Information and Communication Technologies (ICT) Integration by Teacher Educators in Israeli Colleges of Education: the Current State of Affairs, 2008-2009


Abstract: This study examines the current state of ICT integration by faculty members in Israeli Colleges of Education using combined quantitative and qualitative research methods. Findings reflect significant progress in ICT implementation in teaching by faculty in comparison to the previous decade: what was perceived then as innovative -using Office tools, online resources and e-mail - is now routine practice. Most faculty members implement these basic ICT uses. However, only few use technology to bring about change in their teaching methods. Most important goals in the current situation are: (a) further expanding faculty involvement in ICT integration in teaching and (b) developing innovative pedagogical approaches best suited to respond to the demands of the Information Era.

Keywords: ICT integration in teaching, innovation, teacher education, faculty, colleges of education

Introduction

One of the distinguished features of developed countries in the last five years is the growing trend in the reorganization of their education systems in order to respond to the new demands of the Information Era, which include the developing of important student skills: multiple literacies, expertise, innovation, communication, critical thinking and problem solving (P21, 2010; Becta, 2010; Barrel et al, 2010; CERI, 2010). A few countries have developed standards that define the required skills of teachers in the age of information technology. UNESCO has defined a teacher in the 21st century as one that is competent in developing innovative pedagogy encouraging active learning, interaction and cooperation, and is skilled in building diverse learning environments for enrichment and management of teaching with ICT (UNESCO, 2009). Other countries (USA, Australia) have enforced similar standards that define the pedagogical knowledge required in the information age (ISTE, 2008). These standards are challenging for teachers and teacher educators. Koehler & Mishra (2009) designed a framework for teacher knowledge needed today called Technological Pedagogical and Content Knowledge (known as TPACK). This framework complements Lee Shulman’s (1986) construct of pedagogical content knowledge (PCK) by including technology knowledge and emphasizes the crucial role of interaction between all three components in creating “pedagogical techniques that use technologies in constructive ways to teach content” (Koehler & Mishra, 2009). This interaction allows transformation from the industrial paradigm of education (“one size fits all”) to a learner-centered, information age paradigm (Reigeluth et al., 2009) through inquiry, problem solving, collaborative

1 Kaye College of Education, Beer-Sheva, research network at The MOFET Institute, Tel-Aviv, Israel
2 David-Yellin College of Education, Jerusalem, research network at The MOFET Institute, Tel-Aviv, Israel
3 Levinsky College of Education, Tel-Aviv, research network at The MOFET Institute, Tel-Aviv, Israel
4 Kibbutzim College of Education, Tel-Aviv, research network at The MOFET Institute, Tel-Aviv, Israel
5 Arab College of Education, Haifa, research network at The MOFET Institute, Tel-Aviv, Israel
learning, pedagogical models developing creativity and higher order thinking skills. The development of TPACK by teachers is crucial for effective teaching with technology and requires significant efforts by teachers and especially by teacher educators in learning new skills and redesigning curriculum. This process is complex and is presented with multiple teacher barriers in integrating innovative pedagogy (Goktas, Yildirim & Yildirim, 2009; Brzycki & Dudt, 2005; Redmond, Albion & Maroulis, 2005) as well as barriers existed in a system’s support. The adoption of an innovation is a multistage process (Rogers, 2003; Hall & Hord, 1987) and is characterized by different levels of technology use. Hall & Hord proposed the Concerns- Based Adoption Model (CBAM) that describes six levels of innovation use: non-use, preparation, mechanical use, routine use, integration and renewal. According to Rogers’ theory of diffusion of innovations, people differ in their motivation to adopt innovations. Those who are more inclined to innovate adopt ICT skills earlier than those who are less inclined. Rogers divided the population into five categories, according to their willingness to adopt innovation, and represented this distribution as a bell-shaped, normal-distribution curve: Innovator (2.5 percent), Early Adopter (13.5 percent), Early Majority (34 percent), Late Majority (34 percent), and Laggards (16 percent). Innovators and Early Adopters are highly motivated in applying innovation and are characterized by mental flexibility, inclination to adventure and readiness for professional risk. Their motivation is intrinsic in contrast to the Late Majority who need extrinsic stimuli to adopt innovations. Teacher motivation to adopt innovation is not efficient without a meaningful support system. Surry, Ensminger & Jones (2003) studied technology integration in higher education and found seven factors affecting it: Resources (budget, funding), Infrastructure (physical network, hardware, software, etc), Policy (vision and planned actions), People (faculty motivation, attitudes, skills, talents), Learning (outcomes of educational programs), Evaluation (success, barriers, effectiveness, benefits) and Support (technological, pedagogical and administrative). The implementation of the innovation in educational institutions is not simple and straightforward; it requires organizational change (CHANGE, 2003) under strong leadership and strategic planning.

