 6.7, 6.10 and 6.11. The gap between the percentage of users of computers for *personal* tasks and those for *professional* tasks is presented in Figure 6.17.

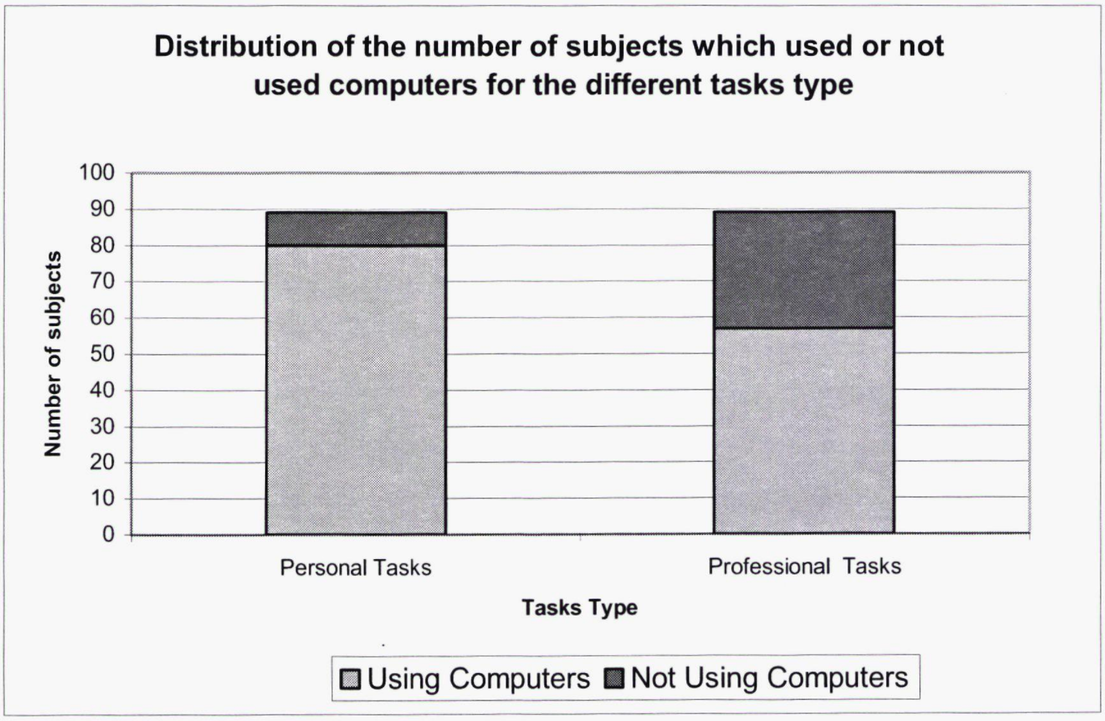


Figure 6.17. Distribution of using and not using computers for the different task types, at the moment the data was collected.

To study the pattern of current computer usage, subjects were asked about the average number of hours they spent per a week using a computer and, more specifically, using the internet, which was assumed to be a popular tool. The results are presented in Figures 6.18 and 6.19.

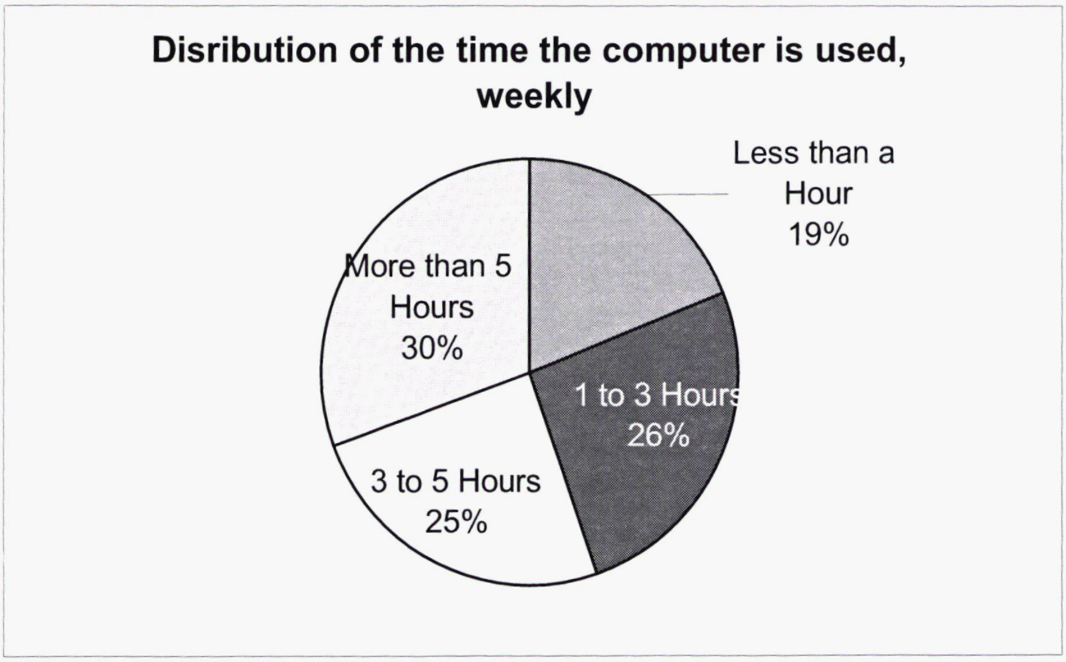


Figure 6.18. Distribution of the time for using a computer weekly.

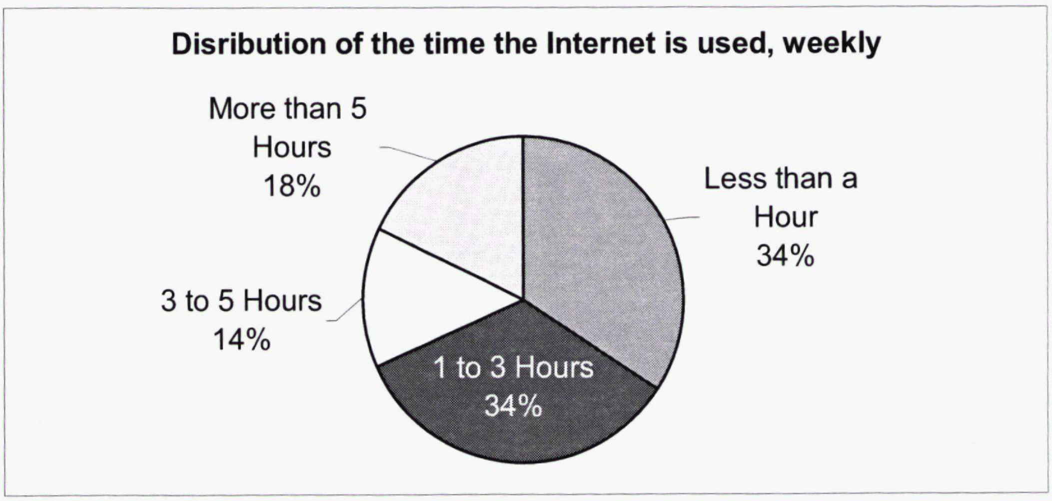


Figure 6.19. Distribution of the time for using the Internet weekly.

Question 14 was designed to learn about subjects' experience with computer technology. *Computer experience* is an important factor in the current study, and it was obtained in other scales as well. In this question, subjects were to rate their experiences on a 5-point Likert Scale. Three percent of the subjects (3 subjects) reported that they lacked computer experience all together, 22% reported poor experience, 42% believed their experience was fair, 21% that it was good, and 12% thought that they were very experienced. In Question 16, subjects stated their typing skill level. The assumption was that subjects, who used the computer frequently, would also have improved typing abilities. The results show that 2% reported a lack of typing skills, 38% had poor skills, 45% good skills, and the other 15%, had an excellent level of typing skills.

6.1.3 Scale # 3: Computer Experience (Pre-workshop Questionnaire)

The third scale was used to learn about the different computer applications subjects used. The Computer Experience Form was also designed to collect temporal information and subjects were to recall the year they started to use the application.

The form consisted of using a list of 41 computer software and tools[6] that were divided into six major categories (Systems, Tool Application, Communication Software, Software and Tools, Teaching/coaching Related Software, and Variety). Subjects were to indicate 1) their current level of expertise (None (0), A little (1), Fair (2), Substantial (3) or Extensive (4)), 2) the year *they first used* this software/tool (if ever) and 3) the year they first used this software/tool (if ever) for *teaching/coaching related tasks.*

In order to get an overview of all the applications and tools that were mentioned in the Computer Experience Scale, the *percentage level of adoption* for each tool, was calculated

[6] The original English scale included 46 items, but as a result of the pilot study several changes have been incorporated into the scale (see section 5.3.1 for more information), and the Hebrew version included 41 items only.

twice, for *personal* as well as for *professional* tasks. In the pilot study, this was accomplished simply by summing up the number of subjects who indicated the year they started to use the tool/application divided by the total number of subjects. The same procedure was repeated for the *professional* usage. However, when the results of this form were analyzed for the Israeli sample, it was found that many subjects did not indicate the year they first started to use any application. That is, they did not mention the year, although they mentioned that they had adopted a tool for a certain level (1 to 4), they. As a result, the calculated percentage level of adoption found by the method used for the Canadian sample was low.

A solution to this problem was to calculate the percentage of adoption differently as the missing answers (level of adoption without a year for starting) were taken into account. The total number of subjects that *did* mention the start-up year was divided into the total number of subjects minus the total number of subjects gave no answer, even though they marked a level of usage. The results are shown in Table 6.3.

Table 6.3

Cumulative Percentage of Adoption for Personal and Professional Uses

	Cumulative percentage of adoption			
Computer Tool/Application	**Personal tasks**		**Professional tasks**	
Windows Operating System (95+)	79.59%	**L.M.**	38.78%	**E.M.**
Word Processing	73.81%	↓	38.10%	↓
Surfing the Internet	54.00%		28.00%	
Spreadsheets	54.00%	↑	22.00%	
E-mail	52.94%	**L.M.**	23.53%	↑
Presentation Package	45.76%	**E.M.**	22.03%	**E.M.**

Win 3.x	34.48%	↓	10.34%	**E.A.**
PC-DOS	26.56%		6.25%	↓
Computer Games	21.05%		5.26%	
On-line Databases (and/or Library Catalogues)	19.18%	↑	8.22%	
Graphics Program (i.e. Drawings, Paint, Clipart)	17.65%	**E.M.**	8.82%	
FTP (upload, download files)	15.94%	**E.A.**	5.80%	
Grading Package	12.90%	↓	8.06%	
On-line Video, Audio	12.16%		4.05%	
Newsgroups	12.16%		4.05%	
Database	11.69%		6.49%	
Programming Language	9.76%		3.66%	
Charting/Graphing	9.46%		4.05%	
Statistics Package	8.33%		4.17%	
Apple	6.90%		2.30%	
WWW Page Creation/Editing	5.88%		3.53%	
Designing and Creating Practice/Lesson Plans	5.26%		3.95%	
Measurements of Performance related Software	5.19%		2.60%	↑
Drill & Practice	4.88%		4.88%	**E.A.**
Authoring (HyperCard, Toolbook, Director)	4.71%		2.35%	**Innovators**
Macintosh	4.49%		1.12%	↓
Desktop Publishing	3.70%		3.70%	
Time and Scheduling software	2.50%	↑	2.50%	
Game Analysis related software	2.50%	**E.A.**	1.25%	
UNIX	2.22%	**Innovators**	2.22%	
Tutorials	1.25%	↓	1.25%	
Virtual Reality	1.22%		1.22%	
Simulations	1.22%		1.22%	
Videodisk	1.16%		1.16%	
Sun	1.14%		1.14%	
Commodore	1.12%		0.00%	
Robotics	0.00%		0.00%	
Integrated Learning System	0.00%		0.00%	
Gopher	0.00%	↑	0.00%	↑
Listservs, BBS	0.00%	**Innovators**	0.00%	**Innovators**

Table 6.3 denotes that the one application that has been diffused the most is the Windows Operating System, used by almost 80% of the sample for personal usage, and by almost 39% for teaching/coaching related tasks. The other four applications diffused over to Late Majority (L.M.) users (i.e., over 50% of the sample, based on Rogers' theory [1995]) are: Word Processing (almost 74% for personal use and 38% for professional-related tasks); Surfing the Internet (54% and 28%, accordingly); Spreadsheets (54% and 22%), and, Sending and Receiving E-mails (53% and 24%). Six additional computerized tools have been diffused to Early Majority users (E.M., over 16% diffusion): Presentation package (such as Power Point); Win 3.x Operating System (not currently in use); PC-DOS (like Windows 3.x, not currently in use); computer games; on-line databases; and, graphics programs (i.e., Drawings, Paint, Clipart, and Drafting).

The Computer Experience Scale was also utilized to calculate three external variables, as described later (6.2): *Innovativeness*, *Professional Innovativeness*, and *Level of Expertise*. It is assumed that these variables affect decision whether or not to adopt an innovation.

Innovativeness was calculated by subtracting the first year a computer application was used, as reported by each subject from 2004 (the year when the analysis took place), The subjects' average innovativeness score, according to that scale, was found to be 9.13 with a standard deviation of 5.95 (n=53). *Professional Innovativeness* was calculated similarly, using the first time a subject used an application professionally. Its description was 3.82 with a standard deviation of 5.10 (n=56).

The following ten figures (6.20-6.29), present the distribution curves of the five most popular applications which were diffused to the *Late Majority* of the sample: Windows operating systems, Word processing, Surfing the Internet, Spreadsheets, and E-mails.

Windows Operating System

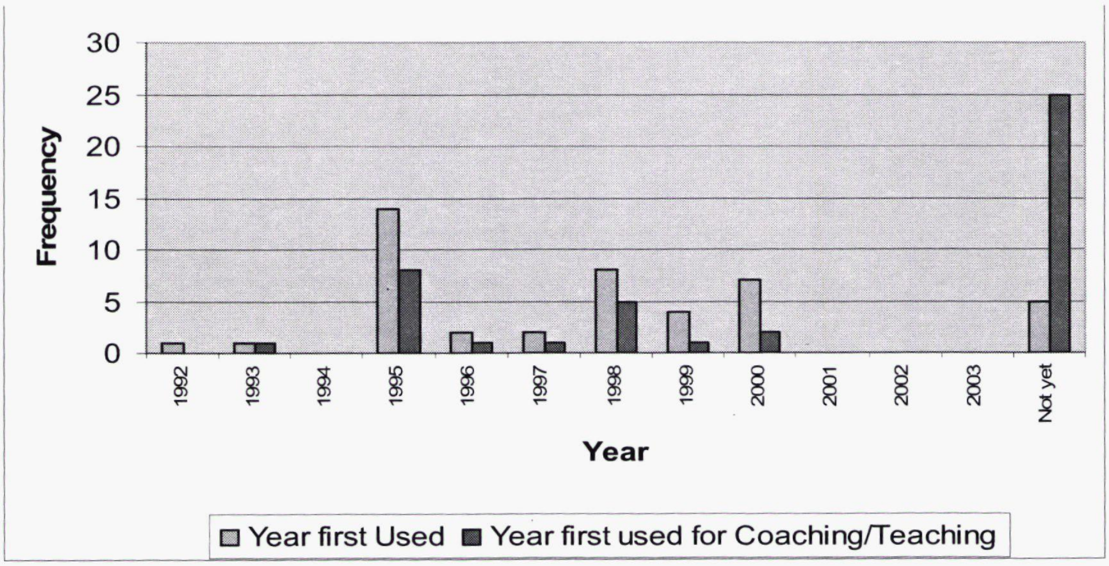


Figure 6.20. Frequency distribution of subjects along the year they first started to use the *Windows Operating System*, for *personal* and *professional* uses.

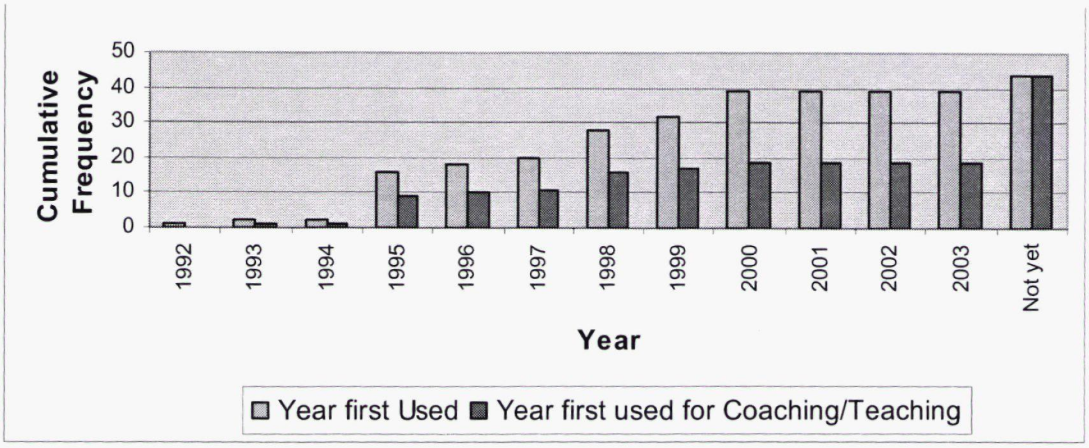


Figure 6.21. Cumulative frequency of the number of subjects along the year they first started to use the *Windows Operating System*, for *personal* and *professional* use.

Word Processing

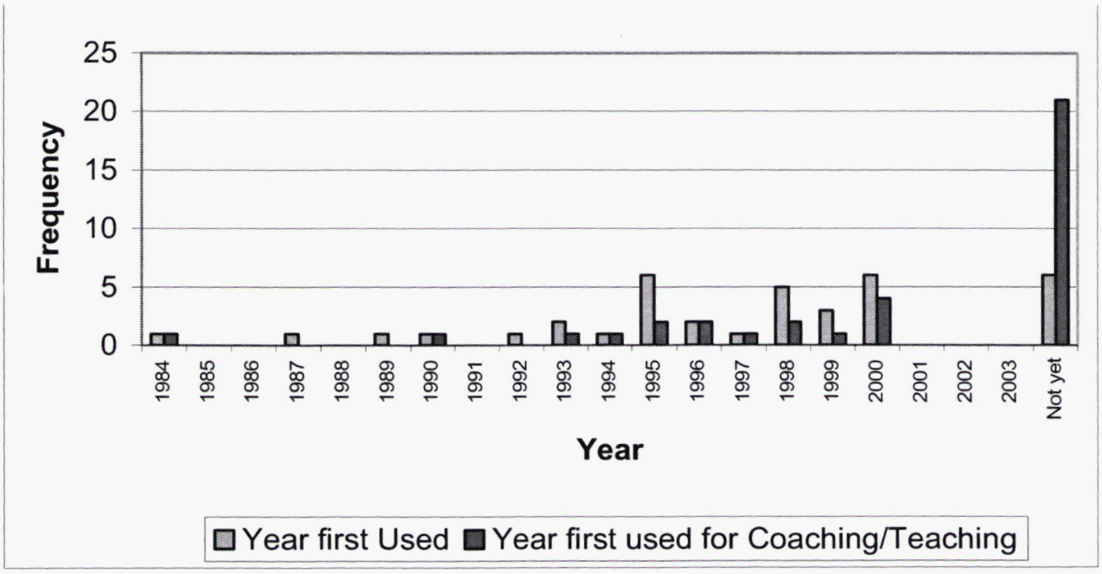


Figure 6.22. Frequency distribution of subjects as a function of the year they first started to use *Word Processing* for *personal* and *professional* use.

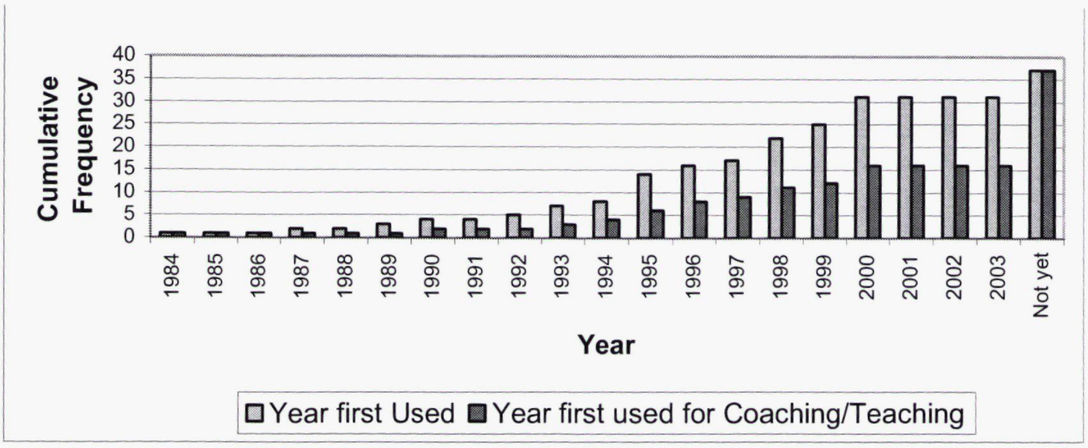


Figure 6.23. Cumulative frequency of the number of subjects along the year they first started to use *Word Processing* for *personal* and *professional* use.

Surfing the Internet

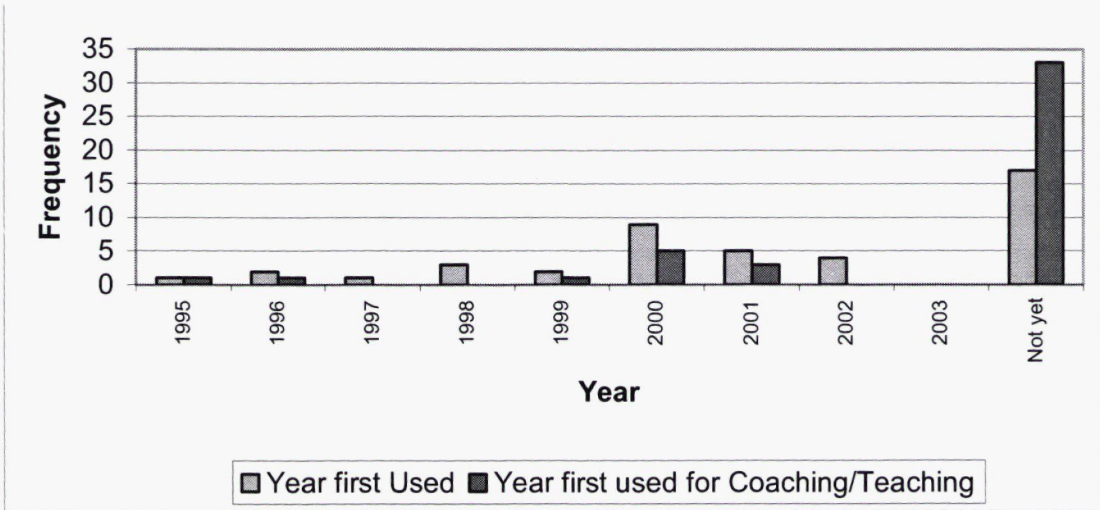


Figure 6.24. Frequency distribution of subjects along the year they first started to surf the *Internet* for *personal* and *professional* uses

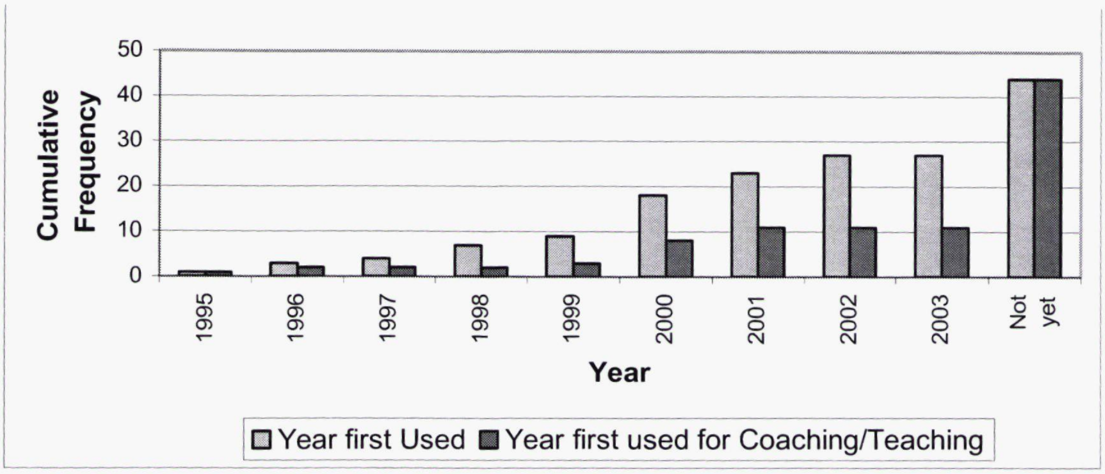


Figure 6.25: Cumulative sum of the number of subjects along the year they first started to use surf the *Internet* for *personal* and *professional* use.

Spreadsheets

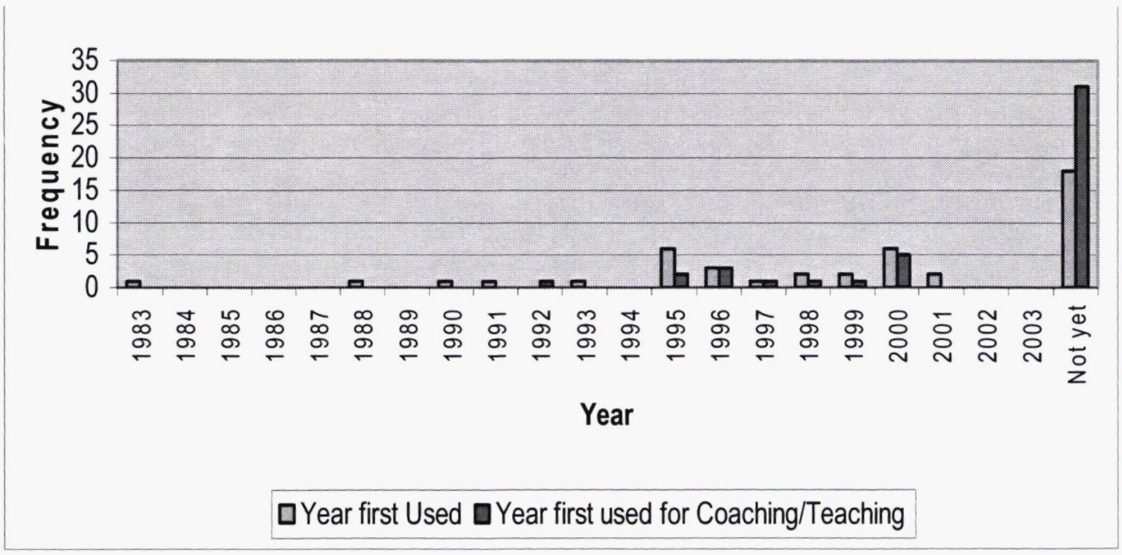


Figure 6.26: Frequency distribution of subjects along the year they first started to use *Spreadsheets*, for *personal* and *professional* use.

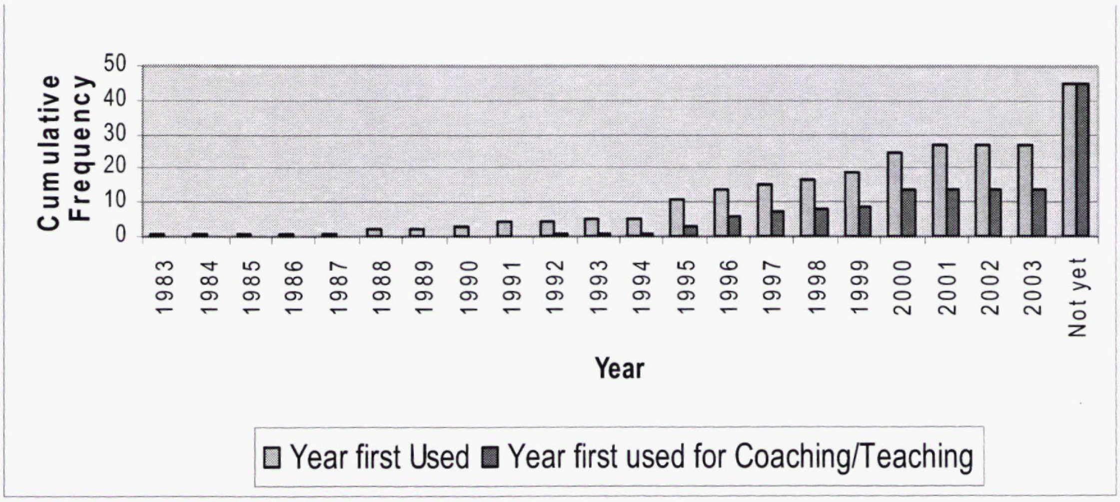


Figure 6.27: Cumulative frequency of the number of subjects along the year they first started to use *Spreadsheets*, for *personal* and *professional* use.

E-mails

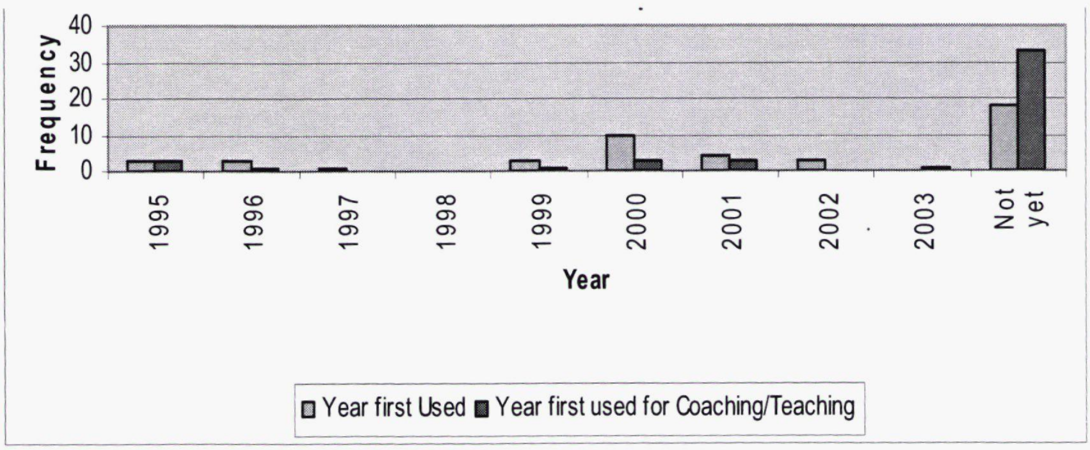


Figure 6.28: Frequency distribution of subjects along the year they first started to use *Electronic Mail*, for *personal* and *professional* use.

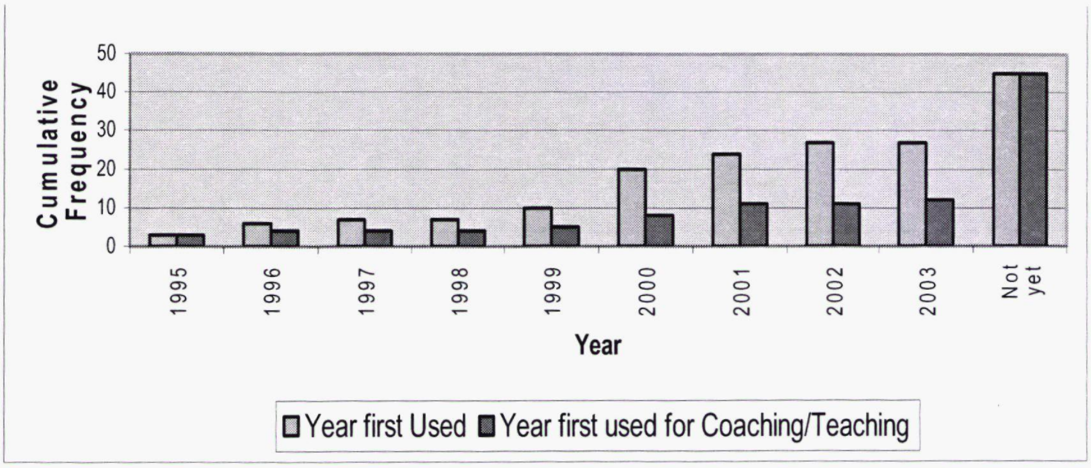


Figure 6.29: Cumulative frequency of the number of subjects along the year they first started to use *Electronic Mail*, for *personal* and *professional* use.

An important phenomenon denoted from Table 6.3 and associated figures, is that an *adoption time-gap* between personal and professional tasks exists. The cumulative percentage of adoption for personal tasks is always higher than for professional ones. That is, teachers and coaches tend to develop a level of personal expertise with a particular technology before attempting to integrate it into their profession. This time-gap is also shown in Figure (6.30) whereby *cumulative* percentage of subjects adopting computers for personal and professional tasks is plotted over the time variable.

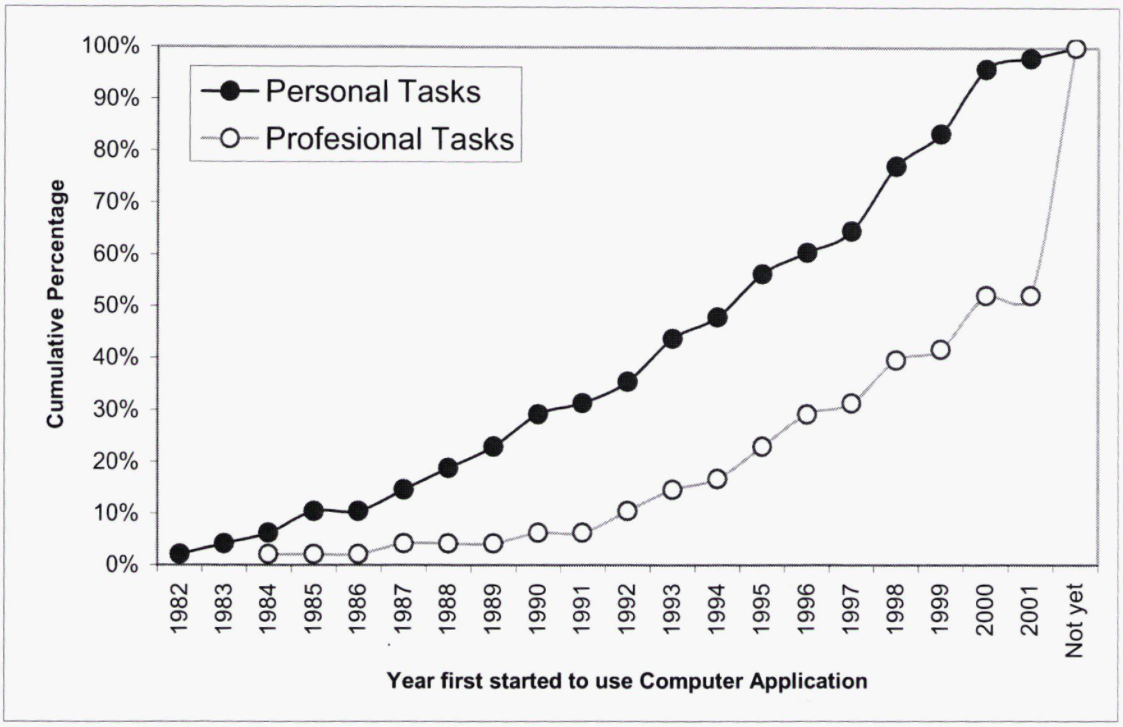


Figure 6.30: Cumulative percentage of the number of subjects along the year they first started to use any computer application for *personal* and *professional* tasks.

The *Level of Expertise,* the third variable from the Computer Experience Scale was calculated by summing each subject's level of expertise (from none (0) to extensive (4)) in all the different tools and applications mentioned in the scale. The mean level was 23.92 with a standard deviation of 20.38 (n=88). The range of the results was 86 (0 to 86) out of a maximum possible range of 164 (0 to 41*4).

The *Computer Experience Scale* was also used to learn about the number of tools/applications that subjects use. In order to do so, only the number of tools that each subject reported on using in levels 2, 3, or 4 was counted. The results show that on average, subjects used 7.58 tools[7] (± 6.20; n= 86). Figure 6.31 shows the distribution of the number of tools used by subjects, which varied from 0 to 28.

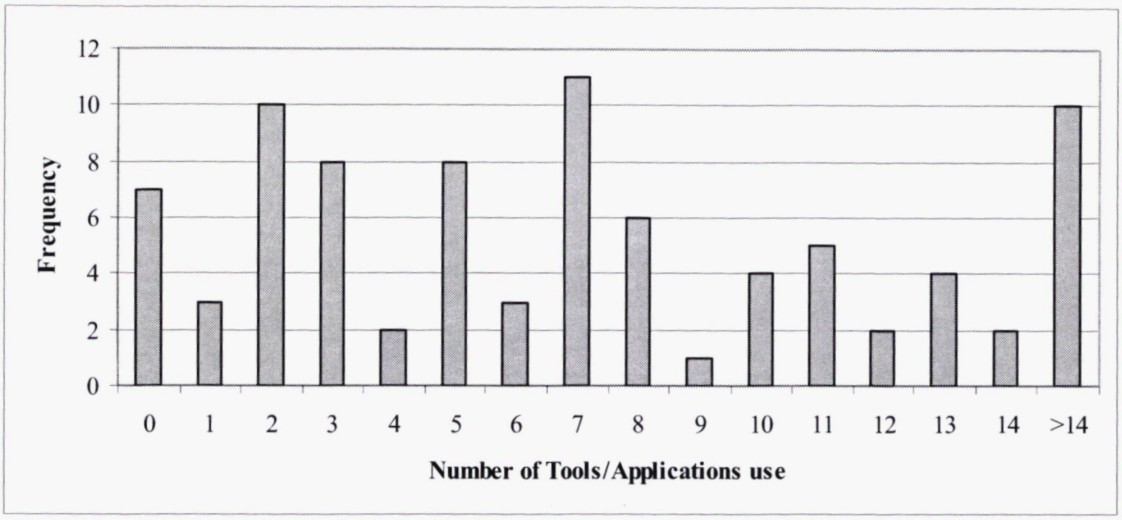


Figure 6.31: Distribution of the number of tools/application used by subjects

6.1.4 Scale # 4: Stages of Adoption of Technology (Pre-workshop Questionnaire)

In order to validate several variables that were collected in the study using newly developed questionnaires, similar variables were collected by well-established questionnaires. The level of technology adoption was measured also by the Stages of Adoption of Technology Scale developed by Christensen (1997) based on Russell's (1995) learning-stages. The users were asked to choose the stage that they believed best described the momentary level (see Appendix D).

[7] It is important to mention that this number of tools includes the use of an Operating System.

The mean response for the perceived stage of adoption of technology was 3.72 with a standard deviation of 1.48 (n=83). The distribution showed that six subjects perceived their adoption stage to be at the first stage (i.e., 7% of the sample). Fifteen subjects (18%) considered themselves in Stage 2, another 15 (18%) in Stage 3, 16 (19%) in Stage 4, 22 (27%) in Stage 5, and 9 (11%) in Stage 6. The distribution of the subjects at the different stages is presented in Figure 6.32.

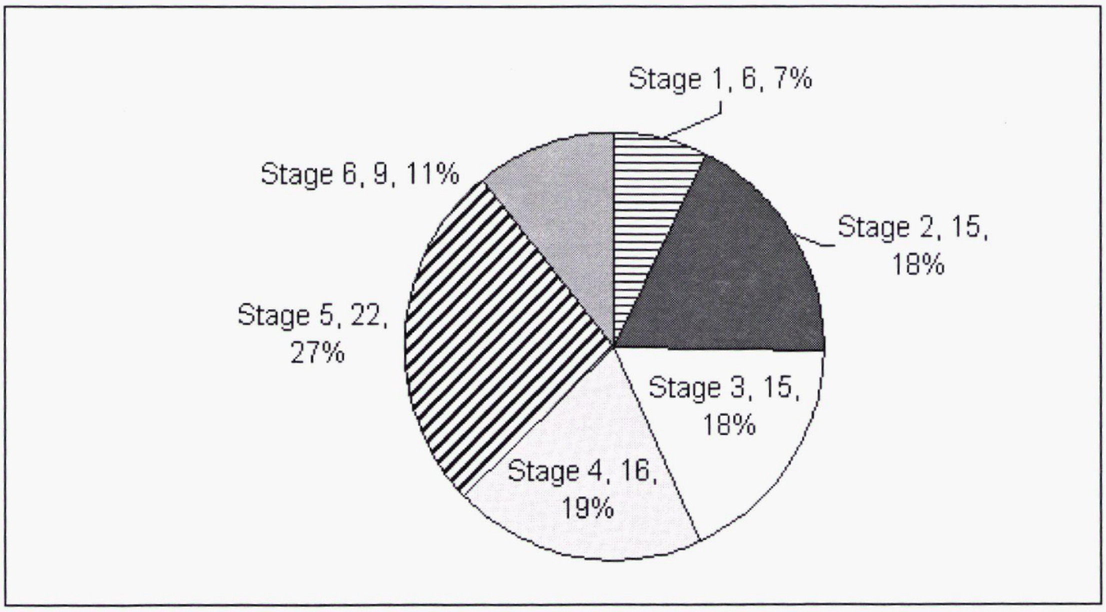


Figure 6.32: Distribution of the perceived stage of technology adoption.

