Interdisciplinary Journal of E-Skills and Lifelong Learning

An Official Publication of the Informing Science Institute
InformingScience.org

IJELL.org

Volume 13, 2017

THE IMPACT OF THE NATIONAL PROGRAM TO INTEGRATE ICT IN TEACHING IN PRE-SERVICE TEACHER TRAINING

Olzan Goldstein *	Kaye Academic College of Education, Beer-Sheva, Israel and MOFET Institute, Tel Aviv, Israel	olzang@kaye.ac.il
Bertha Tesler	David Yellin Academic College of Education, Jerusalem, Israel and MOFET Institute, Tel Aviv, Israel	tbertha@dyellin.ac.il

*Corresponding Author

ABSTRACT

Aim/Purpose	This study examines the impact of the Israeli National Program on pre-service teachers' skills in the integration of ICT in teaching and discusses the influential factors of successful implementation of practices in the field.
Background	In the current Information Age, many countries relate to education as an important factor for national growth. Teacher education plays a significant role in coping with the challenge of educating a new generation of school students to compete in a technology-driven society. In 2011, the Israel Ministry of Education initiated the National Program for transforming teacher education colleges to meet the demands of the 21st century.
Methodology	The study focuses on two research questions: (1) What was the impact of the National Program on pre-service teacher training concerning the integration of ICT in their teaching? (2) What are the predictors of the pre-service teachers' practice of ICT integration in teaching? It is a quantitative study, based on data collected in two rounds two years apart that compares several indices of pre-service teachers' preparation to teach with ICT.
Contribution	The findings offer insights regarding influential factors of successful integration of ICT in education.

Accepted by Editor Fay Sudweeks | Received: July 25, 2017 | Revised: September 25, October 12, 2017 | Accepted: October 15, 2017.

Cite as: Goldstein, O., & Tesler, B. (2017). The impact of the national program to integrate ICT in teaching in pre-service teacher training. *Interdisciplinary Journal of e-Skills and Lifelong Learning, 13,* 151-166
https://doi.org/10.28945/3876

An earlier, shorter version of this paper was presented at the Chais conference 2017, in Raanana, Israel, and included in Y. Eshet-Alkalai, I. Blau, A. Caspi, N. Geri, Y. Kalman, & V. Silber-Varod (Eds.), *Proceedings of the 12th Chais Conference for the Study of Innovation and Learning Technologies 2017: Learning in the Technological Era.* Raanana: The Open University of Israel.

Findings	Analyses showed a significant increase in most of the indices of teacher training according to the National Program, in particular in the number of ICT-based lessons that pre-service teachers taught in their teaching practice at schools. Predictors of ICT integration in teaching were modeling by faculty members and school mentor teachers, the number of ICT-based lessons taught by pre-service teachers, and pre-requisite conditions at schools and colleges.
Recommendations for Practitioners	The current challenge is to promote innovative ICT-based teaching methods among teacher educators, school teacher mentors, and pre-service teachers.
Recommendation for Researchers	The findings underscore the importance of modelling by the school mentors as well as pre-requisite conditions at schools.
Impact on Society	Being acquainted with the most influential factors of successful integration of ICT in teaching by pre-service teachers can improve teacher education as well as the education system in educating future generations.
Future Research	More research is needed to learn about the dissemination of innovative models of ICT integration in teaching by pre-service teachers and their educators.
Keywords	ICT integration in teaching, teacher education, evaluation of systemic changes