Teacher education is challenged by TPACK framework’s demands even more than K-12 education, since teachers’ educators have to be in the front of innovative pedagogy, being a model for future teachers. Unfortunately, teacher education is still far from the desired level (Barrel et al, 2010; Goktas, Yildirim & Yildirim, 2009; Brzycki & Dudt, 2005; Redmond, Albion & Maroulis, 2005) and requires significant improvement. It is important to study the current state of ICT implementation in teacher education to allow evidence-based strategy planning of its reorganization towards the demands of the 21st century.

This study examines the implementation of ICT by faculty members in colleges of education in Israel focusing in three questions:
1. In what ways and to what extent do faculty members use ICT for pedagogical, professional and personal goals?
2. What are the attitudes of the faculty members towards integrating ICT in their teaching?
3. To what extent are the necessary conditions for the application of ICT based teaching met in the colleges of education (e.g. access to computers; access to technical support; ICT skills)?

The Study

The study is a part of interconnected studies on ICT in teacher education carried out by research network, initiated and sponsored by the Research Authority at the MOFET Institute, an intercollegiate center for professional development of teacher educators in Israel. It was conducted using mixed qualitative and quantitative research approaches. In the first stage of the study, the implementation of ICT by faculty members was examined in depth on the basis of four colleges of education in Israel. In the second stage, the study was broadened to additional eight colleges of education where the data were gathered using less complex tools.

Population and sample. There are 26 academic colleges of education in Israel. Their teacher education programs are aimed at preparing teachers to teach early childhood, elementary, middle and special education pupils. The main focus in our research was carried out in four colleges of education in Israel who enjoy the reputation of being advanced in ICT integration. The population of all these colleges together included approximately 13,000 students and 1,550 faculty members. A sample of 401 faculty members (about 25% of the faculty population) and 22 academic managers (Presidents, Heads of Departments, and Heads of ICT support centers) from these four colleges participated in the research. Since these colleges represent an advanced level of ICT implementation, other eight colleges were chosen to broaden the overall picture using less complex while yet satisfactory research tools. The
Heads of the ICT support centers in these eight colleges as well as in the four advanced colleges were interviewed using the same rubric.

**Tools.** Data were collected using three tools: a questionnaire administered to faculty members, semi-structured interviews with academic managers and STAAR Chart’s rubric (CEO, 2000) completed by the ICT Center Heads. The questionnaire was developed based on the RIPPLES model (Surry, Ensminger & Jones, 2003), the CBAM rubric (Hall & Hord, 1987) which was slightly modified for our research purposes and on a questionnaire used in similar research (Granston, 2004). The questionnaire included 25 questions (which comprised 138 items) that examined ICT implementation in teaching; faculty attitudes towards teaching with ICT; ICT skills; difficulties in adopting technology; and ICT uses for professional development. Additional data were related to pre-requisites necessary for ICT integration: ICT accessibility and technical, pedagogical and administrative support available in these institutions. The questionnaire was administered anonymously in the middle of the 2008-2009 academic year using two formats: hard copy and online. The data were analyzed with SPSS software and included checking reliability, factor analysis, correlations and group characteristics comparisons. The second research tool - interviews with academic managers in four colleges - were focused on collecting information regarding their vision of the role of ICT in teacher education, perception of the scope of ICT implementation by faculty, barriers and factors that may influence faculty’s willingness to use ICT in teaching, and the infrastructure and technical support in the colleges. The qualitative content analysis of these interviews was conducted by two researchers using software tools: ATLAS.ti (2010) and Narralizer (2010). The third tool – the STAAR Chart rubric - designed by the CEO Forum on Education and Technology (CEO, 2000) is based on self-evaluation of ICT integration in colleges of education and includes a variety of categories: vision, infrastructure, funding, access to ICT resources, college administrators’ leadership, the faculty’s professional development, pedagogical uses of ICT, pre-service teacher training to teach with technology, and support and cooperation with schools. Within each category, four levels are defined: early, developing, advanced, and target.