6.1.5 Scale # 5: Computer Attitude Scale (Pre-workshop Questionnaire)

The Computer Attitude Scale was used to collect four sub-scales: Anxiety, Confidence, Liking, and Usefulness. The scale included 40 sentences and subjects were instructed to choose the level closest to their agreement or disagreement with the statements, on a 5-point Likert Scale (see Appendix E). By summing up the appropriate 10 items, it is possible to learn about the level of subject's *Anxiety* towards computers, their

Confidence level working with them, level of computer *Likeness* and beliefs about computer *Usefulness*. Table 6.4 describes the descriptive statistics of the four factors.

Table 6.4

Description Statistics of the Computer Attitude Sub-scales Collected with the Pre-workshop Questionnaire

Factor	Statistics of the sample
Anxiety (10 items)	n = 85 Mean: 39.85 Standard Deviation: 7.55 Range: 33 (from 17 to 50)
Confidence (10 items)	n = 84 Mean: 38.55 Standard Deviation: 7.50 Range: 29 (from 21 to 50)
Liking (10 items)	n = 84 Mean: 37.98 Standard Deviation: 7.23 Range: 30 (from 20 to 50)
Usefulness (10 items)	n = 83 Mean: 39.25 Standard Deviation: 5.48 Range: 24 (from 26 to 50)
Total Attitude (40 items)	n = 80 Mean: 156.46 Standard Deviation: 25.64 Range: 104 (from 96 to 200)

6.1.6 Scale # 6: Computer Technology for Physical education teachers and coaches (Pre-workshop Questionnaire)

In order to learn *specifically* about coaches and physical education teacher attitude toward the use of technology in *sport and physical education,* a new scale was designed. It included three parts: 1) General attitude, 2) Attitude toward specific teaching/coaching tools, and 3) Open questions. The quantitative data from the first two scales is presented in Table 6.5, followed by the qualitative data collected by "open" questions.

Table 6.5

Descriptive Statistics of Variables Collected with the Computer Technology for Physical Education Teachers and Coaches Scale (Pre-workshop Questionnaire)

Factor	Statistics of the sample
General Attitude (12 items)	n = 84 Mean: 46.62 Standard Deviation: 5.72 Range: 26 (34 to 60)
Attitude toward Teaching/coaching Tools (12 items)	n = 85 Mean: 48.65 Standard Deviation: 5.49 Range: 24 (36 to 60)
Total (24 items)	n = 82 Mean: 95.22 Standard Deviation: 10.29 Range: 49 (71 to 120)

The *Computer Technology for Physical education teachers and coaches Scale* also included additional "open" questions. In the first, subjects were to indicate any computer tools/applications that they were currently using for fulfilling teaching/coaching assignments. The results suggested that they were mainly using MS Office applications. Forty-two subjects mentioned that they were using MS Word, 32 - Excel, 15 - Power Point, and 2 - Access. Seven subjects reported using the Internet, 2 - drawing applications, 2 - marking packages, and 1 - a statistical analysis package.

6.1.7 Scale # 7: Generalized Self-efficacy (Pre-workshop Questionnaire)

One of the study hypotheses is that subjects' self-efficacy might affect their level of technology adoption. This self-efficacy was measured by the Generalized Self-efficacy Scale that was taken with permission, from Schwarzer and Jerusalem (1995). The score of the scale was calculated by adding up ten items. The mean of the sample generalized self-efficacy was ($n = 84$) 30.26 with a standard deviation of 4.97. The results ranged from low of 17 to max of 46 (out of a possible score of 50, which describes a person with a very high, generalized self-efficacy).

This concludes the descriptive statistics of the main variables collected by the seven scales of the pre-workshop questionnaire. Thereafter, subjects participated in a workshop where they were introduced to the Interactive Volleyball CD-ROM. At the end of the workshop, they were asked to complete the post-workshop questionnaire, which included only two scales. The data of the post-workshop questionnaire is presented in sub-sections 6.1.8 and 6.1.9.

6.1.8 Scale # 8: Perceived Characteristics of the Interactive Volleyball CD-ROM (Post-workshop Questionnaire)

In the first form of the post-workshop questionnaire, subjects were to evaluate the Interactive Volleyball CD-ROM on ten different items, composed from two sub-scales: The Perceived Relative Advantage (items 1-6) and the Perceived Complexity (items 7-10). The ten items were measured on a 7-point Likert scale (ranging from "strongly disagree" to "strongly agree"). The results, presented in Table 6.6, suggests that on average, subjects considered the CD-ROM to have a relative advantage compared to other, more traditional methods (mean score of 33.79 out of 42 maximum score) and that the CD-ROM is easy to operate (mean score of 22.33 out of 28 maximum score).

Table 6.6

Descriptive Statistics of the Variables Collected by the Perceived Characteristics of the Interactive Volleyball CD-ROM Scale (Post-workshop Questionnaire)

Factor	Statistics of the sample
Perceived Relative Advantage (6 items)	n = 75 Mean: 33.79 Standard Deviation: 5.84 Range: 26 (from 16 to 42)

Perceived Complexity (4 items)	n = 76 Mean: 22.33 Standard Deviation: 4.41 Range: 17 (from 11 to 28)

6.1.9 Scale # 9: Intention to Use the Interactive Volleyball CD-ROM (Post-workshop Questionnaire)

In the last scale of the post-workshop questionnaire, subjects were to rank their intention to actually take and use the Interactive Volleyball CD-ROM for their teaching/coaching tasks. Their intention was measured using a 7-point Likert scale (ranging from 1="I will certainty use it" to 7="I will certainty NOT use it"). The average score of the scale was 2.37 with a standard deviation of 1.52 (n=70). Even though the scales ranged from 1 to 7, none of the participants selected 6 or 7. Forty-five percent (31 subjects) said they would certainly use it (level 1), 17% (12 subjects) were a little bit less sure that they would (level 2), and 11% (8), even-though they thought they would, were not as sure (level 3). Eight subjects (11%) could not predict whether they were going to use it or not and, therefore, chose level 4, which is the mid-point of the 7-point Likert scale. Only 11 subjects (16%) did believe that they would not use the CD-ROM, but with a very low certainty level (level 5). The distribution of the replies is shown in Figure 6.33.

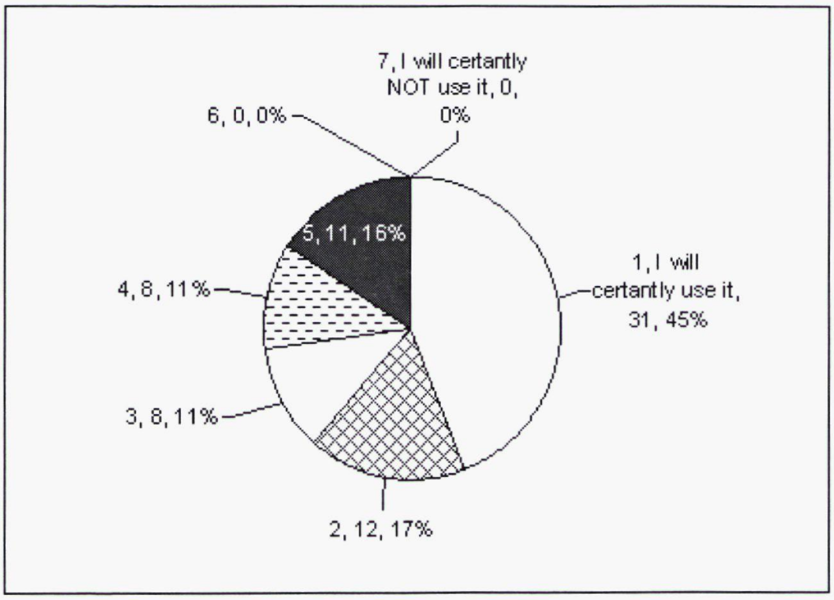


Figure 6.33: Distribution of the intention to use the Interactive Volleyball CD-ROM.

Two other questions were designed to check the influence of whether or not the CD-ROM developed in the English language, had an impact on the Hebrew speaking subjects' decision to adopt the Interactive Volleyball CD-ROM. They were to rank their English level on a 7-points scale, from 1 (excellent) to 7 (none). The results showed that on average subjects (n=70) believed their English level was 3.37 with a standard deviation of 1.22, which suggests that the English level is relatively acceptable. The distributions of the replies are denoted in Figure 6.34.

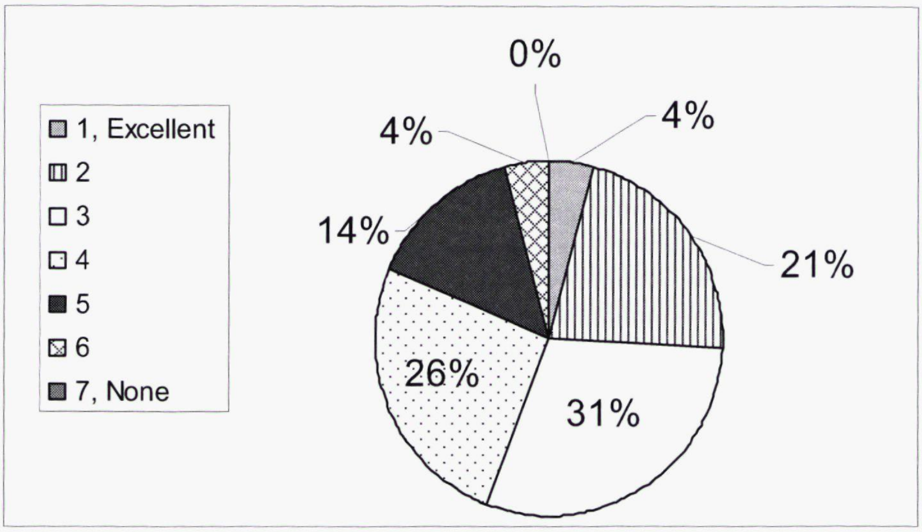


Figure 6.34: Distribution of the English level of the subjects.

In Question 3, subjects were asked directly if they believed that the fact the CD was written in English would affect their intention of use/non-use. Ten subjects (14%) believed that *yes*, their English proficiency affecting their decision whether or not to adopt the CD-ROM, 30% (21 subjects) that it *may* affect it, and 39 (56%) were sure that it would *not* affect the decision. The results are in Figure 6.35.

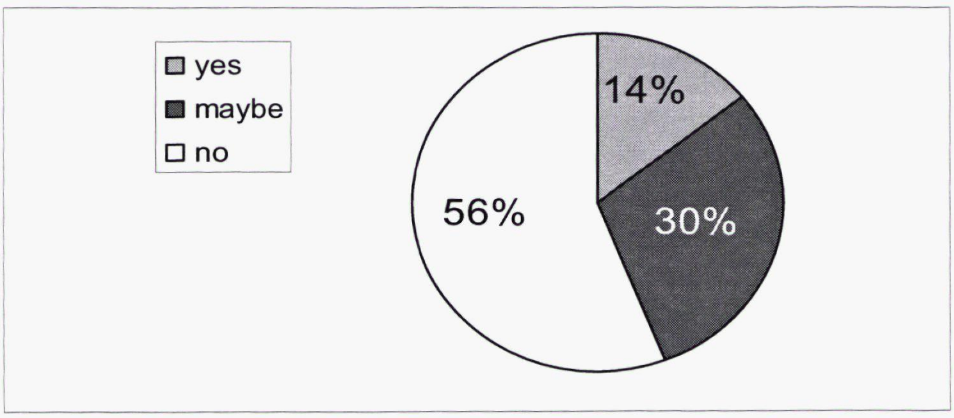


Figure 6.35. Distribution of the influence of the English on the decision whether or not to adopt the CD-ROM

Approximately 18 months after the workshop, the follow-up questionnaire was delivered to the subjects by mail/fax. The return rate was 19 of 90 (response rate = 21.11%). This questionnaire included a Follow-up scale and several scales completed by subjects earlier: Computer Attitudes, Generalized Self-efficacy, Stages of Technology Adoption, Computer Technology for Physical education teachers and coaches (see appendixes J, E, G, D and F). The results are in the following sections (6.1.10-6.1.14).

The main propose of the Follow-up scale was to learn if an adoption of the Interactive Volleyball CD-ROM took place and, if so, in what ways. In addition, any changes in users' attitudes and generalized self-efficacy were also examined.

6.1.10 Scale # 10: Follow-up Scale (Follow-up Questionnaire)

The first scale in the follow-up questionnaire was concerned with subjects' actual use of the CD-ROM, and possible barriers.

In the first question, subjects were to choose if they: never used the CD-ROM (0), used it for few times (1), used it many times (2), or used it on a regular basis (3). The distribution of the responses is presented in Figure 6.36, and shows that none of the subjects used the CD-ROM regularly, only one subject used it many times, 11 used it for few times, and 7 never used it at all. The average score for that variable, was 0.68 with a standard deviation of 0.58 (n=19), suggesting that on average, subjects used the CD-ROM very little.

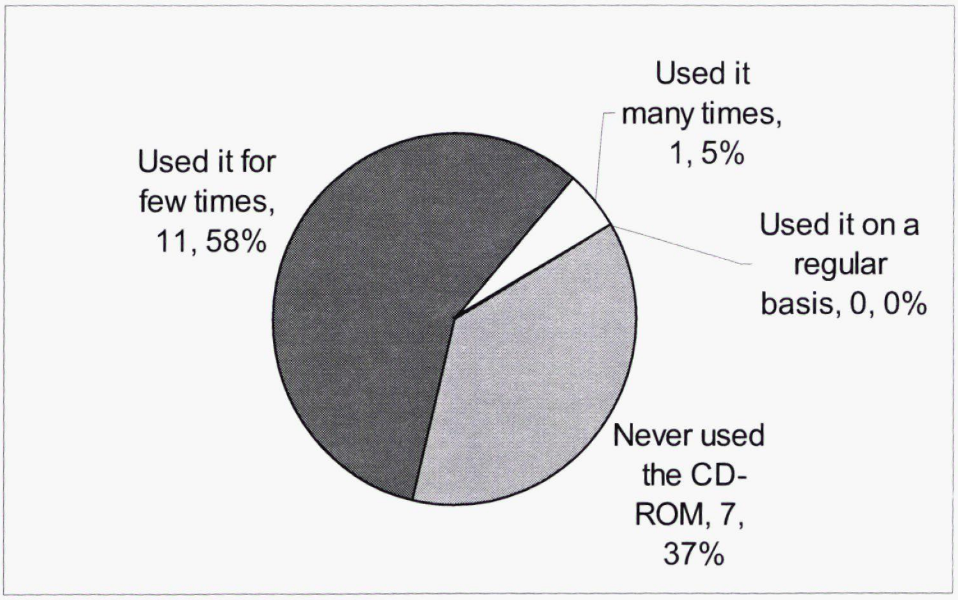


Figure 6.36. Distribution of the responses for the frequency use of the Interactive Volleyball CD-ROM.

When subjects were asked about the ways they used the CD-ROM, 6 reported that they used it for reading and watching the educational content, 8 for looking for drills, 2 mentioned that they were modifying and creating new drills, and 2 were creating lesson/practice plans. It should be noted that several subjects used it for more than one purpose. Three also mentioned that they used it for other purposes: in coaching classes to show drills to students, teaching students at the college, and as a base for a written paper. The distribution of the results is in the next figure (Figure 6.37).

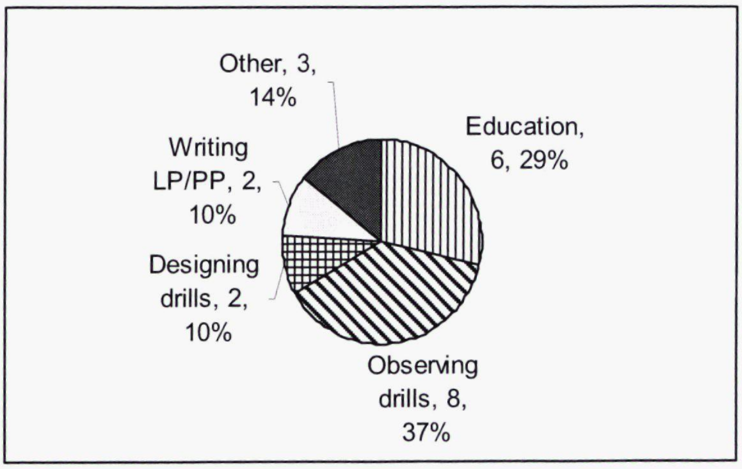


Figure 6.37. Distribution of the different uses of the Interactive Volleyball CD-ROM.

Subjects were also to report the number of drills (Question 3) and the number of practice/lesson plans they have added to the databases (Question 4). Not one of the subjects reported adding new drills to the existing drills database or creating new practice/lesson plans. This was somewhat in contradiction to the report in the previous questions when 2 subjects reported that they used the CD for creating new drills, and 2 for saving new plans. One explanation might be that after the creation of the new drill and planes they were not saved for additional use. Under the "other" option, one subject reported that he used it as a basis for a written paper at the college, while a second subject used it to teach students at the college.

Questions 5 to 9 were concerned with different aspects of the CD-ROM, in order to discover a specific reason subjects used/did not use the CD-ROM. The aspects were: the "look and feel" of the CD-ROM (designing); the CD-ROM's usefulness; relevant to the coach/teacher job; "bugs" that may be found; and the effectiveness of the CD-ROM. On each topic subjects were asked to choose one of: Strongly Agree (2), Agree (1), Neutral (0), Disagree (-1) or Strongly Disagree (-2). Total score for each aspect was calculated by multiplying the number of subjects in each option by its constant (i.e., the number of the subjects that chose Strongly Agree was multiplied by 2, the number of the subjects that chose Agree by 1, and so on). The results are presented the Table 6.7 and Figure 6.38.

Table 6.7

Descriptive Statistics of the Follow-Up Scale (Follow-up Questionnaire)

Topic	**Strongly Agree (2)**	**Agree (1)**	**Neutral (0)**	**Disagree (-1)**	**Strongly Disagree (-2)**	**n**	**Total Score**
Usefulness	4	7	7	0	0	18	15
Designing	5	6	7	0	0	18	16
Bugs	5	4	8	1	0	18	13
Relevance	6	4	7	1	0	18	15
Effectiveness/ Efficiency	3	3	9	3	0	18	6

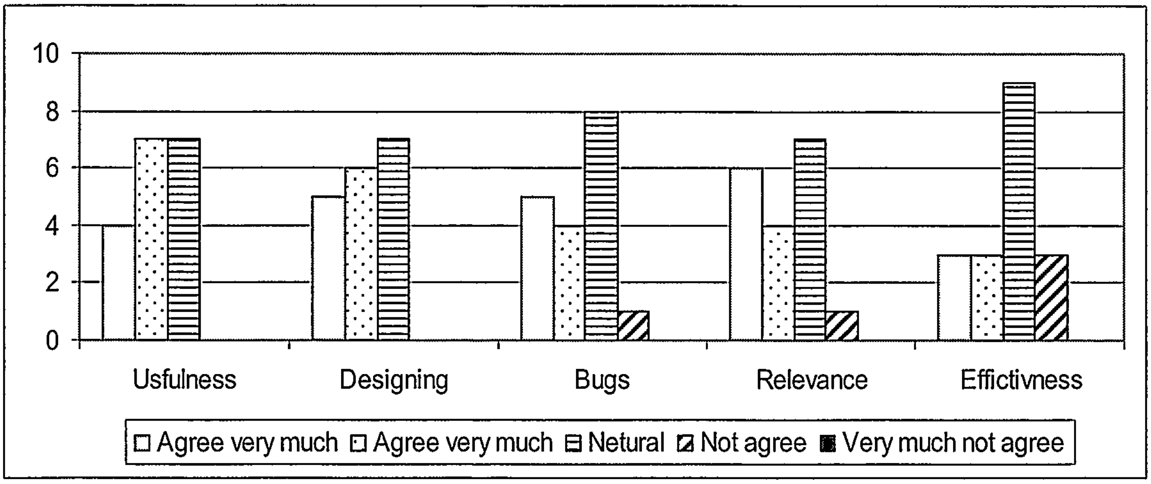


Figure 6.38. Distribution of the replies of the 5 questions regarding the CD-ROM aspects.

According to the previous table and figure, it is evident that the relatively large number of the "Neutral" replays on the different aspects was used. Most likely, subjects that did not use the CD-ROM, or used it a long time ago, could not take a stance. It can also be seen that, on average the majority of the response was positive. That is, on the different statements, subjects agreed or strongly agreed that the CD-ROM was useful to their work, it was well designed, worked smoothly without major "bugs," was relevant to the teacher/coach work, and was more effective than using other methods.

The second part of the Follow-up scale was design to learn about any possible barriers that subjects may have encountered while using, or trying to use, the Interactive Volleyball CD-ROM. This part included ten "closed" questions and one "open." In the closed questions, subjects had to indicate their feeling about the mentioned barrier: Strongly Agree, a major barrier (-2), Agree (-1), Neutral (0), Disagree (1) or Strongly Disagree, not a barrier (+2). The score was calculated in a manner similar to that described in the previous scale. As a result, a negative score suggests that the specific topic might be considered a barrier and a positive score that, on average, subjects suggested that the selected topic was not a barrier. Table 6.8 and Figure 6.39 present the descriptive statistics.

Table 6.8

Descriptive Statistics of the Barriers Information Collected by the Follow-up Scale (Follow-up Questionnaire)

Topic	**Strongly Agree, a major barrier (-2)**	**Agree (-1)**	**Neutral (0)**	**Disagree (+1)**	**Strongly Disagree, not a barrier (+2)**	**n**	**Total Score**
Lack of time	2	4	3	6	3	18	-4
Unavailable hardware	0	2	2	10	4	18	-16
Unstable hardware	0	4	4	7	3	18	-9
Inadequate financial support	0	5	7	5	1	18	-2
No interest from peers	0	9	6	3	0	18	6
Insufficient personal knowledge	2	2	3	8	3	18	-8
Manual inadequate & unhelpful	0	4	4	8	2	18	-8
Not an advantage to work	0	2	5	9	2	18	-11
Personal preference to pen & paper	0	5	3	7	3	18	-8

The CD-ROM is too difficult to operate	0	1	7	9	1	18	-10

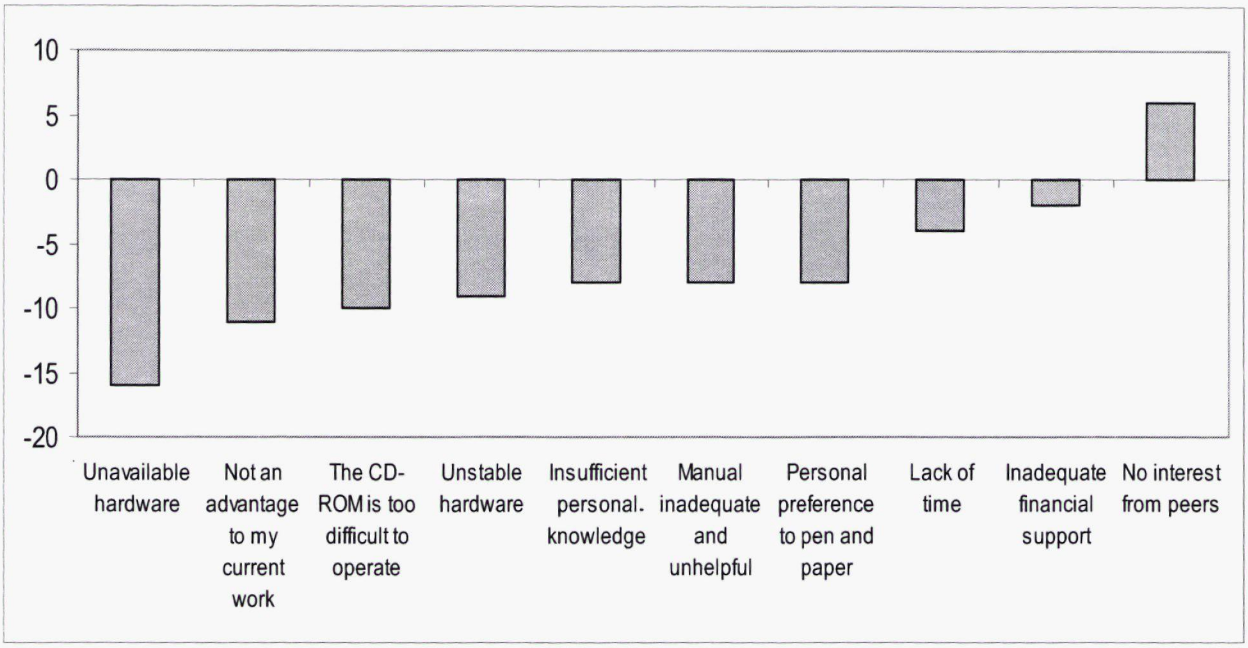


Figure 6.39. Distribution of the replies for possible barriers for not using the CD-ROM ranked by their size

Thess last table and figure, denote that subjects believed that only one possible mentioned factor is not perceived as a real barrier, which may prevent them from using the CD-ROM – the lack of interest from peers. At the same time, all the others (such as lack of time, insufficient hardware, and so on), are ones that might prevent adopting the CD-ROM. Two of these barriers, "Not an advantage to my work" and "The CD-ROM is too difficult to operate," should be of concern for CD-ROM developers and should be further researcher by them. However, from the fact that the number of subjects that actually use the CD-ROM was very low, these results should be taken with conscious. A more elaborate study of potential barriers should take place with actual users of the software.

In the open question, subjects were to list any other potential barriers. Two subjects suggested that the problem was their level of English. One mentioned lack of computer skills, and another, who taught physical education, noted that the CD-ROM drills were more suitable for coaching.

6.1.11 Scale # 11: Computer Attitude Scale (Follow-up Questionnaire)

In the follow-up questionnaire, subjects were to complete the Computer Attitude Scale again. This was done to explore any changes in subjects' attitudes toward working with computers during the time elapsed since the workshop. The results are shown in Table 6.9.

Table 6.9:

Descriptive Statistics of the Computer Attitude Scale (Follow-up Questionnaire)

Factor	**Statistics of the sample**
Anxiety (10 items)	n = 17 Mean: 41.76 Standard Deviation: 7.62 Range: (from 20 to 51): 31
Confidence (10 items)	n = 18 Mean: 39.61 Standard Deviation: 8.71 Range: (from 14 to 50): 36

Liking (10 items)	n = 18 Mean: 37.78 Standard Deviation: 7.16 Range: (from 26 to 47): 21
Usefulness (10 items)	n = 19 Mean: 38.84 Standard Deviation: 5.42 Range: (from 28 to 49): 21
Total Attitude (40 items)	n = 16 Mean: 155.44 Standard Deviation: 26.96 Range: (from 91 to 190): 99

6.1.12 Scale # 12: Generalized Self-efficacy (Follow-up Questionnaire)

The Generalized Self-efficacy scale was also incorporated in the follow-up questionnaire in order to learn about any changes during this period. The calculated mean was 32.63 with a standard deviation of 6.67 (n = 19). The distribution of the Follow-up self-efficacy data are shown in Figure 6.40.

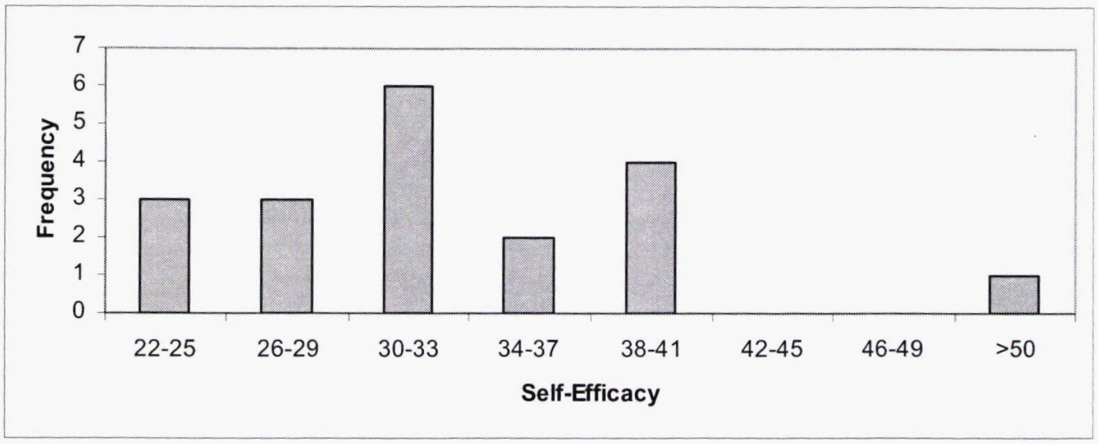


Figure 6.40. Distribution of the *self-efficacy* collected with the follow-up questionnaire.

6.1.13 Scale # 13: Stages of Adoption of Technology (follow-up questionnaire)

Subjects were to indicate the Stage that best described their technology adoption level at that point in time. The results shown are in Figure 6.41, where the mean score was 4.68 with a S.D. of 1.11 (n=19).

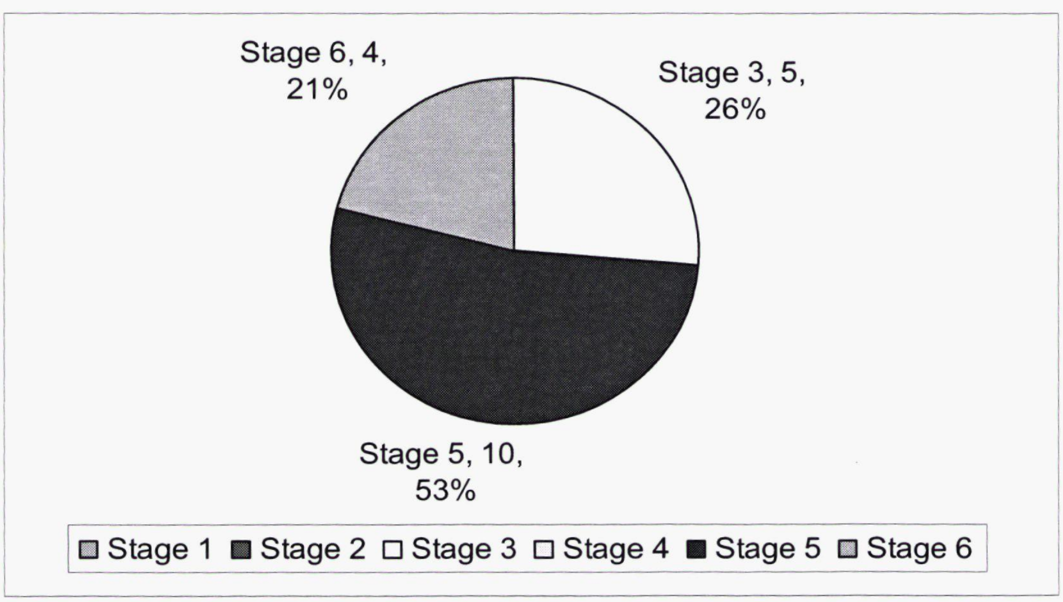


Figure 6.41. Distribution the perceived stage of subjects at the follow-up questionnaire.

6.1.14 Scale # 14: Computer Technology for Physical education teachers and coaches (Follow-up Questionnaire)

In the last scale of the study, subjects completed the Computer Technology for Physical Education Teachers and Coaches Form, which they had already done in the pre-workshop questionnaire approximately 18 months prior. The first 12 questions of the scales composed the subjects' General Attitude while the other 12 questions (13 to 24) were indicated for the Teaching/Coaching tools factor. The results are shown in Table 6.10.

Table 6.10

Descriptive Statistics of the Variables Collected by the Computer Technology for Physical Education Teachers and Coaches Scale (Follow-up Questionnaire)

Factor	Statistics of the sample
General (12 items)	n = 19 Mean: 48.21 Standard Deviation: 5.69 Range: (from 40 to 60): 20
Teaching/coaching tools (12 items)	n = 18 Mean: 50.11 Standard Deviation: 5.22 Range: (from 45 to 60):15
Total (24 items)	n = 18 Mean: 98.28 Standard Deviation: 10.23 Range: (from 88 to 120):32

This concludes the description survey part of the study. In the following sections, explanations of the major variables of the study are described.

6.2 Explanation of Major Variables

The previous section included a description analysis of most of the variables collected with the three questionnaires. This section includes a more detailed analysis of these major variables, later used to test the proposed model.

6.2.1 Level of Expertise

The *Level of Expertise* variable describes subjects' previous level of experience in using computer applications. It was evaluated three different ways. Repetitions were used because one goal of the study was to find methods and scales to measure variables in an easy and reliable way. The three variables were:

1. **Total Level of Expertise** – On the Computer Experience scale, subjects were asked to rank their experience with a list of 41 computer technologies, on a 0 (none) to 4 (very experienced) Likert scale. The *Total Level of Expertise* was calculated summing up the results on all mentioned computer applications. The possible score ranged from 0 to 164 (41*4).
2. **Stage of Adopting Technology** – On the stage of adoption technology scale, subjects were asked to choose that *stage* which best described their level of adoption of technology on a 1-6 scale.

3. **Experience with computer technology** – on the Patterns of Computer Technology Use scale, subjects were to rank their experience with computer technologies on 5-point Likert (from Very Experienced to None)[8].

The descriptive results of these three variables are presented in Table 6.11 and their distribution in Figures 6.42-6.44.

Table 6.11

Descriptive Statistics of the Three *Level of Expertise* Variables.

Variable Name	Mean	Standard Deviation	n	Range	Scale
Total level of expertise	23.92	20.38	88	0-86	0-164
Stage of adoption technology	3.72	1.48	83	1-6	1-6
Experience with computer technology	3.15	1.01	86	1-5	1-5

[8] In order to be able to compare this variable to the other two, its direction has been reversed.

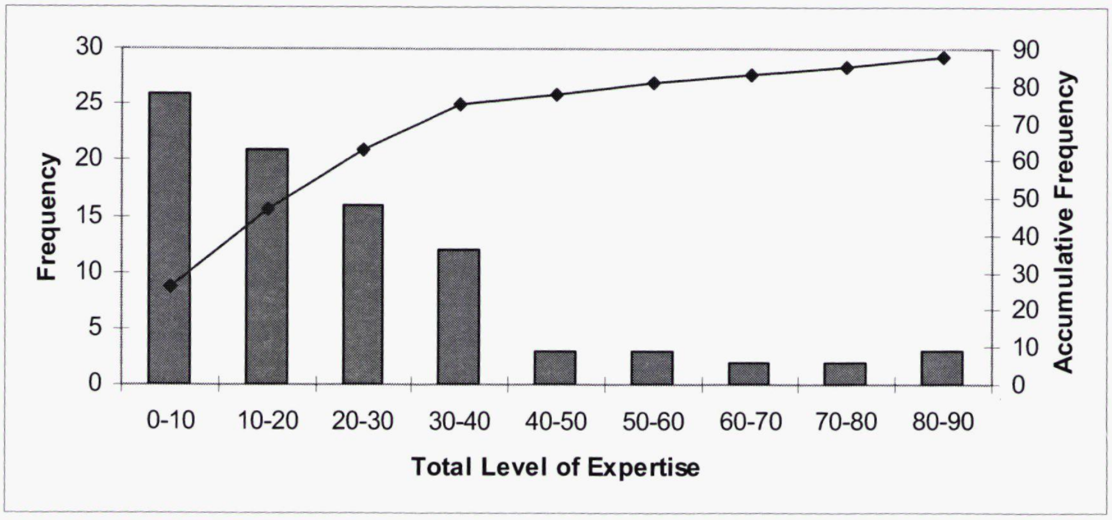


Figure 6.42. Distribution of the *Total level of expertise.*

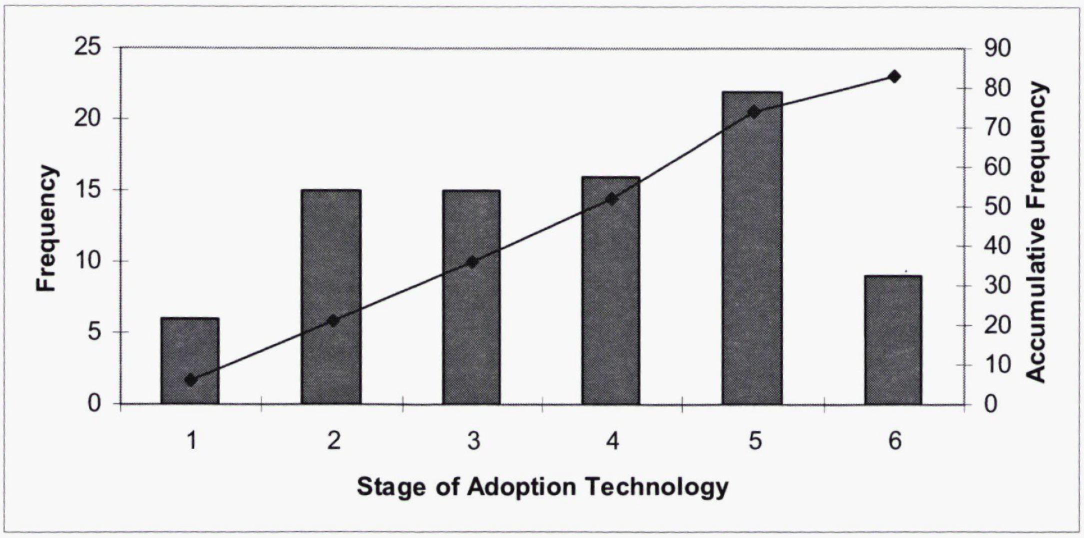


Figure 6.43. Distribution of the *Stage of adoption technology.*

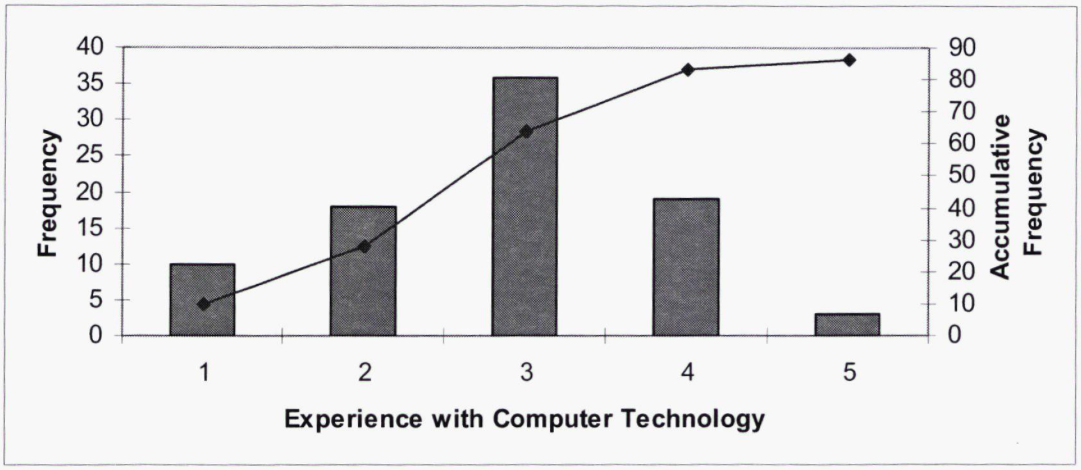


Figure 6.44. Distribution of the *Experience with computer technology.*

The relationships among the three *Level of Expertise* variables were tested with the Pearson Correlation technique. According to Table 6.12, the relationships strength varies from 0.599 to 0.736, and all the coefficients are significant at a level of 0.01.

Table 6.12

Correlation Coefficients and their Significant Levels among Variables that Measured Subjects' *Level of Expertise* Working with Computers

	Total level of expertise	**Stage of adoption technology**	**Experience with computer technology**
Total level of expertise	--		
Stage of adoption technology	0.599** (n=81)	--	
Experience with computer technology	0.736** (n=85)	0.717** (n=81)	--

** Significant at α level = 0.01

To determine whether or not the three variables actually measured the same factor, Cronbach's Alpha Reliability test was performed. However, before perusing the analysis, the three variables were transformed into a similar scale of 1 to 5. This was done by dividing each of the *Total level of expertise* scores by 41 (bringing it to a 0-4 scale), and adding 1's to the results (to a 1-5 scale). The results of the *Stage of adoption technology* were linearly transformed from a scale of 1-6 to a scale of 1-5. The transformed results are shown in Table 6.13.

