Science Education International
Vol. 18, No. 3, September 2005, pp. 211-224

ICASE *International Council of Associations in Science Education*

Technology Integration in Science Studies: Obstacles and Incentives

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ABSTRACT *This study explores the factors that influence science teachers' decisions regarding the implementation of innovative computer-based scientific modules in their classrooms. The advanced educational software was developed especially for the project "Science Beyond 2000" - multidisciplinary study modules that motivate students to see themselves as researchers and use computers as primary laboratory research tools. The context of this study is unique because the study's participants were computer literate and used technology for their personal use or classroom preparations, but rarely for integration in science classes. We followed twelve middle and high school science and mathematics teachers throughout an academic course that presented the "Science Beyond 2000" project. Results that emerged from the study revealed five requirements that must be satisfied for teachers to implement successfully the advanced software. These requirements fall into five categories: Support and scaffolding; Content and curricular considerations; Pedagogical reasoning; Utilization; and Acceptability. Our findings also revealed teacher-student face-to-face communication to be a crucial factor for teachers in acquiring control of the classroom when integrating technology. We identified four types of teachers, each type seeking a different level of control: tight; medium; minimal, and loose. Our data revealed that the willingness to loosen control, transfer the learning responsibility to the student, and abandon ongoing face-to-face communication, enhances technology integration. These findings are of practical importance for educators concerned with the promotion of computer use within the science classroom. The findings emphasize the need to help teachers overcome pedagogical and mental obstacles in integrating computer-based classroom activities.*

KEY WORDS: *Computer Assisted Instruction, teacher control, integration of technology*

Introduction

The integration of educational technology in middle and high school curricula and its contribution for learning and instruction is of great concern to governments, researchers, policy makers, and educators. Technology integration involves increasing investments in facilities, software, communication, workforce, and professional development. Current studies, however, reveal that most graduating teachers are insufficiently experienced to effectively integrate computer-based technologies in their classrooms (Berger *et al.*, 1994; Cuban, 2001; Dawson, Pringle & Adams, 2003; OTA, 1995). In addition, in-service teachers are not adequately trained to teach or use recent technologies such as computerized simulations, electronic databases, and web-based environments (Bruder, 1993; Burniske & Monke, 2001; Collier, Weinburgh & Rivera, 2004).

The World Wide Web (www), with its rich trove of multimedia resources, interactive tools, and telecommunication facilities, accessible from any computer station anywhere in the world, serves as a facilitator for teacher learning. Yet, we know that mere access to technical resources is not sufficient to generate learning or to change teachers' practice (Jaillet, 2004; Valanides & Angeli, 2005; Wiske, Sick & Wirsig, 2001). Furthermore, the expected 'change in practice' is not sufficiently clear, and the proper role of technology in education is still not adequately defined (Chang, 2003; Roblyer & Edwards, 2000).

One could readily think that the problems of educational technology integration into any curriculum would be solved with the provision of sufficient hardware, software, and in-service training, together with a reduction in the number of children per class and the inclusion of Information and Communication Technologies (ICT) in the national curriculum. All these provisions, however, do not facilitate Computer-Assisted Instruction (CAI) and ICT (Pelgrum, 2001). Yet, the integration of educational technologies in instruction and learning is well accepted by educational policymakers as valuable in two aspects: As a facilitator in the delivery of the curriculum and as a factor in the reformulation of the curriculum. Reformulation in this sense means the extension of the curriculum, i.e., adopting new and useful instructional strategies, content, products, and processes that were not possible in the past (Tagg, 1995). However, teachers who perceive educational technologies as minimal or of no practical value will ignore these technologies, including those who are computer literate (Wiesenmayer & Meadow, 1997). Based on this assumption, we decided to explore the factors that influence teachers' decisions in implementing innovative computer-based technology into science classrooms. For example, how do teachers decide what resources they need to implement this technology? How do teachers perceive their professional role while students are involved in computer-based activities?

The Role of Technology in the Classroom

The integration of technology into educational frameworks usually evolves in stages: It advances initially from being a separate subject, through integration into content, towards a transforming role in which technologies are accepted as a pedagogical agent in itself (Unesco/IFIP, 2000). However, the question still remains whether the enormous investment of governments in this process is justified. According to Siegel and Foster (2000), the distribution and use of computers in a teaching environment is justified on the basis of two arguments: Learning improvement (Mehlinger, 1996) and the development of a constructivist approach to teaching, which places the student at the center of the learning process (Schunk, 2000).