**Bias and its solution.** The questionnaire was administered anonymously to all faculty members in four colleges of education firstly by putting hard copy in their personal mail boxes at the colleges, resulting in 196 respondents. The second step was an email request to fill out the online questionnaire which was sent to faculty members (if they hadn't filled it out before) and this time another 205 respondents responded. In order to evaluate the possible bias that might influence the sample, the percentage of website users in the sample was compared to the percentage of website users among all faculty members, reflected in the college websites. A bias was found favoring the website users in the sample (50% vs. 33%). To solve this bias, a new sample was created so that it included all non-website-users and a percentage of randomly chosen website users in accordance to their actual proportion in the population. This unbiased sample included 277 faculty members in four colleges of education.

**Findings**

The research findings relate to two aspects of ICT integration by teacher educators: (a) the scope and ways of ICT implementation by faculty and their attitudes towards using ICT in their teaching and (b) existing prerequisites for ICT integration in colleges of education. The findings based on the more compound research based on four ICT advanced colleges of education will be presented first and then the broader picture will be described on the basis of all 12 colleges.

**ICT Implementation by Faculty Members in four ICT advanced colleges**

ICT implementation for teaching and professional needs by teacher educators was evaluated using different variables: kinds of ICT-based assignments integrated in teaching, use of course websites, ICT skills, self-evaluated level of ICT integration in teaching according to the CBAM model (Hall & Hord, 1987), difficulties related to teaching with ICT, and participation in online professional activities. The results revealed that 80% of the teacher educator respondents integrated basic computerized tasks in their teaching (Internet search, email communication, and digital submission of assignments). Few of them (15%) integrated ICT in advanced ways, i.e., tasks that required authentic problem solving, inquiry, collaborative learning and using advanced Web 2 tools. Less than a third of the teacher educators implemented assignments aimed to train pre-service teachers to integrate ICT in their
field practice. One third of the sampled teacher educators integrated course websites in their teaching. A fifth of the respondents implemented elements of distance teaching, while 5% taught full distance learning classes.

Faculty members’ self evaluation according to the CBAM rubric showed the following distribution: about 50% of respondents placed themselves on the two highest levels of ICT integration (altogether there were 6 levels) in teaching, characterized by routine use ICT in teaching and using ICT in innovative and creative ways. 20% of respondents evaluated themselves as taking their first steps in ICT integration in teaching, while another 20% were just curious or thinking about beginning to use ICT in their teaching. About 10% of respondents pointed out that they weren’t interested in ICT integration in their teaching.

In order to evaluate the dynamics of ICT integration in teaching among the faculty, the faculty members were asked to compare their current scope of such integration with their scope of three years previous. About 60% of the respondents pointed out an increase in their ICT integration in teaching, 30% stayed on the same level of integration and 10% reported a decrease. The cross correspondence of this variable in the groups on different levels in the CBAM model revealed that most respondents in the highest level of CBAM tended to increase their involvement in ICT-based teaching while those who are on the lowest levels tended to stay on their current level ($\chi^2(10)=26.43$, $p<.01$). In other words, there are two prominent groups of faculty members: the advanced teachers who continue to progress in ICT integration and non-ICT integrators who tend to stay where they are.

The faculty members’ attitudes toward integrating ICT in their teaching are mostly positive, however 10% of respondents expressed negative attitudes and explained this by attributing non-appropriateness to that subject matter they taught, a mismatch between ICT-based teaching and their perception of the teacher’s role, the time needed to learn and to prepare ICT-based lessons, inappropriate conditions in their college, technical problems and insufficient students skills in using ICT tools.