Table 6.13

Descriptive Statistics of the *Level of Expertise* Variables after Transformation

Variable Name	Mean	Standard Deviation	n	Original Scale	New Scale
Total level of expertise	1.58	0.50	88	0-164	1-5
Stage of adoption technology	3.18	1.19	83	1-6	1-5
Experience with computer technology	3.15	1.01	86	1-5	1-5

It is evident from the data in the previous table that the distribution of the first variable, the *Total level of expertise,* is somewhat different to the other two. The reason may be the way these three variables were collected. Whereas the last two actually represent *depth* of experience in using computers, unrelated to the number of tools/application used, the first is measuring *variety* in using computers, as subjects were asked to indicate their experience with 41 different applications and tools. Only a subject using a large number of different computerized tools and applications scores high on that scale. At the same time, a subject using only a few applications, even if he/she is very good at using them, scores high on the *Stage of adoption technology* and the *Experience with computer technology* scales, but low on *Total level of expertise.*

This idea was strengthened by the reliability analysis. While the result of the Cronbach's Alpha Reliability test for the three variables was relatively high (0.815), a closer look at the analysis revealed that withdrawing the *Total level of expertise* results in a somewhat higher reliability of 0.831. That is, the information from the Total Level of Expertise does not add any more information. Therefore, it is suggested to separate these variables to calculate two factors measuring somewhat different aspects of experience in using computers.

The first factor is considered as the *Verity Factor* while the other is referred to as the *Computer Expertise Factor* (these factors will later be used to test the proposed model). The last factor was calculated by averaging the two variables: Stage of Adoption Technology and Experience with Computer Technology. It should be noted (based on the reliability analysis) that in further studies, only one scale can be used to represent subjects' Computer Expertise level and the researcher can select either one.

The descriptive analysis of the Computer Expertise Factor (after averaging Stage of Adoption Technology with Experience with computer technology) yielded an average of

3.16 with a standard deviation of 1.04 (n=88). Its distribution is presented in Figure 6.45, including accumulative frequency. The distribution of the Verity Factor is the same as the Total Level of Expertise variable that was previously drawn in Figure 6.42.

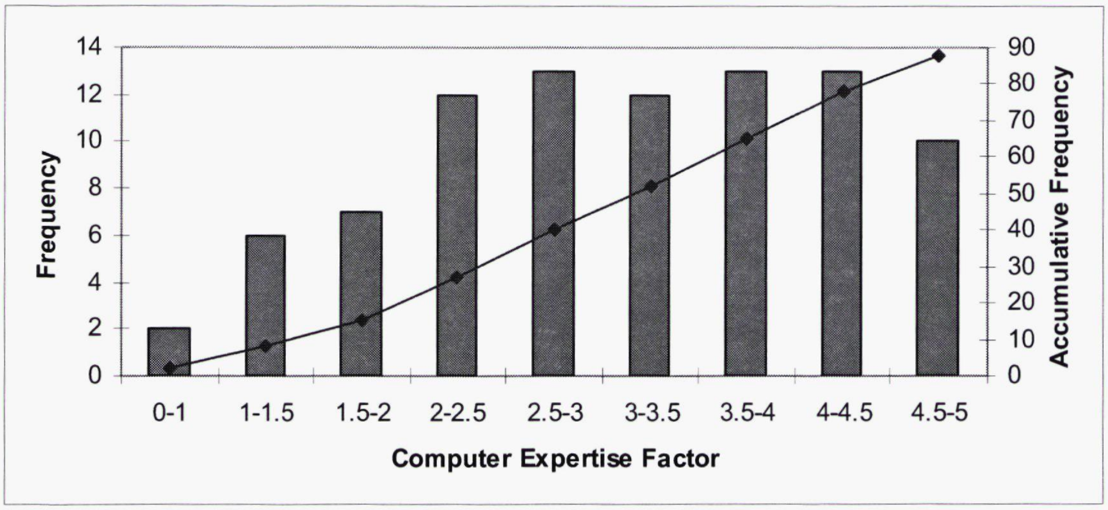


Figure 6.45. Distribution of the *Computer Expertise Factor.*

The relationship between these two factors can be seen in the following figure that presents their regression.

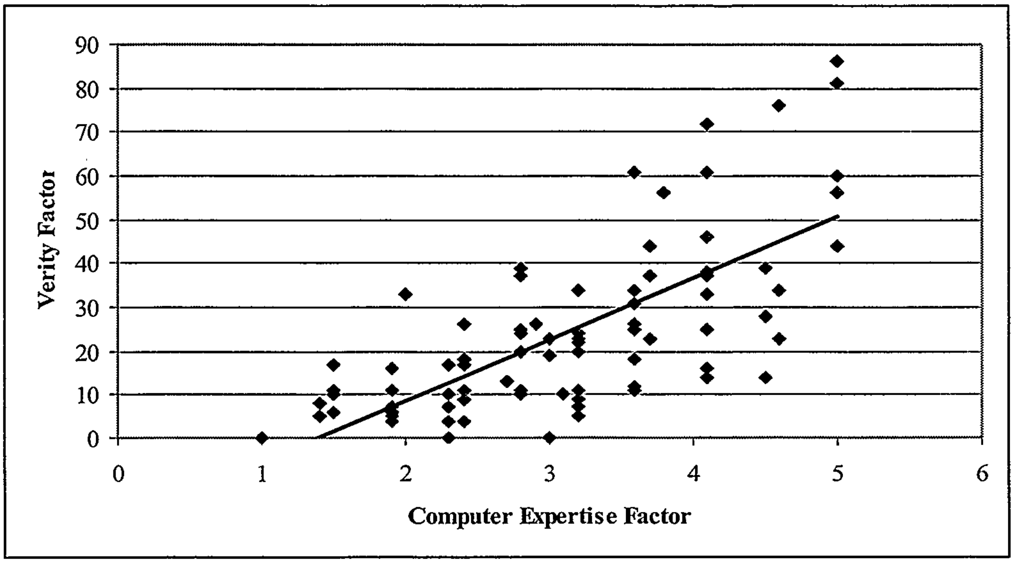


Figure 6.46. Regression between the two *level of expertise* factors (r Pearson = 0.71).

6.2.2 Innovativeness

The adoption level of computer technology can also be measured on a time dimension, as suggested by Rogers (1995). He defined *Innovativeness* as "the degree to which an individual, or other unit of adoption, is relatively earlier in adopting new ideas compared to other members of the system" (p. 22). The innovativeness variable is used in the diffusion of innovations model to categorized members into five adopter categories: Innovators, Early Adopters (EA), Early Majority (EM), Late Majority (LM) and Laggards (Rogers, 1995). The innovativeness score was used to test differences between early adopters and late adopters (see section 6.3.3).

The *Innovativeness* was measured using two different variables. The repetition was done to allow for validity of variables, especially since they were based on subjects' recall ability. The two variables were:

1) **Number of years using applications/tools** – On the *Computer Experience form,* subjects were asked to mark the first year that they started to use any of 41 computer applications and tools. From that scale, the *first time* usage of an application/tool was obtained and the number of years was calculated by subtracting this number from 2004 (the current year when the calculation was taken).

2) **Number of years using computers** – On the *Patterns of Computer Technology Use Scale:* subjects were to report *the first year* they used a computer for *personal tasks.* The number of years was calculated by subtracting this value from 2004 (current year).

The description statistics is presented in Table 6.14 and the distributions in Figures 6.47 and 6.48.

Table 6.14

Descriptive Statistics of the *Innovativeness* Variables.

Variable Name	Mean	Standard Deviation	n	Range
Number of years using applications /tools	9.13	5.95	53	0-22 years
Number of years using computers	9.08	5.52	85	0-24 years

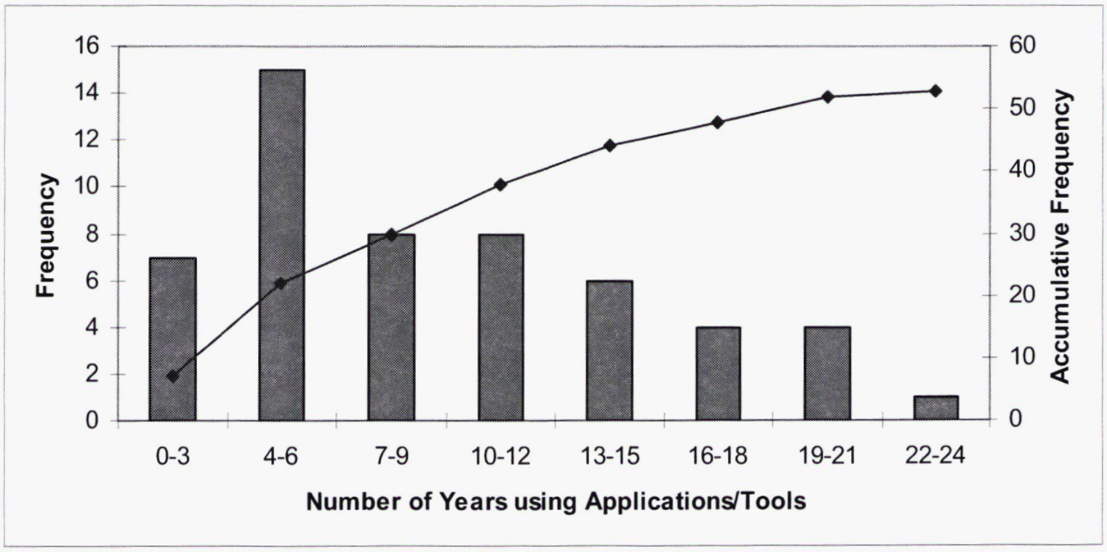


Figure 6.47. Frequency and accumulative frequency of the *number of years using applications/tools* variable.

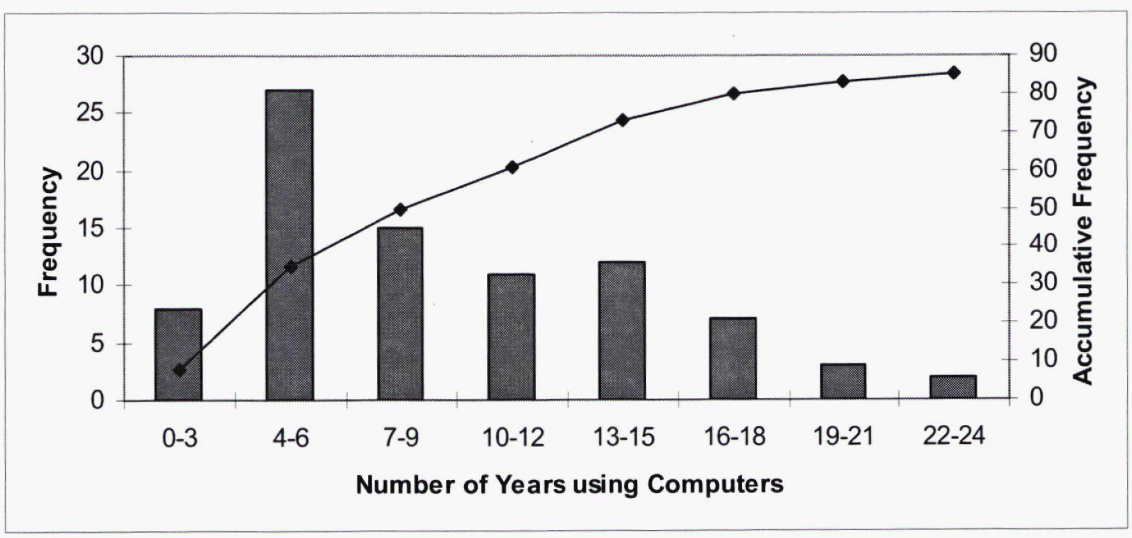


Figure 6.48. Frequency and accumulative frequency of the *number of years using computers*.

Correlation between the two innovativeness variables was performed using the Pearson Correlation test. The results showed that the strength of the correlation to be relatively high - 0.885 (significant at α level=0.01). Their relationship is presented in Figure 6.49.

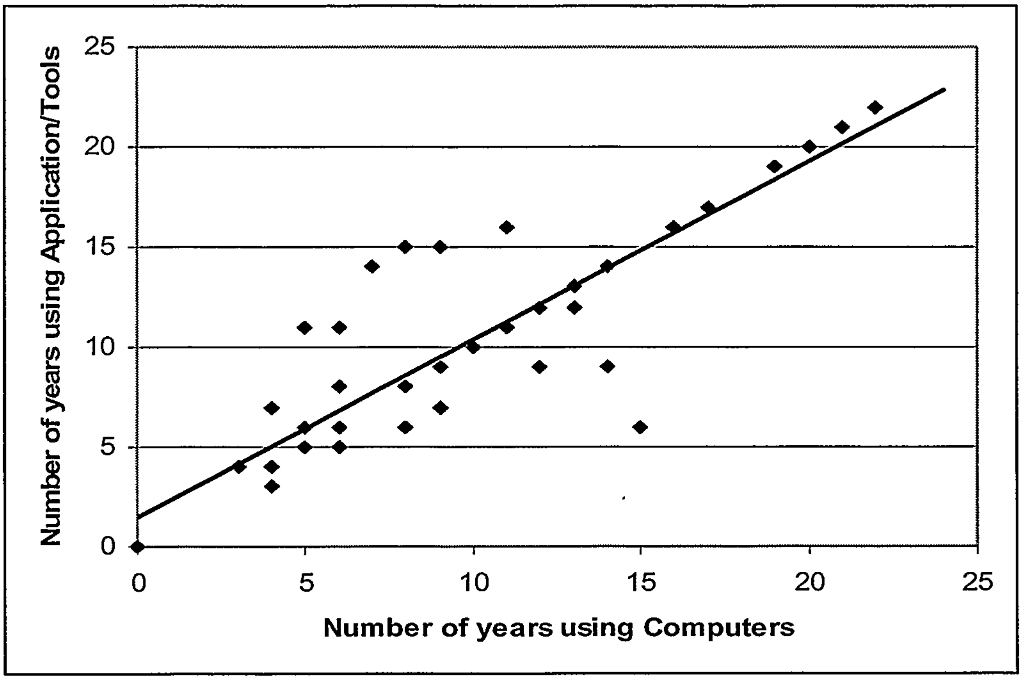


Figure 6.49. Regression between the two *innovativeness* variables.

Table (6.14) indicates that only 59% of subjects (53 subjects) actually cited the *Number of years using applications/tools* variable. The reason was most likely the way this variable was collected. On the *Computer Experience* scale subjects were to mark their expertise level in using each of the 41 tools and, in addition, to state the year they first started to implement it for personal as well as professional usage. The earliest year mentioned by each subject was used to calculate the number of years by subtracting this number from 2004 (the current year when the calculation were taken). Subjects found this scale to be time consuming and complicated and, therefore, many of them did not complete it. Additionally, one of the main problems in conducting this study (discussed in section 5.3) was the large number of scales.

Based on the relatively low number of participants, it was suggested to use only the *Number of years of computer use* variable to create the Innovativeness factor.

6.2.3 Professional Innovativeness

In addition to the *Innovativeness* just described, another time-based variable was used in the study. *Professional Innovativeness* describes the early timeframe in which individuals tended to adopt computer technologies specifically for job-related tasks. In other words, whether the subjects used computer applications and tools to carry out tasks related to teaching physical education and coaching. The professional innovativeness was also measured using two different variables:

1) **Number of years using any applications/tools professionally** – On the *Computer Experience Scale,* subjects were to mark the first time they use any of the 41 computer applications and tools, for completing *job-related tasks.* The overall *first time* that the subject reported using an application/tool for professional tasks was then obtained. The number of years was calculated by subtracting this number from 2004 (the current year when the calculation were taken).

2) **Number of years using computers professionally** – On the *Pattern of Computer Technology Use scale,* subjects were to report the *first year* they

used a computer for *professional tasks.* The number of years was calculated by subtracting this value from 2004 (current year).

Table 6.15 presents the description statistics on the *professional innovativeness* variables, and Figures 6.50-6.51, their distribution.

Table 6.15

Descriptive Statistics of the *Professional Innovativeness* Variables.

Variable Name	Mean	Standard Deviation	n	Range
Number of years using any applications/tools professionally	3.82	5.10	56	0-20 years
Number of years using computers professionally	4.46	4.17	87	0-18 years

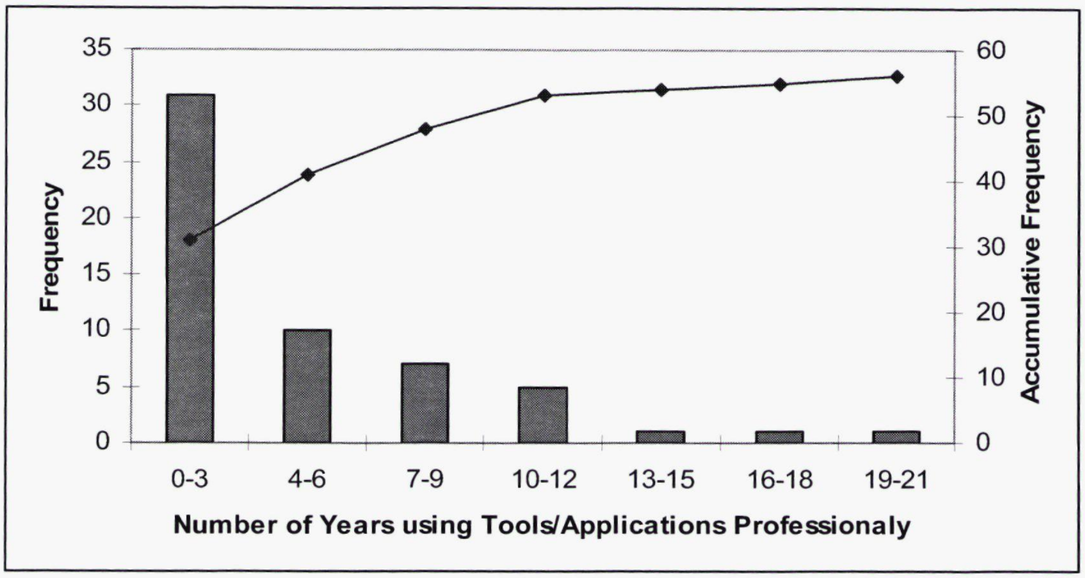


Figure 6.50. Frequency and accumulative frequency of the *number of years using any applications/tools professionally.*

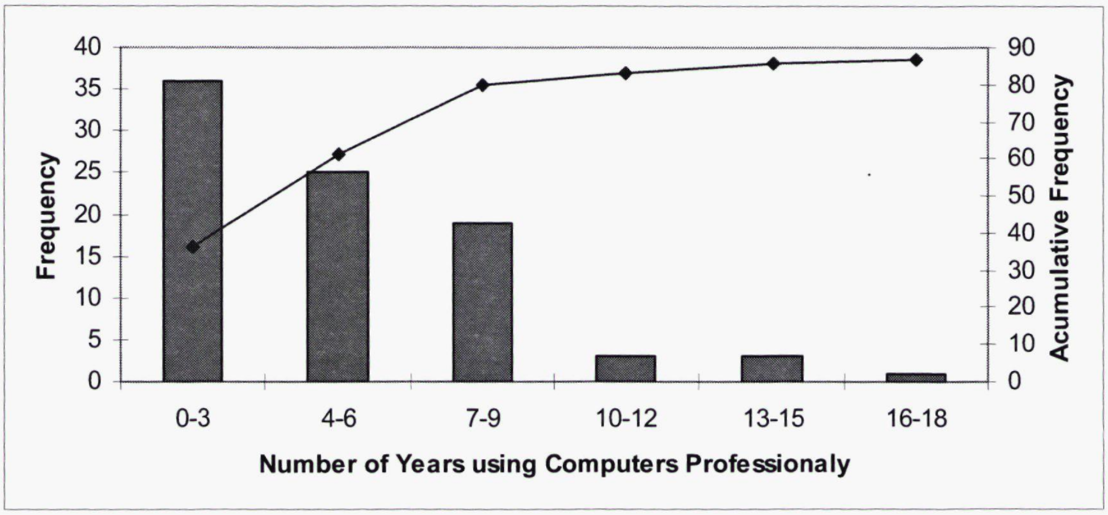


Figure 6.51. Frequency and accumulative frequency of the *number of years using computers professionally.*

The Pearson Correlations between the two professional innovativeness variables presents a relatively high relationship (0.890) with significance at α level=0.01, as can also be seen in the next figure (6.52).

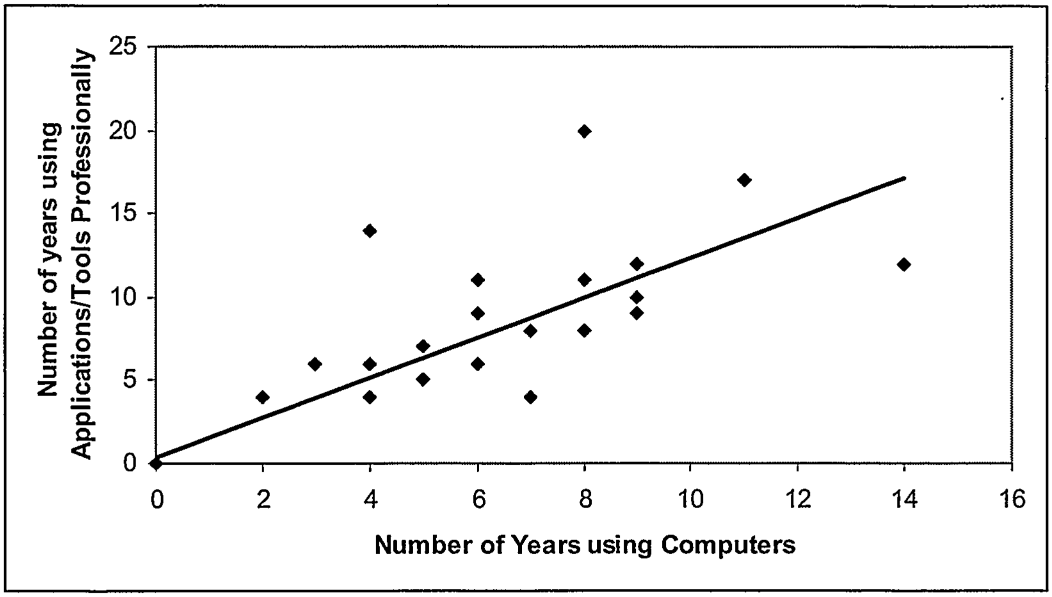


Figure 6.52. Regression between the two (*number of years using any applications/tools professionally* and *Number of years using computers professionally*).

The reliability score for the two professional innovativeness variables was 0.920, which suggests that these two variables are measuring almost the same phenomenon. In accordance with the procedure used to define the innovativeness factor, the *Numbers of years using computers professionally* variable, measured using only one question, was used in the study as the *Professional Innovativeness Factor.*

6.2.4 Self-efficacy

The Schwarzer and Jerusalem (1995) Generalized Self-efficacy scale was used to measure subjects' *Self-efficacy*. The reliability of the 10-item Self-efficacy questionnaire was tested using Cronbach Alpha and was found to be very high 0.907 (n=84). The high reliability score is with accordance to previous studies reported on internal consistency of α that varies from 0.82 to 0.93 (Schwarzer & Jerusalem, 1955).

The analysis also suggests that dropping one item (#3) improves the reliability somewhat (0.91), meaning that sentence #3 does not add to the self-efficacy variable. However, it was decided to use the questionnaire as a whole as it is a fairly well known and tested questionnaire.

The results showed that the average self-efficacy of the 84 subjects repling on that scale was 30.26 with a standard deviation of 4.97. The distribution of the self-efficacy score is presented in Figure 6.53.

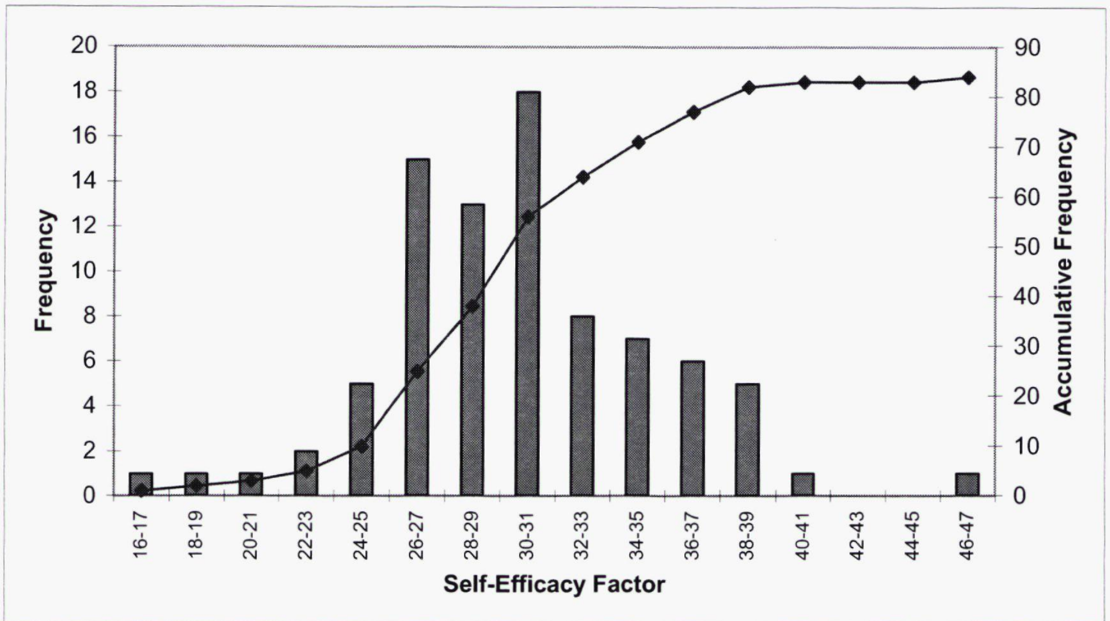


Figure 6.53. Distribution of the subjects' *self-efficacy*.

6.2.5 Attitude

Subjects' attitudes toward working with computers were measured in the pre-workshop questionnaire with two different scales. The *Computer Attitude scale (CAS)*, developed by Loyd and Gressard (1986), was used to measure four separated attitude variables (anxiety, confidence, liking, and usefulness). The scale included 40 sentences on a 5-point Likert scale, 10 on each variable. Loyd and Gressard (1986) suggested using the sum of the four scales to represent total attitude towards working with computers.

Another scale was especially designed in this study to measure attitude of physical education teachers and coaches toward computer technology relevant to their field. It was named *Computer Technology for Physical Education Teachers and Coaches*. The questionnaire was divided into two parts: in the first 12 questions, subjects were asked general questions about their attitude toward working with computers, while the other 12 questions were based on specific physical education and sport related technologies. The description analyses of the attitude variables from the two scales are presented in Table 6.16.

Table 6.16

Description Statistics of the *Attitude* Variables Measured in the Pre-workshop Questionnaire, using the Two Scales.

	Variable Name	Mean	Standard Deviation	n	Scale
Computer Attitude scale (CAS)	**Anxiety**	39.85	7.55	85	1-50
	Confidence	38.55	7.50	84	1-50
	Liking	37.98	7.23	84	1-50
	Usefulness	39.25	5.48	83	1-50
	Total Attitude	156.46	25.64	80	1-200
Computer Technology for Physical education teachers and coaches	**General Attitude**	46.62	5.72	84	1-60
	Attitude toward Coaching/ Teaching Tools	48.65	5.49	85	1-60
	Total coaches/teachers attitudes	95.22	10.29	82	1-120

Cronbach's Alpha Reliability tests were performed on each of the scales in order to learn about the internal reliability of each of the scales. The results are presented in Table 6.17. These results are higher than those reported by Christensen (1998).

Table 6.17

Internal Reliability Scores of the *Attitude* Variables

	Variable Name	Cronbach's α	# items	Cronbach's α if deleted	n
Computer Attitude scale (CAS)	**Anxiety**	0.925	10	0.929 (item 17)	85
	Confidence	0.926	10	--	84
	Liking	0.896	10	--	84
	Usefulness	0.815	10	0.834 (item 32)	83
	Total Attitude	0.968	40	0.969 (item 32)	80
Computer Technology for Physical education teachers and coaches	**General Attitude**	0.794	12	0.795 (item 2) 0.813 (item 10)	84
	Attitude toward Coaching/ Teaching Tools	0.911	12	0.916 (item 19)	85
	Total coaches/teachers attitudes	0.907	24	0.909 (item 4 & 5) 0.911 (item10)	82

Thereafter, correlation coefficients were calculated for the six variables using the Pearson Correlation test in order to learn about inter-relationships. The results are reported in Table 6.18. All correlation coefficients were found to be significant at α level of 0.01. The relationships among the four attitude variables collected with CAS presents relatively high correlations (from 0.636 to 0.880). Their relationships to the newly developed variables varied. It was higher (0.605 to 0.742) with the General Attitude and weaker to the Attitude Toward Teaching/coaching Tools (0.391 to 0.491). The correlation coefficient between the two new variables is 0.684.

Table 6.18:

Pearson Correlations Coefficients and their Significant Levels among *Attitude* Variables Collected at the Pre-workshop Questionnaire

	Anxiety	**Confidence**	**Liking**	**Usefulness**	**General Attitude**
Anxiety	--				
Confidence	0.880 ** (n=84)	--			
Liking	0.795 ** (n=84)	0.828 ** (n=83)	--		
Usefulness	0.636 ** (n=82)	0.699 ** (n=81)	0.839 ** (n=81)	--	
General Attitude	0.605 ** (n=81)	0.639 ** (n=80)	0.742 ** (n=80)	0.726 ** (n=78)	--
Attitude toward Coaching/ Teaching Tools	0.391 ** (n=81)	0.414 ** (n=80)	0.491 ** (n=80)	0.477 ** (n=79)	0.684 ** (n=82)

** Significant level α=0.01

In order to find the reliability among the different attitude variables, the data was transformed to a common scale of 1 to 60 by multiplying the CAS scores (i.e., Anxiety, Confidence, Liking, and Usefulness) by the constant 1.2. The descriptive results of the new, transformed variables are presented in Table 6.19.

Table 6.19

Description Statistics of the Transformed *Attitude* Variables

Variable Name	Mean	Standard Deviation	n	Scale
Anxiety	47.82	9.07	85	1-60
Confidence	46.26	9.00	84	1-60
Liking	45.57	8.68	84	1-60
Usefulness	47.10	6.58	83	1-60
General Attitude	46.62	5.72	84	1-60
Attitude toward Coaching/ Teaching Tools	48.65	5.49	85	1-60

The reliability Cronbach Alpha analysis among the six attitude variables yields a very high internal consistency of 0.918. The analysis also suggests that dropping the *Attitude toward Coaching/ Teaching Tools* variable results in a higher reliability of $\alpha = 0.930$. Therefore, two attitude factors were calculated. The first, *General Attitudes towards working with computers* (or *General Attitude Factor,* in short), was calculated by summing up the four variables from the Computer Attitude scale (i.e., Anxiety, Confidence, Liking, and Usefulness), as suggested by Loyd and Gressard (1984). As reported previously, the sample mean of the *General Attitude Factor* was found to be 156.46 with a standard deviation of 25.64 (n=80). Its distribution is shown in Figure 6.54.

The second attitude factor, *Attitude toward Teaching/coaching Tools (Specific Attitude Factor*, in short), included the 12 questions of the newly designed scale. Its mean was 48.65 with a standard deviation of 5.49 (n=85) and the distribution is noted in Figure 6.54).

The first 12 questions from the newly developed scale were not used because their internal reliability was low (0.794) relative to the other used scales, and due to their reliability with the other four CAS variables (0.901). This suggests that they actually measure a very similar variable and so, are redundant.

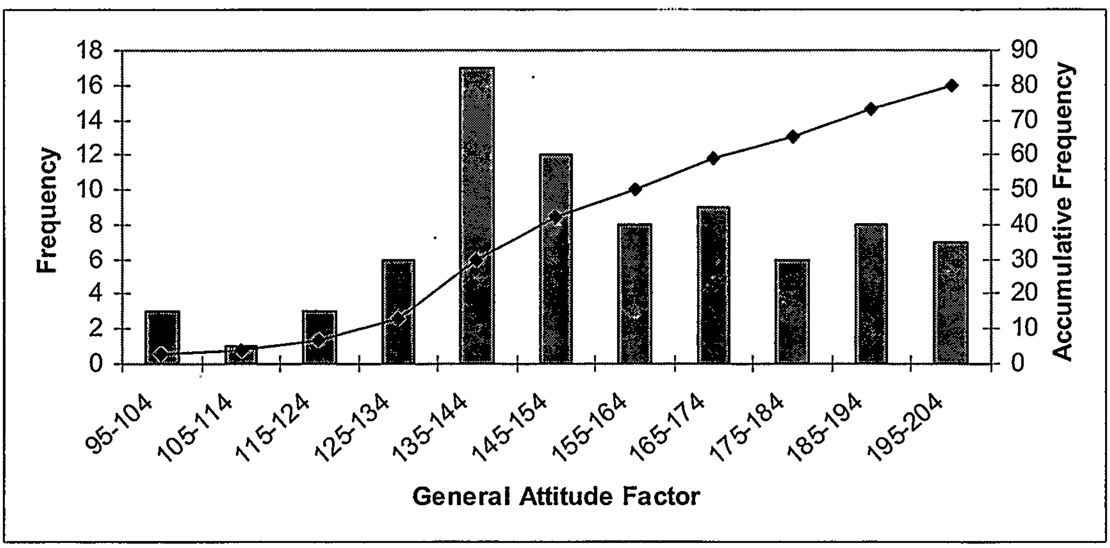


Figure 6.54. Frequency and accumulative frequency of the *general attitude factor*.

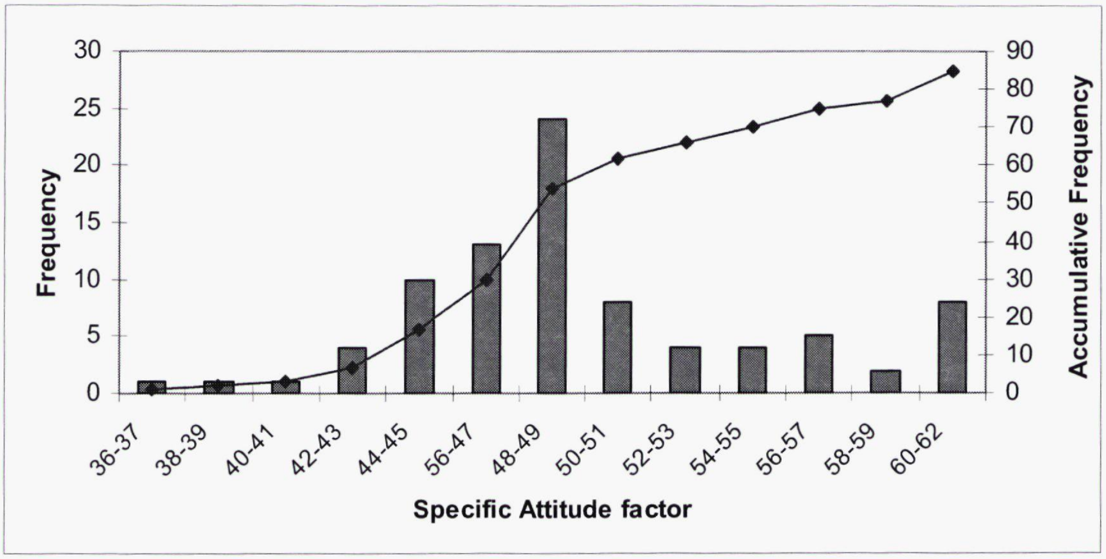


Figure 6.55. Frequency and accumulative frequency of the *specific attitude factor.*

The correlation between these two facts was calculated using the Pearson Correlation test. It was found to be 0.495, suggesting these two variables are measuring different aspects of the *Leval of Expertise* Variable. The graphical representation of the relationship can be seen in Figure 6.56.

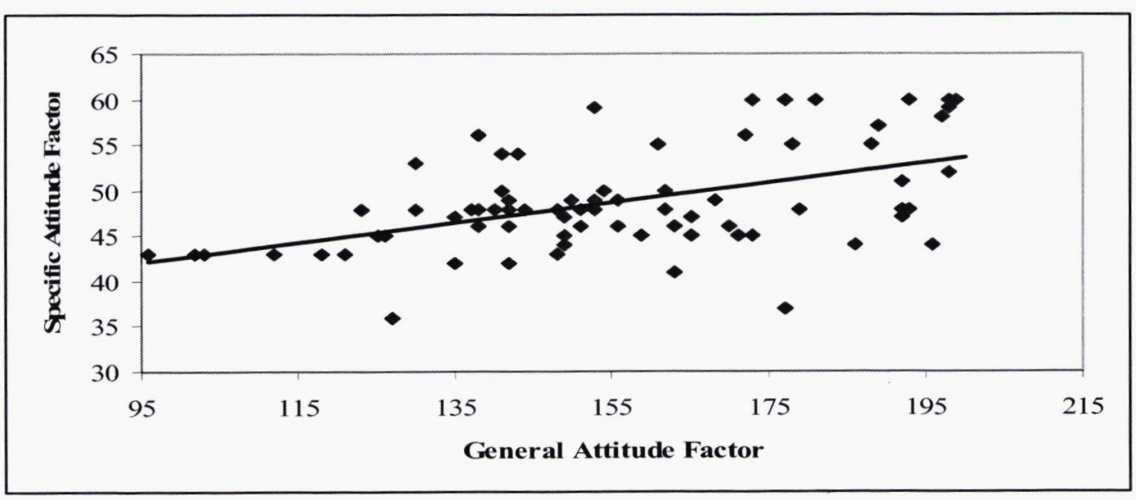


Figure 6.56. Regression between the two *attitude* variables.

6.2.6 Age

Several external variables that may affect subjects' decision whether or not to adopt new technology were also introduced into the model. Subjects' *Age* was one of these. The distribution of subjects' age (mean = 36.94; standard deviation = 9.56) is presented in Figure 6.57.

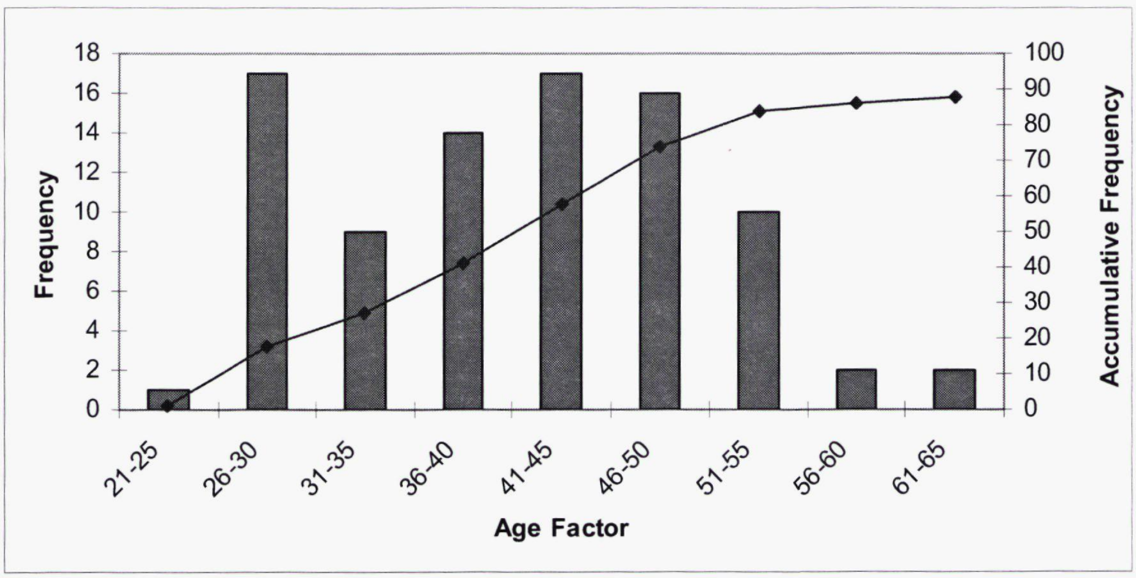


Figure 6.57. Distribution of subjects' *age.*

6.2.7 Teaching/coaching Volleyball Experience

The subjects' *Teaching/coaching Volleyball Experience* is another variable that might affect the decision whether or not to adopt an innovation. Subjects were to note the number of years they had been teaching/coaching volleyball. The volleyball coaching experience distribution is presented in Figure 6.58 (Average = 10.56 years; Standard Deviation = 9.45, n=79).

