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"ISLANDS OF INNOVATION"AND "SCHOOL-WIDE IMPLEMENTATIONS": TWO PATTERNS OF ICT-BASED PEDAGOGICAL INNOVATIONS IN SCHOOLS

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Abstract: *The study reported here is a secondary analysis of data collected in 10 schools as part of Israel's participation in two international studies: IEA's SITES Module 2, focusing on innovative pedagogical practices at the classroom level, and the OECD/CERI case studies of ICT and organizational innovation, focusing on ICT-related innovations at the school system level. We identify and analyze two patterns of ICT-based curricular innovations: "islands of innovation" and "school-wide implementations." In the analysis of both patterns we focus on (a) the levels and domains of innovation reached in schools; (b) the communication agents and school variables affecting the diffusion of the innovation; and (c) the role of internal and external factors affecting the diffusion of the innovation. In the discussion we elaborate the potential value of sustainable islands of innovation models as agents of innovation, and the similarities and differences between both patterns of ICT implementation in schools.*

Keywords: *ICT in education, diffusion of innovation, island of innovation, school-wide implementation.*

INTRODUCTION

Although conceptual and planning work related to the implementation of information and communication technologies (ICTs) in schools goes back in history to the early 1980s (Pogrow, 1983), an increased emphasis on the holistic incorporation of the technology into educational systems began during the 1990s. Since then, significant national efforts have been made in many countries to plan this implementation and to allocate the required government

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funds (Hoffman, 2002). As a result, in the last decade an increasing number of countries have been promoting, as explicit national policies, the incorporation of ICTs into their educational systems: installing computer networks in schools, connecting these to the Internet, and training ICT-oriented teachers (Venezky & Davis, 2002). Special attention has been granted to the process of diffusion of innovative ICT practices in all aspects of school life, including the curriculum, and the teaching and learning processes.

Theories dealing with the diffusion of innovations have been developed in different fields such as economics, business studies, and marketing, in an effort to identify factors affecting the release and marketing of new products (Amendola & Gaffard, 1988). So far most attempts to apply diffusion of innovation theories to education have focused mainly on higher education (Bennett & Bennett, 2003; Macchiusi & Trinidad, 2001), on teachers (Atkins & Vasu, 2000), and on nationwide diffusion of innovation processes (Porter, 2000). Attempts to apply these theories for examining ICT implementation at the elementary and secondary school levels are scarce.

Diffusion of innovative pedagogical practices using ICT in schools is the focus of this paper, in which we examine data collected for IEA's SITES (Second Information Technology in Education Study) Module 2 international study of innovative pedagogical practices using ICT (International Association for the Evaluation of Educational Achievement [IEA], n.d.; see also, Kankaanranta, 2005, this issue). The international research included participants from over 30 countries, including Israel. This article reports on a secondary analysis of the data and is part of a series of papers dealing with ICT-based innovations in 10 Israeli schools which participated in the international study (Mioduser, Nachmias, Tubin, & Forkosh-Baruch, 2003; Nachmias, Mioduser, Tubin, Cohen, & Forkosh-Baruch, 2004; Tubin, Mioduser, Nachmias, & Forkosh-Baruch, 2003).

The Organization for Economic Co-operation and Development [OECD] study (Venezky & Davis, 2002), which was conducted by the Centre for Educational Research and Innovation (CERI), concentrated on case studies as well. Its goal was to analyze how ICT relates to educational innovation; the rise of ICT in education was central to the study. The case studies explored a relationship between successful implementation of educational innovation and successful use of ICT, particularly the school as a social organization: dynamics, conditions, and processes of change. The innovations of interest were those that took place at a school level, with relation to students, teachers, the school organization, or administration.

An interesting finding of our previous analyses (Tubin et al., 2003) was the identification of different scopes and patterns in the diffusion process of ICT-based innovations within the schools. We observed two main patterns: "islands of innovation," in which innovative pedagogical practices included about 15% of the teacher and/or student populations; and "school-wide innovations," involving 50% or more of the teacher and/or student populations. In this paper we take a step further, analyzing the characteristics of both ICT-implementation patterns and elaborating on these characteristics by means of Rogers' (1995) diffusion of innovation theory. We believe that studying the different diffusion-of-innovation patterns within schools will improve our understanding of the implementation processes of ICT-based innovations and their transferability and scalability, and may provide useful information to policymakers in this field.