The faculty members’ skills in using ICT were measured in relation to 11 different tools. The analysis revealed three categories of tools which we called: basic, advanced and high level tools. Basic tools (email, internet search and word) are used by most of faculty (more than 90%). About half of the respondents use advanced tools like educational software, computer games and simulations, programs for instant messaging, PowerPoint and electronic spreadsheets. High level tools, like wikis, blog, electronic forums and synchronous meetings, are used by few respondents. Positive correlations were found between the uses of advanced and high level tools for personal and professional purposes and their implementation in teaching ($r = 0.40 - 0.49; p < 0.001$).

Other indicators for using ICT for professional needs are participation in online webinars and conferences organized by the MOFET Intercollegiate Institute or by other organizations, and the faculty’s involvement in research about ICT connected issues. It was found that about 25% of the sample participated in such activities and about 15% carried out research on issues dealing with ICT in education.

In order to find the underlying factors in ICT integration by faculty members a principal-components factor analysis with orthogonal rotation was performed on the representative measures of the following seven variables: the number of different kinds of ICT-based assignments integrated in teaching, use of course websites, components of distance teaching, ICT skills, self-evaluated level of ICT integration in teaching according to the CBAM model, attitudes towards using ICT in teaching and participation in online professional activities. All these measures loaded to a single factor (representing 55% of the variance in the data), that was called “TPACK literacy” (Technological Pedagogical Content Knowledge literacy). This new measure serves to evaluate general use and ability in ICT-based teaching. The distribution of this variable (in standard Z scores) in the sample is presented in the Fig. 1. It fits the normal distribution (excess = -0.184, standard error = 0.309) with a positive degree of skewness (0.405 with a standard error 0.155). The highest scores belong to faculty who teach courses dealing with educational uses of ICT and perhaps this explains the positive skewness of the distribution.
The high degree of consistency that was found within the TPACK literacy components ($\alpha = 0.84$) may be interpreted as the existence of some personal tendency or motivation to use ICT. It may be concluded that faculty members who intensively use ICT for personal and professional purposes, and have positive attitudes towards educational impacts of ICT will also use it in their teaching. Alternatively, those who don't have such a combination of characteristics will probably not be interested in teaching with ICT, and will possess low scores in TPACK literacy.

The faculty’s difficulties in teaching with ICT were examined with concern to infrastructure (access to internet and computers in the college and at home), pedagogical and technological knowledge, time, access to computers and computer skills among student teachers. Most faculty members pointed out they had little or no difficulty with access to the internet at home or outside the college, while the remaining 25% reported that they experience difficulties. Half of the sample reported on difficulties caused by insufficient pedagogical and technological knowledge, lack of time needed to teaching with ICT, insufficient access for student teachers to computers and the students' low computer skills. We found a negative correlation between the difficulties and the TPACK literacy among faculty members, i.e. the respondents who had higher scores in the TPACK literacy also had fewer difficulties ($r = 0.460$ p < 0.001).

Existing prerequisites for ICT integration in colleges of education

According to the RIPPLES model (Surry, Ensminger & Jones, 2003) prerequisite conditions exist for successful technology integration in teaching, such as ICT accessibility and technical, pedagogical and administrative support of faculty members. The findings reveal that most respondents (about 80%) found ICT resources available on a very basic level in their colleges. Pedagogical support and technical support were perceived as good by 70% of the sample. According to the interviews with the Heads of ICT centers, a variety of workshops are offered to faculty members in their colleges. These workshops are devoted to learning the Web 2.0 tools (wikis, blogs and collaborative tools) and Learning Management Systems. However, few faculty members participated in these workshops, most of whom were already experienced in applying ICT while novices almost did not attend such workshops.

Administrative support can be given in a variety of ways: promotion toward higher academic and managerial positions, recognition and leadership opportunities, release time, acquisition of equipment, monetary incentives for an additional workload needed for preparing courseware and teaching online. It was found that about 60% of the respondents were not aware of the existence or lack of these forms of administrative support, while 75% of the remaining respondents pointed out the absence of this kind of support.

