# The Historical Relationship between Affective Variables and ICT Based Learning and Instruction and Achievement in the Israeli School System

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**Abstract:** ICT methodologies have been part and parcel of learning and instruction in the Israeli educational system since the mid-1970s when the behavioral theory based TOAM closed minicomputer based drill and practice learning methodology was introduced into Israeli schools. Later in the late 1970s the first PCs adapted for educational use were introduced into Israeli schools and continued in the drill and practice tradition. Thereafter, in the mid-1980s with the introduction of more advanced PCs into Israeli classrooms, open courseware coupled with electronic spreadsheets and databases came to the fore in ICT based learning and instruction. In the early 1990s when constructivist learning theory became accepted in the Israeli educational system, simulations and computer-learner interaction became popular ICT based learning methodologies used in Israeli schools. In the late 1990s reality technology was introduced as an ICT based learning methodology and in the mid-2000s ICT based distance learning became a permanent feature of learning and instruction in the Israeli educational system. Alongside the process of ICT introduction into the Israeli educational system, affective aspects of ICT utilization in schools was closely monitored. Much effort was expended in research designed to examine the relationship between ICT use in learning and instruction and scholastic achievement of students at all levels in the school system. Research evidence accumulated over the years indicates that teacher and student autonomy, computer self-confidence, computer efficacy, locus of control, need for innovation, extraversion, and control of the learning process are just a few of the affective variables found to significantly enhance ICT use in Israeli schools. Bearing in mind the progress made in the assimilation of ICT based learning and instruction in Israeli schools, it appears justified for educational policy makers and administrators to consider the importance of affective variables of both teachers and students when assessing their capability to best utilize ICT in school.

**Keywords:** ICT based learning and instruction; behavioral theory; constructivist theory; scholastic achievement; affective variables

## 1. Introduction

Information and Communication Technology (ICT) as an educational medium has not made the impression on educational outcomes as expected. Since the 1960s when the first attempts were made to implement ICT based learning and instruction in the

school classroom, much experience has been gained and much frustration that has been generated. The idea of using ICT based learning and instruction as a foolproof educational methodology is far from been fulfilled. Achievement levels attained by students in different subjects in which ICT has been used for learning and instruction have not improved dramatically, neither has affective education progressed significantly resulting from the use of ICT. Research studies have indicated that only under certain circumstances are educational outcomes improved by the use of ICT in the learning and instructional processes. This chapter will address the Israeli context of the direct relationship between ICT based learning and instruction and enhanced educational achievement as well as the mediating contribution of affective variables to the relationship.

## 2.    ICT Based Approaches to Learning and Instruction: Past and Present

In order to understand the complex issues and problems associated with the utilization of ICT based approaches to learning and instruction in the Israeli school system, the development and progressive implementation and utilization of different ICT learning and instructional methodologies will be examined. Naim (2010) described the significant reasons for the implementation of ICT based learning and instruction in the educational system in Israel. The first reason was the rapid development of technology that put computers within reach of Israeli schools. The second reason resulted from the belief that computerized learning programs would significantly improve the learning process and suit it to the needs of the individual learner. A third reason proposed by Naim was the fact that Israeli public opinion positively adopted the belief that computers were vitally necessary all walks of daily life including the educational arena. Therefore the educational system could not possibly halt progress and began using computers in the school system just as computers became popular in commerce, industry, medicine, transportation and other fields in daily life.

Offir, Katz and Passig (1994) historically described the development of ICT use in the educational process and indicated that the "closed - open" courseware continuum succinctly and accurately depicts the progress made in the use of technology for learning and instruction. The "closed - open" continuum provides an insight as how ICT methodologies evolved and developed in the Israeli educational system since the early 1960s up till the present time.

The theoretical basis of the early ICT learning approaches used in Israel drew from the behavioral school of thought. Skinner (1954, 1958) published a series of papers predicting that "teaching machines" would make learning dramatically more efficient and emphasized the "the constant interchange between program and student". Thus the first computer introduced into the Israeli educational system in the mid 1970s was a Digital "Toam" minicomputer to which individual terminals were connected. These terminals were used by individual elementary school students for diagnostics, drill and practice and evaluation of their work in English and mathematics. The system was totally "traditional", i.e. closed, with teachers unable to effect any changes in the computer software and served as a complementary learning system to the traditional

classroom lesson. The general atmosphere that pervaded the use of the "Toam" system was one of precision regarding the diagnosis and evaluation of students' ability in English and mathematics. Teachers religiously followed students' progress as mapped out by the Toam computer and planned their English and mathematics lessons accordingly. The Toam system was widely used and popularized the initial use of ICT in the Israeli classroom.