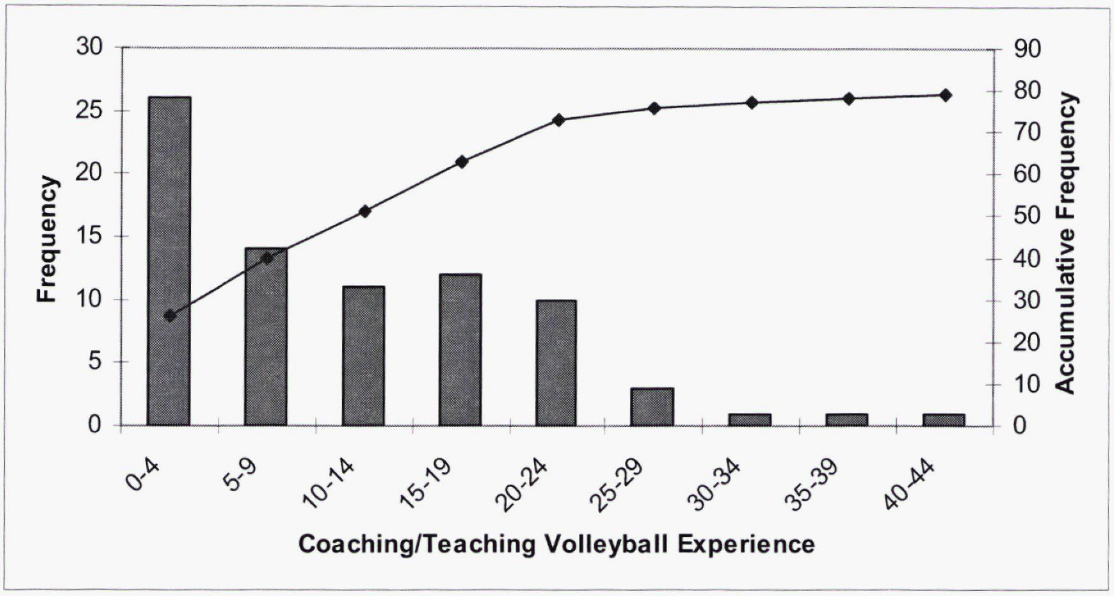


Figure 6.58. Distribution of subjects' *volleyball coaching experience.*

6.2.8 Teaching/coaching Experience

Since many of the subjects were physical education teachers and coaches of sports other than volleyball, it might be the case that their previous experience level in teaching/coaching *any* sport may influence their acceptance of new technology. In two consequent questions, subjects were to indicate if they taught or coached sports other than volleyball, and if so, the number of years. To calculate their Teaching/coaching Experience the larger number between this value and the value from the question regarding their experience in teaching/coaching volleyball was taken. The distribution results (mean= 12.99; standard deviation=9.18; n=79) is displayed in Figure 6.59.

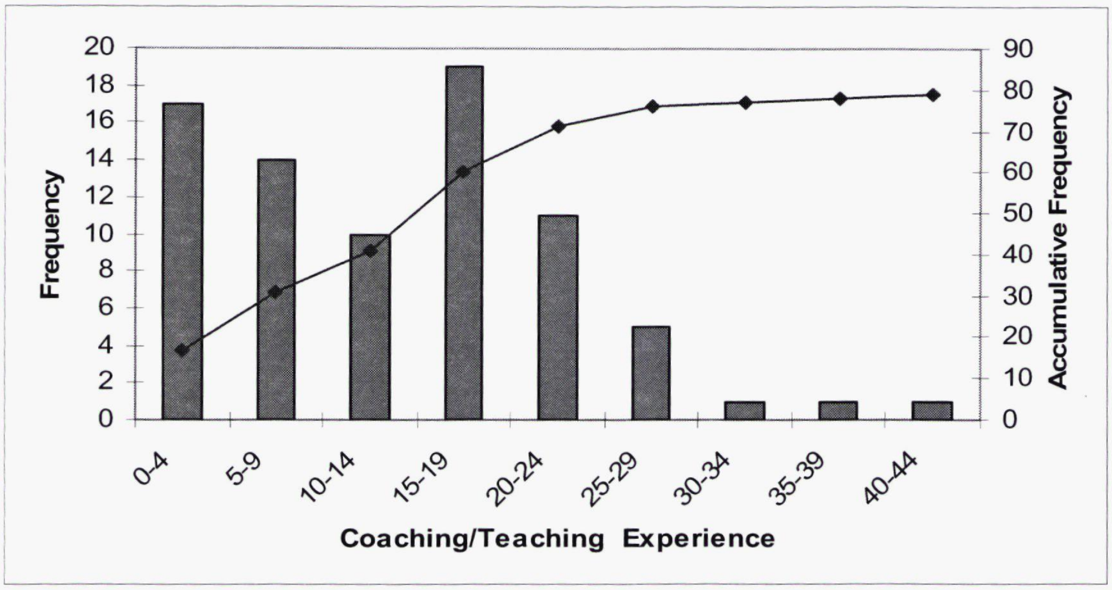


Figure 6.59. Distribution of subjects' *coaching experience.*

6.2.9 Formal Education

Another variable was subjects' formal education. In the first scale on the pre-workshop questionnaire, subjects were to mark their level of university degree. The *Education Factor* variable incorporated this information: 0 - for subjects that do not yet have a Bachelor degree (some of the subjects were college students), 1 - for subject that have only a Bachelor degree, 2 - for subjects that had completed a Masters degree, and 3 - for subjects with a PhD. The distribution of the factor (1.00 ± 0.78; n=89) is shown in Figure 6.60.

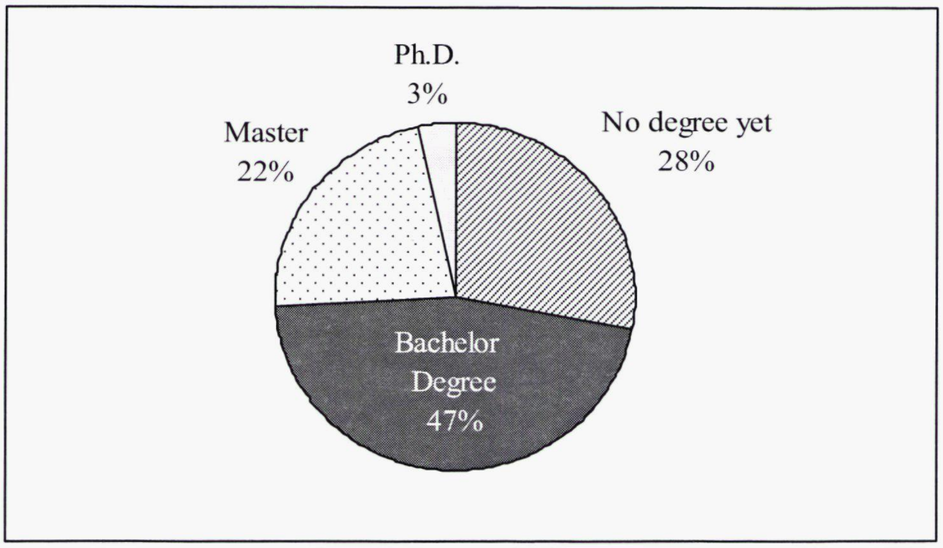


Figure 6.60. Distribution of subjects' *formal education.*

6.2.10 Coaching Education

Similarly, the Coaching Education Factor was calculated where subjects received 1 - for a Volleyball Instructor Certificate, 2 - for a Coaching Diploma, and 3 - for an Advanced Coaching Level. The results are (1.27 ± 1.21; n=89) as shown in Figure 6.61.

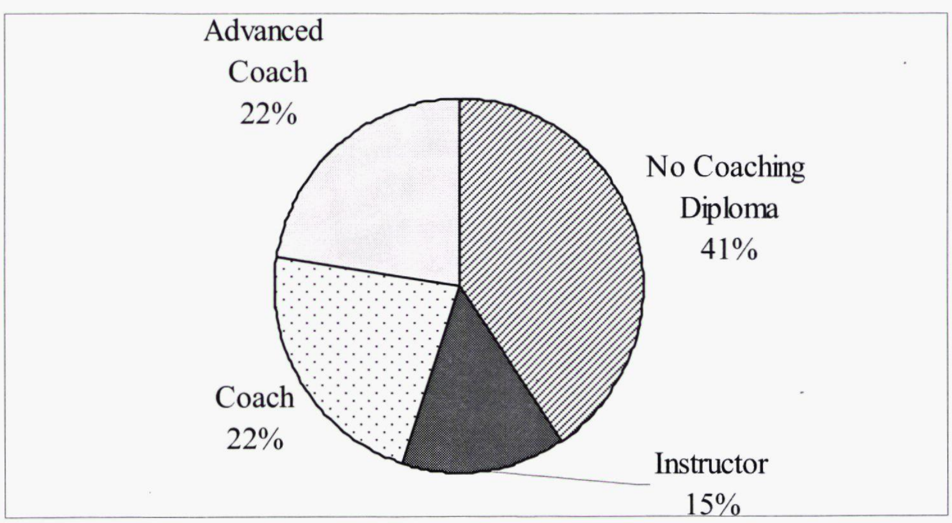


Figure 6.61. Distribution of subjects' *coaching education.*

6.2.11 Gender

The last external variable was gender. In the sample, 49% were males (44) and 51% (46) were females.

In addition to the above variables as well as independent variables, the model included three intermediate variables. These are assumed to be affected by external variables and to impact subjects' intention whether or not to adopt a given technology. These variables were: *Perceived Relative Advantage, Perceived Complexity* of the new technology, and *Intention* to use it. These variables were collected after the workshop via the post-workshop questionnaire that included an introduction to the Interactive Volleyball CD-ROM.

6.2.12 Perceived Relative Advantage

The distribution of the perceived relative advantage variable (Average=33.79, Standard Deviation=5.84; n=75), collected in the post-workshop questionnaires after the subjects were introduced to the CD-ROM, is presented in Figure 6.62.

The reliability result of the six scale items was calculated to be 0.911, which is in accordance with the 0.90 reported by Moore and Benbasat (1991).

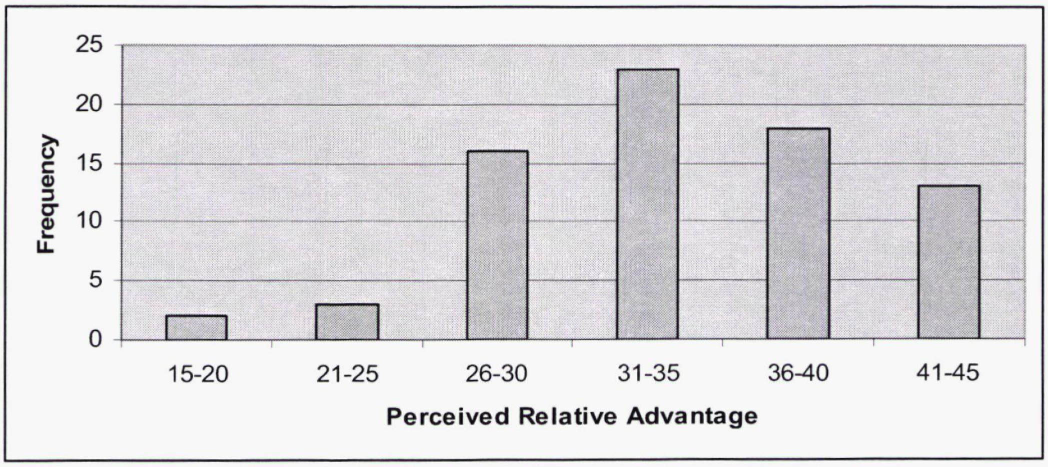


Figure 6.62. Distribution of subjects' *perceived relative advantage.*

6.2.13 Perceived Complexity

The model also suggests that the "ease-of-use" of the innovation is affecting subjects' decision whether or not to adopt the innovation. Therefore, they were asked to mark the Interactive Volleyball CD-ROM's complexity, according to their perception. Using Cronbach's Alpha Reliability on the four perceived complexity items was 0.900, higher than reported by Moore and Benbasat (1991) – 0.84. The distribution of the results (Average= 22.33, Standard Deviation = 4.41; n=76) is presented in Figure 6.63.

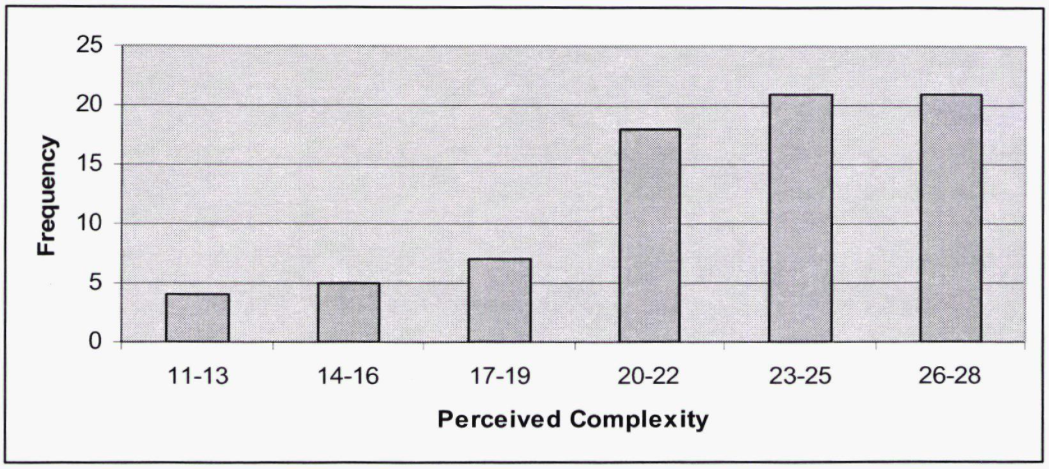


Figure 6.63. Distribution of subjects' *perceived complexity*.

6.2.14 Intention to use the application

In the last question of the post-workshop questionnaire, subjects were to rank their intention to use the CD-ROM on a 1-7 Likert scale. The distribution of the results (Average= 2.37, Standard Deviation = 1.52; n=70) showed, overall, a positive intention to use the CD-ROM. The distribution is presented in Figure 6.64.

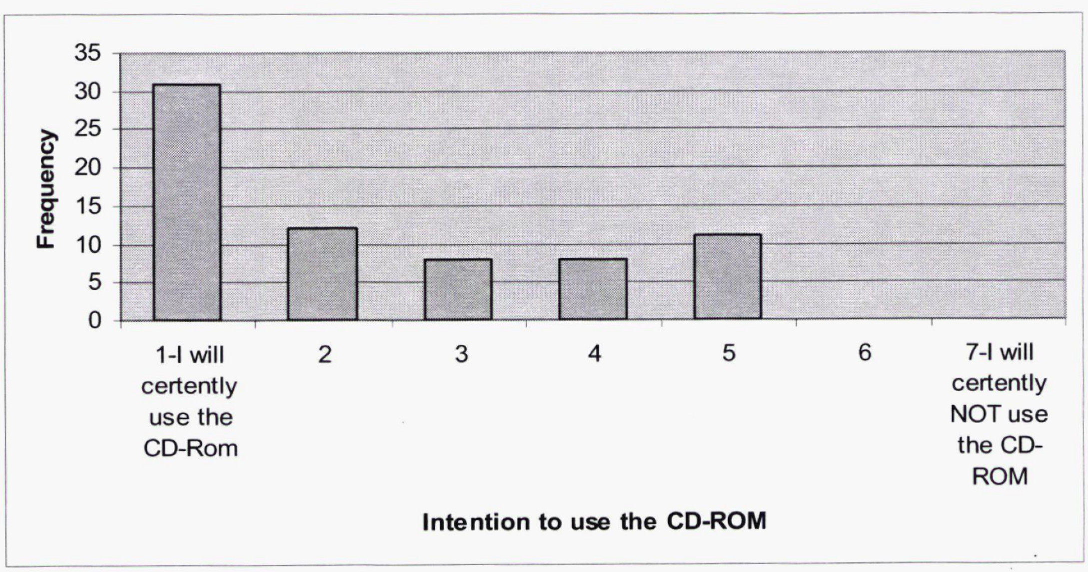


Figure 6.64. Distribution of subjects' i*ntention* to use the Interactive Volleyball CD-ROM.

6.2.15 Actual use of the CD-ROM

In the last question of the follow-up questionnaire, subjects were to report if they used the Interactive Volleyball CD-ROM and, if so, the frequency of usage. They could choose between the options of: Never used the CD-ROM (0), Used it once or few times (1), Used it many times (2), or Used it on a regular basis (3). The distribution of the results to that question is noted in Figure 6.65. It shows that none of the subjects used the CD-ROM on a regular basis. Only one subject reported on using it many times, and 11 used it once or several times.

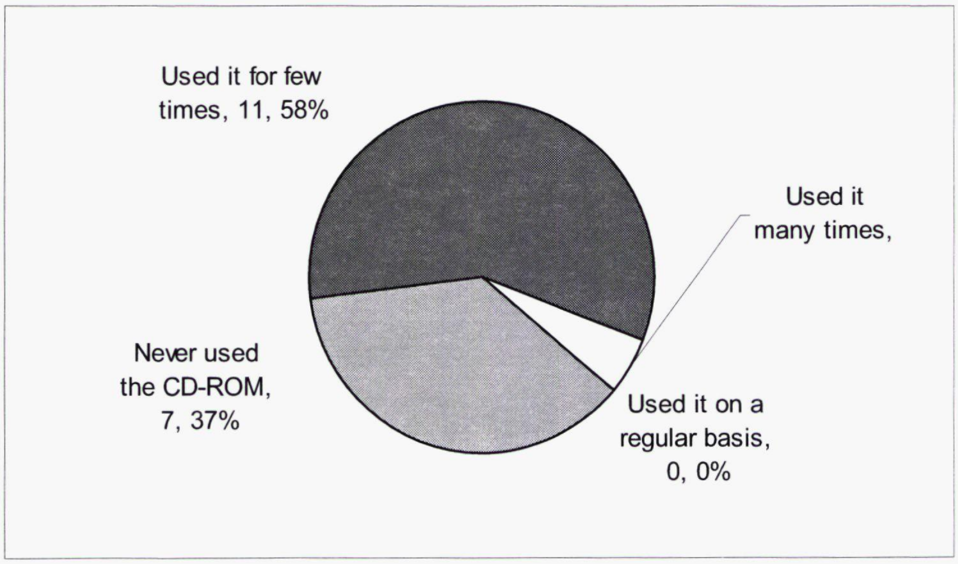


Figure 6.65. Distribution of subjects' responses for the frequency use of the Interactive Volleyball CD-ROM.

Due to the relatively low rate of return of the follow-up questionnaires, the actual use of the CD-ROM was not used in the model but rather the Intention to use it was the model's dependent variable.

This concluded the detailed description of the major variables used in the study. In the next section (6.3) the modified model appropriateness as well as the study's hypotheses are tested.

6.3 The Experiment

6.3.1 Building the Model

A major concern of the study was the role played by external variables in the adoption of a new technology process. Several statistical analyses were used to try to shed more light on this topic. The process was initiated by designing a model to help explain the part that external variables take in the diffusion of an innovation. A more elaborate explanation of the model, and the way it was developed, can be found in section 2.4 and its schematic representation is shown in the Figure 6.66.

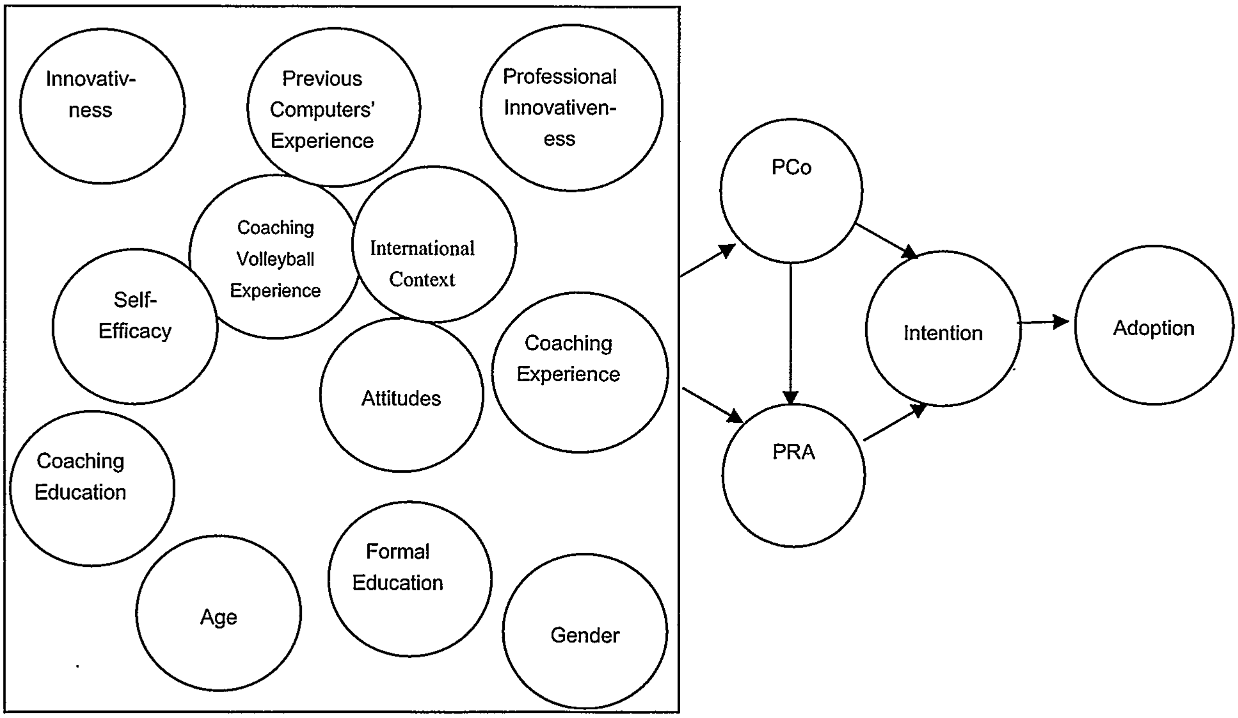


Figure 6.66. A schematic overview of the suggested model.

It was decided to use all participants in the study for the purpose of the model. Since the model is a generic one, it should fit Canadians and Israelis alike. Enlarging the sample size allows us to enter more variables into the model.

As an initial step, the reliabilities of the relevant questionnaire items used in the model were evaluated using Cronbach's Alpha (Cronbach, 1970). Table 6.20 presents a description of the all the variables in the model; their reliability was appropriate. A more elaborate explanation of the variables and their measurement and calculations are cited in section 6.2. It is evident from Table 6.20 that all scales demonstrated acceptable reliabilities (above 0.813).

Table 6.20

Descriptive and Reliability Analysis of the Model Variables (n=125).

Factor	**Variable**	**# of items**	**Description**	**Cronbach's Alpha**
System Use		1	1.10 (±0.76) n=42	--
Intention to use the CD-ROM		1	2.09 (±1.37) n=103	--
Perceived Relative Advantage		6	34.48 (±5.53) n=108	0.909
Perceived Complexity		4	23.03 (±4.27) n=109	0.912
Previous Experience with computers	Level of Experience	1	2.80 (±0.97) n=121	--
	Stage	1	3.97 (±1.49) n=47	--
	Variety Experience	20[9]	20.18 (±13.08) n=121	0.916

[9] The scale included 41 items in Israel and 46 items in Canada. Therefore, in order to compare between the two, an items-reduction process was used which resulted in a total of 20 items

Innovativeness	Innovativeness	1	10.69 (±5.85) n=118	--
	Professional Innovativeness	1	5.84 (±4.91) n=114	--
Computer Self Efficacy (CSE)		10	30.59 (±5.04) n=119	0.905
Attitude towards computers	Anxiety	10	41.10 (±7.19) n=120	0.922
	Confidence	10	39.34 (±6.94 n=119	0.899
	Liking	10	38.13 (±6.94) n=119	0.884
	Usefulness	10	40.65 (±5.44) n=118	0.813
	Specific Attitude	12	49.51 (±5.63) n=119	0.919
Age		1	36.39 (±9.20) n=123	--
Coaching experience	Coaching any Sport	1	12.42 (±8.87) n=114	--
	Coaching Volleyball	1	10.33 (±8.94) n=114	--

Education	Formal Education	1	1.02 (±0.69) n=124	--
	Coaching Education	1	1.19 (±1.15) n=124	--
Gender		1	1.49 (±0.50) n=125	--
International context		1	1.28 (±0.45) n=125	--

The relatively complex proposed model originally suggested, could not be tested because of the limited number of subjects (n=125). Therefore, the process started by performing three step-wise regression analyses. The first was performed using the perceived relative advantage (PRA) as a dependent variable, and all the external variables as independent. Similarly, the second step used the perceived complexity as a dependent variable and the same independents. In the last regression, the intention to use the CD-ROM was the dependent variable, while the perceived relative advantage and the perceived complexity were the independents.

The results of the first Step-wise Multiple Regressions suggested that statistical significance was found for the following variables when the perceived relative advantage of the Interactive Volleyball CD-ROM was used as a dependent variable and the external variables as independent:

- Specific attitude towards working with computers in physical education and sport: r=0.375 (p=0.000)
- Usefulness toward working with computers: r=0.302 (p=0.001)
- Formal Education: r=-0.198 (p=0.020) (no degree + first degree=0; 2^{nd} and 3^{rd} degrees=1)
- International context: r=0.190 (p=0.024) (Israel= 0; Canada=1)
- Professional Innovativeness: r=0.185 (p=0.035)
- Confidence toward working with computers: r=0.176 (p=0.038)

It is interesting to note that perceived relative advantage seems not to be affected by important variables in the diffusion theory such as previous experience and innovativeness. The importance of Attitudes towards working with computers can also be mentioned because 3 out of the 5 attitudes variables tested in the regression were found to be significant, and another – liking working with computers, was found to be almost at the significant level (p=0.057). However, using step-wise regression, only two variables did enter the final model: *Specific attitude* towards working with computers in the physical education and sport fields and *Formal Education.* It is interesting that *Usefulness* toward working with computers did not enter the model even though its relationship probability is higher than education. This is probably due to the existence of correlations between *Specific Attitude* and *Usefulness.* The results suggest that other attitude variables, such as *usefulness,* could not add additional value to the relationship with the dependent once the *specific attitude* variable has entered the model. Therefore, they were left out of the model. The summary of the results is in Table 6.21.

When perceived complexity (PCo) was used as a dependent variable in the Step-wise Multiple Regressions, more variables were found to have significant relationships with it:

- Professional Innovativeness: r=0.433 (p=0.000)
- Anxiety working with computers: r=0.336 (p=0.000)
- Confidence toward working with computers: r=0.329 (p=0.000)
- Usefulness toward working with computers: r=0.306 (p=0.001)
- Specific attitude towards working with computers in the sport and physical education fields: r=0.285 (p=0.002)
- Liking working with computer: r=0.269 (p=0.003)
- Stage: r=0.263 (p=0.004)
- Innovativeness: r=0.259 (p=0.004)
- International context: r=0.249 (p=0.004)
- Self-Efficacy: r=0.254 (p=0.005)
- Verity factor: r=0.245 (p=0.006)
- Computers experience: r=-0.247 (p=0.006)
- Number of Computerized tools used: r=0.167 (p=0.044)

It is obvious that more external variables seem to significantly affect perceived complexity (14 variables) compared to perceived relative advantage (6 variables). The analysis also suggested that only two variables should enter into the model: *Professional Innovativeness* and *Specific Attitude* towards working with computers in the physical education and sport fields (see Table 6.21). Again, even though some attitude variables presented higher correlation coefficients and lower probabilities, compared to *specific attitude*, the statistical analysis indicated that the specific attitude variable should be entered into the model. As mentioned, correlations among variables, such as the different attitudes, can be used to explain the reason why other attitude variables were not entered into the model.

The last Multiple Regressions included the intention to use the CD-ROM as a dependent variable and perceived relative advantage and perceived complexity as two independents. The results confirmed that perceived relative advantage and perceived complexity are significantly correlated with subjects' Intention to adopt or not the CD-ROM, while perceived relative advantage is somewhat more dominating.

Table 6.21

Summary of the Multiple Regression Results

Variables	r	r^2	Probability
Regression #1: *Perceived Relative Advantage* as dependent variable			
Specific Attitude	0.372	0.139	0.000
Formal Education	-0.209	0.044	0.020
Total	0.434	0.188	
Regression #2: *Perceived Complexity* as dependent variable			
Professional Innovativeness	0.433	0.188	0.000
Specific attitude	0.285	0.081	0.002

Total	0.477	0.227	
Regression #3: *Intention* as dependent variable			
Perceived Relative Advantage	-0.549	0.302	0.000
Perceived Complexity	-0.544	0.296	0.000
Total	0.638	0.407	

Table 6.21, shows that about 19% of variability within the perceived relative advantage variable can be explained by the combined variability of specific attitude and formal education. On the same line, the variability of professional innovativeness and specific attitude could determine about 23% of the variability in perceived complexity. Also, the variability within the perceived relative advantage and perceived complexity can explain about 41% of the variability of the intention variable.

Thereafter, the original model was modified to include only those variables that entered the models, using the Step-wise Multiple Regression Analysis results. That is, *specific attitudes, formal education*, and *professional innovativeness*. The model had been tested and found to fir the collected data. Therefore, it was possible to add more variables to the model. Since the relationship between *innovativeness* and *previous experience* were of major interest to the study, they were included in the model. Subjects' previous experience was represented by the *Stage* variable, while *Innovativeness* and *Professional Innovativeness*, by the number of years they had already used computers for *personal* and *professional* uses. The final variable entered into the model was *self-efficacy*, used as an observed variable whereby its total score was used[10]. The path diagram of the tested model is shown in Figure 6.67.

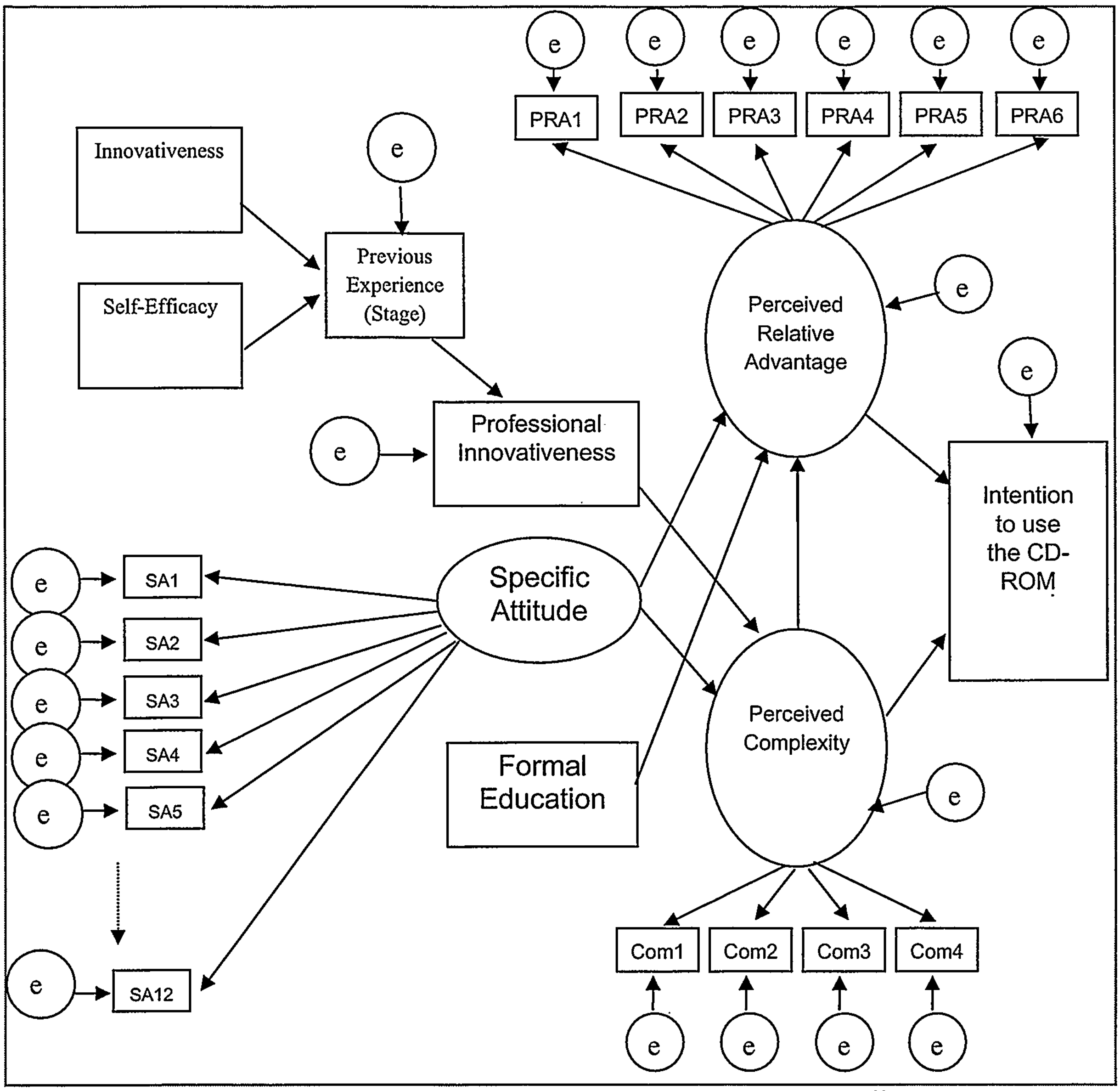


Figure 6.67. The Modified model based on the multiple regression analysis.[11]

[10] This was done due to the model limitation to incorporate more latent variables, based on the sample size.
[11] Large ellipses represent latent variables; Rectangles - observed variables; Small circles - measurement and residual errors; Arrows - causal relations;

6.3.2 Testing the Model

Testing of the model included several steps. Firstly, the latent variables in the model were tested via Confirmatory Factor Analyses (CFA). The first CFA confirmed that the attributes of the innovation scale included two major factors: Perceived Relative Advantage (items 1 to 6) and Perceived Complexity (7 to 10) (see Appendix O for the CFA results). The second CFA suggests that all 12 items in the Specific Attitude scale represented a single factor (see Appendix O). All other variables in the model were used as observed variables: Formal Education, Innovativeness, Professional Innovativeness, Previous Experience (Stage), Self-efficacy, and Intention to use the CD-ROM.

Finally, a Structural Equation Model (SEM), using the estimation method of maximum-likelihood was used. All estimates were produced using AMOS 5. The goodness of fit between the model presented in Figure 6.68 and the collected data was tested.

The following modifications were introduced to the model previously described in Figure 6.67:

- For parsimony purposes, two items were used as observed variables of the PRA latent variable. This was done by using the means of the first three items of the PRA to describe 1 variable, and the means of the other 3 (4, 5 and 6) as the other. The grouping was done arbitrarily after the scale was tested for "unidimensionality."

- Similarly, three variables were introduced as observed variables to describe the Specific Attitude latent variable instead of the original 12 items, as follows: items 1-4 were averaged to compose the first observed variable (that is questions 13 to 16 in the original scale), items 5-8 (questions 17-20) the second, and items 9 to 12 (questions 21-24) the last one.
- The model suggests that some correlations between the unexplained parts (errors) of the variables also occur. Therefore, the introduction of residual correlations between the following items took place:
  - Error associated with the Intention ←→ Error associated item # 3 on the Perceived Complexity scale
  - Error associated with the Intention ←→ Error associated with means of questions 21 to 24 on the Specific Attitude towards working with computers in physical education and sport scale.
  - Error associated with item # 3 on the Perceived Complexity scale ←→ PRA error
  - Error associated with item # 4 on the Perceived Complexity scale ←→ PRA error
  - Error associated with item # 3 on the Perceived Complexity scale ←→ Error associated with item # 4 on the same scale

- Additional correlative relationships among the independent variable (Specific Attitude, Previous Experience, Education, Self-efficacy and Innovativeness), as required by the model also took place.

The printout of the Amos application with all the above schematic representation is shown in Appendix N. A simpler version of the model (not including errors, errors' residual and correlative relationships between dependent variables) is presented in next Figure 6.68, and summarizes the Standardized Regression Weights (β) and the Squared Multiple Correlations of the dependent variables (r^2).

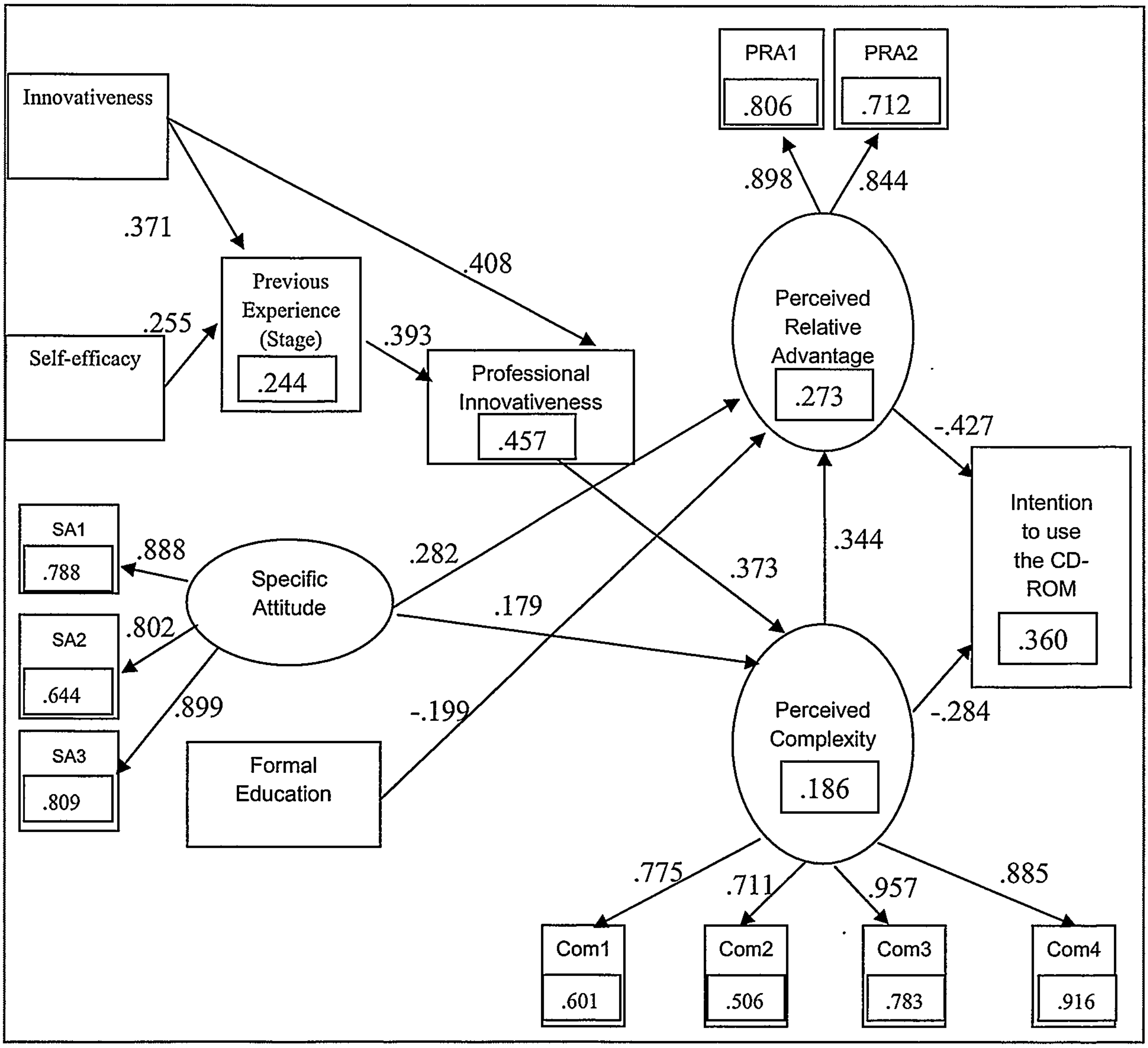


Figure 6.68: The tested model with standardized coefficients[12]

The tested model should be firstly evaluated with regard to the representation of the latent variables by the observed ones. It is apparent from the results that all observed items representing the latent one had squared multiple correlations with the

[12] All correlations found to be significant. For simplicity purposes, all errors, errors' residuals and correlative relationships between dependent variables were taken from the diagram.

latent variables higher than .506. Additionally, the factor loadings are statistically significant ($p<0.05$) and the standardized values, from 0.711 to 0.957, confirm the formal validity of the individuals items.

With regard to the model goodness of fit, there is no single parameter that is recommended. According to the literature, a variety of measurements has been suggested (Bentler & Bonnett, 1980) to test the model goodness of fit. The χ^2 test of the model was calculated as 87.07 with 74 degrees of freedom. The probability of the test was 0.142 (recommended value $p>0.05$), suggesting that the data collected fits the theoretical model. Another suggested measure for fit is the GFI (goodness of fit index) which was equal to 0.917 (expected value>0.9). The RMSEA which represents root mean square error of approximation was = 0.038 (expected value<0.05). P Close=0.728 (expected>0.5). Therefore, the suggested model can be considered as supporting a good fit to the collected data.

6.3.2.1 Testing Related Hypotheses (Hypotheses 1 to 5)

Once the model was defined, the following hypotheses are addressed using the model fitness method:

1. Perceived Relative Advantage is negatively[13] correlated to Behavioral Intention.
2. Perceived Complexity is negatively[13,14] correlated to Behavioral Intention.

[13] Intention was measured on an opposite direction scales where "I am sure I will use it" was equal to 1.
[14] The complexity was actually measured as an Ease of Use variable. That is, higher score=easier to use.

3. Perceived Complexity is positively[14] correlated to Perceived Relative Advantage.

4. External variables are positively correlated to Perceived Relative Advantage.

5. External variables are positively correlated to Perceived Complexity.

The last two general hypotheses were separated into the following more specific four hypotheses, based on the variables tested in the model:

5a. Formal Education is positively correlated to Perceived Relative Advantage.

