ICT Implementation in Mathematics and Science Education Study in Israel: Insights from SITES 2006

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Abstract

The paper herewith presents findings from the third stage of the Second International Technology in Education Study (SITES2006), conducted between the years 2005-2007 as a survey of schools and teachers. The study was aimed to identify ICT-related pedagogical practices in mathematics and science in lower secondary Grade 8 level. This was achieved using an online data collection system. Results indicated that Israeli school principals in all sectors believe in the importance of ICT implementation in science and technology. However, although the student/computer ratio has improved, Israeli schools still hold a ratio higher than the aspired 1:10. As for ICT implementation in mathematics and science, these teachers rarely use information technology in their lessons, compared to their peers worldwide. Also, ICT usage does not facilitate innovative pedagogical paradigms; rather, it perpetuates traditional teaching and learning. This contradicts their attitudes, according to which ICT empowers their teaching abilities and promotes affective teaching and learning. Conclusions indicate several factors involved in ICT implementation in the two mentioned disciplines, depicting a complex reality, in which the gap between attitudes and practice requires special attention of Israeli policymakers.

Keywords: ICT implementation, mathematics, science, SITES

Introduction

Information technologies, being an integral part of our everyday lives, is also becoming more frequently used in formal education. Therefore, in the 1990s of the 20th century, several policy papers related to ICT in education were published either by countries or by international or regional organizations (European Roundtable of Industrialist – ERT, 1997; OECD, 1999; UNESCO, 2003; World Bank, 1998), or by nationalities (Educational Testing Service, 2002; EMB, 1998, 2004; Finnish Ministry of Education, 1999; Singapore Ministry of Education, 2002). Israel was no different, publishing policy papers concerning ICT implementation in education (Ben-Zvi, 1997; Chen, 1996; Ministry of Education 1993).

Hence, there were great expectations for ICT to create change in pedagogy – a tendency examined in a previous SITESm2 study (Kozma, 2003). The Second International Technology in Education Study, carried out in the years 2005-2007, was aimed to examine ICT implementation in teaching processes within schools. The Israeli team, accompanied by a national steering committee, was interested in the technological means which math and science teachers use to promote their teaching, and as a result – students' learning. The SITES 2006 study, a third in a series of three studies (two former studies were carried out during the last decade), is based on the two previous ones, in terms of methodology and results. The goals of the study are: (a) to map ICT usage in schools, (b) to provide insights regarding the means by which school and system factors influence ICT implementation by teachers, (c) to examine ICT implementation in teaching among 8th grade mathematics and science teachers. Results might

also serve Israeli policymakers in identifying required change processes related to ICT within schools, especially those regarding infrastructure.

Method

The study was organized and developed by the IEA as a survey. Israeli sample included 380 principals (of the 400 sampled), 380 ICT coordinators (of the 400 sampled) and 2078 math or science teachers (a minimum of 1,600 teachers was required). The former were position holders in schools which included 8th grade students, while the latter actually taught in 8th grade classes. The sampling procedure was twofold: first, 400 schools were sampled using strict IEA sampling procedures (Law, Pelgrum and Plomp, 2008); hence, principals and ICT coordinators were sampled using school sampling. Then, within school sampling was used for sampling teachers within each of the sampled schools.

Three questionnaires were administered, for each of the samples participants. Questionnaires included issues relevant to each of the participants: policy, attitudes and practice, as well as information about infrastructure and equipment. All data were collected online into a database, avoiding by this typing errors. Response rate in Israel was among the highest – over 90%.

Results

The SITES 2006 study concentrates on the school and teacher levels, hence, findings are described with relation to these two aspects.

ICT and Pedagogy on the School Level

Findings show that Israeli principals believe in the importance of ICT in education. Compared to the SITESm1 study, principals indicated the existence of innovative pedagogy in their schools twice as much in the SITES 2006 study, to an estimation of nearly 30%, this indicates a dramatic change in the importance principals attribute to implementation of novel pedagogy in schools. Israeli principals ascribe importance also to ICT as a means for preparing students for future jobs: 53%, a gap of 15% compared to other countries participating in the study. Also, 58% of the principals highlighted the importance of ICT for future skills (58%).

As for ICT infrastructure, Israeli principals see great importance in upgrading ICT conditions in schools: improving the student/computer ratio (almost 60% set this under high priority), connecting all computers to the Internet (over 70% set this under high priority). Principals in the Arab sector assign high importance to ICT implementation in their schools for collaboration purposes and teamwork, as a lever for implementing innovative pedagogy, for preparing students to future jobs and for increasing their motivation for learning.

Infrastructure in Israeli schools was reported to be greatly improved since the 1999 SITESm1 study; still, the student/computer ratio has not improved, and there is still much to be further developed. As for accessibility to computers, compared to 1999 there has been an increase from 85% of schools with access to computers to 96%. Among these computers, 98% are connected to the Internet, compared to 53% connected in 1999. The student/computer ratio was considered a measure for student access to computers de facto. Results show that only in one third of Israeli schools a ratio of 1:10 which was marked as a goal by the Ministry of Education was achieved. In one quarter of the schools, a ratio of more than 1:20 was reported. This ratio poses Israel in the lower third of the list of countries participating in the SITES 2006 study. In a sense, the data shows deterioration since 1999: the percentage of schools with a student/computer ratio of more than 1:20 has doubled. Moreover, according to this indicator, there seems to be a significant gap

between the sectors: while the student/computer ratio in the Jewish sector is 1:11.1, the results show a ratio of nearly 1:21 in the Arab sector.