In the late 1970s when first generation of personal computers became commercially available in Israel, Apple IIs, Ataris, and Commodore CBMs personal computers connected in rudimentary networks, began replacing the Toam system in the Israeli school system. Offir, Golub and Friedel (1993) reported that the first PCs were used for traditional computer assisted learning and computer assisted instruction, based on drill and practice. Teachers closely followed inflexible computerized syllabi in a number of subjects, among them languages, mathematics and science. All students in elementary and junior high schools studied the same content and learning materials and progressed according to a rigid timetable. This generation of PCs also drew on behavioral theory and the software offered to the educational system was used to complement traditional teaching and was considered to be especially advantageous in providing students with a sound revision platform.

In the mid-1980s Israeli educators began asking pointed questions regarding the validity of behavioral learning as a valid theoretical source and inspiration for ICT use in the educational system. Addition questions raised addressed the relative advantages, effectiveness, and cost-efficiency of ICT based drill and practice as well as the advantages to be gained from the study of basic programming. Heated debates characterized the Israeli educational establishment regarding the direction to be taken in the use of ICT in the educational system (Mevarech and Hativa, 1996) and as a result of these debates other theoretical approaches were suggested. The constructivist theory of learning came to the fore in Israel, albeit alongside the behaviorist approach (Salomon, 1996), and led to the development and adoption of more flexible learning and instruction programs that were introduced into the Israeli educational system. These included the development of the use of electronic spreadsheets (Dreyfus, Feinstein and Talmon, 1997; Givon, 1996) that enhance learner independence and creativity and provide students with sophisticated graphic assistance that enhances the understanding and dissemination of complicated subject matter. Databases, which were also developed and incorporated in this stage of ICT development (Appelberg, 1997), provided students with the opportunity of enriching their knowledge and comprehension of subject matter by facilitating the search for sources hitherto available only in libraries and museums. Ernst (1991) noted that the introduction of the use of spreadsheets and databases in the educational process contributed to the promotion of improved learning and instruction and superior ICT applications in education. He added that the use of electronic spreadsheets accounted for almost 90% of computer assisted instruction and computer assisted learning in the late 1980s.

In the next stage of development in the 1990s, the constructivist learning model almost totally replaced the behaviorist approach and motivated the introduction of simulation software into the Israeli educational system (Hativa, 1996). Simulation, as described by Offir and Katz (1994), is a sophisticated, progressive and improved ICT methodology designed to electronically generate situations that exist in reality and to introduce these situations into learning and instruction. Baranauskas and De Oliveira

(1995) noted that educational computer simulations are based on dynamic interaction between the learner and the computer program and may be defined as part of a modeling process that involves the execution of the model by the learner. Through the methodology of simulation, teachers are able to provide their students with realistic models of subject matter as experienced in real life situations thereby facilitating students' understanding and mastery of the learning situation. Givon (1996) cited simulation as especially effective for the science and technology subjects where experiments can be conducted using ICT instead of having to prepare and use materials in the traditional science or technology laboratory. Leary (1995) confirmed that the achievement of learners using ICT simulation are on a par with and even outstrip achievement in non-simulation learning situations.

The next stage of ICT development in the Israeli educational system took place in the late 1990s and early 2000s and focused on virtual reality software. Turman and Matton (1994) defined virtual reality as a highly interactive ICT based environment in which the user becomes a fully-fledged partner in a virtual world. When experiencing virtual reality the user becomes an immersed participant in the computer generated virtual reality program. Bricken and Byrne (1992) stated that in order to enter the world of virtual reality the learner wears a computerized helmet and gloves which allow him or her to see, hear and touch objects in the virtual world. Henry (1992) stated that on entry into the virtual world the learner feels physically immersed in that world. Regain and Shebliske (1992) reported that learners who enter a virtual world undergo physical and emotional experiences very similar to those that exist in the real world in which they really live. Thus virtual reality provides an all-encompassing learning opportunity that promotes constructivist learning and understanding that surpass other ICT approaches (Katz, 1999). Passig and Sharbat (2001) as well Passig, Klein and Newman (2001) confirmed that the use of virtual reality technology in learning and instruction positively contributes to enhanced performance of both teachers and learners.