5b. Specific Attitude toward working with computers is positively correlated to Perceived Relative Advantage.

5c. Specific Attitude toward working with computers is positively correlated to Perceived Complexity.

5d. Professional Innovativeness is positively correlated to Perceived Complexity.

As it is evident from the results, hypotheses 1-4 and 5b-5d were accepted (their null hypotheses were rejected) while hypothesis 5a was accepted but with an opposite direction. That is, formal education was found to have a negative relationship on Perceived Relative Advantage, meaning that if one has less formal education one perceives a relative advantage (or the usefulness) of the software to be higher.

6.3.3 Innovativeness and Other External Variables (Hypotheses 6 to 17)

Since not all external variables measured were entered in the model and, due to a special interest in some variables of major concern to the diffusion of innovation, additional statistical analysis was introduced. It is important to emphasize that the described analysis from that point onwards, included only the Israeli sample (with the exception of the international context comparison section).

A group of twelve hypotheses of the study suggested that relatively Early Adopters of technologies are different from Late Adopters, with respect to several measurements. In order to test these hypotheses, the study included a quasi-experimental design. The hypotheses that were tested were:

6. Early Adopters are *Younger* compared to Majority
7. Early Adopters are mainly *Males* while Late Adopters were *Females*
8. Early Adopters have more *Education* compared to Majority.
9. Early Adopters have more *Coaching Experience* compared to Majority.
10. Early Adopters have higher *Professional Innovativeness* compared to Majority.
11. Early Adopters have higher *Level of Expertise* with computer technology compared to Majority.
12. Early Adopters have higher *Self-efficacy* compared to Majority.
13. Early Adopters have more positive *Attitudes* toward computers compared to Majority
14. Early Adopters have a higher *Perceived Relative Advantage* on a newly introduced digital technology such as the Interactive Volleyball CD-ROM) compared to Majority

15. Early Adopters have a higher[15] *Perceived Complexity* on a newly introduced digital technology (such as the Interactive Volleyball CD-ROM) compared to Majority
16. Early Adopters have a higher *Intention to use a newly introduced digital technology* such as the Interactive Volleyball CD-ROM) compared to Majority.
17. Early Adopters *Use and Adopt the CD-ROM more* compared to Majority.

The *Innovativeness Factor* described in section 6.2.2, was based upon recall when computer technology was first adopted by the sample. This variable was used to split the subjects into groups. Firstly, into four groups: 1) 16% of Early Adopters, including Innovators and Early Adopters; 2) 34% of Early Majority; 3) 34% of Late Majority and 4) 16% of Laggards. Thereafter, innovativeness was used to create two groups: 1) 16% of Early Adopters, including Innovators and Early Adopters; 2) Majority, including 34% of Early Majority; 34% of Late Majority and 16% of Laggards. The second comparison (2 groups) was later used to test the study hypotheses, while the first comparison describes the appropriate statistical procedure which should be used with an adequate sample size.

[15] As mentioned previously, a low score of complexity = more complexity.

6.3.3.1 Comparing Adopters Categories (4 groups)

As mentioned, the innovativeness variable was used to divide the subjects into four groups[16]. The cutoff could not be created as an exact percentage as proposed by the model because, in many cases, few subjects shared the same values of innovativeness. Therefore, the four groups were: 9.5% (8 subjects) of the subjects that presented the highest innovativeness comprised the Early Adopters; 41% (35 subjects) the Early Majority; 35% (28 subjects) the Late Majority; and 16.5% (14 subjects) the Laggards. A graphical representation of the created groups can be seen in Figures 6.69 and 6.70 (Figure 6.70 also represents the comparison described in sub-section 6.3.3.2.).

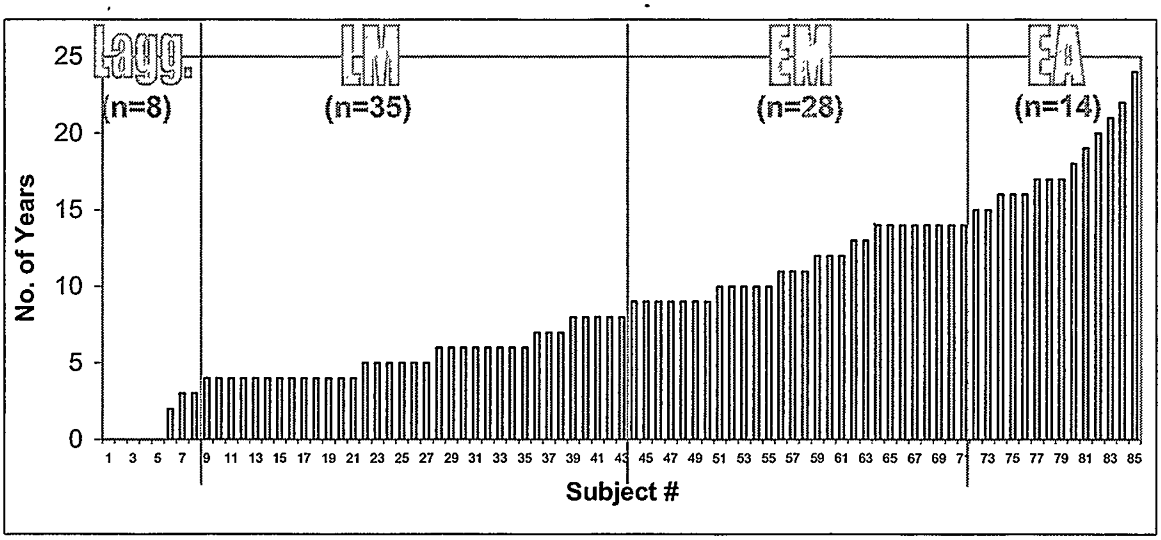


Figure 6.69. Innovativeness scores used to split the sample into 4 groups: E.A., EM, LM and Laggards.

[16] Due to the relatively small sample size, Innovators and Early Adopters were considered as one group of Early Adopters.

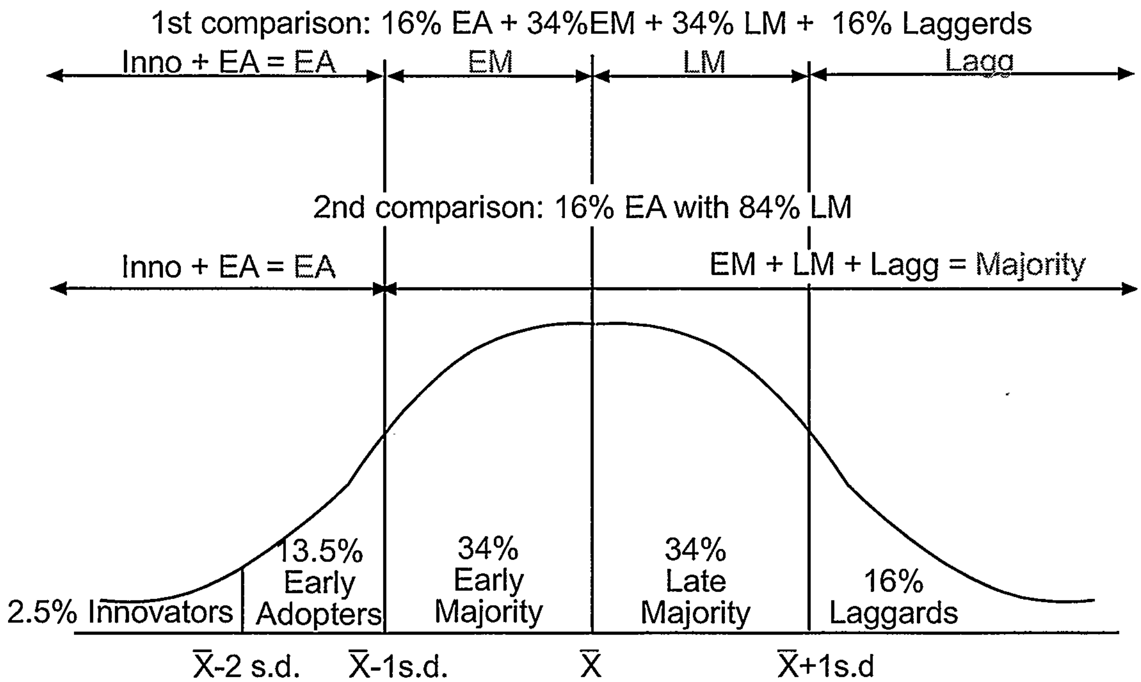


Figure 6.70. Schematic representation of the group comparisons.

A one way between groups ANOVA for significant differences was used to test differences among the four groups. In cases where significant effect was found, a post-hock procedure was used to look for specific differences between the groups. The results are summarized in Table 6.22.

Table 6.22

The Results of the Series of One-way ANOVA for Differences between E.A., E.M., L.M. and Laggards

H. #	Factor	Variable	P One-tailed ANOVA (d.f.=3)	Post-hock
6	Age		P = 0.07 ; NS	--
8	Education	Formal Education	P = 0.05 ; Sig.*	2≠4
		Coaching Education	P = 0.20 ; NS	--
9	Coaching Experience	Coaching Sports	P = 0.21 ; NS	--
		Coaching Volleyball	P = 0.16 ; NS	--
10	Professional Innovativeness		P = 0.00 ; Sig. **	1≠3; 1≠4; 2≠4
11	Experience working with computers	Level of Expertise	P = 0.00 ; Sig. **	1≠2; 1≠3; 1≠4
		Variety Expertise	P = 0.00 ; Sig. **	1≠2; 1≠3; 1≠4
12	Self-efficacy		P = 0.27 ; NS	--
13	Attitudes towards working with computers	Anxiety	P = 0.02 ; Sig. *	1≠3; 2≠3
		Confidence	P = 0.00 ; Sig. **	1≠3; 1≠4
		Liking	P = 0.38 ; NS	--
		Usefulness	P = 0.44 ; NS	--
		General Attitude	P = 0.11 ; NS	--
		Specific Attitude	P = 0.98 ; NS	--
14	Perceived Relative Advantage		P = 0.26 ; NS	--
15	Perceived Complexity		P = 0.27 ; NS	--
16	Intention to use the CD-ROM		P = 0.73 ; NS	--
17	Using the CD-ROM		P = 0.63 ; NS	--

* Significant at α level = 0.05 ; ** Significant at α level = 0.01 ;

The *Gender* variable (Hypothesis # 7) was compared using the Pearson Chi-square technique. The result suggests that at α level of 0.05 the relationship between Gender (Males and Females) and the Innovativeness (Early Adopters, Early Majority, late majority and Laggards) are not significant.

It can be concluded from this table and the gender analysis that the null hypotheses 10 and 11 were rejected, and accepted the alternative ones. However, we failed to reject hypotheses 6, 7, 9, 12, 14, 15, 16 and 17, suggesting that there does not appear to be any significant differences between the groups with respect to age, gender, coaching experience, self-efficacy, perceived relative advantage, perceived complexity, intention to use the CD-ROM and actual use of it. At the same time, hypotheses 8 and 13 were partially accepted.

Because of the limited sample size, which resulted in very small groups when divided into four, the same variables were compared again after splitting the subjects into two groups only, as explained in the next sub-section.

6.3.3.2 Comparing Early Adopters with Majority

In addition to comparing the four groups using ANOVA, a procedure that was suggested by Anderson, Varnhagen, and Campbell (1998), and later followed by Jacobsen (1998), was repeated. Under this procedure, 16% of the population (Early Adopters, including 2.5% Innovators and 13.5% Early Adopters) was compared to the other 84% of the sample (34% of Early Majority, 34% Late Majority and 16% Laggards), as shown in Figures 6.70 and 6.71.

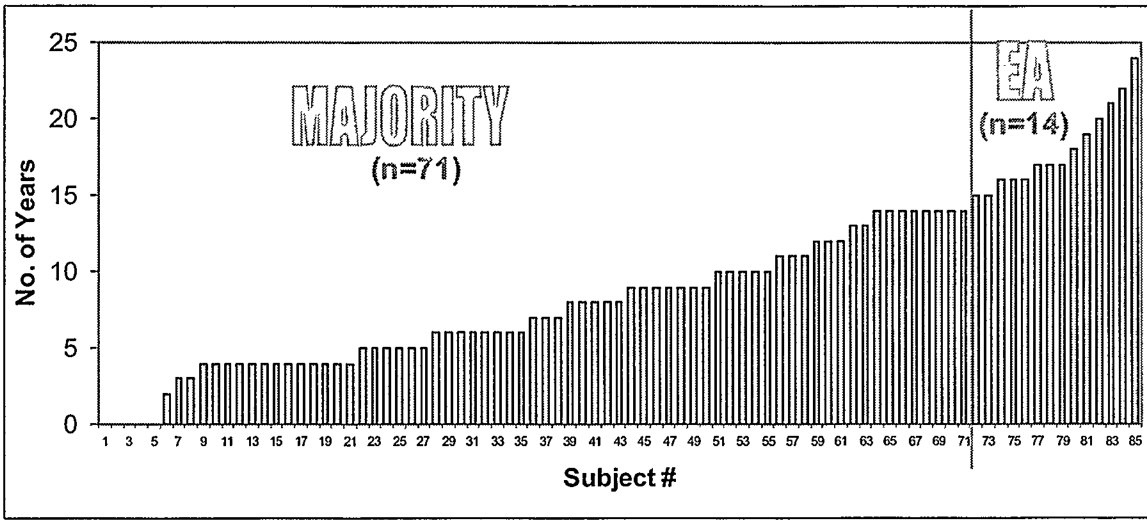


Figure 6.71. Innovativeness scores used to split the sample into two groups: Early Adopters (16%) and Majority (84%).

A major difference from previously mentioned studies should be emphasized. In these studies an assumption was made that members who developed a more extensive expertise with technology, adopted it relatively earlier, and the innovativeness and the level of expertise variables were considered synonymous. As a result, the innovativeness score was calculated by adding up the level of expertise on the Computer Experience scale. However, in the current study, *Level of Expertise* and *Innovativeness* were measured separately. The *Level of Expertise* variable was calculated by adding all the level of experience scores in the Computer Experience scale, while calculation of *Innovativeness* was based on the time dimension, as described in section 6.2. The assumption that *Innovativeness* and *Level of Expertise* are closely related was tested and described latter in section 6.3.4.

After the creation of the two unequal groups, based on the innovativeness factor, Levene's Test was used, followed by a series of one-tailed independent t-tests. The results are summarized in Table 6.23.

Table 6.23

The Results of the Series of Independent t-tests for Differences between Early Adopters and Majority

H. #	Factor	Variable	E.A.	Majority	P One-tailed t-test
6	Age		Mean = 34.79 S.D. = 7.42 n = 14	Mean = 37.21 S.D. = 10.00 n = 70	d.f. = 82 P = 0.19 NS
8	Education	Formal Education	Mean = 1.50 S.D. = 0.76 n = 14	Mean = 0.90 S.D. = 0.78 n = 71	d.f. = 83 P = 0.00 Sig.**
		Coaching Education	Mean = 0.86 S.D. = 0.86 n = 14	Mean = 1.30 S.D. = 1.27 n = 71	d.f. = 25.55 P = 0.06 NS
9	Coaching Experience	Coaching Sports	Mean = 9.33 S.D. = 7.57 n = 12	Mean = 13.51 S.D. = 9.43 n = 63	d.f. = 18.17 P = 0.05 Sig.*
		Coaching Volleyball	Mean = 8.33 S.D. = 8.17 n = 12	Mean = 10.92 S.D. = 9.63 n = 63	d.f. = 73 P = 0.19 NS
10	Professional Innovativeness		Mean = 5.93 S.D. = 5.84 n = 14	Mean = 4.23 S.D. = 3.75 n = 69	d.f. = 15.25 P = 0.15 NS

11	Experience working with computers	Level of Expertise	Mean = 3.46 S.D. = 1.33 n = 13	Mean = 3.15 S.D. = 0.99 n = 71	d.f. = 82 P = 0.16 NS
		Variety Expertise	Mean = 32.08 S.D. = 27.60 n = 13	Mean = 23.21 S.D. = 19.02 n = 70	d.f. = 81 P = 0.08 NS
12	Self-efficacy		Mean = 32.31 S.D. =4.15 n = 13	Mean = 29.90 S.D. = 4.99 n = 67	d.f. = 78 P = 0.05 Sig.*
13	Attitudes towards working with computers	Anxiety	Mean = 39.31 S.D. = 9.20 n = 13	Mean = 40.16 S.D. =7.33 n = 68	d.f. = 79 P = 0.35 NS
		Confidence	Mean = 40.00 S.D. = 8.30 n = 13	Mean = 38.40 S.D. = 7.52 n = 67	d.f. = 78 P = 0.25 NS
		Liking	Mean = 38.54 S.D. = 6.91 n = 13	Mean = 38.16 S.D. = 7.31 n = 67	d.f. = 78 P = 0.43 NS
		Usefulness	Mean = 39.25 S.D. = 5.41 n = 12	Mean = 39.57 S.D. = 5.39 n = 67	d.f. = 77 P = 0.43 NS
		General Attitude	Mean = 159.00 S.D. = 27.46 n = 12	Mean = 157.05 S.D. = 25.60 n = 64	d.f. = 74 P =0.40 NS
		Specific Attitude	Mean = 49.00 S.D. = 5.78 n = 14	Mean = 48.68 S.D. = 5.55 n = 68	d.f. = 80 P = 0.42 NS
14	Perceived Relative Advantage		Mean = 31.17 S.D. = 7.41 n = 12	Mean = 34.05 S.D. = 5.37 n = 60	d.f. = 70 P = 0.06 NS

15	Perceived Complexity	Mean = 22.17 S.D. = 3.41 n = 12	Mean = 22.25 S.D. = 4.67 n = 61	d.f. = 71 P = 0.47 NS
16	Intention to use the CD-ROM	Mean = 2.25 S.D. = 1.21 n = 12	Mean =2.47 S.D. = 1.60 n = 55	d.f. = 65 P = 0.32 NS
17	Using the CD-ROM	Mean = 0.60 S.D. = 0.89 n = 5	Mean = 0.71 S.D. = 0.47 n = 14	d.f. = 4.81 P = 0.39 NS

* Significant at α level = 0.05 ; ** Significant at α level = 0.01 ;

The Pearson cCi-square technique on the *Gender* variable (Hypotheses # 7) suggests that the relationship between *Gender* and the *Innovativeness* is not significant at α level of 0.05.

Based on Table 6.23 and the Chi-Square results, when Early Adopters (16% of the population) were compared with Majority (84% of the population) in *Age, Professional Innovativeness, Level of Expertise, Attitudes, Perceived Relative Advantage, Perceived Complexity* of the CD-ROM, *Intention* to use the CD-ROM, *Actual use* of the CD-ROM, and *Gender*, no significant differences where found. Only with regard to *Self-efficacy*, was it possible to reject the null hypothesis and to accept the alternative that assumes that *Early Adopters* presented more *Self-efficacy* compared to the *Majority*. Two hypotheses were partly accepted. *Early Adopters* had significantly *more Formal Education* but no differences were found in *Coaching Education. Early Adopters* had also significantly less *Experience in Coaching any Sport,* which is opposite that stated in the hypothesis. No differences were found in *Volleyball Coaching Experience.*

The following section describes the test of seven hypotheses which are based on a time comparison.

6.3.4 Time Comparison (Hypotheses 18 to 24)

As mentioned several time before, *time* is an important factor in the Diffusion of Innovation Model (Rogers, 1995). In the study, an attempt was made to follow the diffusion process by administering questionnaires before the start of the study (pre-workshop questionnaire), after the workshop (post-workshop questionnaire), and approximately 18 months later (follow-up questionnaire). A comparison took place between the pre-workshop and the follow-up questionnaires. The low return rate (21.11%) of the follow-up questionnaires, however, reduced the ability to generalize from the comparison results.

The hypotheses were to test the assumption that as time passes, physical education teachers and coaches become more and more computer oriented. On the same time, their scores in the follow-up questionnaires are related to their scores in the pre-workshop ones. The hypotheses tested in relation to the time dimension are:

18. Subjects' *Level of Expertise* in pre-workshop is significantly lower compared to their level during the follow-up-questionnaire.

19. There is significant positive relationship between subjects *Level of Expertise* in the pre-workshop and in the follow-up-questionnaire.

20. Subjects' positive Attitudes toward working with computers in the pre-workshop are significantly lower compare to their level during the follow-up questionnaire.

21. There is significant positive relationship between subjects *Attitudes toward working with computers* in the pre-workshop and in the follow-up-questionnaire.

22. There is a significant positive relationship between subjects' *Self-efficacy* in the pre-workshop and in the follow-up questionnaire.

23. Subjects' *Innovativeness* is significantly lower compare to their *Professional Innovativeness* (adoption gap).

24. There is a significant positive relationship between subjects' *Innovativeness* and their *Professional Innovativeness*.

To test hypotheses 18, 20 and 23, a one-tailed paired t test was performed on the different variables. To test hypotheses 19, 21, 22 and 24, the Pearson Correlation technique was used to learn about any existing relationships. The results are described in sub-sections 6.3.4.1-6.3.4.4, according to the variables tested.

6.3.4.1. Level of Expertise (Hypotheses 18 and 19)

As already mentioned, *Level of Expertise* using computers was collected in the study using three scales: The *Computer Experience* (with 41 tools and applications), *Stage of Adopting Technology,* and one question on the *Pattern of Computer Technology Use.* Only the Stage scale (where subjects were asked to report the stage which best described their level of technology adoption on a 1-6 scale) was measured twice, in the pre-workshop questionnaire as well as the follow-up one carried out about 18 months later.

The test hypothesis 18, which derived from the assumption that, with time, subjects became more computers oriented, a one-tailed paired *t* test between the pre-workshop and the follow-up questionnaires was performed. The results (-2.39: d.f.=18 with a one-tailed probability of 0.014) suggest that the null hypothesis was rejected and the alternative one was accepted at an α level of 0.05.

To test the second related hypothesis (hypothesis 19), theses variables were tested using a correlation technique. This was done to learn if subjects, who presented a high level of experience in working with computers in the pre-workshop, had a relatively high level in the follow-up measurements as well. The Pearson Correlation coefficient between these two variables was found to be 0.803 (n=83) with significance at α level = 0.01, suggesting that there is a significant relationship between the *level of expertise* in the pre-workshop and level of expertise 18 months later.

6.3.4.2 Attitude (Hypotheses 20 and 21)

A series of paired-samples one-tailed t-tests was also conducted to compare the means of the six attitude variables (i.e., Anxiety, Confidence, Liking, Usefulness, General Attitude Factor, and Specific Attitude Factor), which were collected using the *Computer Attitude* and the *Computer Technology for Physical Education Teachers and Coaches* scales. Both scales were used in the pre-workshop and in the follow-up questionnaires. From the two mentioned scales, two factors were calculated, *General Attitude Factor and Specific Attitude Factor,* as described in section 6.2.5. The results are presented in Table 6.24.

Table 6.24

The Results of the Significant Tests Comparing Attitude Variables between the Pre-workshop and the Follow-up Measurements

	Pre	**Follow-up**	**t-test**	**One-tailed probability**
Anxiety	39.24 (±6.37) n=17	41.76 (±7.62) n=17	t=2.21 (d.f.=16)	0.02 Sig*
Confidence	38.50 (±6.24) n=18	39.61 (±8.71) n=18	t=1.14 (d.f.=17)	0.13 Not Sig*
Liking	38.39 (±5.42) n=18	37.78 (±7.16) n=18	t=4.62 (d.f.=17)	0.33 Not Sig*

Usefulness	38.28 (±4.87) n=18	39.28 (±5.22) n=18	t=0.00 (d.f.=17)	0.50 Not Sig*
General Attitude Factor	154.20 (±18.31) n=15	159.73 (±21.51) n=15	t=1.63 (d.f.=14)	0.06 Not Sig*
Specific Attitude Factor	49.22 (±4.70) n=18	50.11 (±5.22) n=18	t=0.78 (d.f.=17)	0.22 Not Sig*

* At α level = 0.05

It is apparent that only the *Anxiety* variable was found to be significantly (at α = 0.05) lower at the time the workshop took place, compared to the follow-up, suggesting anxiety score increased significantly. As was already explained, a high anxiety score in Computer Attitude Scale suggests a higher positive score, which means less anxiety towards working with computers. In all other attitude variables, we failed to reject the null hypotheses and no evidence for significant differences between the two measurements was found. However, it is worth mentioning that the *General Attitude* Factor was close to significance (α=0.06) and a larger number of subjects might present the required significancy level.

In order to determine if the results of the pre-workshop correlated with those of the follow-up questionnaires in the different attitude variable, the Pearson Correlation procedure was used, and the coefficients are presented in Table 6.25.

Table 6.25

Pearson Correlation Coefficients between the Attitude Variables in the Pre-workshop and in the Follow-up Questionnaires

	Pre-workshop - Follow-up Correlation
Anxiety	0.787 ** n=17
Confidence	0.899 ** n=19
Liking	0.634 ** n=18
Usefulness	0.589 * n=18
General Attitude Factor	0.792 ** n=15
Specific Attitude Factor	0.531 * n=18

It is evident that the relationship between the pre-workshop and follow-up questionnaire attitude factors varies from medium to very strong. They range from 0.531 to the *General Attitude Factor* to 0.899 to the *Confidence*. All relationships are found to be significance at α level of 0.05 and four also to be significance at α level of 0.01.

6.3.4.3. Self-efficacy (Hypothesis 22)

Self-efficacy was also collected during the pre-workshop and the follow-up questionnaires. The correlation between the two self-efficacy results was 0.455 (n=18). It was found to be not significant at α level = 0.05. It suggests that the Self-efficacy score in the follow-up measurement was very little (r^2= 0.21) related to their score in the pre-workshop. Therefore, we failed to reject the null hypothesis that suggests that *there are no significant relationship between the Self-efficacy during the pre-workshop questionnaire and the Self-efficacy during the follow-up questionnaire.*

6.3.4.4. Innovativeness – Professional Innovativeness Time-Gap (Hypotheses 23 and 24)

The last two time-related hypotheses were concerned with the *time-gap* between *Innovativeness* and *Professional Innovativeness,* as was reported in a previous study (Jacobsen, 1998). That is, subjects first adopt computers for personal use and, after a period, they adopt them for job-related tasks as well. This "time" difference was reported to be about a decade for university faculty (Jacobsen, 1998). In Figure 6.72, the time-gap found in the current study is shown. It includes two adoption curves by plotting the percentage of new users each period, one for personal tasks and the other for professional ones. A more detailed analysis of the time-gap, presented separately for the most popular software, was previously discussed in section 6.1.3.

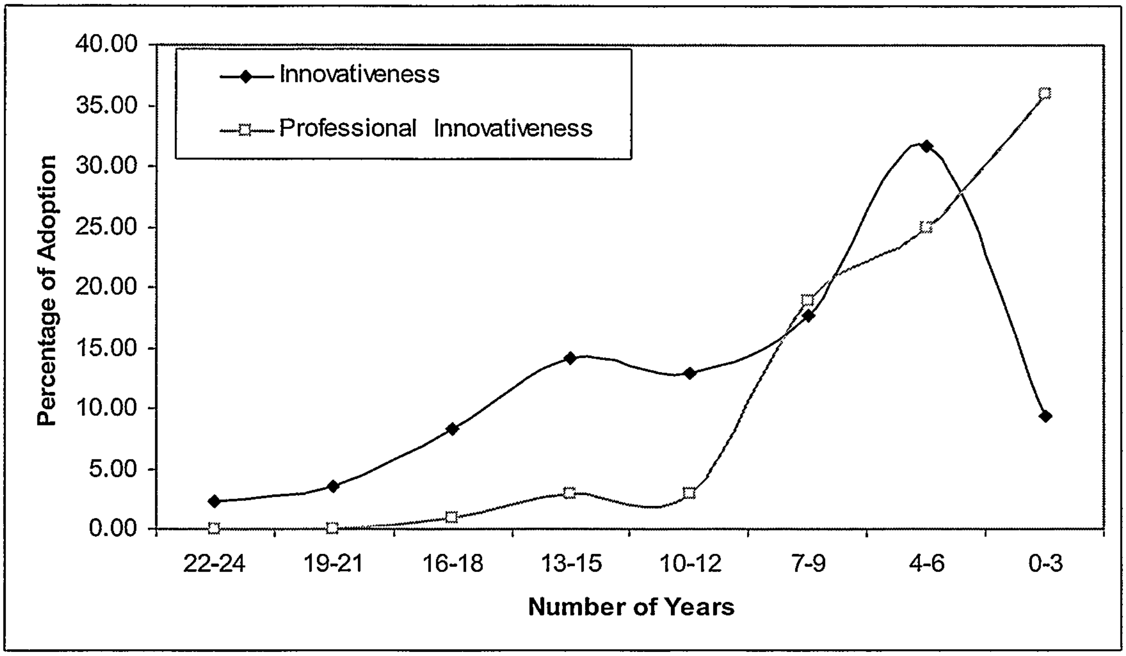


Figure 6.72. Adoptions curved for Innovativeness and Professional Innovativeness.

To test hypothesis 23, the means of subjects' *Innovativeness* was compared to their *Professional Innovativeness*, as obtained from the pre-workshop using a one-tailed *t* test. The one-tailed paired *t*-test results (t=7.89; d.f.=82; p=0.00) showed that subjects *Innovativeness* is significantly higher than their *Professional Innovativeness* at α level of 0.01). On average, this time-gap is equal to 4.5 years, less than the 10 year gap reported by Jacobsen (1998).

The relationship between *Innovativeness* and *Professional Innovativeness* were tested using the Pearson Correlation procedure. The result (0.449; d.f. = 82) showed medium strength relationship with significancy at α = 0.01. A graphical representation of the relationship can see in the following regression graph.

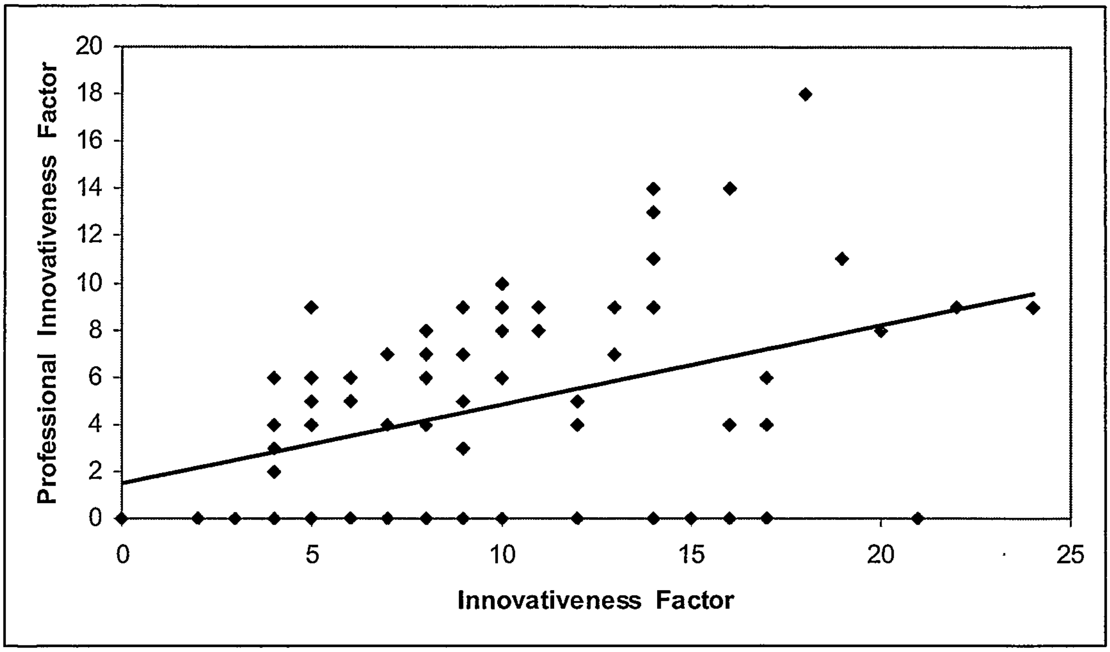


Figure 6.73. Correlation between Innovativeness Factor and Professional Innovativeness Factor.

6.3.5 Level of Expertise and Innovativeness Relationship Hypothesis (Hypothesis 25)

Another aim of the study was to learn about the relationship between *Level of Expertise* in using computers and *Innovativeness*. In a previous study (Jacobsen, 1998), an assumption was made that "for one to developed 'extensive' expertise with a particular tool, they have been relatively earlier to adopt than one who rates heir expertise as 'a little' " (Jacobsen, 1998, p: 59). In these studies, *Innovativeness* was examined by using the *Computer Experience Scale,* adding the level of expertise (0 to 4) on each of the computer software and tools. In the current study, this is the way *Total Level of Expertise* was measured, which was later named the *Verity Factor* (see section 6.2.1)

The hypothesis that the *Verity Factor is significantly related to Level of Innovativeness* was tested using the Pearson Correlation. The results (0.451 α = 0.01) suggested that the relationship between these two variables is only medium significant. These variable relationships is shown in Figure 6.74.

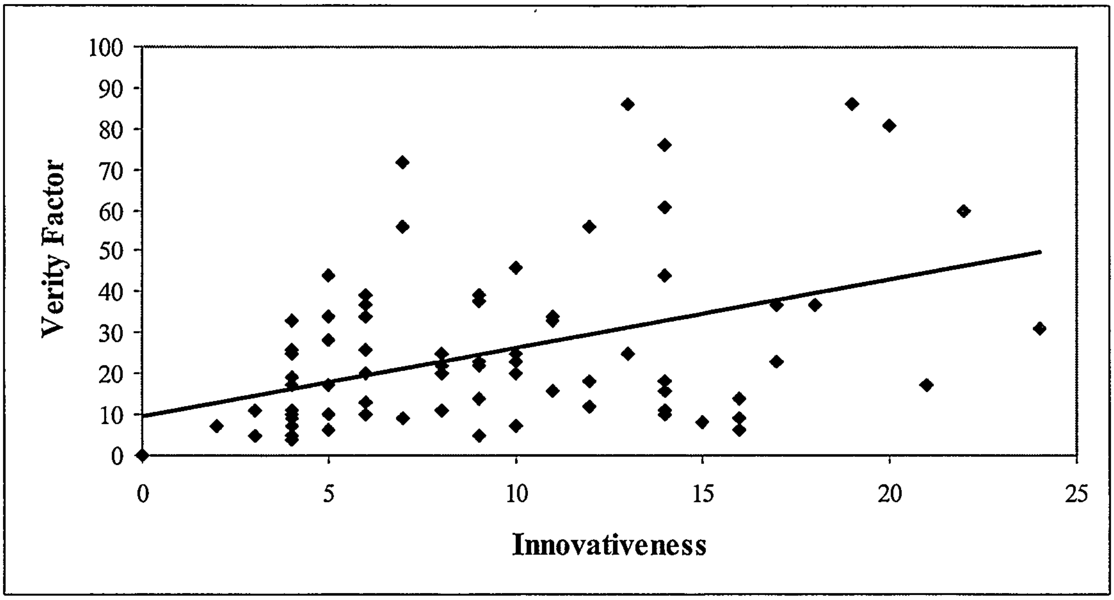


Figure 6.74. Regression between the *Innovativeness* and the *Verity Factors.*

Additionally, *Innovativeness* was assumed to affect previous experience that consciously affects *Professional Innovativeness* (sub-section 6.3.1). In these relationships, previous experience was represented by perceived *stage* of technology adoption. A direct relationship between *Innovativeness* and *Professional Innovativeness* was also suggested. The results, graphically presented in Figure 6.75, suggest that the relationship between innovativeness and previous experience (represented by the *Stage* variable) is only medium (0.37) but significant (at α=0.05).

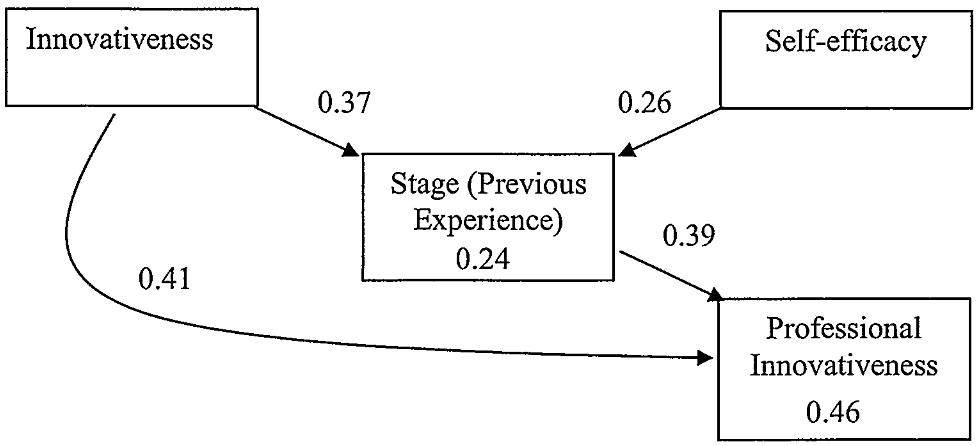


Figure 6.75. Correlations between Innovativeness, Stage and Professional Innovativeness.

The next sub-section describes a comparison between the Canadian sample, (pilot study) and the Israeli sample, which was produced to test hypotheses 26 to 28.

6.3.6 Canada-Israel Comparison (Hypotheses 26 to 28)

Another focus of the study was the international context of the diffusion process. While the actual study took place in Israel during 2001-2003 via three workshops, a pilot study was performed in Canada in one workshop, at the end of 2000. This sub-section presents a comparison between the two samples. The first part (6.3.6.1.) includes the survey results while sub-sections 6.3.6.2-6.3.6.5 present a comparison analysis to examine statistical differences between the two samples. Comparison might shed some light on the international context differences between physical teachers and coaches in Israel and in Canada, as discussed in chapter 7.

6.3.6.1. Descriptive Comparison

The following two tables present data from the two samples on major demographic variables (6.26) and volleyball related variables (6.27).

Table 6.26

Descriptive Comparison between the Israeli and Canadian Samples in Demographic Variables

Variable	**Canadian Sample n=35**	**Israeli Sample n=90**
Age	Mean = 35.00 years S.D.= 8.19 years	Mean = 36.94 years S.D. = 9.56 years
Gender	Men = 57% Women = 43 %	Men = 49% Women = 51%
Educational Level Attained:		
Students at the last year of college:	0%	20%
Bachelor Degree:	97%	72%
Master Degree:	6%	25%
Doctorate Degree:	0%	3%

Coaching Education Level Attained:		
Coaching Certificate:	63%	45%.
Coaching Levels:		
Level 1/Instrctor:	59%	27%
Level 2/coach:	27%	45%
Level 3/advanced coach:	14%	22%
Level 4:	0%	NA
Profession:		
Students at the last year of college	0%	20%
Teachers:	91%	74%
Phy. Ed. Teachers:	66%	98%
Other teachers:	38%	7%
Coaches:	86%	57%
Other profession:	3%	6%

Table 6.27

Descriptive comparison between the two samples in volleyball-related variables

Variable	**Canadian Sample n=35**	**Israeli Sample n=90**
Total No. of Teaching/Coaching Years	Mean = 9.83 years S.D.= 7.79 years	Mean = 11.39 years S.D.= 9.55 years

Teaching/Coaching Other Sports		
Yes:	83%	64%
No:	17%	36%
Age of Population		
Children, 6-12 years old:	43%	62%
Adolescents, 13-17 years old:	100%	72%
Mature Athletes, 18-30 years old:	31%	34%
Mid-Ages, 31-40 years old: (4/35):	11%	22%
Seniors, 41-63 years old:	6%	6%
Aged population, 64 years old on:	0%	1%
Average No. of Volleyball Practice/Lesson Plans Written Weekly (during the season)	Mean = 3.01 plans S.D.= 0.93	Mean = 5.09 plans S.D.= 5.09 plans
Time Spend Preparing a Practice/Lesson Plan		
Not at all:	11%	22%
Less than 1 hour:	9%	5%
1-2 hours:	86%	70%
2-4 hours:	0%	3%
More than 5 hours:	0%	0%
Availability of Coach Assistance		
Yes:	51%	9%
No:	49%	91%

Factors Most Affect the Decision to Select a Computer Software		
An advertisement in the media:	11%	23%
A colleague recommendation:	57%	63%
Availability of software:	63%	35%
District policies and procedures:	9%	28%
Other:	29%	18%

6.3.6.2. Level of Expertise (Hypothesis 26)

Based on the analysis in sub-section 6.2.1, computer prior experience level was represented by two factors. The *Variety Factor* was calculated as the sum of subjects' level of experience (0-4) on the different tools and applications listed in the Computer Experience Scale. Since the number of tools/applications on the scales were different in the English version (46 tools) and the Hebrew version (41 tools[17]), the results were divided into the number of tools on the scale to actually present the mean of the variety level.