Most computers are located in computer labs; classrooms are rarely equipped with ICT infrastructure. As for implementation, ICT is mostly used for standard applications and software. At the time f the study, few schools were equipped with interactive whiteboards (7.6% indicated at least one interactive whiteboard). Mobile devises (e.g. handhelds) were reported in only about 12% of the schools; this finding is important, as handhelds promote ubiquitous learning. Still, most principals classified these devises as unimportant and not needed.

More than 40% of ICT coordinators report obsolete and unsatisfactory computers and ICT equipment, lack of adequate equipment in laboratories and lack of digital resources for teaching and learning. These are defined by them as obstacles in fulfilling school goals using ICT.

ICT coordinators are considered key players in issues of technical support. In 54% of the schools, teachers are involved in technical support. In 27% of the schools, students are involved in technical support, e.g. real-time support. Israel is one of the countries in which commercial companies are relatively involved in technical support (about 30% of the schools). These companies are mostly attached by contract not to the schools but rather to the Ministry of Education or the local authorities. Still. ICT coordinators report an increasing need for availability of technical and pedagogical support, mainly due to an overload of responsibilities carried by the ICT coordinator alone.

Teachers are encouraged to develop their ICT skills, especially regarding Internet implementation in their teaching (63.5% reported this statement) and development of authentic tasks related to real-life needs (more than 60%). Contrary to this, in more than a fifth of the schools teachers were not encouraged to enhance their collaboration using ICT. Also, less than a third of the teachers reported they were not at all encouraged by their schools to communicate with parents using ICT. In the Arab sector, principals report wider encouragement of teachers to use ICT than in the Jewish sector, especially regarding collaboration with people and instituted outside the school.

As for in-service training, for Israeli teachers it was not compulsory at the time; therefore, compared to other countries, accessibility of practice was reported as relatively low, especially regarding technical issues, software etc.; however, training focused on pedagogical issues of ICT implementation in teaching and learning was reported in concurrence with the international average.

ICT Implementation in Mathematics and Science

In general, mathematics and science teachers rarely use ICT in their teaching, compared to their peers in other countries. Only 22% of mathematics teachers of 8th grade students reported using ICT at least once in the previous year for their teaching (using ICT to prepare a lesson was also included in this figure), compared to an international average of about 50%. This places Israel on the bottom part of the list of participating countries (one place before last). As for science teachers, 53% reported using ICT at least once in the previous year for their teaching – a figure just lower than the international average. In most countries, science teachers' average ICT use is higher than mathematics teachers. However, in Israel the gap is the widest.

Within the Arab sector about 31% of mathematics teachers reported using ICT at least once in the previous year for their teaching, compared to only 19% of their peers in the Jewish sector. In

science, the situation is reversed, though the gap is smaller: while 55% of science teachers in the Jewish sector reported using ICT, 46% of their peers in the Arab sector reported doing so.

Most Israeli mathematics and science teachers who use ICT in their teaching practice do so in accordance to a traditional educational paradigm, i.e. assimilation of ICT into the curriculum, rather than using ICT as a lever for change. Traditional uses include: display of information and demonstrations (29.4%), and assessment (25.5%); as for assessment, this also includes typing written exams – ICT is rarely used for online assessment. Still, there are also ICT uses for inquiry tasks (30.6%) as well as for data management (25.4%). The innovative use of ICT reported increases the gap between mathematics and science teachers, in favor of the latter.

Discussion and Implications

ICT implementation in Israeli schools has developed continuously in the last few decades, especially since the 1990s, when overt policy measures were published, serving as guidelines to the national computerization processes the education system has experienced (Nachmias, Mioduser, Forkosh-Baruch, and Tubin, 2008). And indeed, where attitudes are concerned, ICT is considered a means of empowering teaching and learning. The question is: why is there such a discrepancy between beliefs and attitudes, and ICT implementation de facto? Findings identify factors such as insufficient infrastructure, on the one hand, and preservation of traditional teaching approaches on the other hand (Nachmias, Mioduser and Forkosh-Baruch, 2009). Also, there is the human factor: lack of confidence and a difficulty to embrace ICT due to lack of ICT skills (Jones, 2004).

ICT is considered a lever for change in education, but may also facilitate learning via traditional paradigms (Dede, 2008). Dede proposes support of ICT implementation in relation to traditional as well as emerging or innovative paradigms. Also, the power of the communication features of ICT needs to be emphasized, pursuing goals such as (a) promoting ubiquitous learning, which is a complex concept and one not easily put into practice; (b) increasing the circles of partners participating in the educational process, up to the inclusion of the community at whole. Perhaps the movement of schools towards self-administration, empowering principals, who hold such high aspirations and ambitions, at least in their declarations, may promote increased ICT implementation, thereby upgrading teaching and learning in mathematics and science, and throughout the whole curriculum.

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