In order to take advantage of all the ICT developments in the Israeli educational system that took place from the mid-1970s until the present time, much educational thought and effort has been put into developing the various stages of software development into an integrated multimedia system. Multimedia methodology, which includes closed and open software as well as simulation and virtual reality packages, has become an important component of the ICT based educational process. Passig and Levin (2000) provided an in-depth analysis of multimedia packages suitable for the educational process and stated that when utilizing multimedia methodologies in learning the student does not only study the subject matter, but also learns how to deal with the synthetically programmed environment. The relatively easy use of technology and the uniformity of the multimedia interface have significant implications for both teacher and student, since they may provide a platform for a higher level of motivation, concentration, and understanding of the content being studied. The design of multimedia educational packages provides a clear, consistent and attractive ICT platform, which contributes towards the ability of teachers and students to reach excellence through user-friendly learning and instruction methodologies.

# 3.    Distance Learning Approaches: Past and Present

Since its inception as a mass delivery system in the early part of the twentieth century, distance learning has been utilized in order to provide students in the educational system the opportunity to study in locations separated by large distances from centers of learning. Chu (1999) intimated that the first generation of distance learning approaches, which utilized traditional printed material and communication by mail and telephone, served essentially as a one-way communication technology that, while providing students with content matter, inhibited interaction between teachers and learners. In the late 1960s and the early 1970s first generation distance learning technology was superseded by second generation audio recordings, radio and television broadcasts (Southworth, Flanigan and Knezek, 1981) which provided students with an improved delivery platform. Both first and second generation distance learning delivery systems were designed primarily to produce and distribute learning materials as efficiently as the technology of the day permitted. Both generations of distance learning lacked the key element of real-time interactive communication between students and teachers.

The 1980s and 1990s saw the development of sophisticated third generation distance learning systems which include interactive video, email, internet, and intranet technologies. Learning and instruction activity through the medium of these distance learning systems was redefined to include and focus on teacher-student interaction (Trentin, 1997). Interactive videoconferencing, and interaction through the medium of internet or intranet offer one-to-many or one-to-one tuition in which teachers and students are able to communicate on-line thereby solving key instructional and learning problems in real time (Katz, 1998). Third generation distance learning systems are flexible and present teachers with the opportunity of continuously monitoring overall progress of their students. These systems also allow tutors to modify, reinforce and even model educational processes, thereby fulfilling the cognitive as well as affective needs and requirements of students. Interactivity, which characterizes third generation distance learning, has also been shown to meet student needs more fittingly and comprehensively than the older distance learning modes. Interaction provides the student with a new cognitive environment that both activates and motivates learning and contributes to student satisfaction as well as to a feeling of control of the learning process (Finnie, 1989). Trentin (1997) confirmed that interactivity available in third generation distance learning methodologies promotes active engagement of students in the learning process and leads to improved academic achievement.

Katz (1998) described how the three generations of distance learning technology sophisticated were utilized in the Israeli educational system beginning with first generation technology in the 1960s, continuing with second generation technology in the 1970s and 1980s, and with the implementation of third generation technology in the 1990s. Third generation distance learning systems that include synchronous interactive video, asynchronous learning and instruction, email, internet and intranet technologies are still popular in the Israeli educational system mainly at the elementary, secondary and tertiary levels. According to Katz learning and instruction through the medium of synchronous distance learning methodologies has been redefined to include and focus on teacher-student interaction. Interactive video-

conferencing, and interaction through the medium of internet or intranet and email, offer one-to-many or one-to-one tuition in which teachers and students are able to communicate on-line thereby solving cardinal instructional and learning problems in real time. Third generation distance learning methodologies are characterized by their flexibility and allow teachers to continuously monitor overall progress of students. These methodologies also permit tutors to modify, reinforce and model educational processes, thereby fulfilling the cognitive needs and requirements of students. Interactivity available in third generation distance learning methodologies enhances active engagement of students in the learning process and leads to improved academic achievement. The implementation of distance learning technologies at different educational levels (elementary, secondary, tertiary) has been found to promote efficient and effective learning and instruction (Katz, 1998; Katz, 1999).