Hypothesis 26 suggested that *there is a significant difference between Israelis and Canadians in level of expertise.* To test the differences between the two samples, an independent t test was performed. The results (t=2.34, d.f.=121, p=0.02) suggest that at α level of 0.05, the null hypothesis was rejected and the means of the two samples differ from each other significantly. That is, on average, Canadians (0.81, ± 0.49) use a larger number of computers tools and applications compared to Israelis (0.58, ± 0.50).

[17] This was done to reduce the number of items in the questionnaires, result from the pilot study, explained in chapter 5.

The second level of experience factor was calculated as the mean of subjects' Stage and reply regarding level of experience in working with computers (on 5-point Likert scale). The *t*-test results, comparing the two samples in the *Experience Level Factor* presented a similar trend seen in the variety factor (t=2.32, d.f.=121, p=0.00). On average, Canadians (3.58, ± 0.39) had a higher level of expertise in using computers compared to Israelis (3.16, ± 1.04).

An interesting comparison between Israelis and Canadians is shown in the choice of tools and most popular applications.

Table 6.28

Differences between the Israelis and the Canadian Samples in Percentage of Adoption of the Different Tools and Application

Tool/Application	Israeli sample	Canadian sample	Difference (Δ)
Windows Operating System (95+)	78%	91 %	13%
Word Processing	74%	94 %	20%
Spreadsheets	54 %	83%	29%
Internet	54 %	94%	40%
E-mail	53%	89%	36%
Presentation package	46%	51%	5%
Computer games	21 %	37%	16%
On-line databases	19 %	57%	38%
Graphics program	18%	77%	59%

Grading package	13%	80%	67%
Macintosh	4%	71%	67%

It is evident that the diffusion of any of the applications is larger in the Canadian sample compared to the Israeli one. The differences range from 67% (Macintosh and Grading package) to 5% in the Presentation package. However, it should be noted that, in both samples, the Windows operating system and the Microsoft Office application were very popular compared to other applications.

In Table 6.29, comparisons of other variables related to computer level of experience are shown.

Table 6.29

Descriptive comparison between the two samples in *Level of Expertise* related variables

Variable	**Canadian Sample n=35**	**Israeli Sample n=90**
No. of computers owned :		
None:	20%	16%
1:	37%	22%
2:	10%	25%
3:	11%	28%
4:	11%	9%
5:	0%	6%

Access to a computer for *personal* use:		
Yes:	77%	89%
Sometime:	17%	11%
No:	6%	0%
Access to computers, software and needed equipment for *teaching/coaching tasks:*		
Yes:	63%	53%
Sometimes:	26%	29%
No:	11%	18%
Participation in courses/workshops for using computer technologies		
Yes:	83%	82%
No:	17%	18%
Typing skills		
Non-existent:	3%	2%
Poor:	11%	38%
Good:	74%	45%
Excellent:	11%	15%

Methods used to update knowledge of educational computer:		
Computer magazines or journals:	11%	22%
Computer courses:	37%	27%
User groups:	20%	6%
Workshops:	83%	11%
Other	14%	49%
Experience with other computer-based instruction software		
Yes, quite a few :	17%	14%
Yes, only one or two	46%	44%
No	6%	43%
Satisfaction from computer-related teaching/coaching tasks support		
Very satisfied (+2):	9%	3%
Satisfied (+1):	37%	14%
Natural (0):	26%	41%
Unsatisfied (-1):	29%	29%
Very unsatisfied (-2):	0%	13%
Satisfaction from training available to you for computer-related teaching/coaching tasks		
Very satisfied (+2):	9%	4%
Satisfied (+1):	31%	11%

Natural (0):	26%	38%
Unsatisfied (-1):	34%	38%
Very unsatisfied (-2):	0%	10%
Acquisition of initial computer skills		
Self taught	57%	51%
Formal course:	46%:	33%:
From a peer:	54%	34%
From a player/student:	3%	8%
From support staff:	17%	1%
Other:	3%	2%
Range of computer knowledge and skills are primarily the result of:		
Self-teaching:	86%	80%
Formal course:	26%	55%
Peer teaching and support:	43%	11%
Support staff assistant:	11%	2%
Other:	6%	6%
No. of hours spent weekly using a computer		
Less than 1 hour:	6%	19%
1 to 3 hours:	20%	26%
3 to 5 hours:	34%	25%
More than 5 hours:	40%	31%

No. of hours spent weekly using the Internet		
Less than 1 hour:	40%	34%
1 to 3 hours:	23%	34%
3 to 5 hours:	23%	14%
More than 5 hours:	14%	18%

6.3.6.3. Innovativeness (Hypothesis 27)

According the hypothesis 27, *there is a significant difference between Israelis and Canadians in innovativeness*. The independent *t*-test results suggest that the two groups differed significantly at α=0.01 (t= 5.31, d.f.= 116, p=0.00) and that the Canadian subjects started to use computers earlier (14.82 years ± 4.52) compared to Israelis (9.08 years ± 5.52).

To graphically compare the two samples in *Innovativeness*, that is, the length of time subjects were using computer applications, the data was plotted (see Figure 6.76). It includes the distribution of the total sample (n=125) as well as the distribution of each country, separately, after the percentage of adoption has been found. Even though the curves do not represent a clear "bell shape," applying a "Regression line," using a Polygon from order 2, may represent the general tendency of the curves to resemble a bell shape, as suggested by Rogers (1995). It can be seen that the adoption curve peak for the Canadian sample occurred about 13 years ago compared to 4 years ago for the Israeli sample.

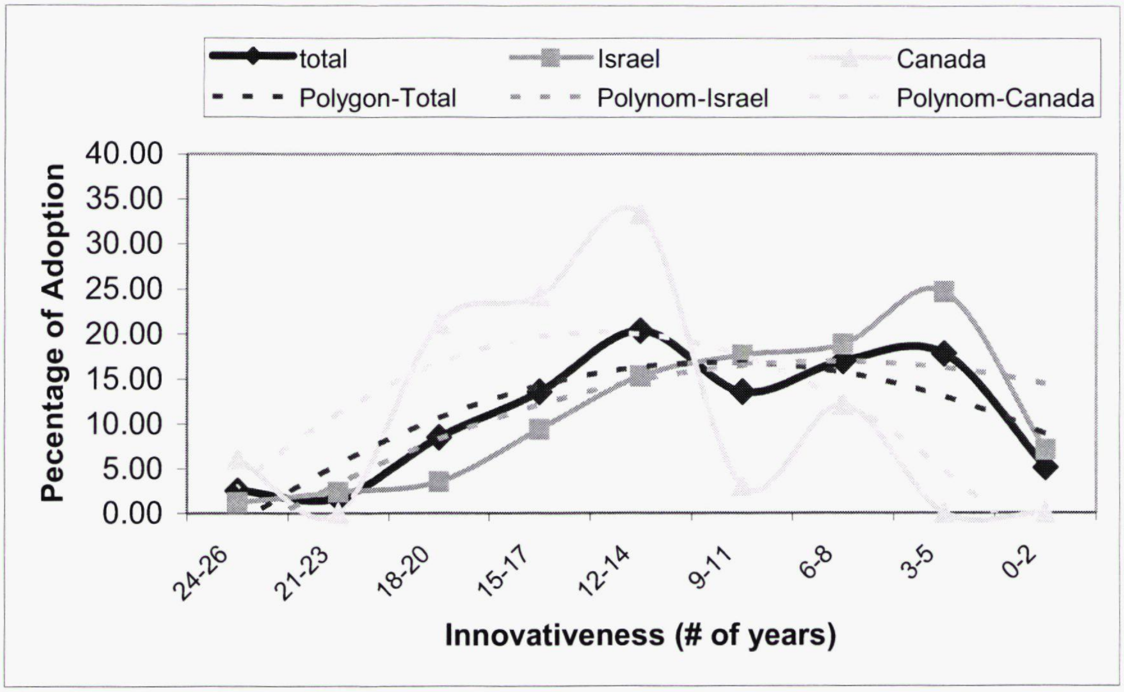


Figure 6.76. The three Innovativeness Distributions Curves (Total sample, Canadian and Israeli).

The two samples were also compared using the accumulative percentage of adoption of computer technology *each year*. The results show that although the two groups started to use computers at about the same time by the Innovators of the populations (24 years ago, i.e., 1980), the diffusion accelerated faster among the Early Adopters of the Canadians and the Critical Mass Point had been reached in about 5 years. By contrast, it took those in Israel to reach the same point after 9 years. The diffusion in the Early Majority even increases the difference as it took 4 years for the entire early Majority to adopt it in Canada, and 6 years in Israel. The diffusion process of computer technology was completed around 6 years ago (1998) in Canada, while it is not yet completed in Israel.

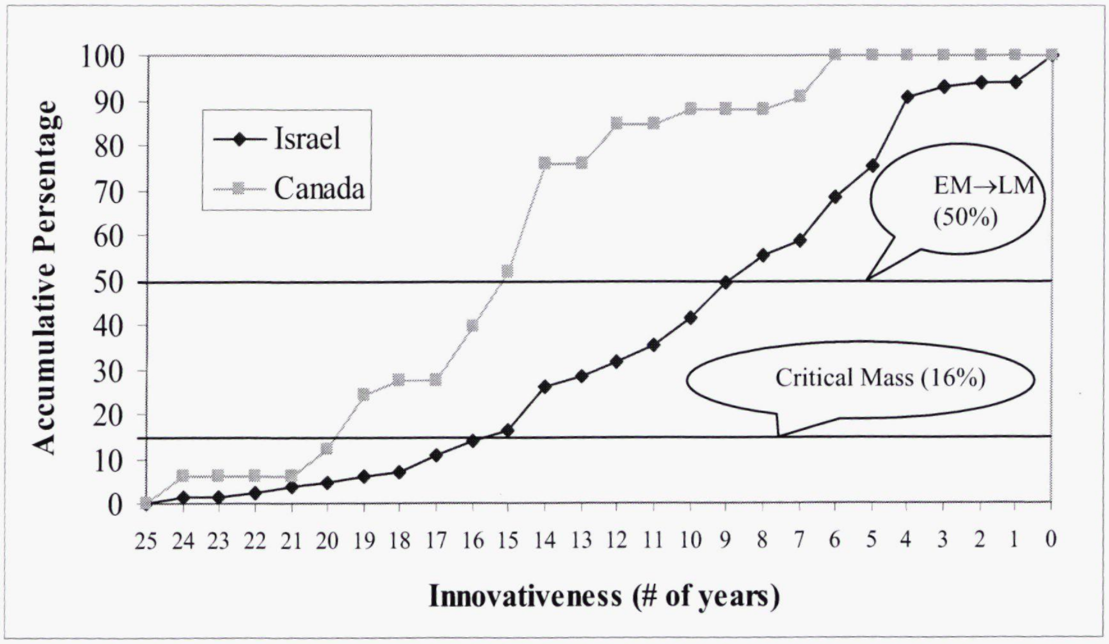


Figure 6.77. A comparison between the shape of the Israeli and the Canadian Accumulative Percentage of Adoption.

6.3.6.4. Professional Innovativeness (Hypothesis 28)

Similarly to the previous section, the Canadian sample was compared to the Israeli sample also in *Professional Innovativeness*. *Professional Innovativeness* is the number of years that subjects were already using computers to perform job-related tasks. The *t*-test results suggested that the *Professional Innovativeness* mean of the Canadian sample is significantly higher than the Israeli mean (t=6.27, d.f.=112, p=0.00) using α level of 0.05.

The graphical representation of the curves (Figure 6.78) suggests that the Israeli sample is better described as a straight line while the Canadian sample resembles a bell shape (using a second order Polynomial fit). This may suggests that the Israelis have not yet reached the peak point and are still at a stage where rapid adoption takes place.

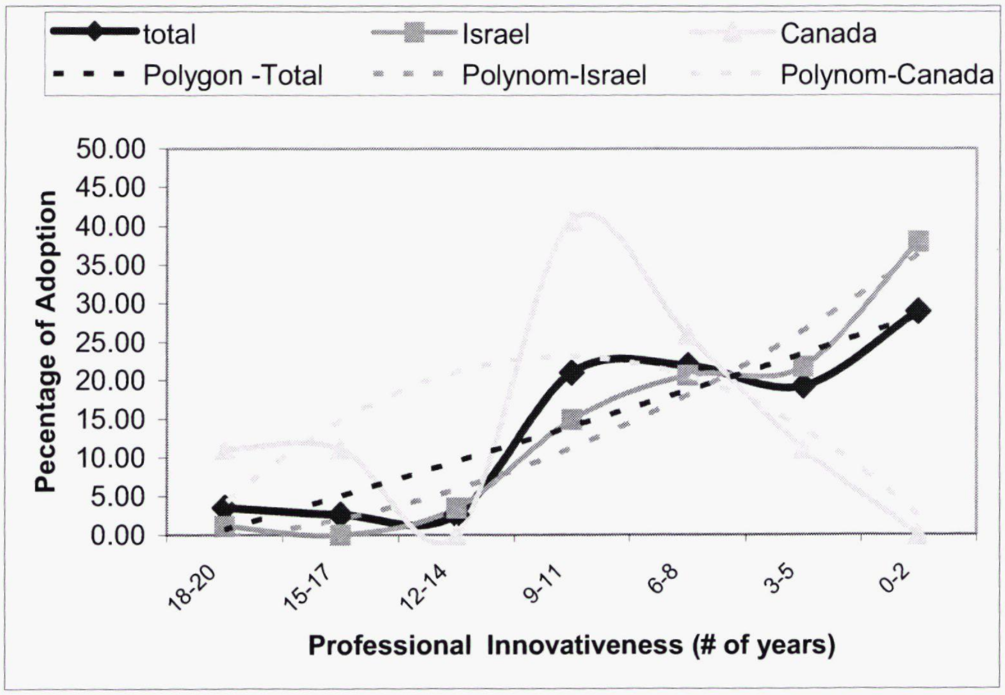


Figure 6.78. The three Professional Innovativeness Distributions Curves (Total sample, Canadian and Israeli).

Another view of the professional innovativeness process between the two countries could be observed when the accumulative percentage of adoption for every year was plotted (see Figure 6.79). In contrast to what was described with regard to general uses of computers it seems that both curves, overall, are very similar in shape; that is, the diffusion rate in both countries is almost the same. That is, the Canadians started the process of professional use of computers about two years before the Israelis, but they have continued at about the same rate of diffusion. For both samples, the diffusion has not yet finished[18], as several subjects have reported not using computer applications in the field for teaching and coaching.

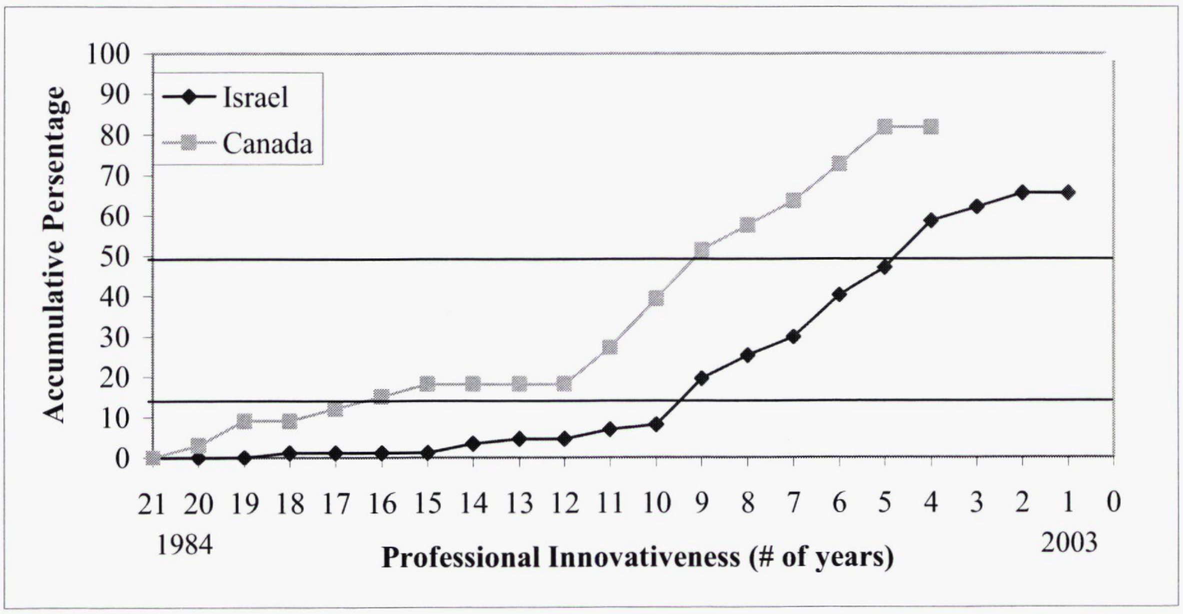


Figure 6.79. Accumulative Percentage of subjects that started to use computers for professional purposes each year of the Canadian sample and the Israeli sample.

6.3.6.5. Other Factors

Table 6.30 presents *t*-test results of comparison between the Israeli and the Canadian subjects, in additional factors.

[18] The data for the Canadian sample is available only to 2000.

Table 6.30

t-tests Results which Compared between the Israeli and the Canadian Samples

Variable	**Israel's mean (±s.d.)**	**Canada's mean (±s.d.)**	***t*-test (d.f.)**	**Probability**
Self-efficacy	30.26 (±4.97) n=84	31.37 (±5.20) n=35	1.10 (117)	0.28 NS
Total Attitude	156.46 (±25.64) n=80	167.86 (±17.26) n=35	2.40 (113)	0.06 NS
Specific Attitude	48.65 (±5.49) n=85	51.68 (±5.46) n=34	2.72 (117)	0.01 Sig.**
Age	36.94 (±9.55) n=88	35.00 (±8.19) n=35	1.06 (121)	0.29 NS
Coaching Volleyball Experience	10.56 (±9.45) n=79	9.83 (±7.79) n=35	0.40 (112)	0.69 NS
Coaching Experience	12.99 (±9.18) n=79	11.13 (±8.09) n=35	1.03 (112)	0.30 NS
Formal Education	0.99 (±0.79) n=90	0.97 (±0.17) n=35	0.13 (123)	0.90 NS
Coaching Education	1.26 (±1.21) n=90	0.97 (±0.95) n=35	1.24 (123)	0.21 NS
Perceived Relative Advantage	33.79 (±5.84) n=75	36.06 (±4.44) n=33	1.99 (106)	0.05 Sig.*
Perceived Complexity	22.33 (±4.41) n=76	24.64 (±3.49) n=33	2.66 (107)	0.01 Sig.**

Intention to use the CD-ROM	2.37 (±1.52) n=70	1.48 (±0.67) n=33	3/19 (101)	0.00 Sig.**
Using the CD-ROM	0.68 (±0.58) n=19	1.43 (±0.73) n=23	3/63 (40)	0.00 Sig.**

It can be concluded that the Canadian and the Israeli samples seem to be drawn from similar populations when demographic variables tested: Age, Coaching Volleyball Experience, Coaching Experience, Formal Education and Coaching Education. Similarly, two additional variables did not seem to be differentiated: *Self-efficacy* and *Total Attitude*. However, they significantly differ from each other in: Specific Attitude, Perceived Relative Advantage, Perceived Complexity, Intention to use the CD-ROM and Using the CD-ROM. In all these variables, Canadians present higher results.[19]

Chapter 7 includes a discussion of the results presented here and their possible significance.

[19] It should be reminded that the direction of the Intention to Use the CD-ROM variable is opposite and a lower score suggests higher intention to use the application.

CHAPTER 7

DISCUSSION AND CONCLUSIONS

The current study was concerned with the way people make decisions about whether or not to adopt a new technology. A new Interactive Volleyball CD-ROM has been developed, and its acceptance/rejection intention has been studied using different research methods (a survey, a quasi-experimental design, a time-based comparison, and a model goodness of fit). The theoretical background of the study was based on two main models that are widely used and described in the literature: the Technology Acceptance Model - TAM (e.g., Davis et al. 1989) and the Diffusion of Innovation Theory – DoI (e.g., Agarwal & Prasad, 1997; Brancheau & Wetherbe, 1990; Rogers, 1995). While DoI is a generalized theory that was found to be suitable for describing the diffusion of a wide range of new ideas, TAM is more suitable for describing innovations within the information technology area.

More specifically, a major study aim was to shed light on the role that external variables (e.g., prior experience in using computer, self-efficacy, innovativeness, and attitudes toward working with computers) play in a new technology acceptance process.

This chapter is organized by the groups of questions/hypothesis posted in the methodology section.

7.1 The Survey - Answering Study Questions

The first goal of the study included an exploratory investigation of the Interactive Volleyball CD-ROM targeted population, that is, physical education teachers and volleyball coaches. According to the user-centered approach (Norman, 1998b), investigating user needs is a very important stage prior to developing any new technology.

A detailed description of the survey results, including tables and figures, can be found in section 6.1. This section attempt to answer the eight main questions described earlier in Methodology.

7.1.1 Innovativeness

Question 1: What are the categories of adopters (as defined by Rogers, 1995) to which computerized technology been diffused?

The answer to the first question is based on Rogers' (1995) Diffusion of Innovation model. According to the model, *Innovativeness*, or the degree to which an individual is relatively early in adopting new technology (Rogers, 1995) is a major factor. In the study, it was obtained by finding the first year a computer application was used by each subject. Thereafter, the first year mentioned was subtracted from 2004 (the year when the analysis took place), and the subjects' average innovativeness score, according to that scale, was found to be 9.08 with a standard deviation of 5.52 (n=85).

According to Rogers (1995), individuals can be categorized, depending on their innovativeness, into five main categories: Innovators (2.5%) of the population, Early Adopters (13.5%), Early Majority (34%), Late Majority (34%) and Laggards (16%). Since individuals in the two groups differed in demographic variables, personality characteristics, beliefs, it is very important to know the level of diffusion of the specific technology in focus. Therefore, one of the outcomes of the analysis process, which should precede development of any software, should include testing the target population's level of innovativeness.

On the Pattern of Computer Use questionnaire, 90% of the sample reported that they were already using computers. This suggests that at this stage, the use of computers has been diffused to all Adopter categories including Laggards (last 16% of the population).

In order to compare the level of computer usage between the population of physical education teachers and coaches, and the general population, information about computers adoption in Israel was searched. However, the only data that was found at the Israeli Central Bureau of Statistics website was related to a 1999 survey. To do the comparison, the percentage of computer users within our sample, until the year of 1999, was calculated to be 72%. The data in the 1999 survey is related to the leisure habits of persons aged 14 and over, according to various characteristics which suggests that 29.7% of the population used computers in the past week. Additionally, 13% used computer applications such as word-processing, spreadsheets, etc., 17.8% played computer games, and 12.9% "surfed" the Internet. It is very difficult to compare this information because of the question wording and the different methods which were used to collect the data. While this study dealt with starting the start of computer usage, the Israeli Central Bureau of Statistics queried computer use in the past week. No additional information was found for proper comparison.

The most important conclusion from this data is that some physical educators and coaches may be near the last stage of computer usage diffusion and, therefore, the community is very diverse with regards to innovativeness, and includes all five adopter groups. According to Rogers (1995), different factors impact different adopter groups. The Early Adopters are more technology dominated and so use new technology just because of its availability without taking into consideration its easy-of-use. At the same time, Late Adopters, consider the "friendliness" or the level of complexity of the software to be of major concern. Norman (1998b) adds to the idea that Late Adopters can be viewed as individuals for whom technology does not matter, as they take it for granted. Their decision whether or not to adopt a technology is usually a task-specific decision. They are looking for "power tech.."

In accordance with Norman's (1998b) "Life Cycle of a Technology" model, the study results suggest that the computer industry is now in its "mature" stage, since 90% of the sample reported use of computers. Hereby, Late Adopters dominate the market (Norman using Moore's [1995] definition indicates that the first 16% of the population are Early Adopters and the rest of the population (84%) are Late Adopters). He argues that human-centered products need to be balanced on three "legs" like a stool: marketing, underlying technology, and user experience. Each is critical. If one dominates, imbalance occurs and the product probably fails. However, different aspects of the product are important at different stages in the life cycle. Early Adopters are interested in the capabilities of technology. Marketing and user experience have to be just "good enough." Late Adopters are much fussier and require a balance of all aspects.

Norman (1998b) also points out that the technology industry is actually presenting a paradox because, while the success of a new technology depends of its acceptance by the majority of Late Adopters, many technologies are still designed and produced for Early Adopters. According to his view, this is the reason for the failure of some of the technologies. It is only when the technology itself is transparent to the user and it is easy to use that the gap between Early Adopters and Late Adopters is closed.

Few people would doubt that computers have become a big part of daily life. The results presented here show that this is also true for Israelis who are teaching physical education and coaching in general. However, this may not necessarily be true when it comes to performing teaching tasks and coaching. This issue is discussed in sub-section 7.1.2.

7.1.2 Professional Innovativeness

Question 2: What are the categories of adopters to which computerized technology been diffused for performing teaching/coaching tasks?

The major concern of the study was the use of computerized tools (such as the Interactive Volleyball CD-ROM) by physical education teaches and coaches for carrying out their job-related tasks. Therefore, subjects were asked about software that they used and the year they first started to use it. This value was referred to as *Professional Innovativeness* or, Definition of Innovativeness, the degree to which an individual is relatively early in adopting computerized tools for teaching and coaching tasks, compared to other members of a system, based on Rogers (1995). It was calculated taking first time professional computer usage reported. The Professional Innovativeness mean was calculated as 4.36 with a standard deviation of 4.17 (*n*=87), suggesting that using computes for job-related missions started on average to take place about four years before 2004 (i.e. around mid 1999).

In the Pattern of Computer Use questionnaire, 64% reported the use of computers for professional tasks. This suggests that computers are used to fulfill teaching and coaching related task by about four major groups, based on Rogers' (1995) model: Innovators, Early Adopters, Early Majority, and part of the Late Majority group. However, it should be noted, as discussed in question 5, that most of the applications used at that point are general, rather than specifically designed for that purpose.

7.1.3 Innovativeness and Professional Innovativeness Time-Gap

Question 3: What is the time-gap between the adoption of a technology for personal uses and its adoption for professional purposes?

The study results show that subjects tend to adopt a computer application for general purposes and, only after a period of time, do they start to use it for teaching or coaching tasks. This is in accordance with Jacobsen (1998) in a study of university faculty members. She looked at the adoption of computers for three different tasks: professional, research, and teaching. The results showed that subjects appeared to have adopted computers for professional and research tasks approximately a decade earlier than for teaching tasks.

Results from the current study suggest that on average, subjects reported that they used computers for personal tasks about four and a half years before they used them for teaching and coaching related tasks. It should be pointed out that in both situations, teaching applications seem to occur much later than to other tasks (personal use in the current study, and professional and research tasks in Jacobsen, 1998).

7.1.4 Level of Experience

Question 4: What is the current level of experience in computer usage of physical education teachers and coaches, and what are the trends in using computers?

One assumption underlying the study is that the diversity of the target population regarding previous experiences with computers is an important factor that needs to be taken into consideration when developing new, computerized technology. This idea is based on Rogers' (1995) suggestion that it is necessary, at times, for multiple innovations to be adopted at the same time. Such an example was offered by Hahn and Schoch (1997) from a different study area. They pointed out that it is not possible to introduce cars that use hydrogen as a fuel without providing a way to refuel such cars and an infrastructure to support such refuelling. The researchers refer to this phenomenon, where adopters of an innovation do not have to adopt all members of the cluster, but if they adopt one, then it is more likely that they will adopt others, as "an innovation cluster." In the field of IT this is more obvious when users of one software, such as word-processing, need to use another computerized tool such as a Windows operating system or the Internet.

To answer the question regarding prior level of experience in computer use, subjects were given the Computer Experience scale with a list of 41 tools and applications. They were to rank their level of expertise on each on a 0-4 scale. Total Level of Expertise was calculated by adding the usage of each tool or application. Additionally, the Level of Expertise was also measured with two additional questions. In the first, subjects were asked to mark their current stage in adopting computerized technology (on a 1-6 scale). In the Pattern of Computer Technology Use, they were to rank their prior experience with computers (from none [0] to very experienced [4]). The different methods were used in order to validate some of the scales for possible future use.

Data analysis described in chapter 6, suggests that prior level of experience in using computers can include two dimensions. The first is the level of expertise, while the second is the diversity usage, or, in other words, the variety of applications and tools that are used. As explained, the level of expertise factor was found by averaging scores on the Stage of Adoption of Technology and the Experience with Computer Technology items, after bringing both of them to a common, 1 to 5 scale. The average score was found to be 3.61 with a standard deviation of 1.04. The second computer experience variable was designed to determine the various ways in which coaches use computers. This was done by adding the level of experience with the 41 tools and applications on the Computer Experience scale. The results showed that on average, subjects' scored 23.92 on a 0 to 164 scale. On another related variable, the number of tools, which subjects reported using in levels 2, 3 or 4, was counted. On average, subjects reported using 7.58 tools. It should be noted that only three subjects reported that they were using only one tool. This might support the "technology cluster notion," suggesting that subjects tend to use more than one computerized tool.

To answer the second part related to trends in using computers, subjects were to note the average number of hours spent per week using a computer. Thirty-one percent reported that they used computers for more than 5 hours a week, 25% for 3 to 5 hours a week, 26% 1 to 3 hours, and 19% for less than 1 hour. When asked about the amount of time per week they used the Internet, the majority (35%) reported less than 1 hour, or for 1 to 3 hours (34%).

7.1.5 Computerized Tools and Applications

Question 5: What are the computerized tools and software that are used by physical education teachers and coaches?

The Computer Experience scale, with a list of 41 applications and tools, was used to learn about the software usage. The results showed that the most popular computerized tool in the sample was the Windows operating system, which was about 80% of users. Word-processing applications were used by 74%, Internet and Spreadsheet were used by 54%, and 53 % sent and received e-mails. These five applications were used by more then 50%, suggesting that they were used by Innovators, Early Adopters, Early Majority, and Late Majority alike. The only category that had not started to use these applications was the Laggards. However, based on the fast rate of computer application diffusion, one can assume that some of the Laggards have started to use it by now.

The sixth tool mentioned was a Presentation package (such as the popular Power Point), used by 46%. This suggests that it was still used only by Early Majority. That, of course, only true with respect to Israeli physical education teachers and coaches.

Rogers (1995) has defined a "critical mass" point to be when the diffusion curve of an innovation has passed the 16% adoption level takes place. In the current study, 11 applications had passed the critical mass point. The other five, in addition to the six just mentioned are: Windows 3.1 (34%), PC-DOS (27%); computer games (21%); on-line databases (19%); and, graphics programs (18%). It is important to note that two of the mentioned tools (PC-DOS and Windows 3.1) are no longer in use, as the popular operating system now is Windows. This is somehow in contradiction to Rogers' (1995) suggestion that any innovation fully diffuses eventually. With the rapid changes in today digital technology, that suggestion should be regarded with caution.

It seems that subjects are using general tools such as Microsoft Office rather than specially designed tools when it comes to carrying out teaching and coaching tasks. When asked about the tools they used for professional tasks, an identical list of applications was generated. Again, the most popular tool was the Windows operating system (39%) and, thereafter, word-processing (38%), Internet (28%), e-mail (24%), presentation packages (22%) and spreadsheets (22%). The only difference was on the rank of spreadsheet, which scored a little less than e-mail and presentation tools, with respect to teaching and coaching usage. It should be noted that none of the tools used for professional purposes passed the diffusion of 50%, suggesting that only the Innovators, Early Adopters, and Early Majority were using computerized tools to perform teaching and coaching tasks.

Additionally, all the previously mentioned tools are general ones that can be used for many purposes. When it comes to specific tools, those that can be used in teaching and coaching only (e.g., grading, statistics, designing and creating practice/lesson plans, tutorials, simulation), the diffusion level is relatively low. Thirteen percent were using a grading application, which was the most popular specific teaching/coaching computerized tool reported. This suggests that this specific type of applications is used only by the Innovators and Early Adopters.

7.1.6 Users' Needs

Question 6: What are the major requests (needs) of physical education teachers and coaches major from computerized tools?

The development process of the Interactive Volleyball CD-ROM was started by identifying the needs of teachers and coaches. Those were: 1) knowledge of background information and theory of coaching; 2) database of drills that are the content of practice/lesson, and 3) tools for developing practice/lesson plans. As a result, the developed CD-ROM is a suggested solution for these needs. However, a more comprehensive review these needs is required before developing future applications because such information was not found in relevant literature.

The survey included an open question where subjects indicated potential other functions of such tools. Not many replied to this question (48 responses or only 53%). Of these, 12 apologized that they could not answer this question as they did not have enough knowledge. The majority of the relevant responses suggested that such a tool should include a drills database; preferably, a multimedia-based bank. Other common suggestions were: statistics, knowledge base about teaching and coaching, and skill analysis. It should be mentioned that no one was asking for a planner tool such as the one included in the

Interactive Volleyball CD-ROM. To the author's understanding, this is not due to the lack of a need for such a tool, but rather to the lack of information that such a tool can be developed.

To strengthen this point and to learn about the time-saving potential of a lesson/practice planner, subjects indicated the average amount of time they dedicated to creating and managing practice/lesson plans as well as the average number of plans written weekly. The last variable was found to be about five (5.09) plans a week, but with a large diversity (S.D.= 5.09). Twenty-two percent reported that they did not dedicate time for preparing plans, and four others (5%) dedicated less than one hour for planning. However, the majority of the sample (70%), it took on average, 1.5 hours to write a practice/lesson plan, and 3%, about three hours. In the majority of cases (91%), the teachers and coaches wrote the plans themselves, and only 9% used assistance. It may be concluded, therefore, that on average, a teacher or coach spends 7.64 hours weekly (1.5 h. times 5.09 plans) on writing practice/lesson plans. Future studies would be beneficial to determine whether or not using the Interactive Volleyball CD-ROM to create practice/lesson plans can decrease this amount of time.

7.1.7 Purchasing Trends

Question 7: What are the major trends among physical education teacher and coaches in relation to the acquisition of computerized tools?

In order to explore the technology adoption process, subjects were to state when they bought their first computer for *personal* and for *professional* tasks. Thirteen subjects (15%

of the sample) did not buy one for personal use, while 68 (76%) did not buy one for job-related purposes. The distribution of the replies to questions 3 and 4 is shown in Figures 6.12 to 6.15. Similarly, subjects were queried on the number of computers they owned. The distribution suggests that 6% (4 subjects) already owned five computers, 9% (6 subjects) owned four, 28% (19 subjects) owned three and 25% (17 subjects) owned two. Fifteen subjects (22%) owned only one computer and seven subjects (10%) did not own a computer. This data is contradictory to that from Question 3, which suggests that 15 subjects (more than double of the amount) did not buy a computer for personal uses. This might be related to the large number of missing replies for this question and also that subjects, who did not own a computer, did not reply to this question.

The only information found on the Israeli Central Bureau of Statistics website that compares is the data in 2003, where 54.6% of families in Israel reported at least one home computer, while 30.8% were connected to the Internet. The current study suggests that 85% already had a computer for personal use, which is similar to that reported to the Israeli Central Bureau of Statistics survey. This is not surprising taking into consideration that the sample is relatively educated in an academic profession, while the general survey included all families in Israel.

The survey was mostly interested in computer assisted instructional tools such as the Interactive Volleyball CD-ROM. To learn about previous experiences with teaching/coaching related software, the question was directed at familiarity with such software, and if it was currently used. The results showed that 43% were not aware of any teaching/coaching related software at all. Forty-four percent were to some degree, but only one or two. Only 14% were quite familiar with such tools. At the same time, only 19% was currently using teaching/coaching related software, while the majority (81%) was not.

Subjects were to indicate whether or not they would like to incorporate computer software to their teaching/coaching, and if so or "Maybe," they were to explain further. The replies were as follows: 63 (78%) of the 81 return answers were affirmative; 14 (17%) replied with "potential" incorporation; and only 4 (5%) did not want to use technology in their work. Explanations included computer usage advantages such as time-saving, organization, easy demonstration, efficiency, improving computers skill, and so on. When asked the kind of application they wanted, planning practices in various sports, skill analysis, statistical packages, and Internet websites were cited.

In order to better plan a strategy for diffusing sport-related applications, factors that most affect decisions in selecting computer software were important. The results show that the most important factor (76%) was a recommendation from a colleague. All other factors lagged behind: 35% were affected by software availability, 28% by district policies and procedures, and 23% by advertisement in the media. Some (18%) also mentioned other factors such as cost, quality of the product, and recommendation from a family member or friend.

7.1.8 Barriers

Question 8: What are possible barriers in implementing the Interactive Volleyball CD-ROM?

Access, *training* and *support* are assumed to be key issues in adopting computer technology. Therefore, several questions were designed to learn about the availability of these variables.

Eighty-nine of the subjects reported steady access to a computer for personal tasks, but only 53% for completing professional tasks. An additional 11% stated sometime access for personal uses, and 29% for teaching/coaching related tasks. The importance of available access to hardware and software is also inline with research within the Diffusion of Innovation paradigm that examined innovations that failed to be adopted. Teasley (1996) for example, studied the diffusion of educational computing within a school. The availability of hardware and software and the differing levels of computing skills among teachers were important factors in their decisions about computer use.

With regard to "satisfaction from support" related to computer integration into teaching/coaching, only two subjects were "very satisfied" with such support, and 11 other subjects were "satisfied." That is, in total, only 17% were satisfied or very satisfied with professional-related support. On the other hand, 42% were "unsatisfied" (29%) or "very unsatisfied" (13%). An additional 41% reported a neutral position, which may also indicate that they had no support and, therefore, could not answer this question.

A similar trend was reported for the question about "training satisfaction." Fifteen percent were satisfied (11%), very satisfied (4%), while 48% were unsatisfied (38%), or very unsatisfied (10%). This trend is important to the educational ministry in Israel because it is trying to increase the level of technology integration into profession-related tasks. Better training and support programs probably increase the level of computer usage.

Training is an important factor at the beginning, when first learning to use computers, but also in updating computerized skills. In that context, the question was posed on acquisition of *initial computer skills*. The most common replies were: self-taught (51%), from a peer (34%), and by a formal course (33%). It is apparent that the majority acquired computer skills in a non-formal method such as self-teaching or from a friend. When asked about acquisition of overall range of computer knowledge and skills, the results showed that 80% did so mainly by self-teaching. The second most common response (55%) was taking a "formal course." However, it should be pointed out that 82% did participate in computer courses/workshops and only 18% did not.

With regard to updating knowledge about computer usage and applications, 22% reported that they read relevant magazines and journals, 27% took a computer class, 6% participated in user groups, 11% in a workshop. However, the majority (49%) reported updating knowledge in a different way such as friends, Internet, self-teaching, family members, and so on.

While the survey part of the study was used for specific research questions, several experimental designs were employed to test research hypotheses (see Methodology section).

7.2 The Experiment - Testing Study Hypothesis

Two major theoretical models have been used in the study to further investigate the diffusion process: first, the Innovation Diffusion Theory (Rogers, 1995; Agarwal and Prasad, 1997), and second, the Technology Acceptance Model (TAM) (Davis, 1989; Davis et al., 1989). Both models suggest that external variables (e.g., innovativeness, attitude, previous experience, and others) play an important role in the adoption or rejection of a new technology. However, these two models do not identify specific variables and relationships even though Rogers (1995) has listed such possible variables. The "modified" model constructed for the purpose of the current study, tested some of these. It is suggested that the ability to predict computer usage behavior has been an important focus of interest of IT research for several years Therefore, one of the main study aims was to explore further, the role of external variables within the field of diffusion of innovation.

Prior studies investigated the relationship between individual characteristics and the outcomes of the information technology acceptance process. In most cases however, the research lacked theoretical background and did not allow insights into the factors that mediate between individual characteristics and diffusion of innovation. For example, research has rarely attempted to explain variables that intervene between individual differences in accepting IT and the success in using IT (Agarwal & Prasad, 1999). Applying a "structural equation modeling" (SEM) procedure may allow for the exploration of those interrelationships between external variables, innovation characteristics and adoption intention. The following sub-sections 7.2.1-7.2.5 discusse the analysis of the 28 study hypotheses.

7.2.1 TAM-related Hypotheses (Hypotheses 1-3)

The statistical analysis tested the goodness of fit between the proposed model and the collected data (i.e., validation of the model). The first three hypotheses were based on the relationships suggested in TAM between the innovation attributes and the intention to adopt a technology (see subsection 4.1.2 for the list of the hypotheses).

Two innovation attributes were measured: innovation perceived relative advantage and innovation perceived complexity. Using both SEM and Multiple Regression techniques, the results yielded support for the hypotheses which propose that innovation attributes affect a person's decision to adopt or reject an innovation. The effects of the perceived complexity on the perceived relative advantage of an innovation (as suggested by TAM) were confirmed. The results showed that using SEM, 36% of the variance of the intention to adopt an innovation can be explained by two characteristics: perceived relative advantage and perceived complexity. Using a Step-wise Multiple Regression analysis the value was even higher (41%).

Rogers and Scott (1997), based on other studies, reported that 49-87% of the variance in the rate of adoption can be explained by five perceived attributes of the innovation: Relative Advantage, Compatibility, Complexity, Trialability, and Observability. In this study, only two attributes (PRA and PCo) were measured. Presumably, adding more innovation attributes could further increase the power to explain the variance of in intention to adopt an innovation.