BACKGROUND

In recent years major steps were taken in many countries to supply schools with an ICT infrastructure (Pelgrum & Anderson, 1999), in the hope that technology will support innovative pedagogies and improve the teaching and learning processes. However, one of the main difficulties concerning the diffusion of innovative ICT-based practices in schools is finding ways to engage teachers and students in using the new technologies effectively (Dodgson & Bessant, 1996).

Rogers (1995) describes *diffusion of innovation* as the process by which an innovation is communicated through certain channels, over time, and among the members of a social system. Below we will briefly elaborate the key components of the definition, that is, innovation, communication agents, time frame, and social system.

Innovation

Innovation is not a clearly defined concept (Bamberger, 1991), and educational innovation using ICT is even more complex. ICT, when implemented in a school, is perceived as innovative per se, regardless of the content addressed in its use (e.g., a skill or a concept), its function (e.g., part of a learning task or a communication tool), or its application scope (e.g., school-wide or limited to a class or small group). In this study, following the definitions adopted by the IEA international research group, ICT-supported innovations are defined as pedagogical solutions and means supporting a shift from traditional educational paradigms towards emerging pedagogical approaches based on our current understanding of learning, such as fostering learner-centered and constructivist processes, and the acquisition of lifelong learning skills (Pelgrum, Brummelhuis, Collis, Plomp, & Janssen, 1997; Mioduser et al., 2003). These skills may include the planning of one's own learning, self-assessment of learning processes and outcomes, making decisions as to whether and when to act as an active or passive learner, adapting to changes in learning settings, applying collaborative skills, or integrating knowledge from different disciplines using different learning strategies for different situations (Knapper & Cropley, 2000). To conclude, an innovation is much more than a technical development, but rather a qualitative educational shift towards a new paradigm as a result of an ongoing process (Mioduser, 2005)

Rogers (1995) refers to three main types of innovations. *Continuous innovation* reflects a gradual change or improvement of an already existing product, even if the adopters use it in the same fashion as before; *dynamically continuous innovation* implies either creation of a new product or a radical change to an existing one, which in turn alters its diffusion patterns; and *discontinuous innovation*, a new and innovative product which brings total change to consumers' acquisition and usage practices.

The above classing is compatible with the three-level scale we defined in the analysis framework we developed for studying innovative ICT-based pedagogies in Israeli schools participating in SITES M2 (Mioduser et al., 2003). The three levels of innovation we defined were assimilation, transition and transformation. At the *assimilation* level, specific pedagogical conditions undergo qualitative change, but the school curriculum as a whole (e.g., content and goals), the instructional means (e.g., textbooks), the learning environment (e.g., classrooms, labs), and the learning organization (e.g., timetable) remain unchanged. At the *transition* level, ICT supports the integration, within the school's everyday functioning, of

new contents, didactic solutions, and organizational solutions side-by-side with the traditional ones. At the *transformation* level, substantive changes take place in the school system as a whole. Traditional processes still exist, but the school identity is mainly defined by the rationale and goals of new approaches and lines of operation; student and teacher roles are enriched with new dimensions; new contents are introduced to the curriculum; new teaching methods are developed and implemented; and, for particular activities, the traditional time and space configuration are transformed.

Overall, research findings from different international and national studies show that schools using ICT are mainly at the assimilation or transitional levels. However, many examples can be found of particular agents at the school level who put in time, effort and creative thinking into coping with the complex task of implementing ICT in transformational pedagogical ways (Mioduser, 2005; Mioduser & Nachmias, 2002; Pelgrum & Anderson, 1999).

Communication Agents and Adoption Time Frame

Diffusion of innovations takes place not only through general or formal communication channels (e.g., mass media), but also—and perhaps mainly—through interpersonal communication. The information flow in this communication mode is marked by processes such as knowledge transactions among individuals, leaders' influence, or peer pressure. The diffusion process at this level is time consuming. And, according to Rogers (1995), the adopter of the innovation goes through a five-stage process: awareness, interest, evaluation, trial, and adoption.

Two factors affect communication or diffusion paths of ICT-based innovations in schools: key function-holders within the school and the school background. In most schools, it seems that people such as the principal, the computer coordinator, and computer experts serve as opinion leaders who mediate between the new technology and the teachers, and promote the diffusion of the innovation (Cuban, 2002). Also, school background factors, such as school size, school level (elementary, high school), location within the country (central, periphery), or settlement type (urban, rural settlement, such as a kibbutz), affect processes such as interpersonal communication, solidarity among teachers, or the effectiveness of peer pressure. This in turn affects the way the innovation is communicated, adopted, and shared by the teachers, and the time frame for the diffusion process.