A survey of the literature shows that most studies review the current status of computers in the classroom. Computers are used in elementary schools primarily for drill and practice, and in secondary schools primarily for word processing, or as "tutorial software" to support rote learning (Jonassen, 1996; Mergendoller, 1996). Computers have not transformed the learning environment in the classroom, but they have been "transformed" to fit current school practice (Wiesenmayer & Meadow, 1997). Furthermore, the main goals of educational technologies and the methods and models to implement them are still in flux. One can find different ideas regarding the role of technologies in the classroom, such as:

- a tool to address specific inquiry outcomes with the students (Cotton, 1991).
- a tool to simulate, animate, and visualize data, phenomena, models or systems (Ronen & Eliahu, 2000).
- a new way to perform traditional tasks, i.e., researching information on the

Internet, or using software in the place of overhead slides (Cotton, 1991).

- a peripheral instructional tool to supplement the textbook (Berger, Lu, Belzer, & Voss, 1994; Bruder, 1993).
- a tool and resource for the teacher (Yerrick & Hoving, 1999).

Teachers' Pedagogical Reasoning and Implementation of Information and Communication Technologies (ICT)

Computer Assisted Instruction (CAI) and ICT integration in the classroom involve the management of a complex range of sources of software and hardware, different teaching styles, and different types of learning tasks. This integration requires teachers to have a high level of teaching skills and professionalism (Valanides & Angeli, 2005; Webb, 2002). People who are self-taught in ICT have usually acquired the requisite skills for personal needs. They are unlikely to have developed the knowledge, skills, and processes required to teach ICT to others or to integrate them into learning environments. Valanides and Angeli (2005) claim that in order to achieve that, ICT – related pedagogical content knowledge (ICT – related PCKg) is needed. ICT – related PCKg is described as the ways knowledge about tools and their affordances, pedagogy, content, learners, and context are synthesized into an understanding of how particular topics can be taught with ICT in ways that signify the added value of ICT. Thus, computer-based educational technologies, used in classroom settings are not self-implementing. Successful implementation usually relies upon teacher decisions and pedagogical reasoning (OTA, 1995).

There is a strong overlap between teacher decisions regarding practice and the beliefs upon which teacher base these decisions. Teachers' beliefs and experiences have been shown to influence future practice more than the nature of the technology itself (Miller & Olson, 1994, 1995). Lehman (1994) argues that when teachers are expected to 'change practice' or to implement educational innovations, they cite common obstacles in rank order: 1) access; 2) training; 3) teacher personality; 4) time; and 5) school curricula. Like Lehman (1994), Berger and Carlson (1988) report that access is perhaps the most commonly cited limiting factor for making use of technology in science teaching. Additional problems suggested by Stoll (1995) are an insufficiency of good software, technological complexities of the computers, rapid outdating of learned technology, and lack of teacher training.

Three factors, often referred to as predictors of implementation, are popularly used to correlate teachers' attitudes towards technological innovation and practice. These factors are: Degree of reception of implementation of innovation; perceived behavioral control; and immediately available support (Crawley & Koballa, 1994). Moreover, there is strong evidence that teachers' ideas, beliefs, personality and values also influence practice regarding implementation of technological innovations (Fang, 1996; Katz & Francis, 1995; Moseley *et al.*, 1999).

The Personality Factor

Two key issues confronting educators today are the wide range of attitudes among teachers towards CAI, and the effectiveness of initial teacher training in promoting positive attitudes. Studies suggest that teacher personality attributes may provide an important predictor of attitude and ability to adapt to novel and innovative situations of CAI in the classroom (Cox, 1997; Pocius, 1991). Offir and Katz (1990) demonstrated that teachers characterized as risk-takers in their personal and professional lives feel more at home with computers in the classroom and are more likely to utilize and favor CAI than teachers who are less willing to take risks. Eysenck and Eysenck (1985) developed a coherent model of personality that has been shown to be an effective predictor of positive attitudes towards computer use (Katz & Francis, 1995) Angeli and Valanides (2004) assert that when studying the performance of individuals interacting with technology, individual differences in cognitive ability, and/or cognitive style have to be considered. They studied the achievements of primary student teachers in freshman classes during problem-solving with modeling software. The students were classified according their cognitive style as field-dependent or field independent (FD/I). FD/I is generally considered to represent differences in learners' visual perception, or comprehension of information. Angeli and Valanides showed that the cognitive characteristics of FD and FI individuals have important implications for the relationship between the individuals and the corresponding cognitive demands of the computer-based learning environment.