The results, suggest that the rate of adoption of different innovations depends on the perceived qualities of them in accordance with TAM and the DoI. That is, the nature of the innovation has implications for its diffusion. Moreover, it is widely recognized that the perception of the innovation by a potential adopter, and not the "objective" characteristics of the innovation, is the determinant factor in the diffusion of an innovation (Rogers, 1995). In principle, innovations that possess favorable characteristics tend to be more attractive and easier to adopt. Therefore, such technologies tend to diffuse more rapidly than do those with less favorable characteristics (Rogers, 1995).

Perceived relative advantage (PRA) has been found in this study to be the most important attributes of an innovation, which may affect the intention to adopt. PRA refers to the extent the potential adopter perceives an innovation as superior to alternative products, services, or concepts (Rogers 1995). Similarly, previous research by Tornatsky & Klein (1982) shows that the relative advantage of an innovation is the best predictors of the extent of adoption. Also, in a study by Tan Tsu Wee (2003) using a different approach the importance of PRA was emphasized. In the study consumers were to report the variable they believed to affect their tendency to adopt a technology. The results note that customers rated relative advantage as the most important factor.

The second factor found to contribute to the intention decision to adopt an innovation was perceived complexity of the innovation. "Complexity" is defined as the extent to which an innovation is perceived as difficult to understand and to use (Rogers, 1995). "Ease-of-use" refers to the same characteristic of the innovation but with opposite results. "Complexity" is the term mostly used by Rogers' (1995) diffusion model, while

TAM uses "perceived ease-of-use." High perceived complexity of an innovation may cause delays and lower probability of adoption.

As suggested by TAM, complexity has been also found to affect perceived relative advantage and, therefore, has also an indirect affect the intention to use the CD-ROM. That is, the relationship between perceived complexity and relative advantage and IT diffusion (i.e., the adoption process) according to the original TAM, suggests that perception of the relative advantage of a new technology is influenced by its ease-of-use characteristic. Thus, the term relative advantage is emphasized while capturing the relative character of this advantage concept. Considering its complexity level, the innovation will be perceived as offering a high or low relative advantage.

In brief, hypotheses 1, 2, and 3 validate TAM's relationships based upon the collected data. The results of the present study provide positive evidence for this first set of hypotheses. Perceived Relative Advantage and Perceived Complexity of the Interactive Volleyball CD-ROM significantly affected the intention of adoption by sport practitioners. Furthermore, Perceived Complexity affected Perceived Relative Advantage of the CD-ROM application.

7.2.2 External Variables and Innovation Attributes (Hypotheses 4 and 5)

Multiple Regression Analysis was used to select the most important external variables that affected the perceived innovation attributes, and subsequently, the intention to adopt an innovation. The results show that *professional innovativeness*, *specific attitudes towards working with computers in physical education and sport*, and *formal education* are the three most relevant variables to affect adoption intention. While *specific attitude* may have affected perceived relative advantage and perceived complexity, the *professional innovation* factor affected only the perceived complexity while *formal education* affected only the perceived relative advantage.

It is worth noting the specific relevance of the variables chosen for the model. Of the five attitude variables measured in the present study (anxiety, confidence, liking, usefulness, total attitude and specific attitudes), only *specific attitudes* was included in the model. This variable describes attitudes towards using computerized tools in coaching and teaching practice. Similarly, *professional innovativeness* included in the model, refers to context-related innovativeness. This aspect was measured by asking subjects to recall the first usage of computers to fulfill assignments in physical education and sports work. *Formal education* may also be a variable related to the profession because the subjects had a Bachelor in Physical Education. This may suggest that the external variables that affect the process outcomes may be specific to the type of innovation although the process of adoption, follows a general model suitable for different populations and different types of innovations.

The negative relationship between formal education and perceived relative advantage should be noted. According to the results, individuals with a higher formal education (Masters and PhD levels) tend to perceive the advantage of an innovation as relatively low. It might be that such individuals are already more experienced and more commonly exposed to similar applications and therefore perceived the relative advantage of the CD-ROM as lower.

The suggested model assumes a relationship between previous experience, innovativeness, and new attributes of professional innovativeness. It was implied that innovativeness can be conceptualized as a "general personality dimension." Professional innovativeness, on the other hand, describes a specific behavior within a certain category. This idea was also posed recently by Vishwanath (2005), who measured two types of innovativeness: a global innovativeness and a context-specific one.

The model suggests that innovativeness and self-efficacy (two personality traits) contribute more than 24% to the variance of prior experience in the use of computers. In addition, innovativeness and prior experience can both account for 46% of the variance when predicting professional innovativeness. This is a relatively high level of explained variability (or prediction) of one variable by other two, especially given the small number of participants.

Based on these findings, it is concluded that the two hypotheses (4 and 5) on the relationship between selected external variables (innovativeness, self-efficacy, previous experience, professional innovativeness, specific attitude and formal education) on the intention to adopt an innovation were supported by the data. Professional innovativeness and specific attitude positively correlated with perceived complexity. Specific attitude also correlated positively with PRA, while formal education was negatively related to the former. Additional relationships found between the external variables are described in the model.

7.2.3 Adopter Categories and Individual Differences (Hypotheses 6 – 17)

A set of hypotheses tested in the current study are concerned with the individual differences among groups of adopters. By individual differences, it is referred to user-related factors that include characteristics such as demographics and personality traits, as well as situational variables such as prior experience and attitudes. Understanding the differences between adopter groups may be a way to reach successfully, individuals at various stages of adoption (Robinson, Fornell & Sullivan, 1992).

Based on the assumption that individuals differ in their readiness to adopt new products, Rogers (1995) described a scale of five types of persons exposed to technology: Innovators, Early Adopters, Early Majority, Late Majority and Laggards. At one extreme, Innovators are the pioneers and risk takers, who take up an innovation very early in the diffusion process. At the other end, Laggards are opposed to adopt an innovation until relatively late in the diffusion process (if they do so at all).

Employing quasi-experimental design, twelve hypotheses put forward in this study were concerned with differences among categories of adopters. Two comparisons were described in the Results. The individuals were first divided into four groups, where, Innovators and Early Adopters were collapsed to form one group. Additionally, two major groups (Early Adopters [16%] and Majority [84%]) were compared to test the hypotheses. This regrouping was carried out because of the relative small sample size. Beyond that, a two-group comparison is commonly accepted as reported in the literature (e.g., Venkatesh & Brown, 1998). This categorization is also correlated with Moore (1991) who used Rogers' (1995) ideas as a basis to market high-tech products to a mass market. Moore suggested that there is a "chasm" between the second and the third of Rogers' categories (i.e., between Early Adopters and Early Majority) in about 16% of the population.

It should be noted at this point that individuals were divided into adopter categories according to their innovativeness, which is a relative dimension. That is, a person is considered as a member of a category depending on his/her innovativeness on a scale that compares his/her level of innovativeness relative to others within the same social system. This is in agreement with DoI (Rogers, 1995), suggesting a diffusion process is related to a social system (Rogers, 1995). However, innovativeness is not only a relative term but also a continuous variable that is simplified, and used as a conceptual tool that enables the grouping of people into innovativeness categories.

The following table summarizes acceptance or rejection of the null hypotheses concerned with individual differences among categories of adopters using the two-group categorization scheme.

Table 7.1

Summary Results of the Acceptance/Rejection of Hypotheses 6-17

H. #	**Factor**	**Variable**	**H_0 Rejection**
6	Age		No
7	Gender		No
8	Education	Formal Education	*Yes*
		Coaching Education	No

9	Coaching Experience	Coaching Sports	No (opposite direction)
		Coaching Volleyball	No
10	Professional Innovativeness		No
11	Experience working with computers	Level of Expertise	No
		Variety Expertise	No
12	Self-efficacy		*Yes*
13	Attitudes towards working with computers	Anxiety	No
		Confidence	No
		Liking	No
		Usefulness	No
		General Attitude	No
		Specific Attitude	No
14	Perceived Relative Advantage		No
15	Perceived Complexity		No
16	Intention to use the CD-ROM		No
17	Using the CD-ROM		No

Two demographic variables were found to differentiate significantly between Early Adopters and the rest of the population: formal education and previous coaching experience (number of years). It was found that Early Adopters have significantly more years of formal education, but less experience in coaching compared to the majority group. In addition, self-efficacy (a personality trait variable) was also found to be associated with categories of adopters. Early Adopters tend to have a higher level of self-efficacy as compared to the rest of the population.

The Diffusion of Innovation literature is inconsistent with regard to individual differences. Studies on innovators and Early Adopters often vary in the demographic profiles. Early Adopters are often termed 'venturesome and respectable' (Rogers, 1985). Other studies show that Innovators tend to have a higher income, a higher education, and are slightly younger than the majority. Innovators and Early Adopters are often characterized as having more favorable attitudes towards risk and rate higher on opinion and leadership (Atkin, Jeffres & Neuendorf, 1998). It is generally agreed that Early Adopters tend to be better educated than Late Adopters (Brancheau & Wetherbe 1990; Rogers 1995) and, consequently, Early Adopters are more likely to have a wider exposure to computers and, potentially, are more computer-literate than are Late Adopter. This is also consistent with findings reported in marketing research that has identified different profiles of consumer Innovators (Dickerson & Gentry, 1983; Holak, 1988).

From a technology innovation-marketing vantage point, Moore (1991) regarded Early Adopters and Early Majority groups of individuals as two significantly different "markets." He suggested that the transition from Early Adopters to Early Majority offers particular potential for marketing strategy failure because of the large differences between the two groups.

However, from a scientific point of view there is little evidence to substantiate the claim that there are differences in psychological and demographic characteristics between categories of adopters (Venkatesh & Brown, 1998). Atkins, Jeffres, and Neuendorf (1998) and Lin (1998), argue that demographic profiles are not sufficient to predict adoption behavior. The adoption of technology is better predicted by user needs, which is considered to be a prime determining factor (Atkins, Jeffres, & Neuendorf, 1998).

A more specific discussion about differences in subjects' self-efficacy and perceived attributes of the innovation are in sub-sections 7.2.3.1 and 7.2.3.2.

7.2.3.1 Self-efficacy and Adopters' Categories

Self-efficacy has been widely studied (Bandura, 1977; Barling & Beattie, 1983; Webster & Martocchio, 1992). Self-efficacy is a person's belief about what his/her ability to perform a particular task or behavior. Previous research suggests that individuals with a high self-efficacy choose to perform challenging tasks, set higher goals, and invest more effort than do individuals with a low self-efficacy (Schwarzer, Mueller, & Greenglass, 1999).

Initial evidence for higher self-efficacy of Early Adopters versus that of the Majority (which she referred to as "main streamers") was reported by Jacobsen (1998). The results of the present study also suggest that generalized self-efficacy can distinguish between Early Adopters and the Majority. Early Adopters present a greater level of generalized self-efficacy compared to the rest of the population.

A computer self-efficacy scale was especially design to measure the judgment of one's capability to use an information technology (Agarwal, Sambamurthy, & Stair, 2000). Results show that self-efficacy may have a significant influence on a person's actual computer usage (Compeau & Higgins, 1995). Marakas, Yi, & Johnson, (1998) reviewed 40 studies on computer self-efficacy and found that a majority established a relationship between computer self-efficacy and some computer-related behavior. Agarwal et al. (2000) found that computer self-efficacy is strongly correlated with perception of ease-of-use of various software packages.

7.2.3.2 Innovation Characteristics and Adopters' Categories

In the current study, differences between the two groups of adopters in PRA and in Perceived Complexity were not significant. Therefore, in this study there does not appear to be any support for the position that attributes of innovation influence Early Adopters differently than they do the Majority.

Moore (1991) suggests that people in each adopter category are systematically different from those in the preceding category and he refers to such differences across categories as "cracks in the bell-curve." His view may suggest that innovations that succeed among Innovators and/or Early Adopters are likely to fail among Early and/or Late Majority groups since the innovation may not have characteristics to attract adopters in later categories.

Other studies (Davis et al., 1989; Fishbein & Ajzen, 1975) assume that there is a common set of determinants of behavior shared by various segments of the population. More specifically, the same set of innovation characteristics such as those identified by Davis, et al. (1989) (e.g., usefulness, ease-of-use) is expected to influence the adoption of an innovation across all adopter categories. The results therefore, support TAM whereby no differences were found between the adopter categories in the perceived characteristics if the innovation, That is, the perceived characteristics seemed to affect all individuals in the same manner.

7.2.4 Time Related Hypotheses (Hypotheses 18-24)

Time is a very important factor in Rogers' model (1995). The current study included three *time* measurements during the process of adoption. Data was assessed before the workshop, after the workshop, and about 18 months later. When pre-workshop data was compared with the follow-up it was found that with time, level of expertise increases while anxiety level towards working with computers decreases. However, no significant differences were found for other attitudes variables (liking, confidence, usefulness, general and specific). Therefore, with regard to attitudes towards computers, anxiety might be a more "sensitive" attitude compared to other measurements. In order to start using computers, subjects need to decrease anxiety. Once computer usage is adopted, other attitude variables may change.

The present results reject the hypothesis advocating that self-efficacy increases as a function of time. That is, self-efficacy is a stable personality characteristic that does not change with time (over a period of 18 months). This may be an important point for the prediction of intentions towards an innovation. Since it is a relatively stable trait, it may be reliably measured. Henceforth, it may be helpful for predicting a person's intention to adopt technologies. However, its outcome on the process was not fully tested in the present model.

Additional, time-related hypotheses disregard the time-gap between general and professional innovativeness. Subjects' innovativeness has been found to be significantly higher than their professional innovativeness. On average, this time-gap has been approximately 4.5 years. Jacobsen (1998) reported around ten years for university faculty. That is, a decade had elapsed between the onset of computer adoption for professional and research tasks and adoption for teaching. After comparing those results with the current study, it is suggested that this gap is decreasing because of the evolution of computer technology and its ever-increasing influence in our lives. However, further research is needed before reaching a conclusion.

7.2.5 Innovativeness - Previous Experience Relationship (Hypothesis 25)

Previous experience with computers is an important external variable investigated within the diffusion of innovation. Its importance is rooted in the work of Rogers (1995) under the concept of "technology cluster."

Empirical evidence suggests that Early Adopters are often among the most frequent users within a product category or within similar product categories (Gatignon & Robertson, 1985). According to these researchers, such innovators have a greater technological knowledge as well as the ability to process complex information that, in turn, improves outcome predictions. Neuendorf et al. (1998) suggested that new technologies are more likely to be adopted if they operate in a similar way to existing technology. They noted that the concept of "technology cluster" provides a better description of innovators than more general profiles in new technology application.

This concept can even be extended to technologies from different categories and not exclusively to within the computer applications family. For example, ownership of diverse technologies was found to predict the use of other functionally similar products (Atkin & LaRose, 1994). Similarly, computer ownership may allow predicting cellular phone ownership and frequency of use (Vishwanath & Goldhaber, 2003). Thus, understanding the influence of previous experience on technologies other than computers may be relevant to understand the influence of previous knowledge on the adoption rate of new technologies. This idea also coexists with the perception of innovativeness as a global and general personality characteristic, as previously discussed.

In previous studies (Anderson, Varnhagen, & Campbell, 1998; Jacobsen, 1998), it has been commonly assumed that innovativeness and level of expertise are synonymous as far as computers use is concerned. In the present study, this assumption was tested by examining the relationship between Total Level of Expertise in computer usage (i.e., a sum of level of expertise on a 0-4 scale in the relevant tools and applications) and innovativeness (onset year of use of relevant tools). The Pearson correlation shows that the relationship between these two variables is only moderate ($r = 0.451$), but significant at $p<0.01$. Therefore, it may be concluded that these two variables are, indeed, related but each one contributes only about to 20% of the variance of the other.

Also in the proposed model, a one-way relationship was assumed, whereas innovativeness was hypothesized to affect individuals previous experience with computers.

Again, the correlation was significant but yielded a low-moderate score (r =0.37). Moreover, approximately 24% of variance in previous experience can be explained by the combination of innovativeness and self-efficacy.

7.2.6 International Context Differences (Hypotheses 26-28)

The last group of hypotheses is intended to assess innovation diffusion in different countries and cultures. This was done within the diffusion of innovation framework which is concerned with the effects of society on the rate of diffusion. Rogers (1995) suggested that "social norms" are factors that influence acceptance of an innovation. Therefore, in the present research effort, data were collected in two countries under the assumption that the two are different in some aspects of their cultural grounds. It was hypothesized that if there are differences in the diffusion of innovation these might be a result of international context differences.

Firstly, the results show that Canadian practitioners (physical education teachers and coaches) were significantly more innovated, experienced, and literate in computers than their Israeli counterparts. However, it is not known if these are exclusive findings only related to respective populations of physical educators and coaches in either country, or part of more global trends at a national level in Canada and in Israel. In order to address this concern, relevant statistical databases were searched through the Internet and by other means.

The website of the International Communication Union (ITU) (http://www.itu.int) (containing databases regarding the number of PC and Internet users around the world) reports that there were 70.54 PC users per 100 inhabitants (i.e., about 7,054 users per 10,000 inhabitants) in Canada, 2004 , and 6,300.60 Internet users per 10,000 inhabitants. By contrast, in Israel, there were 73.40 PC users per 100 inhabitants (i.e., about 7,340 users per 10,000 inhabitants), and 4,663.36 Internet users per 10,000 inhabitants. The same source reported the statistics for the years 2001 and 2002. Therefore, different trends can be observed in both countries as far as computer-use habits are concerned (see Figure 7.1).

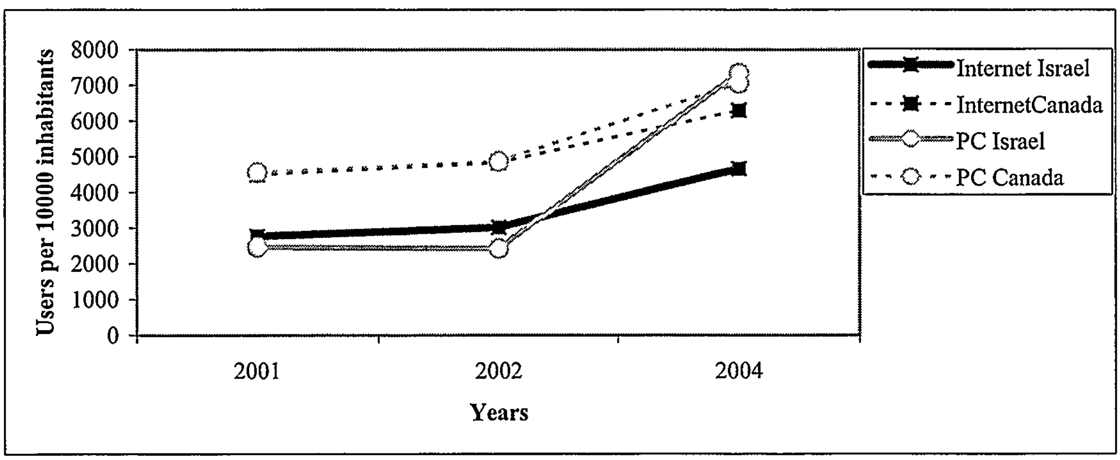


Figure 7.1. Number of PC and Internet users per 10,000 inhabitants (based on the data on ITU website).

While in 2001 and 2002 the relative number of PC and Internet users in Israel was relatively low as compared to the diffusion in Canada during the same period, the gap was closed for PC users during 2003 and 2004. However, the Internet still has diffused more in Canada compared to Israel.

Bearing in mind the diffusion of innovation theory and the S-shaped curve of innovation diffusion, it can be argued that the diffusion curve in Canada is somewhat different compared to that in Israel. This may be explained through Rogers' (1995) idea of "communication channels." Rogers (1995) defined communication channels as a method for transmission of information about an innovation from one individual to another. According to his theory (as can be see in Figure 2.1) communication channels affect all five phases of innovation diffusion process.

Rogers (1995) suggested that, basically, there are two types of communication channels: mass media and interpersonal channels. The difference between the two is the way information is disseminated. Mass media transmits information knowledge through sources such as radio, TV, newspapers, and the Internet. Interpersonal communication channels relate to sharing information between two individuals (person-to-person).

A parallel explanation was suggested by Hall and Hall (1987) who presented a theory for high and low communication context. Communication context is "the information that surrounds an event and is inextricably bound up with the meaning of that event" (Hall and Hall, 1987, p: 7). Such a theoretical concept may be relevant because countries can be differentiated by to their communication context. For example, Hall and Hall suggested that Japanese, Arab, and Mediterranean cultures should be labeled as "high-context" due to their extensive networks and close inter-personal relationships. On the other hand, the USA, Germany, Switzerland, and Scandinavian countries were labeled as low-context since people require more context-specific information in their communications. Even though Canada and Israel are not mentioned specifically, it can be suggested that Israel belongs to the former group with a high-communication context and Canada to the second group.

Therefore, it is suggested that information in Israel is based more on interpersonal or high-context communication channels and, thus, the diffusion of an innovation started at a relatively low rate. However, the rate accelerated once a "critical point" was exceeded and, thereafter, the rate of the diffusion exhibited a steep slope. A "critical mass point" is defined as the point whereby individuals have adopted an innovation for it to succeed, based on the rate or momentum of adoption (Rogers, 1995). As a result, the two countries exhibited different adoption curves, as schematically represented in the Figure 7.2.

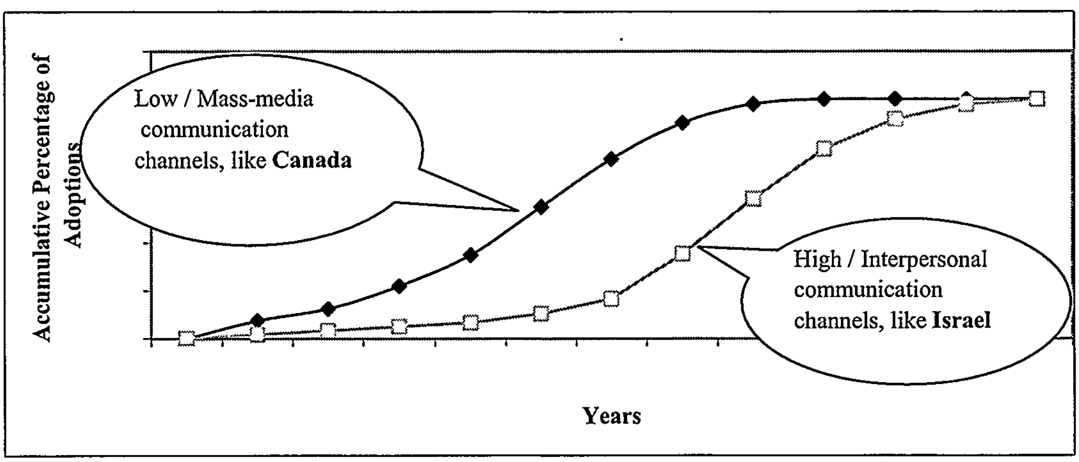


Figure 7.2. A schematic illustration of two curves representative of different S-shape diffusion of innovation processes.

Even though this phenomenon is not completely evident from the graphs in Figure 6.77 (i.e., Israeli and the Canadian cumulative percentages of PC adoption), a tendency could still be observed. For example, in 1995 (9 years ago), the difference between the number of teachers and coaches in Canada and those in Israel, who use computers, is relatively large (almost 40%; 88% in Canada and 49% in Israel). In 2003, this gap decreased to less than 10%. However, the gap remains with regard to professional innovativeness where in 2000, it was still equal to about 23% (82% adopt computers for professional uses in Canada, and 59% in Israel).

It might be argued that this comparison between innovativeness and professional innovativeness is somewhat similar to the previously reported data about PC and Internet adoptions. That is, each country presents a typical diffusion curve, but the population is at a different stage in each technology usage. This is shown schematically in Figure 7.3. While Israel and Canada are close to a plateau in the curve of adoption, at almost 100% adoption in the general use of PC (black/solid arrows), both countries are still far from an asymptotic state regarding Internet or professional innovativeness within physical education and sport areas.

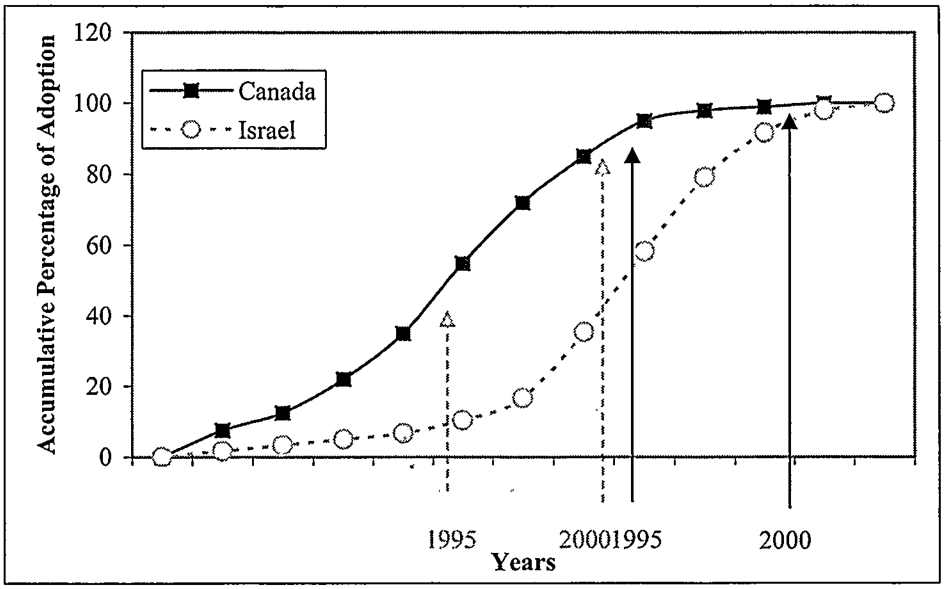


Figure 7.3. Schematic representation of Israeli and Canadian adoption curves: A comparison between two different S-shaped curves and two possible innovations (black/solid arrows – general innovation; red/dashed arrows – context specific).

7.3 Limitations of the Study

There are several limitations that may potentially influence the generalization from the current study:

1) Sample limitations – The study did present some limitations, whereby several are related to the sample. The latter was relatively small and, thus, it is unlikely to be an ideal representative of the general population of teachers and coaches all around the world. Nevertheless, participants were volunteered to participate in the study because they knew that they would receive a free CD-ROM for personal use. Therefore, it might be that only these participants, who were interested in instructional software, took part in the study. Moreover, subjects were withdrawn from populations that were relatively close to the places were the workshop was hosted. This includes the Calgary area in Canada and the center of the country in Israel. It might be that these samples are limited to these two areas only and can not be generalized to represent the population of these countries (this is more likely to be true in Canada than in Israel which is a relatively small country)

Since participants were limited to the study of adoption of the Interactive Volleyball CD-ROM, the "generalizability" of this study should be limited to similar types of innovations within similar settings. This opens the door for further research to identify to what extent the differences persist across different types of innovations and other populations.

2) Limited number of variables within the model – The study included the collection of many independent variables that may affect individuals' intention to adopt or to reject technology. However, due to the limited number of subjects, only a few variables could be tested in the model. It is suggested that replications of the study should take place with more subjects, and thereby, more complex relationships among the variables can be studied. Additionally, the model points out possible significant relationships among variables; however, the validity of conclusions regarding causality needs to be tested in future studies with controlled interventions, or by applying the model in a variety of settings.

3) Data accuracy – It was assumed that the participants in this study would accurately and truthfully respond to the survey questions. However, one of the main problems of the study was the relatively large and lengthy number of questionnaires. To complete the pre-workshop questionnaire took on average about 30 minutes. This long period may have resulted in inaccuracy of the answers as subjects became less able to concentrate and hence, less corporative. As a result, the number of missing data was relatively large.

A large number of questionnaires was used because this study was exploratory in nature and one of the first to study physical education teachers and coaches. It is suggested that future studies should be more focused and collect less data.

A more specific problem was encountered in places where subjects were asked to recall the first year they started to use software or hardware. Similar questions revealed inaccuracy in recalling such information. Additionally, the option of "not starting to use" was unavailable in some places. Therefore, a missing year was considered as missing data. It is suggested that in further research, where a similar procedure is used, one of the options in the questionnaires should be: “I did not start to use it yet.” This way, it is possible to distinguish between missing data and those who did not start to use computers.

7.4 Further Examination

The study presents a modified model that explains 36% of the variance in the intention of teachers and coaches to adopt the Interactive Volleyball CD-ROM. This model can serve as a starting point for further adoption research while encouraging exploration and integration of additional variables and their relationships to develop a more comprehensive model for instructional technology adoption.

In particular, the implementation process of the innovation was not fully examined in the current study and it is suggested to design future experiments which will follow the implementation as well.

Additionally, as mentioned, it is recommended that similar studies try to replicate the study results and solve some of the limitations such as sample size, sample selection, and limited number of questionnaires.

7.5 Summary

The study includes an exploratory part designed to answer eight questions and a confirmatory part designed to validate a modified model in the field of sport and physical education. For the purpose of the study, an Interactive Volleyball CD-ROM has been developed based on the user-center approach as described in chapter 3.

The exploratory part data was used to learn about the adoption of computers by teachers and coaches for general purposes as well as specific uses within physical education and sport. Additionally, purchasing trends, as well as any possible barriers found in trying to adopt the CD-ROM, were also tested.

Thereafter, the process of the CD-ROM acceptance and intention to adopt was studied under the frameworks of Diffusion of Innovation and TAM. The modified model was validated to fit technology acceptance within physical education and sport related topics. The major relationships and components within TAM (David et al, 1989) have been validated. It is suggested that a relatively high percentage of the intention to adopt the CD-ROM (36%) could be explained by teachers' and coaches' Perceived Complexity and Relative Advantage of the tool.

A major concern of the modified model was the role of external variables. Several variables and their relationship were introduced to the model and found to affect significantly, the Intention to use the CD-ROM. These variables were self-efficacy, innovativeness, previous experience, professional innovativeness, specific attitude, and education. While some variables found to present direct relationship with the innovation's attributes, other presented indirect affect only.

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Appendix A

General Information Questionnaire

Explanation - The first 13 items of the scale were designed to obtain demographic information such as age, gender, profession and teaching/coaching experience. The purpose of three other items (14 to 16) was to collect data about the coaches/teachers habits regarding planning practices or lessons, while the last item (17) asked the coach to identify the factors that affect most his/her decision in selecting computer software.

General Information Scale

Instructions: For each question, please write your response or choose the answer that best applies to you by putting an "X" in the appropriate square.

1. Name: ____________________

2. Next year I will teach/coach volleyball at: ____________________

____

3. Telephone number: ____________________

4. Fax number: ____________________

5. Email address: ____________________

6. Age: ____________________ (years)

7. Gender: ☐ Male ☐ Female

8. Highest level of education:

   ☐ Some high school education (_____ years)
   ☐ High school diploma
   ☐ Post-high school education (_____ years)
   ☐ Bachelor's degree (Major: ____________________)
   ☐ Instructor Certificate
   ☐ Coaching Certificate:
      ☐ Level 1 ☐ level 2 ☐ Level 3 ☐ level 4
   ☐ Physical Education Diploma
   ☐ Master's degree
   ☐ Doctorate degree
   ☐ Other: ____________________

9. Profession:
   - ☐ Teacher
     - ☐ Physical education teacher
     - ☐ Other ____________________
   - ☐ Coach
     - ☐ College coach
     - ☐ University coach
     - ☐ Other ____________________
   - ☐ Other

10. How many years (in TOTAL) have you been teaching/coaching volleyball?

    ____

11. Do you coach or teach other types of sport?
    - ☐ No
    - ☐ Yes (please indicate which ones): ______________________

12. If you answered YES to the previous question, how many years (in TOTAL) have you been teaching/coaching? _______________

13. Populations you coach/ed or teach/ed (check all that apply to you)
    - ☐ Children 6-12
    - ☐ Adolescents 13-17
    - ☐ Mature Athletes 18-30
    - ☐ Mid-Ages 31-40
    - ☐ Seniors 41-63
    - ☐ Aged population 64 on
    - ☐ Other: ____

14. What is the average number of teams/classes that you are coaching / teaching volleyball per a year?_________________

15. How much time do you usually spend in preparing a practice / lesson plan?

☐ Not at all ☐ Less than an hour[20] ☐ 1-2 hours per a plan

☐ 2-4 hours per a plan ☐ More than 5 hours a plan

16. Do you have coach's assistance or other staff that help you with the preparation of the plans?

☐ Yes (how many?____________________) ☐ No

17. Which of the following factors most affects your decision to select computer software? (check all that apply to you)

☐ an advertisement in the media ☐ a colleague recommendation

☐ availability of software ☐ district policies and procedures

☐ Other (please specify): ________________________________

Thank you for taking the time to complete the questionnaires. Your participation is appreciated.

[20] This option was added only to the Hebrew version of the scale

Appendix B

Patterns of Computer Technology Use

Explanation: The adaptation from the original scale of Jacobsen (1998) includes rephrasing of some of the questions to include teaching/coaching-related terms (items 2, 4, 5, 6, 7, 8, 9, 10, 11, 14, 15 and 18 from the original scale). Items 1, 3, 12, 13, 16 and 17, of Jacobsen (1998) were deleted due to their specificity to faculty and university environments. Items 13-18 in the new scale were added. Those items were designed to get information about the coaches: average time spent in a week using the internet, experience with computer technology, courses/workshops taken, typing skill level, venues to acquire computer related knowledge and experience in viewing computer-based instructional software.

Patterns of Computer Technology Use

Instructions: This survey is intended to gather information about individual computer use patterns. For each question, please write your response or choose the answer that best applies to you by putting an "X" in the appropriate square.

1. In which year did you first use a computer for your personal tasks (i.e., writing, e-mail, etc.)? ___________________

2. In which year did you first use a computer for professional teaching/coaching tasks (i.e., demonstration, CD-ROM software, Internet, etc.)? ___________________

3. In which year did you buy your first computer for PERSONAL/HOME use?
   ____

4. In which year did you buy your first computer for PROFESSIONAL (teaching/coaching) use? _________________

5. How many computers have you owned since buying your first computer?
   ____

6. Do you have exclusive access to a computer for professional use[21]?
   ☐ Yes ☐ Sometimes ☐ No

7. Do you have ready and convenient access to computers, software and needed equipment for teaching/coaching tasks[2]?
   ☐ Yes ☐ Sometimes ☐ No

[21] The order of the options on the English version was Yes, No, Sometimes

8. How satisfied are you with SUPPORT you can get for computer-related TEACHING/COACHING tasks?

   ☐ Very satisfied ☐ Satisfied ☐ Natural ☐ Unsatisfied ☐ Very unsatisfied

9. How satisfied are you with TRAINING available to you for computer-related TEACHING/COACHING tasks?

   ☐ Very satisfied ☐ Satisfied ☐ Natural ☐ Unsatisfied ☐ Very unsatisfied

10. How did you acquire your INITIAL computer skills?

    ☐ Self taught ☐ Formal course ☐ Self-teaching and formal courses
    ☐ From a peer ☐ From a player/student ☐ From support staff
    ☐ Other ________________

11. Overall, your range of computer knowledge and skills are primarily the result of:

    ☐ Self-teaching ☐ Formal course ☐ Both self-teaching and formal courses
    ☐ Peer teaching and support ☐ Support staff assistant
    ☐ Other ________________

12. On average, how many hours do you spend using a computer per week?

    ☐ Less than 1 hour ☐ 1 to 3 hours ☐ 3 to 5 hours ☐ More than 5 hours

13. On average, how many hours do you spend on the Internet per week?

    ☐ Less than 1 hour ☐ 1 to 3 hours ☐ 3 to 5 hours ☐ More than 5 hours

14. How would you rate your experience with computer technologies?

    ☐ Very Experienced ☐ Good ☐ Fair ☐ Poor ☐ None

15. Have you taken any courses/workshops for using computer technologies?

☐ Yes ☐ No

16. How would you rate your typing skill now?

☐ Non-existent ☐ Poor ☐ Good ☐ Excellent

17. How do you plan to keep up-to-date with your knowledge of educational computer use? (Choose the one that most applies.)

☐ Computer magazines or journal ☐ Computer courses

☐ User groups ☐ Workshops

18. Have you ever viewed any computer-based instruction software?

☐ Yes, quite a few ☐ Yes, only one or two ☐ No

Thank you for taking the time to complete the questionnaire. Your participation is appreciated.

Appendix C

Computer Experience

Explanation: This scale is based on Jacobsen (1998). The original scale included 44 items. In this study the English and the Hebrew scales were somewhat different.

For each of the items, the users are first asked to estimate their level of expertise (on a 5-point Likert-type scale: 0=none, 1=a little, 2=fair, 3=substantial and 4= extensive). The users are also asked to recall the first year they used each of software or tools, and the first year they incorporated them into teaching or coaching. The original scale (Jacobsen, 1998) does not include the question about the first year of using the software. This question was added to allow a comparison between the year specific software was used for general purposes and the year it was first used for coaching and teaching.

For the **English version**, several items from the original scale have been merged together. This was done for items concerned with graphics software (Drawing and Paint programs, Clipart and Drafting) as well as for items concerned with authoring (HyperCard, Toolbook, Linkway, HyperStudio). Text Editing was deleted from the original scale. In addition, several applications specifically related to coaching and teaching physical education were added. Those included: the Designing and Creating practice/lesson plans software, Performance measurements-related software, Game analysis software and Timing and scheduling software. A last question was also added, asking the coaches to identify any other software they used.

After collecting data in the pilot study, the scale was changes a little bit in the **Hebrew version**. This was done due to the length of the scales. The changes included adding the "Commodore" option to the Operating System category. All other open items (Other) within a specific category were deleted (items # 16, 25, 29 & 42). The last item was left to include any other tool/software that may be used by the subjects and that was not mentioned in the scale. Item #22 (World Wide Web browsing, searching) was deleted due to similarity with item # 44 (surfing the Internet). Items # 43 (Robotics) and item # 45 (Virtual Reality) were moved to the teaching/coaching related software, and category of Variety was been deleted. As a result, the number of items was reduced to forty-one.

Enclosed are the English and the Hebrew versions of the Computer Experience Scale.

Computer Experience (English Version)

Instructions: For each of the following 46 examples of computer software and tools, please indicate: (1) your current level of expertise (None, A little, Fair, Substantial or Extensive), (2) the year in which you first used this software/tool (if ever) and (3) the year you first used this software/tool (if ever) for teaching/coaching related tasks.

		Level of Expertise:					Year first	Year first used
		None	A little	Fair	Substantial	Extensive	used:	for Teaching/coaching
Operating Systems:								
1.	Apple	☐	☐	☐	☐	☐	______	______
2.	Macintosh	☐	☐	☐	☐	☐	______	______
3.	UNIX	☐	☐	☐	☐	☐	______	______
4.	PC-DOS	☐	☐	☐	☐	☐	______	______
5.	Win 3.x, NT	☐	☐	☐	☐	☐	______	______
6.	Win 95, 98	☐	☐	☐	☐	☐	______	______
7.	Sun	☐	☐	☐	☐	☐	______	______
8.	Other: ______________	☐	☐	☐	☐	☐	______	______

		Level of Expertise: None	A little	Fair	Substantial	Extensive	Year first used:	Year first used for Teaching/coaching
Tool Applications:								
9.	Word-processing	☐	☐	☐	☐	☐	______	______
10.	Desktop publishing	☐	☐	☐	☐	☐	______	______
11.	Database	☐	☐	☐	☐	☐	______	______
12.	Spreadsheets	☐	☐	☐	☐	☐	______	______
13.	Charting-graphing	☐	☐	☐	☐	☐	______	______
14.	Presentation package	☐	☐	☐	☐	☐	______	______
15.	Graphics program (i.e. Drawings, Paint, Clipart, Drafting)	☐	☐	☐	☐	☐	______	______
16.	Other: ______________________	☐	☐	☐	☐	☐	______	______
Communications Software:								
17.	Electronic mail	☐	☐	☐	☐	☐	______	______
18.	Newsgroups	☐	☐	☐	☐	☐	______	______
19.	Listservs, BBS	☐	☐	☐	☐	☐	______	______
20.	FTP (upload, download files)	☐	☐	☐	☐	☐	______	______

		Level of Expertise: None	A little	Fair	Substantial	Extensive	Year first used:	Year first used for Teaching/coaching
21.	Gopher	☐	☐	☐	☐	☐	________	________
22.	World Wide Web browsing, searching	☐	☐	☐	☐	☐	________	________
23.	On-line databases (and/or library catalogues)	☐	☐	☐	☐	☐	________	________
24.	On-line video, audio:	☐	☐	☐	☐	☐	________	________
25.	Other: ____________________	☐	☐	☐	☐	☐	________	________

Software & Tools

		None	A little	Fair	Substantial	Extensive	Year first used:	Year first used for Teaching/coaching
26.	Programming language experience (i.e., Logo, Basic, C, Fortran, etc.)	☐	☐	☐	☐	☐	________	________
27.	Authoring (e.g., HyperCard, Toolbook, Linkway, HyperStudio, Director, Autoware)	☐	☐	☐	☐	☐	________	________
28.	WWW page creation/editing	☐	☐	☐	☐	☐	________	________
29.	Other: ____________________	☐	☐	☐	☐	☐	________	________

Teaching/coaching related Software

		None	A little	Fair	Substantial	Extensive	Year first used:	Year first used for Teaching/coaching
30.	Tutorials	☐	☐	☐	☐	☐	________	________
31.	Drill & Practice	☐	☐	☐	☐	☐	________	________
32.	Simulations	☐	☐	☐	☐	☐	________	________

		Level of Expertise: None	A little	Fair	Substantial	Extensive	Year first used:	Year first used for Teaching/coaching
33.	Integrated Learning System	☐	☐	☐	☐	☐	________	________
34.	Games	☐	☐	☐	☐	☐	________	________
35.	Statistics package	☐	☐	☐	☐	☐	________	________
36.	Grading package	☐	☐	☐	☐	☐	________	________
37.	Designing and Creating practice/lesson plans software	☐	☐	☐	☐	☐	________	________
38.	Measurements of performance related software	☐	☐	☐	☐	☐	________	________
39.	Game analysis related software	☐	☐	☐	☐	☐	________	________
40.	Time and Scheduling software	☐	☐	☐	☐	☐	________	________
41.	Videodisk	☐	☐	☐	☐	☐	________	________
42.	Other: ____________________	☐	☐	☐	☐	☐	________	________

Variety

		None	A little	Fair	Substantial	Extensive	Year first used:	Year first used for Teaching/coaching
43.	Robotics	☐	☐	☐	☐	☐	________	________
44.	Surfing the Internet	☐	☐	☐	☐	☐	________	________

45. Virtual Reality

☐ ☐ ☐ ☐ ☐ ________ ________

46. Any other software you have been using? ____________________________

☐ ☐ ☐ ☐ ☐ ________ ________

Thank you for taking the time to complete the questionnaire. Your participation is appreciated.