Social System Factors Affecting the Diffusion of the Innovation

Social system refers to the group or groups of people among whom an innovation diffuses within their settings (Rogers, 1995). Research on educational change addresses many factors associated with the social systems that are involved in the diffusion of a pedagogical innovation (Datnow & Stringfield, 2000; Fullan, 2001; Kinsler & Gamble, 2002; Tyack & Cuban, 1995). These can be classed into two main categories: internal and external factors. Internal factors are located within the school and include, for example, the principal, teachers, computer coordinator, but also the school's vision and history, teacher training, and ICT infrastructure and maintenance. External factors reside outside the school boundaries, and include the government, municipality, parents, experts, intervening organizations, as well as national and regional policy and finance (Nachmias et al., 2004). This distinction is vital to the question of whether the school can generate innovations based on its internal resources by

changing their use and purpose (reengineering) or changes in decision-making policies (restructuring), if systemic external action is required (Papagiannis, Easton & Owens, 1998).

Emphasis on factors within the school is based on the assumption that the main barriers to change are existing thinking patterns and human behavior; therefore conceptual change among school staff members is the first step required towards organizational learning and innovation adoption (Argyris & Schön, 1996; Sizer, 1992). In contrast, emphasis on factors outside the school stresses the role of decision makers and top-down processes (e.g., placement of students, allocation of resources) as vital to any change taking place at the school level (Papagiannis et al., 1998; Tyack & Cuban, 1995). Cuban (2002) claims that both groups of factors are necessary for ICT-based innovation to diffuse into and improve the schools.

Research Questions

Our research objective was to examine the differences between two patterns of ICT implementation in schools: *islands of innovation* and *school-wide implementation*. According to the diffusion of innovation theoretical considerations presented above, our secondary analysis of the data collected in the Israeli schools addresses three main questions:

- What levels of innovation were observed in schools in each of the implementation-pattern groups?
- What communication agents and school variables affect the diffusion of the innovation in schools in each of the implementation-pattern groups?
- How do internal and external factors affect the diffusion of the innovation in schools in each of the implementation-pattern groups?

METHOD

The study this paper reports on was based on qualitative methods for data collection, and included the examination of 10 Israeli cases studies in which successful ICT implementation occurred. Our goal was to reach a comprehensive understanding of the ICT-based-innovations diffusion process (Stake, 2000). The selection of schools was based on indicators such as meaningful use of ICT, changes in teacher and student roles, curricular changes and evidence of sustainability, scalability and transferability (Kozma, 2000; OECD/CERI, 2000).

The research population included two elementary schools, one lower secondary school, three high schools and four six-year secondary schools. The schools were chosen by a steering committee based on the SITES M2 international and local indicators of innovative pedagogical practices using technology (see Tubin et al., 2003).

Data collection tools for each school included questionnaires and interviews (with the principal, computer coordinator, teachers involved in the innovation, teachers not involved in the innovation, student focus groups, parent focus groups, agents external to the school), class observations, and documentation related to the ICT-based innovation. The study was conducted between February and July 2001. Researchers spent a 5-day period in each of the schools. All raw materials were transcribed and uploaded, in addition to the final Hebrew reports and documentation, to the research website (Tel-Aviv University, n.d.), as were the final school research reports in English (IEA, n.d.).

After the main data analysis process, done according to the international study criteria and procedures (see Kozma, 2003), a secondary analysis was done on the data from the 10 participating Israeli schools. This analysis is reported in this current paper. Two analysis tools were applied to assess both the levels and domains of innovation in each school (Mioduser et al., 2003) and the factors—internal and external—involved in the innovation implementation (Nachmias et al., 2004).

The dimensions of the levels-and-domains-of-innovation schema are defined by two axes. The horizontal axis represents levels of innovation, ranging from preliminary alterations of the school routine due to the initial assimilation of ICT to far-reaching transformations of pedagogical practices and learning processes. Three main levels were defined, as briefly mentioned in the Background section: assimilation, transition and transformation. The vertical axis details domains of innovation, focusing on four main constituents of the school milieu: time/space configurations, students, teachers, and the curriculum.