The above studies and research in this area (Pocius, 1991) show that cognitive and personality traits are primary factors to be considered when introducing educational technologies into classrooms. Additional considerations include assessing the suitability of the individual teacher to computer use, and developing the time schedule for integrating innovative software into the curriculum (Katz & Francis, 1995).

Hence, we found it important to further explore the factors that influence teacher decisions regarding the implementation of innovative computer-based scientific materials in their classrooms.

"Science Beyond 2000": Innovative CAI Curriculum

The flood of scientific information that is published in the professional and popular media stimulates science teachers to introduce new scientific and technological discoveries into the classroom, in addition to the regular syllabus. To facilitate this goal, the "Science Beyond 2000" project was established by scientists and science educators at Bar-Ilan University.

The project is innovative and original in its approach, content, and methods of teaching. The "Science Beyond 2000" program includes multidisciplinary study modules at the forefront of scientific research, including explanations of basic scientific concepts, and general models for the characterization of systems in nature. The project motivates students to see themselves as researchers. In addition, the program involves students in scientific thinking, and presents them with challenges and open questions. "Science Beyond 2000" emphasizes computers as primary laboratory research tools enabling the complex calculations necessary for solving problems that were heretofore unsolved. The students operate interactively the software and perform simulations. They study natural phenomena such as: Fractal structures in nature, the spread of diseases and fires, polymers, models of brain and mind activities, chaos, transportation, landslides, earthquakes, and gene expression patterns. "Science Beyond 2000" was implemented in Israeli junior high schools and high schools during the 2000-2001 academic year.

Goals and Main Questions

The main goal of this study was to explore teachers' attitudes and ideas regarding the usage and integration of the advanced educational software that was especially developed as part of "Science Beyond 2000." We wanted to find out what may help and motivate the teachers to implement these modules and software. As mentioned before, the main questions of the study were:

1) How do science teachers decide what resources they need to implement innovative computer-based activities?
2) How do teachers perceive their professional role while students are involved in computer-based activities?

Methodology

Context of the Study

We followed science teachers that took part in an academic course, entitled "Science Beyond 2000," that was part of the program for a Master's degree (MA) in Science Teaching at Bar-Ilan University. The course met for four hours once a week, for five months. "Science Beyond 2000" exposes students to new theoretical science teaching approaches, and demonstrates methods of teaching such approaches with the aid of computer-based technologies especially designed for these modules.

Sample

Twelve in-service science and mathematic teachers from Israeli high or junior high schools participated in the course. The average period of in-service teaching was 20 years, with a range from 8 to 37 years of experience.

Data reported was collected from semi-structured interviews and observations. All participants were asked the same questions. We permitted open discourse as needed during the interviews. Most interviews were conducted face-to-face, but five participants were interviewed by e-mail.

Figure 1 presents the English translation of the questions that were asked in Hebrew during the interviews.

- What factors do you consider when you have to choose a program/instructional materials to teach?
- Does the inclusion of educational software in instructional materials influence your decision whether to use these materials? How and to what extent?
- Describe a lesson that involved your students working with computers.
- How did CAI influence your instruction?
- How did CAI influence your feelings during the instruction?
- How do you plan the integration of computer-based activities in your science classrooms?
- Do you design computer-based activities for your lessons?
- What, in your opinion, do teachers need in order to implement innovative software, such as the programs introduced to you during this course?

Figure 1. Questions Asked During the Semi-structured Interview.

All discourses were analyzed (Shkedi, 2003) and categorized into groups arranged under five themes.

- Support and scaffolding.
- Content and curricular considerations.
- Pedagogical reasoning.
- Utilization.
- Acceptability.

These themes may facilitate teachers' trainers and policymakers by serving as guidelines for planning the introduction of new instructional methods and innovative educational software into classrooms. The analysis also makes it easier for educators to propose methods of overcoming common pitfalls in implementing the computer-based scientific modules.

Data Analysis and Results

The analysis of the data under these themes revealed a list of different support needs that may facilitate implementation of innovative software. There were qualitative differences in the nature of teachers' accounts of support needed, as well as attitudes and perceptions about computer-based technologies in the classroom. Table 1 presents the main findings that emerged from the study.