Broadening the view to other colleges

The findings described in the two previous sections concern the data collected in four teacher education colleges which are considered advanced in ICT integration. This sample is not representative but is rather biased upward, reflecting a better situation than the actual conditions in the rest of the colleges. In order to get a more general picture, additional data were collected through semi-structured interviews with Heads of ICT Centers at eight other colleges of education. These respondents together with the Heads of the ICT Centers at the four advanced colleges filled out a STaR Chart rubric designed by the CEO Forum (CEO, 2000). The rubric allowed for evaluation on a four level scale (early, developing, advanced, and target) of a variety of categories including access to ICT resources, the faculty’s professional development, pedagogical uses of ICT and various kinds of support.

The following results were found: as for access to ICT resources, half of the colleges are at the developing level and the other half are at the advanced level. As for the teaching staff: five colleges are at the beginning level of integrating technology and six colleges are at the developing level of technology integration. Most colleges reported on offering ICT-based courses but in all colleges, the integration of ICT in pedagogical training is very limited. The
Discussion

This study examined the scope and ways of ICT integration in teaching by faculty members in colleges of education in Israel and the state of necessary prerequisites as it was perceived by faculty. Various characteristics of ICT-based teaching are positively correlated with each other: kinds of ICT-based assignments integrated in teaching, use of course websites, ICT skills, the self-evaluated level of ICT integration in teaching according to the CBAM model, attitudes towards using ICT in teaching and participation in online professional activities. This allowed the introduction of the new variable, “TPACK literacy,” which was almost normally distributed in the sample. This variable can be used in comparing group means in the same college or comparing means among various colleges.

A comparison between the findings of the current study with the findings in a similar study carried out twelve years ago (Shlayer, Shany & Schild, 1998) shows significant progress in ICT integration in teaching by faculty members in colleges of education. At that time, 28% of faculty integrated word processing in their teaching, now more than 85% do that. If workshops, at that time, taught the basic skills in using hardware, Office tools, internet and email, today workshops deal with the collaborative and creative tools (wikis, blog, document sharing etc.) and Learning Management Systems (LMS). If, at that time, building course websites required programming skills, now websites are easily opened (even automatically in some colleges) within an LMS. What were then perceived as novel ways in ICT-based teaching has become the norm and which we now call teaching by use of traditional ways of ICT integration. At the same time, new challenges are posed nowadays by the further rapid development of ICT, and higher levels of ICT integration are expected from faculty, such as integration of a LMS in teaching and implementation of innovative pedagogical methods (inquiry, problem solving, collaborative learning, creative and critical thinking development). The findings showed that most faculty members use traditional ways of ICT integration while innovative pedagogical models are implemented by only a few respondents. Despite the existence of LMS in the colleges allowing faculty to open websites easily for their courses, only one third of them used websites. As for a time dynamic of ICT use in teaching, two prominent groups of faculty members were found: the advanced teachers who continue to progress and non-ICT integrators who tend to stay in the same place. We explain this finding based on Rogers’ diffusion of innovation theory (2003). Our research assumes that currently, the Innovators, the Early Adopters and only a part of the Early Majority (defined in Introduction) among teacher educators have been involved in the process of ICT integration at the level of website implementation and higher (about one third of the sample). According to Rogers’ theory this population is characterized by intrinsic motivation in adoption of innovation, while the rest of population needs extrinsic stimuli. Therefore, in order to attract the rest of the teacher educators into the process, more planned efforts are required.

Existing ICT resources and technical and pedagogical support were perceived by respondents, in general, as satisfactory, while administrative support is almost absent. The integration of ICT in teaching requires time-consuming efforts in learning new skills and presents a significant workload for courseware development and teaching. The lack of appropriate incentives for ICT-based teaching decreases the novice teacher's motivation to adopt technological innovations as well as the veteran teachers’ motivation to persist on their current level of TPACK literacy.

In light of these findings, it is necessary to take action on the following points:

- The development of strategies to motivate and to involve all faculty members in ICT-based teaching,
- The promotion of innovative pedagogical models best suited to the demands of the Information Age through collaborative efforts of teacher educators,
- The provision of meaningful pedagogical, technological and administrative support for faculty and pre-service teachers.

Recently, the Israel Ministry of Education has established a new program focused on the development of 21st century skills emphasizing the role of ICT in education. Perhaps this study will serve as a basis for evidence-based decision making for future educational management.
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