The levels of internal and external factors affecting the innovation were rated according to the analysis framework detailed in Nachmias et al. (2004). The framework is composed of two axes: the vertical axis presents 21 factors gathered within 7 categories (roles within the school, roles outside the school, organization of learning, organizational climate, staff training and development, infrastructure and resources, and ICT policy); the horizontal axis indicates the intensity of the factors' influence in a five-level scale, (1 being the lowest and 5 being the highest). All data were evaluated by two independent judges using the above tools and reaching an agreement rate of 83%.

Finally, all schools were classified according to one of two diffusion-of-innovation patterns: *island-of-innovation* schools (IoI), in which the innovation engaged only a specific group of students and/or teachers, or *school-wide implementation* schools (SW), in which most of the school's student and/or teacher populations were involved. The description of the content and scope of the innovations implemented in the participating schools is presented in Table 1. In schools comprising the IoI group, 4% to 14% of the students and 2% to 28% of the teachers were involved in the activities. In SW schools, 64% to 100% of the students and 27% to 100% of the teachers were involved.

A note should be made about the research limitation. The 10 schools were not intended to be a representative sample of schools in Israel. Rather, they were chosen as remarkable examples of successful ICT implementation in innovative pedagogies. This sample is obviously insufficient if the objective is to yield significant statistical conclusions. However, as the selected schools are similar in nature to most schools in Israel, the results can shed light on similar patterns and processes in the other schools by way of "naturalistic generalizations" (Stake, 1997).

RESULTS

This section presents the results with reference to the three research questions. The first question was: What levels of innovation were observed (in schools) in each of the implementation-pattern groups?

Data presented in Table 2 describe the levels of innovation in each domain for schools in both groups of diffusion patterns. Given our specific theoretical framework, higher levels of

Table 1. Nature and scope of innovations implementing ICT in 2 diffusion patterns: "islands of innovation" and "school wide implementation."

Innovation Title	Description of Innovation	% students involved	% teachers involved
Islands of innovation			
Computer trustees IL002	A group of 40 students out of 630 serves as computer trustees, supporting teachers during lessons, running the school ICT support center, and coaching senior citizens as well as special education students.	6%	28%
Computerized radio station IL006	40 students out of 660 in the radio and communications division study towards their matriculations theoretical as well as practical issues relating to mass communications, print and broadcast media, operate a computerized studio and prepare reports and broadcasts.	6%	4%
Excellence center IL009	175 students out of 1,250 study in the excellence center, simulating surroundings within a hi-tech factory, aiming to create a connection between education and industry: students get acquainted with the hi-tech world, while industrialists connect to educational practice.	14%	8%
Peace network IL010	60 students out of 1,400 use the Internet as a lever for facilitating tolerance, the changing of prejudice, bonding with peers from the Arab culture and improving of English as a foreign language.	4%	6%
Computerized greenhouse IL015	70 students out of 800 use the computerized greenhouse as a site for planning and carrying out projects in biology, technology, ecology and engineering, some of which are matriculation subjects. The greenhouse is connected to research institutions, and experts coach the students.	9%	2%
School wide implementation			
Computerized projects: "Beehive" IL001	All 623 students participate in ICT projects accompanied by Web sites, as a lever for developing learning communities in subject matters such as literacy, geography, science, mathematics, history and technology.	100%	50%
ICT-rich future school IL003	All 1,000 students implement ICT as a means of developing independent learning skills, adjusting to different learning styles, applying a variety of fields of interests, raising motivation and strengthening bonds with parents.	100%	100%
Website story IL007	800 students out of 1,250 implement Web-based learning in educational websites developed by teachers and students in over 20 subject matters, according to curricular needs.	64%	50%
"Aviv" virtual school IL008	All 1,260 students are exposed, during their studies, to innovative ICT use, develop computer literacy, and interact with experts in project-based distant learning in a virtual school.	100%	35%
Virtual learning space: man & environment IL013	All 380 students develop independent learning skills by inquiry projects related to school geographical surroundings, accompanied by a virtual learning space developed mainly by the students.	100%	27%

Table 2. Levels of innovation in 10 Israeli initiatives implementing ICT by domains and diffusion patterns.