INTRODUCTION

In the current information age, many countries relate to education as an important factor for national growth in crucial areas such as: industry, economics, politics, security, and society (Kozma, 2008; P21, 2010). Education systems have to deal with the challenge of educating a new generation of students, i.e., the future human capital, who will lead, work, and live in the information society in the next decades. Models of education that fit the needs of the Industrial Age do not meet the requirements of the current Information Age. Educators must reconsider the use of traditional pedagogical models and develop new models that will better suit the education needs of the new generation, fit the frame of the minds of the students, and be based on modern modes of assessment (Johnson, Levine, Scott, Smith, & Stone, 2009). However, education systems in most countries as well as in Israel are still far from reaching these stated goals: many teachers continue to adhere to traditional teaching methods and do not use information technology in their lessons (Israeli National Education Measurement and Evaluation Authority, 2008; Johnson et al., 2009). Taking into account the current and future needs of education, many countries try to reorganize their educational systems (CERI, 2010; P21, 2010), defining the important abilities required in the 21st century: multiple literacies, expertise, innovation, critical thinking, problem solving, and collaboration.

In 2011, the Ministry of Education in Israel began implementing the National Program for the transformation of the education system to meet the demands of the 21st century (Israeli MOE, 2011). The main impetus of this program was related to the results of the PISA international survey (2009) which showed that the computerized equipment of Israeli schools and students' achievements in science and mathematics were low compared to other countries (Ben-David, 2011). This new program aims at developing important student skills, such as ICT literacy, critical thinking, problem-solving, interpersonal communication, and collaboration skills as well as self- and life-long learning skills. These goals are to be achieved through the implementation of ICT-based innovative pedagogy as well as the upgrading of the infrastructure and equipment in the schools. As part of the program, it was decided to re-design the curricula in teacher education colleges, integrate ICT-based innovative teaching methods by faculty members as well as upgrade the technological infrastructure. A three-year plan of implementation in the teacher education colleges started in 2012 (Melamed et al., 2010), with eight colleges entering the program each subsequent year. The implementation process in seven of these colleges was accompanied by a three-year evaluation study described below.

LITERATURE REVIEW

Pre-service teacher training plays an important role in systemic reorganization plans (Black & Smith, 2009; P21, 2010) since newly ICT-skilled graduates might serve as change agents in education systems. Advanced countries are trying to adapt teacher training to the needs of the Information Age through setting standards, designing teacher training programs, and strengthening the connection between teacher training institutions and schools (Rizza, 2009). A few countries have developed standards that define the required skills of teachers in the age of information technology (ICT-Competency Standards for Teachers), and they have established long term plans for their implementation. UNESCO has defined a teacher in the 21st century as one who is skilled in building diverse learning environments for enrichment and management of teaching with ICT (UNESCO, 2009). This teacher is seen as competent in developing innovative pedagogy encouraging active learning, interaction, and cooperation while emphasizing team work.

The current state of teacher preparation for ICT-based teaching, even in advanced countries, is yet insufficient to reach the above-mentioned goals (Voogt et al., 2017). For example, Blamire, Cassells, and Walsh (2017) conducted the literature review that was based on the analysis of 70 research studies from a variety of European countries over the years 2002 – 2017. According to the review, in most countries there is little evidence of follow-through from government policy to ICT implementation in initial teacher training; ICT is not integrated in subject curricula and is not compulsory in teacher training; the training of pre-service teachers in the pedagogical use of ICT develops due to enthusiastic teacher educators. Regarding Australia, Black and Smith (2009) reported "fundamental systemic flaws in the pre-service teacher education system in terms of developing teacher competence in embedding ICTs in pedagogy and practice": the weakness of curriculum, poor modeling of ICT-based teaching by faculty, insufficient field practices by student teachers, the inadequacy of the computer systems at partner field schools, and the absence of ICT-based teaching skills assessment in a formal accreditation of pre-service education graduates. Australian student teachers' scores in technological-pedagogical-content knowledge (TPACK) were found to increase from first to fourth year level, but their final scores were still low relative to the mid-point (Sweeney & Drummond, 2013). In the USA, the National Center for Education Statistics reported that almost all teacher education institutions included in their curriculum topics related to training pre-service teachers to teach with technology (Kleiner, Thomas, & Lewis, 2007). However, the National Association of State Boards of Education (2012) pointed out that only 60 percent of the USA educators who received certification in educational technology felt prepared to incorporate these skills into their pedagogical strategy. Similar problems in teacher training are mentioned in other countries (Granston, 2004; Meisalo, Lavonen, Sormunen, & Vesisenaho, 2010; P21, 2010; Tømte, Hovdhaugen, & Solum, 2010).