As a result of the increasingly successful adoption of distance learning methodologies in the Israeli educational system, fourth generation distance learning is gradually being introduced at the secondary and tertiary levels. Ismail et al (2010) confronted the implications of learning and instruction using fourth generation technology based distance learning courses. Learning has become significantly more flexible and content sources more accessible. Creating, sharing and knowledge capitalization are all facilitated by fourth generation distance learning. Wider sources of learning are provided in ICT based distance learning courses and worldwide expertise can systematically be brought to the student's desktop.

With the rapid development of fourth generation distance learning delivery, increasingly more research studies have been conducted in an attempt to evaluate the major issues related to ICT based distance learning. For example Chandra and Watters (2012) indicated that learning physics through the medium of fourth generation technology not only enhanced students' learning outcomes, but also had a positive impact on their attitudes toward the study of physics. Valaitis et al (2005) found that students who experienced up to date technology based distance learning courses perceived that the methodology increased their learning flexibility and enhanced their ability to process content, and provided access to valuable learning resources. Abdallah (2009) found that latest technology based distance learning methodologies contributed to improved quality of students' learning experiences.

One of the emerging learning strategies that has developed in technology based distance learning in recent years and is receiving growing attention from both students and teachers is in the domain of mobile learning (Prensky, 2005). It should be noted that the use of mobile learning is multi-dimensional and mobile technology now provides technological possibilities including voice, text, still-camera, video, paging and geo-positioning capabilities. These tools provide a rich variety of platforms that enhance the learning process. Moreover, mobile learning is not bound by space or time and students can choose to engage in learning without almost any limitations (Dieterle & Dede, 2006). Thus fourth generation distance learning technologies and methodologies are perceived to make a positive contribution to education and the Israeli educational authorities are increasingly insistent on the adoption of such technologies for teaching and learning (Naim, 2010).

## 4. Affective Variables and ICT

The research to date conducted to determine the relationship between ICT based learning and instruction and achievement is inconclusive. On the one hand, Hunley et al (2005), Gonzalez (2011), Alsafran and Brown (2012), Townsend (2012), Fairlie and Robinson (2013) in the United States and Mevarech (1988), Katz (1993) as well as Katz and Yablon (2009; 2011a; 2012) in Israel found no significant relationship between the use of ICT technologies in learning and instruction and academic and scholastic achievement. On the other hand Huffman, Goldberg and Michlin (2003), Lowther, Ross, and Morrison, (2003), Judge (2005) in the United States, Cheema and Zhang (2013) in the 2003 Program for International Student Assessment (PISA) study, and Liao (2007) in Taiwan found that ICT based learning and instruction are positively related to academic and scholastic achievement.

The evidence regarding the relationship between ICT based learning and instruction on the one hand and achievement on the other is inconclusive, Mevarech and Hativa (1996) and Katz and Yablon (2011a) suggested that the findings and results of research projects that examined the mediating effect of affective variables on the relationship between ICT based learning and instruction be studied. Mevarech (1988), Katz (1993), Ellington (2003), and Liu et al (2006) indicated that the relationship between ICT utilization in the educational system and academic and scholastic achievement is largely dependent on affective variables that seemingly mediate ICT based learning and instruction on the one hand and achievement on the other. Thus it was postulated that affective variables that act as mediators may hold the key to understanding the relationship between ICT based learning and instruction and academic and scholastic achievement.

Mevarech (1988) emphasized the fact that affective variables are of major importance when assessing the effectiveness and efficiency of ICT based learning and instruction approaches. According to Mevarech attitudinal research can shed light on how effectiveness and efficiency may be enhanced in the course of the educational process. One of the major issues apparently related to positive ICT attitudes as well as to efficient ICT in the classroom, is that pertaining to teachers' as well as students' attitudinal profiles (Kulik, Bangert-Drowns and Williams, 1983). Chandra, Bliss & Cox (1988) stated that the attitudinal sets that teachers bring with them to the instructional situation seem to be important factors in their decisions to utilize ICT in the instructional process or to disregard them as instructional aids.