	Time & space configuration			Students	Teachers		Curriculum			
School	Physical space	Digital space	Time	Student role	Teacher student*	Teacher-teacher**	Content	Didactic solutions	Assess. methods	Innovation average
Islands of innovation										
IL002	1	2	3	3	3	1	2	2	1	2.0
IL006	2	4	4	4	4	2	4	3	4	3.4
IL009	3	4	3	4	4	3	5	3	4	3.7
IL010	1	3	4	3	4	3	4	3	1	2.9
IL015	5	5	5	5	5	2	5	5	5	4.7
Domains average	2.4	3.6	3.8	3.8	4.0	2.2	4.0	3.2	3.0	3.3
School-wide implementation										
IL001	3	3	1	2	3	3	3	3	3	2.7
IL003	5	3	4	4	3	5	5	4	4	4.1
IL007	2	4	3	4	3	3	2	3	3	3.0
IL008	1	3	1	2	2	3	3	2	3	2.2
IL013	3	5	5	4	5	4	5	5	4	4.4
Domain average	2.8	3.6	2.8	3.2	3.2	3.6	3.6	3.4	3.4	3.3
Difference	-0.4	0.0	1.0	0.6	0.8	-1.4	0.4	-0.2	-0.4	0.0

* Teacher-student means the teachers' role, decisions and performance in their interaction with students, ranging from main source of leadership to the level of expert colleague and partner.

** Teacher-teacher means the teachers' role, decisions and performance in their interaction with fellow teachers.

innovation could be expected in IoI schools. In these schools, the activity is generated and implemented by a specific group of highly motivated students and teachers, a factor that has the potential to facilitate and accelerate the innovation adoption process. The findings, however, show that the average level of innovation for all domains in both groups of schools was identical, putting all schools at the transition level on our scale.

However, a closer look at the different domains reveals interesting differences. In IoI schools, learning time and scheduling were defined more flexibly and teacher-student relationships were more open and equal than in the SW schools. The relatively small number of participants and the exterritorial nature of some of the projects enabled flexibility of time in IoI projects, as opposed to SW implementations, which were normally embedded within the school timetable.

In regard to changes in teachers' roles and functioning, the findings indicate different processes for teacher-peers and teacher-students interactions. In SW schools, the nature of teachers' interactions with their peers changed to a large extent, stressing collaborative work and creativity aimed at advancing the implementation of the innovation. Often, changes in teachers' roles were supported (and demanded) by the very school policies that promoted the implementation of the innovation. In IoI projects, however, in which teacher-student partnerships were a driving force in the innovation implementation, a sense of confidence and mutual commitment to the task enabled the emergence of strong and non-mediated tutor-tutee relationships (often including the switching of roles between them). In this domain, most IoI schools reached the transformation level of innovation. A clear trend showing changes in students' roles in these schools logically complements the image that stresses the IoI's nature as student-centered, process-oriented, and learning-by-doing pedagogical solutions.

Table 3. Means, standard deviations and variances of levels of innovation by domains and diffusion patterns of 10 Israeli initiatives using ICT.

School	Physical space	Digital space	Time	Student role	Teacher/ student	Teacher/ teacher	Content	Didactic solutions	Assess. methods
Islands of innovation									
Mean	2.4	3. 6	3.8	3.8	4.0	2.2	4.0	3.2	3.0
Std. dev.	1.67	1.14	.83	.83	.70	.83	1.22	1.09	1.87
Variance	2.80	1.30	.70	.70	.50	.70	1.50	1.20	3.50
School-wide implementation									
Mean	2.8	3.6	2.8	3.2	3.2	3.6	3.6	3.4	3.4
Std. dev.	1.48	.89	1.78	1.09	1.09	.89	1.34	1.14	.54
Variance	2.20	.80	3.20	1.20	1.20	.80	1.80	1.30	.30

The variance in the level of innovation within the domains for both diffusion patterns of innovation is presented in Table 3. A domain in which low variance was observed in both patterns of implementation was that of teacher relationship patterns with fellow teachers. In contrast, the domain of assessment methods varies from 1 to 5 in IoI projects (*SD*=3.5), but only from 3 to 4 in SW implementation (*SD*=.3), whereas the difference between the means is small. Another domain that displayed a difference between variances was the flexibility of time: in IoI projects the mean score was high (*M*=3.8) and the variance was low (*SD*=.70), while in SW implementations the mean score was lower altogether, but the variance was much higher (*SD*=3.2).