Table 1
Needs and Requirements to Facilitate the Implementation of Innovative Software, as Specified by Teachers

Theme	Requirements	
Support and scaffolding	1)	Continuous technical support
	2)	Continuous psychological support
	3)	User friendly and simple software
	4)	Easy accessibility of the software/program
Content and curricular considerations	5)	Matches the national and/or school curriculum
	6)	Can be integrated into subject matter learned in class
	7)	Contains scientific or professional background material
	8)	Answers a special need (i.e., explains an abstract concept, covers a syllabus topic that lacks proper instructional materials, etc.)
Pedagogical reasoning	9)	Appropriate for the level of students' knowledge and abilities
	10)	Suitable for a heterogeneous class
	11)	Utilizes an innovative approach that attracts teachers' interests
	12)	Supports effective learning
	13)	The aims and goals of the software/program are clear to the teacher
Utilization	14)	Supplies enough data for further inquiry
	15)	No need for further elaboration and planning before introduction to students
	16)	Does not require special resources, equipment, or extended hours
Acceptability	17)	Appropriate for the teacher
	18)	Appropriate and relevant for the students
	19)	Appropriate for the teacher's personality and their educational agenda
	20)	Recommended by other teachers

Below, we discuss a specific significant finding regarding "teacher control" that emerged from the responses to the two questions: "What, in your opinion, do teachers need in order to implement innovative software such as the programs introduced to you during this course?" "How do you plan the integration of computer-based activities in your science classrooms?"

'Teacher Control' in Computer-based Activities

Analysis of answers and explanations revealed an aspect that is rarely mentioned in the literature: teachers' perceptions about 'teacher control' in the classroom during computer-based activities.

Where CAI is concerned, the term 'teacher control' usually refers to controlling what students are doing while working with their computers. What emerged from our interviews is that teachers are most concerned about face-to-face teacher-student communication. Participants in our study expressed different attitudes regarding how much student-teacher communication should occur, and the degree of independence students may take while working on their computers. These attitudes influence the structure of the computer-based lessons, and how teachers plan for these learning activities. We identified four different levels of control that teachers want to achieve during CAI. These range from a need for great control in the classroom (centralism) through a need for minimal control without any need for face-to-face communication. The need for tight control in the classroom, in fact, serves as an obstacle for CAI, while the need for minimal control enhances and provides an incentive for CAI. Those teachers, who wish to maintain face-to-face communication in the classroom, plan computer-based activities only (if at all) within well-structured instruction, and only for a limited part of the lesson. Those teachers who are ready to loosen their control plan CAI according to the students' and their convenience, not necessarily when the teacher is present or during school hours.

An analysis of the results of the four levels of control follows:

Tight control ('Centralism'): Two teachers indicated that they do not intend to integrate the modules and software that were introduced to them, though they have no problem operating the various software and communication tools. They use computers only for their personal needs or to plan classroom instruction. These teachers claim that during computer-based activities they lose control of the class, and they prefer to teach in the traditional format, where the teacher is the center of the learning process. These teachers expect to control the class and communicate with all the students, as Anat elaborated:

> *I like to see every student in the classroom when I teach.* ***I like to see their faces and expressions.*** *I stand in front of them and I know what they are doing. I like to feel that I control the lesson. I ask questions, we discuss topics, I move around the class and drawing their attention. When students are working with computers, I can't control what they are doing all the time. Students can play, they can enter other sites, and they often do not communicate with me. That is why I almost never use computers in my lessons.*

Medium control: The need for a measure of face-to-face communication was also expressed by two other teachers. Their need, however, did not completely halt the integration of CAI in their classes. These teachers have a need to be dominant in class, and they cannot tolerate student-student interactions that are not directly related to the lesson itself. These teachers understand, however, the advantages that CAI offers, and the importance of information accessibility on the Internet. The teachers integrate CAI into their teaching, but only for a limited time, and in a structured manner. Zahava said,

I plan a lesson that involves computers, only if it is really needed. For instance, if we need to look for information about a topic, I design a well-planned activity: The students enter only the specific sites I give them. If they have to use the electronic worksheet in 'Excel,' I give them short tasks with specific instructions. I demonstrate how they can accomplish the task. Then I give them more instructions and show them how they can do it themselves. ***The lesson is very structured.*** *They may not proceed alone.* ***We proceed together, step by step.***

Minimal control: Seven teachers fall into this category. They conduct computer-based activities occasionally without fear that they will lose control of the class. They have doubts, however, as to how much learning is achieved during computer-based activities. They trust mainly themselves and prefer to teach most of the lessons without CAI, which may interfere with the students' attention. When these teachers conduct computer-based activities, they allow the students to work independently.