The case of Israeli teacher education colleges was studied during 2008-2009 by an intercollegiate research network (Goldstein et al., 2011) and found a similar picture: most of the pre-service teachers graduated with no practical experience in ICT integration in teaching. In most courses, pre-service teachers were exposed to basic forms of ICT integration in teaching while innovative models of ICT integration (e.g., collaborative learning, inquiry, web-based synchronous and asynchronous distance learning) were rare; collaboration between college faculty and school staff for the purposes of pre-service teacher training of ICT integration in teaching was quite weak. These findings were widely discussed by the professional community of teacher educators with administrators holding key positions in the Ministry of Education and served as the basis for data-driven decisions in designing the goals and strategies of the National Program for transforming the teacher education colleges to meet the demands of the 21st century. With the beginning of the National Program implementation in the colleges of education, the above-mentioned research network renewed an evaluation process of the impact of the program on pre-service teacher preparation for ICT integration in teaching.

The Conceptual Framework of the Study

The study aimed to compare the stages of pre-service teacher preparation for ICT integration in teaching in the first and in the final third year of the National Program implementation. It was important to design a conceptual framework and concrete measures allowing such a comparison. As a basis, we used the framework of the previous study (Goldstein et al., 2011) as well as the other studies (Agyei & Voogt, 2014; Black & Smith, 2009; Brun, 2012; Shah & Ulrich, 2017). Following the findings related to the first year of the study, we completed this framework by adding further issues. The final conceptual framework of the study is shown in Figure 1.