The second research question posed was: What communication agents and school variables affect the diffusion of innovation (in schools) in each implementation-pattern group? The analysis of the innovations in the participating schools focused on the initiating agent, on the duration of the innovation, and on several school variables (such as, size, location, grade levels) that may affect diffusion patterns. The results are shown in Table 4. Preliminary assumptions could be that certain configurations of the above variables might lead to the emergence of either IoI or SW diffusion patterns. For example, it can be hypothesized that in schools where the principal is the initiator of the innovation, where the small size of the school facilitates peer cohesion and mutual influence, and the innovation has been sustainable for a long period of time, school-wide innovation implementation is more likely to occur. Overall, data in Table 4 indicate no noticeable differences between diffusion patterns for most variables.

However, two issues deserve to be mentioned. In SW schools the principal takes a more predominant role in initiating the innovation and the diffusion process than in IoI schools, where leaders (teacher, computer coordinator) normally took the initiative. Also, the duration of the innovation is slightly longer in IoI schools (including the exceptional Greenhouse Project running since 1985; see Table 1). These findings indicate the pioneering nature of IoIs: highly motivated soloists succeeded in initiating innovative processes several years ago, within a context (school culture, peer and principal perceptions), not yet certain of the emerging technologies' potential for teaching and learning. Several of these initiatives still persist as IoIs and have not grown into larger school-wide initiatives due to scalability or sustainability objective constraints (e.g., the Greenhouse or the Excellence Center).

Table 4. Communication agents and school variables that affect initiatives implementing ICT in Israeli schools by two diffusion patterns: "islands of innovation" and "school wide implementation."

School	Innovation initiator	Size (student body)	Location	Settlement type	School-level	Innovation initiated
Islands of innovation						
IL002	Leader	630	Center	Urban	Lower secondary	1998
IL006	Principal	660	Center	Urban	6-year secondary	1998
IL009	Principal	1,250	Periphery	Urban	6-year secondary	1997
IL010	Leader	1,400	Center	Urban	Higher secondary	1996
IL015	Leader	800	Periphery	Rural	6-year secondary	1985
School-wide implementation						
IL001	Principal	623	Center	Urban	Elementary	1998
IL003	Principal	1,000	Center	Urban	Elementary	1995
IL007	Leader	800	Center	Urban	Higher secondary	1998
IL008	Principal + Leader	1,260	Periphery	Urban	6-year secondary	1997
IL013	Principal	380	Periphery	Rural	6-year secondary	1999

The final research question was: How do school internal and external factors affect the diffusion of the innovation in each implementation-pattern group?

Overall, the intensity of the internal factors was higher in the SW implementation pattern. The highest values were detected with regard to the effect of the principal, ICT coordinator, leading teachers, school's vision, and a history of innovations in school. The configuration of all the above factors at high intensity levels suggests that there is a need for a systemic predisposition of the school, including its vision and past experience in implementing innovations, for SWs to emerge and be successfully adopted. In contrast, these are not necessary factors for IoIs to exist over time as sustainable realities. Table 5 presents the intensity-levels of the internal and external factors on a scale of 1 (*low intensity*) to 5 (*high intensity*).

Accessibility of training is a factor present at a more intense level in SW schools than in IoIs. What this finding signifies is that SW implementations demand the creation of formal and systematic channels for information flow and diffusion of the innovation-related conceptual and operational knowledge and practice. IoI initiatives depend less on formal training and communication procedures, as described by a 16-year-old student in charge of the hardware at the Greenhouse: "*Here I study things that I wouldn't have studied at home or at school…. I wouldn't have known anything about operating computer systems, about what to do when a computer stops working…. When I came here there were four students older than me, and they taught me all this, and now I'm teaching the younger ones*."

Table 5. Intensity of external and internal factors involved in the innovations by two types of diffusion patterns: "islands of innovation" and "school-wide implementation."