Research studies carried out in a number of countries have indicated the relationship between affective variables characterizing teachers and ICT based learning and instruction. Stibble (1984), Smylie (1988) and van Deusen and Donham (1986) suggested that self-need for innovation among teachers contributes significantly toward their utilization of ICT based learning and instruction processes. Yaqhi (1996) indicated that teachers felt that the use of computers in the school classroom made a positive contribution to students' achievement. They emphasized the motivational advantages of computer use in the instructional process. Bradley and Russell (1997) indicated that Australian teachers perceived that attitudes such as anxiety and social embarrassment were negatively correlated with a feeling of computer competence and inversely related to a feeling of control when using ICT based learning and instruction in elementary schools. Harris (1999) postulated that

teacher autonomy and product involvement are two major attitudinal factors that positively correlate with enhanced computer use by teachers at the tertiary educational level. van Braak, Tondeur, and Valcke (2004) found that technological innovativeness and positive feelings towards the efficacy of ICT based instruction as well as gender (male) were related to effective computer use in the school classroom. Sadik (2006) confirmed that Egyptian teachers, characterized by computer confidence, computer liking and computer usefulness (factors developed by Loyd and Gressard, 1984), were able to more efficiently utilize ICT to enhance the instructional process in their classrooms. Karim (2012) found that head teachers as well as deputy head teachers in Pakistan who held positive attitudes toward the use of computers in learning and instruction were confident that the use of ICT enhanced the quality of the educational process.

Research studies were conducted in a the United States as well as in a number of European and Asian countries in order to examine the relationship between students' attitudes to ICT based learning and instruction and scholastic achievement. Griswold (1984) found that positive attitudes such as self-recognition and self-confidence in computer assisted learning are related to higher levels of achievement attained by elementary school students. Munger and Loyd (1989) found that both male and female high school students who held more positive attitudes toward computers were found to attain a higher level of achievement in than students of both sexes with more negative attitudes. Woodrow (1991) described the existence of a significant relationship between locus of control and students' attitudes toward the use of computers in the classroom. Kirkman (1993) indicated that 12 year-old students who held more enthusiastic attitudes toward computers, were more confident using computers and spent more time using them, attained a higher level of scholastic achievement that students whose attitudes and experiences with computers were less positive. Anderson and Hornby (1996) pointed out that participation of students in ICT based learning at the tertiary level leads to more positive computer attitudes than those held by students who did not experience ICT based learning. Tsai and Tsai (2003), in their research study of elementary school students, indicated the existence of a positive relationship between higher computer mastery, more positive computer attitudes, and lower computer anxiety on the one hand and higher-order metacognitive skills in selecting main ideas and using resources helpful for learning language comprehension on the other. The results of a study conducted by Pilli and Aksu (2013) confirmed the existence of a positive relationship between fourth grade students' attitudes toward computer-assisted learning of mathematics, their attitudes towards mathematics and their scholastic achievement in mathematics.

Studies have been conducted over the years in the Israeli educational system with regard to the relationship of affective variables towards ICT based learning and instruction. These studies have yielded empirical evidence similar to that found in other countries as described in the above paragraphs. Following are studies that examined affective attitudes of Israeli teachers to ICT based learning and instruction. Offir and Katz (1990) indicated that risk-taking was an important variable related to teachers' positive perceptions of computers as making a significant contribution to the learning and instructional processes. Teachers were took risks in their daily lives were more positive about ICT based learning and instruction than teachers who were more cautious and avoided risk-taking behavior. Katz and Offir (1991) reported that

teachers, whose attitudinal profiles included a clear tendency toward extraversion, personal stability, and tough mindedness, were more positive about using computers in learning and instruction and were more successful in their educational roles than teaches who were introverted, less stable and sensitive.