For example, Levana, commented:

I can manage with those kinds of lessons that the students do independently on the computer. I approach students who need help. But I don't like this teaching style and I don't know how much they learn. This style also does not fit all students. There are students who need more support and guidance. I prefer the situation when all students work on the same task during the lesson. I don't like the situation, when the students can 'wander around' the Internet, and look at irrelevant web sites during the lesson.

Similarly another teacher, Lili, emphasized the fact that she has no fear of CAI. She explains:

I am teaching for almost 38 years, and the truth is that I loved computers from the very beginning. I was one of the first (in my school) who started to look for ways to use computers in science classrooms. On my own initiative, I developed learning materials with the aid of computers. I even sold some. But today, technical problems are more crucial. You need a technician nearby; there are not enough hours in the computer labs; computers are not powerful. Yet, it is great to surf the Internet and learn from educational software.

However, Lili contested:

It is difficult to conduct a lesson based on computers. You need another teacher or some one else to help. If you don't monitor students' activity constantly, some students immediately start to look for websites that interest them but are not relevant to the lesson. Also, I don't like the situation that I have to move around and repeatedly explain to each student, what needs to be done, and to check what each pupil is doing. To solve this problem, the school administration agreed to purchase a special system that enables me to see what each student is doing with his computer. This ability enables me to ***feel that I control what they are doing, and at the same time permits each student to proceed at his own pace*** *- as long as the students complete the task, and I can assess their work.*

Loose control: The lowest level of 'teacher control' as defined in this study is associated with the highest level of CAI and ICT implementation. This level is exemplified by Devora who teaches high school physics. She thinks that computer-based activities must be held primarily after school, at home She feels comfortable with computers and confident in her teaching. She does not want to control her students' learning and does not need to communicate with them face-to-face throughout the entire instruction. She thinks that students must be responsible for their own learning, and that learning can occur also outside of school hours. She sees the role of the teacher as a guide and support for students, as needed. She does not necessarily have to be physically present in the same room with the students. Devora explains:

> *It is not obligatory for students to be present in class with me. I talk with them and provide them learning tasks through our forum.* ***We are not bound by or limited to school time.*** *This arrangement is convenient for both the students and me.* ***Each student enters the forum when it is convenient and obtains assistance from me.*** *In such a way, I am much more available to assist the students.*
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> *Those who meet with difficulties do not hold the others back, and those who proceed faster, receive higher-level tasks. This way I expand my teaching time. Students know that whenever they send me questions or work to evaluate, I will respond and will return it to them the same night or the next morning. I think it is a waste of time to work with the computers in class. In class, I only demonstrate and explain the tasks. Then, they complete the task or activity at home. For example, I ask them to activate a simulation that I found on the Internet, and then they must answer some questions and send it to me in the forum. I also add links to encyclopedia on the net or to certain scientific websites to clarify a special term or principle. If they take a break during homework, and play on the computer, I don't care. It does not waste lesson time. As long as they take responsibility, complete the task, and do it well, I can concentrate on teaching when we are in the classroom. I don't have to be the 'policeman'.*

Discussion

The context of this study was unique since all participants feel comfortable with computers. They are experienced, professional teachers, studying for a Master's degree. Yet, we found that seven teachers do not often integrate computer-based activities into their classroom teaching. Other participants (4) rarely try. Furthermore, although the course in which they participated exposed them to a variety of appropriate software, and taught them ways to integrate this software into their instruction, the participants believed that it would be difficult for them to implement the software in class. This, despite the fact that they seemed very enthusiastic to explore the advanced software that was developed as part of the course and project. Our findings emphasized the need to help teachers overcome pedagogical, technical, and psychological obstacles in implementing computer-based scientific modules.