	Factor	School-wide innovation	Islands of innovation	Gap
External Factors	Ministry of Education	3.4	2.8	0.6
	Municipalities	3.0	3.4	-0.4
	Parents	2.6	2.0	0.6
	Intervening factor	3.8	4.2	-0.4
	Expert teacher for students	2.8	2.2	0.6
	National ICT policy	3.4	3.0	0.4
	Local ICT policy	4.2	3.8	0.4
	Financing of innovation	3.8	4.4	-0.6
Average		3.4	3.2	0.2
Internal Factors	Principal	4.8	3.8	1.0
	Teaching staff	3.0	2.0	1.0
	ICT coordinator	4.6	3.2	1.4
	Leading teachers	4.8	3.8	1.0
	History of Innovation	4.8	4.0	0.8
	Vision and ICT goals	4.6	2.8	1.8
	Relevancy of training	3.8	2.8	1.0
	Accessibility of training	4.0	2.8	1.2
	Computers and peripherals	4.0	3.4	0.6
	Technical support	4.4	4.4	0.0
Average		4.3	3.3	1.0

The intensity of external factors was found to be similar in both diffusion patterns, even though IoIs have more outside-school financing resources, and more support from external intervening agents. As stated by the founder of the computerized Greenhouse: "*The model I believe in is to create profitable islands outside the school, by linkage to hi-tech companies or to investors… because our culture has to have places in which people will want to get motivated to invent and to achieve the things that are important to them*."

DISCUSSION AND CONCLUSIONS

In this study we examined the differences between two patterns of ICT implementation: islands of innovation (IoI) and school-wide-implementations (SW). IoIs appear to be interesting innovational configurations within schools, if they prove to be sustainable (as in the cases we studied) rather than short-lived episodes. They are specific in terms of their goals and functions,

the conditions required for their development and maintenance, the role configurations among the participants, and their connection to other processes in the school's milieu.

The goals and functions of IoIs are in general ambitious, aiming at depth rather than extension (e.g., in terms of number of students involved, number of topics covered, and characteristics of the activities). They are usually initiated and sustained by a leader or small group of leading figures, facing the challenge of implementing a novel pedagogical solution or the assimilation of new technologies into teaching and learning processes. Often, these are sustainable but not scalable, as in the cases of the educational greenhouse or the computerized radio station (see Table 1). The activities demand long-term learning processes, close and intense teacher-student interactions, and specific resources that cannot be easily scaled (e.g., due to complexity of implementation or costs). In IoIs, an evident change in the teachers' role and teacher-students relationships was observed. Changes in different aspects of the activities were observed as well, for instance in content (curricular aspects) or time configuration (e.g., not constrained to the school's regular time slots and even took place beyond school hours), according to the demands of the activity (e.g., consulting an expert or doing group work). Finally, factors external to the school were found important to the functioning of IoIs, as in the case of intervening agencies supporting the initiation of activities (e.g., educational R&D institutions), regional high-tech industries providing both support (e.g., expertise, equipment) and opportunities for the students to participate in real-life projects, or administrative units in the educational system structure promoting novel pedagogical initiatives in schools.

In SW implementations, different domain and factor emphases were observed. The principal's vision and motivation is of central importance in the innovation, and formal school policy is the rationale for the large-scale implementation. Involving a considerable number of teachers, SWs brought a change in the nature of teacher-teacher relationships, based on collaboration and mutual support needed for coping with the innovation implementation. The demand for, and the effect of structured teacher training, was also observed. Overall in SWs, principals and decision makers face the challenge of defining an appropriate balance between the demands posed by the innovative practices, and the features (e.g., structural, curricular, human) characterizing the regular functioning of the school.

We will conclude by raising several questions emerging from this study that deserve further examination. These questions relate mainly to the potential transferability and scalability of IoIs. Are these always cases of strongly situated and specific factor-dependent activities? It is possible to devise institutional mechanisms for replicating these activities on a larger scale without losing the essential traits of IoI in translation? Is the transition from IoIs to SWs a process to be encouraged, a desired institutional-developmental path? What would be the systemic picture of a school in which SWs and IoIs coexist, in terms of the different school life parameters (e.g., policies, allocation of resources, conflicting time and space solutions, responses to curricular demands, balance between exceptional vs. standardized curricular solutions)?

In the analysis of the Israeli case studies displayed in this paper, we presented the features and traits of two main innovation implementation patterns, including pros, cons and trade-offs of each pattern. The strengths and potential contribution of SWs, when appropriately implemented, are evident. But the value and effect of sustainable IoIs, as seeds for change over time (involving at each and every stage a new group of teachers and students), and models for replication (even partially) by others in school and beyond, represent an intriguing research issue with theoretical and practical implications as well. We can assume that the

examination of the whole data set from the SITES M2 along the lines presented in this paper might produce comprehensive insights on the nature of islands of innovation in schools.

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