Katz (1999) studied a group of kindergarten teachers who underwent 10 hours of ICT based virtual reality simulation as opposed to 10 hours of workshop activity experienced by a comparison group of their counterparts. Both ICT and workshop methodologies were designed to promote improved understanding of kindergarten children's needs. Results of the study indicate that the kindergarten teachers who were trained through the ICT virtual reality technology developed a better understanding of children's needs and perceptions than those trained through the workshop method. Passig and Levin (2000) indicated that in schools where sophisticated multimedia learning and instructional packages were introduced into the school curriculum, teacher motivation and interest in the instructional process was increased and contributed to the enhancement of student achievement. Katz (2005) studied two groups of final year teacher trainees who were exposed to instruction presented in two different distance learning delivery systems. The first group of teacher trainees experienced instruction via a sophisticated flexible ICT based platform and the second group was exposed to an advanced but rigid video-conferencing instructional delivery system. Results of the study indicate that the students exposed to the flexible ICT based instructional approach indicated significantly higher levels of student satisfaction and control over the learning process than their counterparts who were instructed via video-conferencing methodology. Katz (2002) noted that affective attitudes such as independence, creativity, tough-mindedness, sociability, risk-taking, and stimulus-seeking have been shown to make a positive impact on teachers in their willingness to use ICT based learning and instruction in their classrooms. It is evident from the empirical evidence quoted above that these affective attitudes of teachers are vital to positively enhanced ICT utilization that conceivably leads to an improvement in the educational process.

Studies were conducted in Israel in which the relationship between students' affective attitudes and ICT based learning and instruction was examined. Katz and Offir (1990) found that positive attitudes toward ICT based learning and instruction were related to self-esteem, school motivation and satisfaction. Elementary school students with positive self-esteem preferred ICT based learning as did students who expressed dissatisfaction with teachers who used traditional and conservative teaching methods. Katz (1994) investigated attitudes of Israeli junior high school students who excelled in their ICT based learning. Results of the study indicate that pupils with higher learning self-image, higher social self-image, and internal locus of control tend to hold more positive computer related attitudes than pupils not characterized by these personality traits. Barak, Waks and Doppelt (2000) described how Israeli high school students, characterized as having high scholastic potential but functioning as underachievers, were taught higher order thinking skills and strategies via ICT based learning and instruction. As a result of the utilization of computers in the learning process these students' scholastic achievement, self-efficacy and study motivation were significantly enhanced. Katz (2002) demonstrated how affective attitudes held by students, such as self-image, social-image, self-confidence, internal locus of control, satisfaction, and study motivation are related to students' willingness to

participate in ICT based learning and instruction. Katz and Yablon (2011b) showed in their study that students who received ICT based learning and instruction were significantly more positive on three affective variables, namely learner motivation, learner autonomy and learner control of the learning process than students who received traditional class-based instruction.

## 5.    Conclusions

Empirical evidence has clearly indicated the existence of a relationship between affective variables and teachers' as well as students' perceptions of ICT based learning and instruction. Need for innovation, risk-taking, stimulus seeking, tough mindedness, extraversion, personal stability, sociability, self-image, social image, self-confidence, study motivation, learner autonomy, control of the learning and instructional process are just some of the affective attitudinal variables related to enhanced ICT based learning and instruction as well as to enhanced scholastic achievement. There is growing empirical evidence that the abovementioned affective variables serve as mediators between ICT based learning and instruction and achievement. Because of the affective nature of the mediating variables and the vast intricacies of the psychological basis of these variables, it is impossible to suggest a unitary model that can adequately describe the relationship between ICT learning and instruction and achievement under all circumstances. Therefore the model, being dependent on the affective make up of teachers as well as students, is one that can only address the principles of the relationship between ICT based learning and instruction and educational achievement.

Furthermore it would be a serious misjudgement to assume that all teachers and learners perceive ICT in the educational framework from the same point of view. Just as in traditional learning and instruction teachers usually prefer instructional approaches that impress them as suitable for their own particular instructional needs and students usually prefer learning methods that correlate with their own particular learning needs, the same is correct vis-à-vis the use of ICT based learning and instruction. Not all teachers perceive ICT based teaching as suitable for their needs and not all students feel that ICT based learning is suited to them. Thus differential ICT based learning and instruction is necessary in the educational process, a situation not yet recognized as valid or necessary by educators and educational policy planners.

It should be noted that although ICT based learning and instruction is now part and parcel of daily educational routine and one could intuitively conclude that attitudinal structures or constraints are relatively unimportant when considering the motivation to use ICT based methodologies in education in general and in the learning situation in particular, the evidence presented in this chapter confirms the chain of findings reviewed above that indicate that affective variables and attitudes of teachers and students are primary differential factors to be taken into consideration when assessing their capacity to best utilize ICT in learning and instruction.

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