Computer Experience (Hebrew Version)

Instructions: For each of the following 41 examples of computer software and tools, please indicate: (1) your current level of expertise (None, A little, Fair, Substantial or Extensive), (2) the year in which you first used this software/tool (if ever) and (3) the year you first used this software/tool (if ever) for teaching/coaching related tasks.

		Level of Expertise: None	A little	Fair	Substantial	Extensive	Year first used:	Year first used for Teaching/coaching
Operating Systems:								
1.	Apple	☐	☐	☐	☐	☐	________	________
2.	Macintosh	☐	☐	☐	☐	☐	________	________
3.	UNIX	☐	☐	☐	☐	☐	________	________
4.	PC-DOS	☐	☐	☐	☐	☐	________	________
5.	Win 3.x, NT	☐	☐	☐	☐	☐	________	________
6.	Win 95, 98	☐	☐	☐	☐	☐	________	________
7.	Sun	☐	☐	☐	☐	☐	________	________
8.	Commodore	☐	☐	☐	☐	☐	________	________

		Level of Expertise: None	A little	Fair	Substantial	Extensive	Year first used:	Year first used for Teaching/coaching
	Tool Applications:							
9.	Word-processing	☐	☐	☐	☐	☐	________	________
10.	Desktop publishing	☐	☐	☐	☐	☐	________	________
11.	Database	☐	☐	☐	☐	☐	________	________
12.	Spreadsheets	☐	☐	☐	☐	☐	________	________
13.	Charting-graphing	☐	☐	☐	☐	☐	________	________
14.	Presentation package	☐	☐	☐	☐	☐	________	________
15.	Graphics program (i.e. Drawings, Paint, Clipart, Drafting)	☐	☐	☐	☐	☐	________	________
	Communications Software:							
16.	Electronic mail	☐	☐	☐	☐	☐	________	________
17.	Newsgroups	☐	☐	☐	☐	☐	________	________
18.	Listservs, BBS	☐	☐	☐	☐	☐	________	________
19.	FTP (upload, download files)	☐	☐	☐	☐	☐	________	________
20.	Gopher	☐	☐	☐	☐	☐	________	________

		Level of Expertise:					Year first used:	Year first used for Teaching/coaching
		None	A little	Fair	Substantial	Extensive		
21.	On-line databases (and/or library catalogues)	☐	☐	☐	☐	☐	______	______
22.	On-line video, audio:	☐	☐	☐	☐	☐	______	______
	Software & Tools							
23.	Programming language experience (i.e., Logo, Basic, C, Fortran, etc.)	☐	☐	☐	☐	☐	______	______
24.	Authoring (e.g., HyperCard, Toolbook, Linkway, HyperStudio, Director, Autoware)	☐	☐	☐	☐	☐	______	______
25.	WWW page creation/editing	☐	☐	☐	☐	☐	______	______
	Teaching/coaching related Software							
26.	Tutorials	☐	☐	☐	☐	☐	______	______
27.	Drill & Practice	☐	☐	☐	☐	☐	______	______
28.	Simulations	☐	☐	☐	☐	☐	______	______
29.	Integrated Learning System	☐	☐	☐	☐	☐	______	______
30.	Games	☐	☐	☐	☐	☐	______	______

		Level of Expertise:					Year first	Year first used
		None	A little	Fair	Substantial	Extensive	used:	for Teaching/coaching
31.	Statistics package	☐	☐	☐	☐	☐	________	________
32.	Grading package	☐	☐	☐	☐	☐	________	________
33.	Designing and Creating practice/lesson plans software	☐	☐	☐	☐	☐	________	________
34.	Measurements of performance related software	☐	☐	☐	☐	☐	________	________
35.	Game analysis related software	☐	☐	☐	☐	☐	________	________
36.	Time and Scheduling software	☐	☐	☐	☐	☐	________	________
37.	Videodisk	☐	☐	☐	☐	☐	________	________
38.	Robotics	☐	☐	☐	☐	☐	________	________
39.	Surfing the Internet	☐	☐	☐	☐	☐	________	________
40.	Virtual Reality	☐	☐	☐	☐	☐	________	________
41.	Any other software you have been using? ____________________	☐	☐	☐	☐	☐	________	________

Thank you for taking the time to complete the questionnaire. Your participation is appreciated.

Appendix D

Stages of Adoption of Technology

Stages of Adoption of Technology

Instructions: Please read the descriptions of each of the six stages related to adoption of technology. Write the number of the stage that best describes where you are in the adoption of technology at the bottom of the page.

Stage 1: Awareness

I am aware that technology exists, but have not used it - perhaps I'm even avoiding it.

Stage 2: Learning the process

I am currently trying to learn the basics. I am often frustrated using computers. I lack confidence when using computers.

Stage 3: Understanding and application of the process

I am beginning to understand the process of using technology and can think of specific tasks in which it might be useful.

Stage 4: Familiarity and confidence

I am gaining a sense of confidence in using the computer for specific tasks. I am starting to feel comfortable using the computer.

Stage 5: Adaptation to other contexts

I think about the computer as a tool to help me and am no longer concerned about it as technology. I can use it in many applications and as an instructional aid.

Stage 6: Creative application to new contexts

I can apply what I know about technology in the classroom. I am able to use it as an instructional tool and integrate it into the curriculum.

The stage that best describes where I am now is number ________.

Thank you for taking the time to complete the questionnaire. Your participation is appreciated.

Appendix E

Computer Attitude Scale

Brenda H. Loyd and Clarice P. Gressard, University of Virginia

Explanation: The questionnaire is based on a 5-point Likert scale. The early questionnaire developed by Loyd and Gressard (1984) was based on a four-point scale, but the questionnaire that was used by Christensen (1998) was adapted to 5-point scale, and it composes 40 statements. The user is asked to state his/her level of agreement with each of the items (questions 2, 5, 7, 8, 10, 13, 15, 18, 20, 21, 23, 24, 26, 29, 31, 32, 34, 37, 39 and 40: Strongly agree=1, Agree=2, Undecided=3, Disagree=4 and Strongly disagree=5, while for questions 1, 3, 4, 6, 9, 11, 12, 14, 16, 17, 19, 22, 25, 27, 28, 30, 33, 35, 36 and 38, Strongly agree=5, Agree=4, Undecided=3, Disagree=2 and Strongly disagree=1). The questions were coded so that the higher the score, the more positive the attitude (e.g., a higher confidence score means more confidence, and a higher anxiety score means less anxiety). The four sub-scores that can be obtained from the questions are: Anxiety (questions: 1, 5, 9, 13, 17, 21, 25, 29, 33, 37), Confidence (questions 2, 6, 10, 14, 18, 22, 26, 30, 34, 38), Liking (questions 3, 7, 11, 15, 19, 23, 27, 31, 35, 39) and Usefulness (questions 4, 8, 12, 16, 20, 24, 28, 32, 36, 40).

COMPUTER ATTITUDE SCALE

Brenda H. Loyd and Clarice P. Gressard, University of Virginia

Instructions: The purpose of this survey is to gather information concerning people's attitudes toward learning about and working with computers. It should take about five minutes to complete this survey. Below are a series of statements. There are no correct answers to these statements. They are designed to permit you to indicate the extent to which you agree or disagree with the ideas expressed. Place a checkmark in the space under the label that is closest to your agreement or disagreement with the statements.

		Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
1.	Computers do not scare me at all.	☐	☐	☐	☐	☐
2.	I'm no good with computers.	☐	☐	☐	☐	☐
3.	I would like working with computers.	☐	☐	☐	☐	☐
4.	I will use computers many ways in my life.	☐	☐	☐	☐	☐
5.	Working with a computer would make me very nervous.	☐	☐	☐	☐	☐
6.	Generally, I would feel OK about trying a new problem on the computer.	☐	☐	☐	☐	☐
7.	The challenge of solving problems with computers does not appeal to me.	☐	☐	☐	☐	☐
8.	Learning about computers is a waste of time.	☐	☐	☐	☐	☐
9.	I do not feel threatened when others talk about computers.	☐	☐	☐	☐	☐
10.	I don't think I would do advanced computer work.	☐	☐	☐	☐	☐
11.	I think working with computers would be enjoyable and stimulating.	☐	☐	☐	☐	☐
12.	Learning about computers is worthwhile.	☐	☐	☐	☐	☐
13.	I feel aggressive and hostile toward computers.	☐	☐	☐	☐	☐

	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
14. I am sure I could do work with computers.	☐	☐	☐	☐	☐
15. Figuring out computer problems does not appeal to me.	☐	☐	☐	☐	☐
16. I'll need a firm mastery of computers for my future work.	☐	☐	☐	☐	☐
17. It wouldn't bother me at all to take computer courses.	☐	☐	☐	☐	☐
18. I'm not the type to do well with computers.	☐	☐	☐	☐	☐
19. When there is a problem with a computer run that I cannot immediately solve, I would stick with it until I have the answer.	☐	☐	☐	☐	☐
20. I expect to have little use for computers in my daily life.	☐	☐	☐	☐	☐
21. Computers make me feel uncomfortable.	☐	☐	☐	☐	☐
22. I am sure I could learn a computer language.	☐	☐	☐	☐	☐
23. I don't understand how some people can spend so much time working with computers and seem to enjoy it.	☐	☐	☐	☐	☐
24. I can't think of any way that I will use computers in my career.	☐	☐	☐	☐	☐
25. I would feel at ease in a computer class.	☐	☐	☐	☐	☐
26. I think using a computer would be very hard for me.	☐	☐	☐	☐	☐
27. Once I start to work with the computer, I would find it hard to stop.	☐	☐	☐	☐	☐
28. Knowing how to work with computers will increase my job possibilities.	☐	☐	☐	☐	☐
29. I get a sinking feeling when I think of trying to use a computer.	☐	☐	☐	☐	☐
30. I could get good grades in computer courses.	☐	☐	☐	☐	☐

	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
31. I will do as little work with computers as possible.	☐	☐	☐	☐	☐
32. Anything that a computer can be used for, I can do just as well some other way.	☐	☐	☐	☐	☐
33. I would feel comfortable working with a computer.	☐	☐	☐	☐	☐
34. I do not think I could handle a computer course.	☐	☐	☐	☐	☐
35. If a problem is left unsolved in a computer class, I would continue to think about it afterward.	☐	☐	☐	☐	☐
36. It is important to me to do well in computer classes.	☐	☐	☐	☐	☐
37. Computers make me feel uneasy and confused.	☐	☐	☐	☐	☐
38. I have a lot of self-confidence when it comes to working with computers.	☐	☐	☐	☐	☐
39. I do not enjoy talking with others about computers.	☐	☐	☐	☐	☐
40. Working with computers will not be important to me in my life's work.	☐	☐	☐	☐	☐

Thank you for taking the time to complete the questionnaire. Your participation is appreciated.

Appendix F

Computer Technology for Physical education teachers and coaches

Explanation: The 'General' sub-scale includes 12 items on a 5-point Likert scale (1=strongly disagree, 2=disagree, 3=unsure, 4=agree and 5=strongly agree) which measure attitudes toward the use computerized technology for tasks that are related to sport and physical education. In the second scale, the 12 items indicate specific computerized tools and software that may be used for coaching and teaching-related tasks. Again, the coaches are asked to chose the answer that best describes his/her attitude (scale (1=strongly disagree, 2=disagree, 3=unsure, 4=agree and 5=strongly agree) toward each of the statements.

The four sections in the Open Questions part, ask users to: (1) list any computer technology or tools he or she are currently using for fulfilling teaching or coaching tasks, (2) explain why he/she would like, or dislike to incorporate computer software into the teaching/coaching process, (3) let us know what type of software or tools he/she would like to see developed, and (4) add any other comments.

Computer Technology for Physical education teachers and coaches

Instructions: We are interested in your opinion and feedback on the use of technology in coaching and teaching related tasks. For each question, please choose the answer that best applies to you by putting an "X" in the appropriate square.

General:

1. There is a role for technology in coaching and teaching physical education

   ☐ strongly disagree ☐ disagree ☐ unsure ☐ agree ☐ strongly agree

2. Technology and computers can improves athletic performance.

   ☐ strongly disagree ☐ disagree ☐ unsure ☐ agree ☐ strongly agree

3. I feel comfortable using computer technology in sports.

   ☐ strongly disagree ☐ disagree ☐ unsure ☐ agree ☐ strongly agree

4. I often avoid using computers because I am not comfortable working with them.

   ☐ strongly disagree ☐ disagree ☐ unsure ☐ agree ☐ strongly agree

5. I currently use computer technology to coach and/or teach physical education

   ☐ strongly disagree ☐ disagree ☐ unsure ☐ agree ☐ strongly agree

6. Knowing how to use computers is a worthwhile skill

   ☐ strongly disagree ☐ disagree ☐ unsure ☐ agree ☐ strongly agree

7. Teaching/coaching training should include instructional applications of computers

   ☐ strongly disagree ☐ disagree ☐ unsure ☐ agree ☐ strongly agree

8. I believe that it is important for me to learn how to use a computer

   ☐ strongly disagree ☐ disagree ☐ unsure ☐ agree ☐ strongly agree

9. The computer is a timesaving device for planning and coaching.
   ☐ strongly disagree ☐ disagree ☐ unsure ☐ agree ☐ strongly agree

10. Technologies and devices are only relevant for individual sports and not for team sports, in which team strategies are more important.
   ☐ strongly disagree ☐ disagree ☐ unsure ☐ agree ☐ strongly agree

11. In the long run, the use of the computers will decrease teachers' preparation and planning time.
   ☐ strongly disagree ☐ disagree ☐ unsure ☐ agree ☐ strongly agree

12. I would like to incorporate computer software in the teaching/coaching process
   ☐ strongly disagree ☐ disagree ☐ unsure ☐ agree ☐ strongly agree

Coaching and Teaching

13. The use of computer simulations and models in the field of coaching and teaching physical education is useful.
   ☐ strongly disagree ☐ disagree ☐ unsure ☐ agree ☐ strongly agree

14. The use of computers and other technologies for motion analysis in the field of coaching and teaching physical education is useful.
   ☐ strongly disagree ☐ disagree ☐ unsure ☐ agree ☐ strongly agree

15. The use of computers in team/class management and administration in the field of coaching and teaching physical education is useful.
   ☐ strongly disagree ☐ disagree ☐ unsure ☐ agree ☐ strongly agree

16. The use of computers for planning training drills in the field of coaching and teaching physical education is useful.

☐ strongly disagree ☐ disagree ☐ unsure ☐ agree ☐ strongly agree

17. The use of computer technology for analyzing athletes' sport performances in the field of coaching and teaching physical education is useful.

☐ strongly disagree ☐ disagree ☐ unsure ☐ agree ☐ strongly agree

18. The use of computer technology for measuring abilities of the players/students in the field of coaching and teaching physical education is useful.

☐ strongly disagree ☐ disagree ☐ unsure ☐ agree ☐ strongly agree

19. The use of computer technology for student grading in the field of coaching and teaching physical education is useful.

☐ strongly disagree ☐ disagree ☐ unsure ☐ agree ☐ strongly agree

20. The use of computer software and their accompanying sport measurement technologies for coding game situations in the field of coaching and teaching physical education is useful.

☐ strongly disagree ☐ disagree ☐ unsure ☐ agree ☐ strongly agree

21. The use of computer software for designing game strategies and explaining them to athletes in the field of coaching and teaching physical education is useful.

☐ strongly disagree ☐ disagree ☐ unsure ☐ agree ☐ strongly agree

22. The use of computers for planing practice or lesson plans for physical education teachers and coaches is useful.

☐ strongly disagree ☐ disagree ☐ unsure ☐ agree ☐ strongly agree

23. The use of computers for professional development and training of physical education teachers and coaches is useful.

☐ strongly disagree ☐ disagree ☐ unsure ☐ agree ☐ strongly agree

24. The use of computers and other technologies for time planning and scheduling for physical education teachers and coaches is useful.

☐ strongly disagree ☐ disagree ☐ unsure ☐ agree ☐ strongly agree

Open Questions

25. Please list the computer technology tools you currently use for fulfilling teaching or coaching tasks: ____

____

____

____

____

26. Would you like to incorporate computer software to the teaching/coaching process?

Yes / No / Maybe. Please explain why _________________________

____

____

____

____

____

27. If you answered 'Yes' or 'Maybe' to the previous question, please let us know what type of software or tools you would like to see? ______________________

28. Other comments. Please feel free to write any comments or suggestions that you have relating to the use of computer technology in sport and physical education.

Thank you for taking the time to complete the questionnaire. Your participation is appreciated.

Appendix G
Generalized Self-efficacy

Schwarzer, R. & Jerusalem, M. (1995)

Generalized Self-efficacy / By: Schwarzer, R. & Jerusalem, M. (1995)

Instructions: Please read each statement below, and mark an answer from 1-4 to indicate how well you feel the statement describes you (1=Not at all true, 2=Sometimes true, 3= Often true, 4=Almost always true)

1. I can always manage to solve difficult problems if I try hard enough.

   ☐ Not at all true ☐ Sometimes true ☐ Often true ☐ Almost always true
2. If someone opposes me, I can find means and ways to get what I want.

   ☐ Not at all true ☐ Sometimes true ☐ Often true ☐ Almost always true
3. It is easy for me to stick to my aims and accomplish my goals.

   ☐ Not at all true ☐ Sometimes true ☐ Often true ☐ Almost always true
4. I am confident that I could deal efficiently with unexpected events.

   ☐ Not at all true ☐ Sometimes true ☐ Often true ☐ Almost always true
5. Thanks to my resourcefulness, I know how to handle unforeseen situations.

   ☐ Not at all true ☐ Sometimes true ☐ Often true ☐ Almost always true
6. I can solve most problems if I invest the necessary effort.

   ☐ Not at all true ☐ Sometimes true ☐ Often true ☐ Almost always true
7. I can remain calm when facing difficulties because I can rely on my coping abilities.

   ☐ Not at all true ☐ Sometimes true ☐ Often true ☐ Almost always true
8. When I am confronted with a problem, I can usually find several solutions.

   ☐ Not at all true ☐ Sometimes true ☐ Often true ☐ Almost always true
9. If I am in trouble, I can usually think of something to do.

   ☐ Not at all true ☐ Sometimes true ☐ Often true ☐ Almost always true
10. No matter what comes my way, I'm usually able to handle it.

    ☐ Not at all true ☐ Sometimes true ☐ Often true ☐ Almost always true

Appendix H

Perceived Characteristics of the Interactive Volleyball CD-ROM

Explanation: The perceived characteristics of the Interactive Volleyball CD-ROM questionnaire were made-up of two scales: The Perceived Relative Advantage (items 1-6) and the Perceived Complexity (items 7-10). Ten statements were implemented where the user was asked to indicate the best answer that described his/her opinion on a 7-point Likert scale (ranging from "strongly disagree" to "strongly agree").

The first six items were made up from the five items recommended by Moore and Benbasat (1991) to use in the short version of the scale, plus the addition of the item that tests the perceived productivity of the innovation. The last four items were from the short version of the perceived ease-of-use (Moore and Benbasat, 1991) and were used to measure the perception of the coaches about the complexity of the Interactive Volleyball CD-ROM.

Perceived characteristics of the Interactive Volleyball CD-ROM

Instruction: Please read each statement below, and mark an answer from 1-7 to indicate how well you feel the statement describes you (1= Strongly Disagree, 7= Strongly Agree)

	Strongly Disagree						Strongly Agree
1. Using the Interactive Volleyball CD-ROM would enable me to accomplish tasks more quickly.	1	2	3	4	5	6	7
2. Using the Interactive Volleyball CD-ROM would improve the quality of work I do.	1	2	3	4	5	6	7
3. Using the Interactive Volleyball CD-ROM would make it easier to do my job.	1	2	3	4	5	6	7
4. Using the Interactive Volleyball CD-ROM would enhance my effectiveness on the job.	1	2	3	4	5	6	7
5. Using the Interactive Volleyball CD-ROM would give me greater control over my work.	1	2	3	4	5	6	7
6. Using Interactive Volleyball CD-ROM would increase my productivity.	1	2	3	4	5	6	7
7. Learning to operate the Interactive Volleyball CD-ROM was easy to me.	1	2	3	4	5	6	7
8. My interaction with the Interactive Volleyball CD-ROM was clear and understandable.	1	2	3	4	5	6	7
9. I believe that it would be easy to get the Interactive Volleyball CD-ROM to do what I want it to do.	1	2	3	4	5	6	7
10. Overall, I believe that the Interactive Volleyball CD-ROM was easy to use.	1	2	3	4	5	6	7

Appendix I

Intention to Use the Interactive Volleyball CD-ROM

1. Rank your intention to use the Interactive Volleyball CD-ROM

I will certainly use it						I will certainly NOT use it
1	2	3	4	5	6	7

(The following 2 questions were incorporated only at the Hebrew version)

2. How would you rank your English ability?

Excellent						None
1	2	3	4	5	6	7

3. Is the fact that the CD-ROM is written in English affects your intention?

☐ Yes ☐ Maybe ☐ Not at all

4. Please write the main factors which affect your intention to use or not to use the CD-ROM:

____

____

____

____

____

Appendix J

Follow- Up Scale

Explanations: This scale was sent to the schools at the end of the volleyball season (November 2000). The scale was especially designed for this study and was made up of two parts. In the first part, coaches reported on their experience and evaluation of the Interactive Volleyball CD-ROM. Of the nine questions that were designed, four were to learn about the way and the frequency with which the coaches actually used the CD-ROM, and five were to evaluate the software. Two of the questions (3 and 4), were designed to use objective variables that may give information regarding the use of the software. Coaches were asked to indicate the number of drills they have been modifying or designing using the software, as well as the number of practice/lesson plans they created.

In the second part, coaches were asked to rate their opinions about barriers they encountered while using the CD-ROM. Ten possible barriers were listed and the coaches were asked to indicate how significant each of them was to the use of the interactive volleyball CD-ROM. A five-point scale was used (1=strongly agree, a major barrier, 2=agree, 3-neutral, 4=disagree, and 5= strongly disagree, not a barrier). Additionally, an open question asked the coaches to indicate any additional barriers that may prevent teachers and coaches from using and/or integrating the Interactive Volleyball CD-ROM.

Follow-up Scale

Part 1: We would like to learn about your experience with the Interactive Volleyball CD-ROM and your evaluation of the software. Please read each statement below and mark the answer to indicate how well you feel the statement describes you.

1. I have used the Interactive Volleyball CD-ROM since I got it:

   ☐ Never ☐ Few times ☐ Many times ☐ On a regular basis

2. I used the CD-ROM for the following purposes (please check all that apply):

   ☐ Reading and watching the educational content

   ☐ Looking for drills

   ☐ Modifying and creating my own drills

   ☐ Creating lesson/practice plans

   ☐ In the gym with my students

   ☐ Other (please specify): ____

   ____

3. Please indicate the number of modified/new drills you have in your drills database [In order to do it, go to the search screen, make sure that none of the criteria are chosen, and click on the SEARCH button. The resulting list will include ALL the drills you have in your database. The total number of drills can be found below the list on the right-hand side (i.e., -/400, you have 400 drills)]. Please copy this number here:

   ____

4. Please indicate the number of practice/lesson plans you have in the practice/lesson plans database [In order to do it, go to the practice/lesson plan screen. Choose OPEN PRACTICE PLAN from the PRACTICE PLAN MENU. A dialogue box should open on your screen. Please count the number of practice/lesson plans created by you in the list]. Please copy this number here: ______________________

5. Overall, I find that the CD-ROM can help me carry out my teaching/coaching related-tasks:

   ☐ Strongly agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly disagree

6. I found the CD-ROM to be very well designed:

   ☐ Strongly agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly disagree

7. I found the CD-ROM to work as expected, and to be without bugs.

   ☐ Strongly agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly disagree

8. I think that this program meets the relevant needs of coaches/teachers.

   ☐ Strongly agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly disagree

9. I believe that the CD-ROM is more effective/efficient than other methods:

   ☐ Strongly agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly disagree

Part 2. One of the goals of the current research project is to gather additional information about the barriers that may prevent or discourage teachers and coaches from using the Interactive Volleyball CD-ROM in their teaching or coaching tasks. In your opinion, how significant is each of the following barriers to the use of the Interactive Volleyball CD-ROM? Five Point Scale: 1=Strongly agree, a major barrier, 2=Agree, 3=Neutral, 4=Disagree, 5=Strongly disagree, not a barrier.

1. Lack of time.

☐ Strongly agree, a major barrier ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly disagree, not a barrier

2. Unavailable hardware (computers and CD-ROM drives) that I can use.

☐ Strongly agree, a major barrier ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly disagree, not a barrier

3. Unstable hardware (breaking down).

☐ Strongly agree, a major barrier ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly disagree, not a barrier

4. Inadequate financial support for computer integration.

☐ Strongly agree, a major barrier ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly disagree, not a barrier

5. No interest from peer teachers and coaches.

☐ Strongly agree, a major barrier ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly disagree, not a barrier

6. Insufficient personal knowledge on how to use and integrate the CD-ROM.

☐ Strongly agree, a major barrier ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly disagree, not a barrier

7. The supplement material (manual) was inadequate and unhelpful.

☐ Strongly agree, a major barrier ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly disagree, not a barrier

8. The CD-ROM is not an advantage to my work.

☐ Strongly agree, a major barrier ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly disagree, not a barrier

9. I personally prefer to use pen and paper than computers.

☐ Strongly agree, a major barrier ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly disagree, not a barrier

10. I found the CD-ROM to be too difficult to operate.

☐ Strongly agree, a major barrier ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly disagree, not a barrier

11. In addition to those listed above, the following barriers may prevent teachers and coaches from using and/or integrating the Interactive Volleyball CD-ROM

____

____

____

____

____

____

Thank you for taking the time to complete the questionnaire. Your participation is appreciated.

Appendix K

Cover Letter for Participants

Dear xxx,

My name is Tsilya Raz-Liebermann. I am a doctoral student in the Department of Graduate Division of Educational Research at the University of Calgary, conducting a research project under the supervision of Dr. Larry Katz, as part of the requirement towards a Ph.D. degree. I am writing to provide you with information regarding my research project "The Diffusion of Innovations Model Modified for Educational Technology Using the Volleyball Interactive CD-ROM with Coaches" so that you can make an informed decision regarding your participation.

The purpose of the study is to assess the effectiveness of a multimedia-based CD-ROM for teachers and volleyball coaches. As part of the study, you will be asked to fill out three questionnaires. The questionnaires were design to assess: (1) your previous usage of technology, (2) your self-efficacy, (3) your attitude toward working with computers, (4) your evaluation of the Interactive Volleyball CD-ROM and (5) your experience using the CD-ROM. As part of the study, you will also be asked to participate in a two-hour training session that will take place at the University. The session will include a one-hour hands-on workshop. As part of the session, you will be given a task to perform using the Volleyball Interactive CD-ROM. The computer screen on which you will be working may be videotaped. Additionally, you may be chosen to be interviewed about your experience in using, or not using, the CD-ROM.

You should be aware that even if you give your permission to participate, you are free to withdraw at any time for any reason and without penalty. Participation in this study will involve no greater risks than those ordinarily experienced in daily life.

Only group results will be reported in any published studies. The raw data will be kept in the locked file cabinet and it will be destroyed two years after completion of the study.

If you have any questions, please feel free to contact me at (403) 220-5181, my supervisor Dr. Larry Katz at (403) 220-3418, the Office of the Chair, Faculty of Education Joint Ethics Review Committee at (403) 220-5626, or the Office of the Vice-President (Research) of the University of Calgary at (403) 220-3381. Two copies of the consent form are provided. Please return one signed copy to me and retain the other copy for your records. Thank you for your cooperation.

Sincerely,
Tsilya Raz-Liebermann

Appendix L

Consent Form for Research Participation

I, the undersigned, hereby give my consent to participate in a research project entitled "The diffusion of innovations model Modified for Educational Technology Using the Volleyball Interactive CD-ROM with Coaches."

I understand that such consent means that my participation in this study will involve participating in a workshop, completing questionnaires, being interviewed and performing a utilization test.

The questionnaires will collect data about computer use, self-efficacy items, demographic information and evaluation of the Interactive Volleyball CD-ROM. The questionnaires also collect information about my attitudes toward working with computers, as well as my perception of the software itself. The one-hour hands-on workshop will be designed to teach me how to use the Volleyball Interactive CD-ROM efficiently. During the utilization task, I will be asked to use the Volleyball Interactive CD-ROM to complete a task relevant to coaching volleyball. Data will be collected about the way I am using the applications through videotaping the computer screen. The entire session will take approximately two hours. In a follow-up, I will be asked about my actual use of the software. I will fill out a related questionnaire, and I may be selected for an interview. I will be asked about any incentives and barriers I may have encountered when trying to integrate the CD-ROM into teaching and coaching.

I understand that participation in this study may be terminated any time by my request or at the request of the investigator. Participation in this project and/or withdrawal from this project will not adversely affect me in any way.

I understand that this study will not involve any greater risks than those ordinarily occurring in daily life.

I understand that only group data will be reported in any published reports.

I have received a copy of this consent form for my records. I understand that if I have any questions, I can contact the researcher at (403) 220-5181, the supervisor (Dr. Larry Katz) at (403) 220-3418, the Office of the Chair, Faculty of Education Joint Ethics Review Committee at (403) 220-5626, or the Office of the Vice-President (Research) of the University of Calgary at (403) 220-3381.

________________ ____________________________ __________________

Date Participant's Printed Name Signature

Appendix M

Example of Screens from the Volleyball Interactive CD-ROM

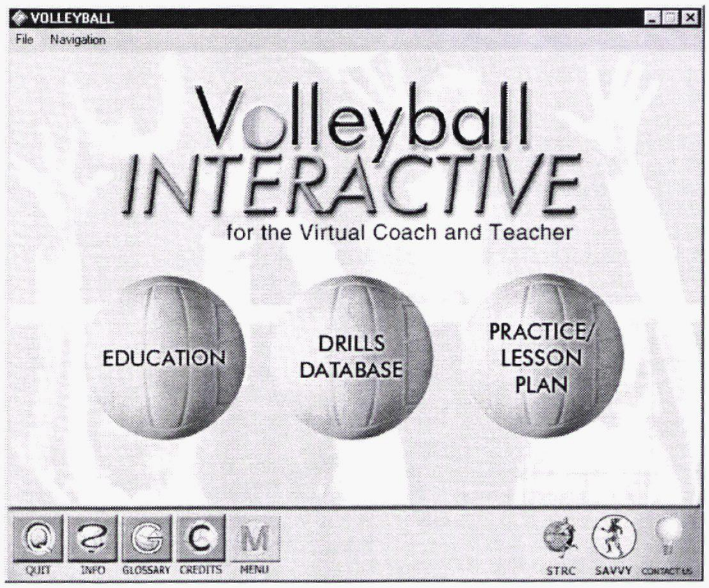


Figure M.1: The main-menu screen of the Interactive Volleyball CD-ROM

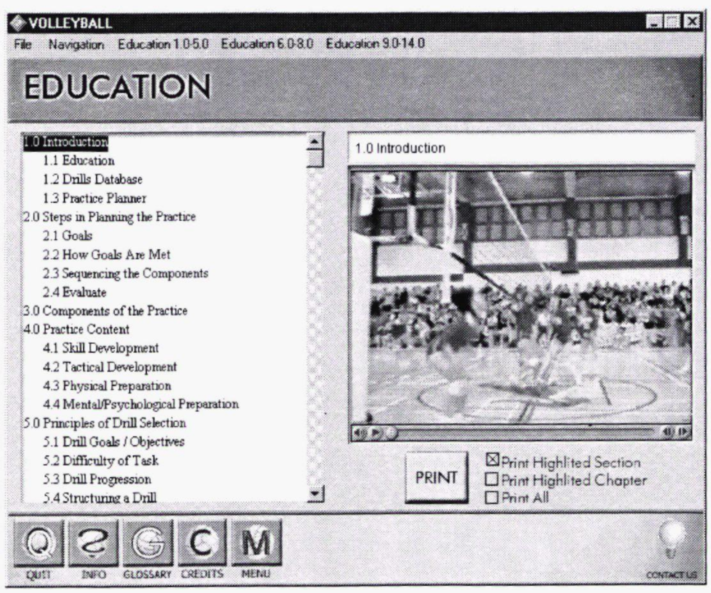


Figure M.2: The education screen of the Interactive Volleyball CD-ROM

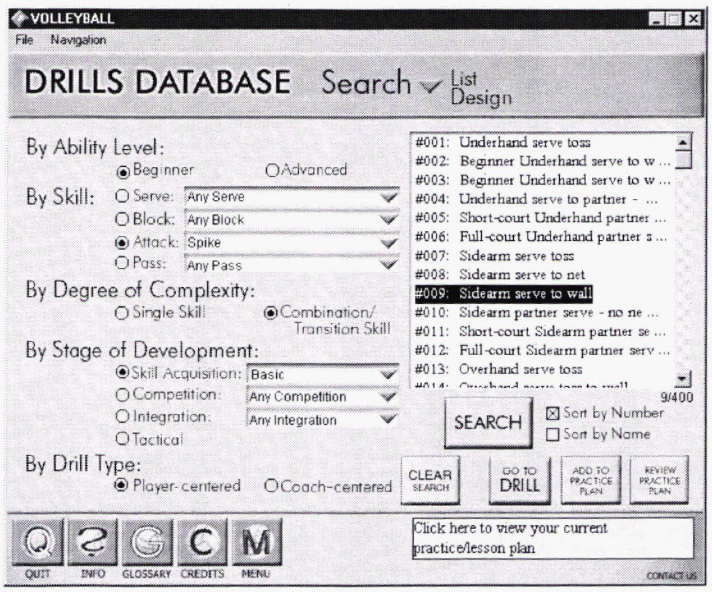


Figure M.3: The search screen of the drills' database in the Interactive Volleyball CD-ROM

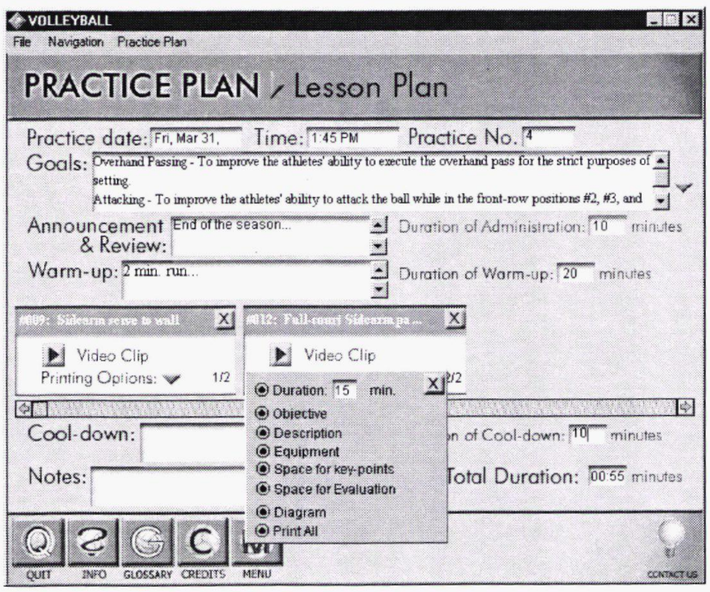
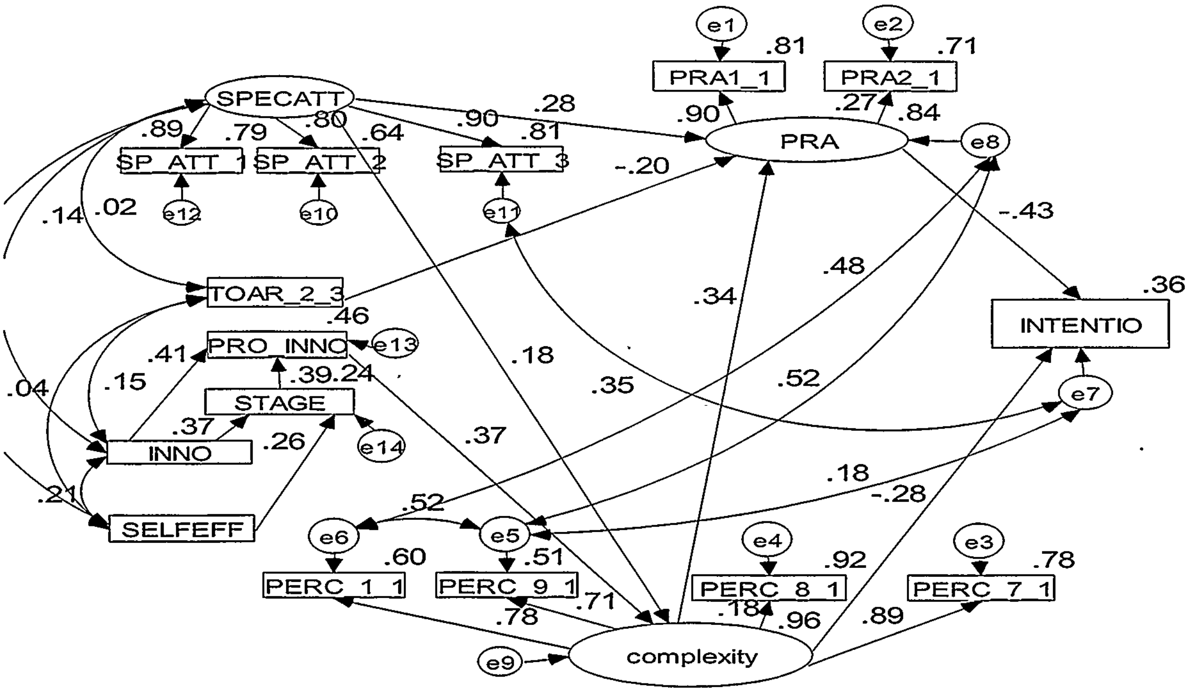


Figure M.4: The practice/lesson plan screen in the Interactive Volleyball CD-ROM

Appendix N

Printout of the Model



Standardized estimates
chi-square=87.067 df=74 p-value=.142
gfi=.917 agfi=.865 rmsea=.038 pclose=.728

Appendix O

Confirmatory Factor Analyses Results

A factor analysis was preformed using SPSS version 12 on 2 scales that were introduced into the model. The perceived innovation's characteristics which included 10 items (PerC_1 – Perc_10) and the 12 items of the attitude towards using computers in sport and physical education scale (PE13 – PE24). The results confirmed that the first scale was made up of two separate factors: Perceived Relative Advantage (PerC_1 – PerC_6) and Perceived Complexity (PerC_7 – PerC_10). The other scale was found to be unidimensional with only one factor.

Rotated Component Matrix(a)

	Component	
	1	2
PerC_1	.658	.203
PerC_2	.832	.242
PerC_3	.868	.255
PerC_4	.923	.141
PerC_5	.818	.230
PerC_6	.801	.057
PerC_7	.041	.914
PerC_8	.112	.939
PerC_9	.442	.751
PerC_10	.374	.808

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

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