These findings are in agreement with other studies Cuban (1986) reported that simply providing access to new technologies is unlikely to transform educational practice. Eylon and Bagno (1996) claim that support and scaffolding are most important when new ways of teaching are introduced. They found that to achieve stable practice of innovative instructional methods, teachers need to experience three stages: active learners, reflective teachers, and adaptive innovators. Eylon and Bagno (1996) comment that teachers need support in each of these stages, in particular when fundamental changes are introduced. Quite often, programs provide experience only during some of these stages. For example, teachers participate in a workshop, and experience learning in new ways, but there is no follow-up guidance when they implement the method in their classrooms. Wiske, Sick and Wirsig (2001) elaborate that most learning opportunities for teachers fall short: These opportunities tend to be short-term workshops, focused on general topics, rather than deep knowledge of subject matter and pedagogy. Such workshops are often inattentive to teachers' individual interests, disconnected from specific classroom practices, and isolated from ongoing support by coaches and colleagues.

Moreover, Putman and Borko (2000) offered positive suggestions by emphasizing the need for professional discourse communities. They pointed out the difficulty of creating such communities in schools which seldom value or support reflective analysis of teaching practice. They suggest that effective professional development must combine the use of web-based resources with activities that motivate, focus, support, and sustain teachers' practices. Zhao and Cziko (2001) introduced a novel model of goal-oriented behavior, Perceptual Control Theory (PCT), to understand why and how teachers use and do not use technology. This model examines teachers as goal-oriented, purposeful agents. They claim that PCT provides a comprehensive model for understanding technology infusion. From a PCT perspective, three conditions are necessary for teachers to use technology: The teacher must believe that technology can achieve or maintain a higher-level goal than what has been used; the teacher must believe that using technology will not interfere in reaching other goals and the teacher must believe that he or she has or will have the ability and resources to use technology. The five themes specified in this study may also facilitate teacher trainers and policymakers in serving as guidelines for planning the introduction of new instructional methods and innovative educational software into classrooms.

When the participants of this study were asked to describe how they plan computer-based activities, we found that the majority does not conduct such lessons frequently. Although all interviewees indicated that they feel comfortable with computers, they mentioned often 'control' as an obstacle 'Teacher control' in the classroom appeared to be an important element when teachers consider whether to integrate computer-based activities into lessons. Many teachers obtain a sense of worth and competence from keeping control in the classroom (Bell, 1998). Using new activities can make some teachers believe that they have minimal or no control, especially when the activity is computer-based, and students proceed at their own pace.

Analysis of the data revealed a range in the level of teachers' need to control the students during lessons. The participants of this study revealed that they seek control not in the sense of discipline, but in the sense of communicating face-to-face with the students and obtaining information about each student regarding his level of concentration, understanding, participation in the activity, and commitment to work. These levels affect the way teachers plan computer-based activities: 'Tight control' – as we called 'centralism' - may halt implementation of CAI. Lower levels: 'Medium control' and 'Minimal control' may facilitate the frequent use of technology in science classrooms. 'Loose control' facilitates both frequent use of

CAI in the science classrooms and enables the integration of computer-based activities during after-school hours, and as an extension of instruction to include after-school hours.

These findings emphasize that personality traits remain primary factors in considering the implementation of educational software. Management of teachers' attitudes is an important aspect of the change process and the introduction of new teaching innovations into the classroom. Addressing the emotional issues, conflicts, uncertainties, pressures, anxieties, and worries that arise is a part of personal development (Bell, 1998). These feelings are often not emphasized adequately in the professional literature.

Concluding Remarks

Above all, this study emphasizes the necessity to encourage science teachers to integrate technology into their instruction by means of technical, psychological, pedagogical, and social support. Training programs and in-service courses that train teachers in the implementation of CAI and educational software should refer to the needs and requirements expressed by the participants of this study (Table 1). Throughout the fulfillment of these specifications, educators will be better able to facilitate the implementation of CAI and ICT in science classrooms. Moreover, this study revealed that the willingness to loosen control over students, transfer the learning responsibility to the student, and abandon the need for constant face-to-face communication may play a crucial factor in the successful integration of technology into the classroom.

Our findings support the claims of other researchers (Yorick & Hoving, 1999) that teachers' attitudes, social supports, and perceived behavioral control affect the prospects of technology implementation in the classroom. Efforts need to be invested in solving obstacles that teachers encounter, both after their participation in training courses and after the delivery of technological equipment and resources. Continuous support during implementation is crucial for teacher 'change of practice' especially during integration of technology in science classrooms.

Acknowledgements

We wish to thank Prof. Shlomo Havlin and Prof. Haim Taitelbaum for their professional support and fruitful cooperation. In addition, we acknowledge the valuable comments and advice of Prof. Zecharia Dor-Shav, and the teachers who participated in this study. We also thank Yosef Mackler for his editorial assistance.

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