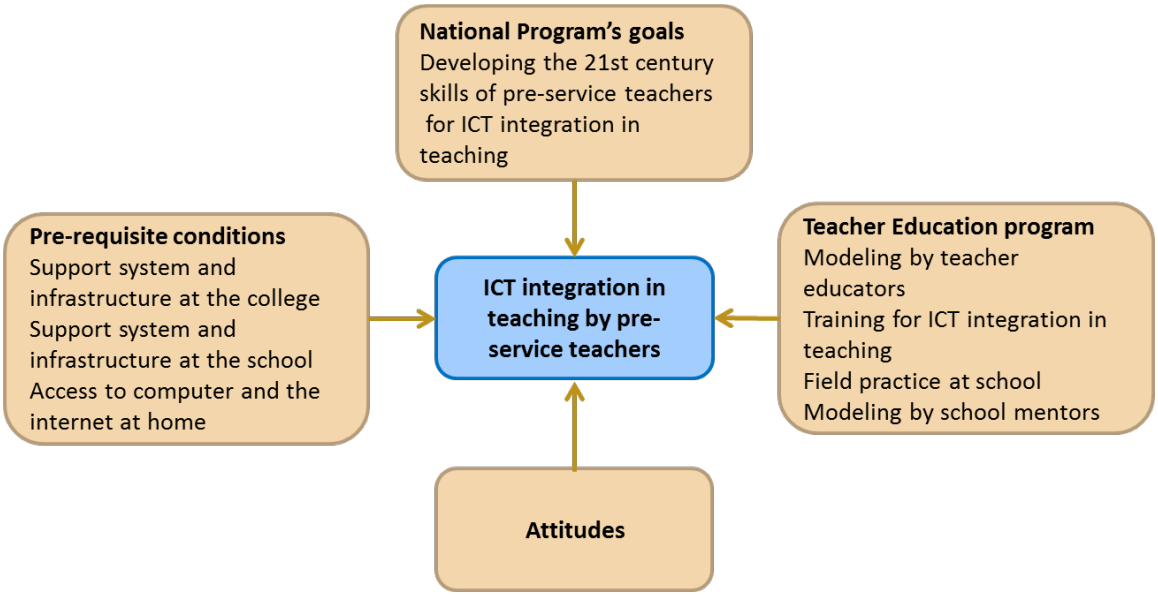

Figure 1. The conceptual framework of the study

There are four issues influencing pre-service teachers' preparation for ICT integration in teaching. The National Program defined the goal of teacher education as preparing pre-service teachers to be able to develop important 21st century skills of their school pupils. The practical content, pedagogical and technological knowledge of the pre-service teachers is formed by a combined influence of different factors: the curriculum, modelling by teacher educators, direct training to teach with technology, field practice at school, and modelling by school mentors. The willingness of the pre-service teachers towards ICT integration depends on personal attitudes toward the usefulness of ICT in education. There exist several conditions that can promote or hinder this willingness: a support system and infrastructure at colleges and schools, and computer and the Internet availability at home.

The study focuses on the following research questions:

1. What was the impact of the National Program on pre-service teacher training concerning the integration of ICT in their teaching?
2. What variables predict the extent of the pre-service teachers' practice and the ways in which they integrate ICT into teaching?

Methodology

The study was conducted using quantitative methods which give an overall picture of the phenomenon and allow for examining the interrelations between relevant variables as well as a comparison of the mean values of group indices based on large quantitative data. The study compares several indices of pre-service teacher training to teach with ICT collected by a questionnaire in two rounds two years apart: at the beginning of the National Program implementation in 2013, and towards its completion in 2015.

PARTICIPANTS

The participants were pre-service teachers studying in Israeli colleges of education in which the National Program was implemented. In the first round, 1402 pre-service teachers from seven colleges of education participated in the study while, in the second round, there were 922 respondents from eight colleges. The respondents belong to different programs and stages of study: bachelor degrees, academic retraining certification programs, and master's degrees. For different purposes, different sub-samples of the overall sample were used (Table 1).

Table 1. The samples and sub-samples of the participants

Samples and sub-samples	Goal	Round/s	Number of colleges	Number of participants
Total samples	Descriptive statistics	First	7	1402
		Second	8	922
Sub-samples in the advanced stages of undergraduate studies and academic retraining	Descriptive statistics and statistical inference about means for evaluating the changes between the two rounds	First	7	642
		Second	7	412
Sub-sample of the respondents whose mentor teachers used ICT in teaching	Predictive statistics for identifying factors influencing teaching practice	Second	8	239

To compare the changes between the two rounds of data collection, we chose pre-service teachers from seven colleges of education who were in the advanced stages of undergraduate studies (third and fourth years) and pre-service teachers in academic retraining certification program (a total of 642 in the first round and 412 in the second round). For the purposes of predictive statistics, we used the sub-sample of the second round, as the questionnaire used in the second round had additional meaningful indices about conditions in the field practice at schools. This sub-sample included 239 respondents who mentioned that their school mentor teachers integrated ICT in teaching.

INSTRUMENTS

The questionnaire used in the first round was based on a questionnaire developed by Goldstein et al. (2011) that focused on the following components: modeling by faculty members, training pre-service teachers to use ICT in teaching, personal characteristics of the respondents, and prerequisite conditions in the college and home required for ICT integration (infrastructure and technical support). It was adapted for the purposes of the current study to include references to new online learning environments (for example, social networks) as well as the new learning management system (Moodle) incorporated by the colleges. In addition, questions relating to the goals of the National Program (such as, being leaders in the process of innovative ICT integration in teaching and managing school life) were included in the questionnaire. We also added three open-ended questions where the pre-service teachers were asked to describe the best ICT-based lessons delivered by faculty members, school mentor teachers, and pre-service teachers themselves. The analysis of the responses on the open-ended questions in the first round revealed additional factors influencing pre-service teachers' practices in schools. Therefore, we added to the questionnaire in the second round three questions regarding modeling by school mentor teachers, pre-service teachers' teaching methods, and prerequisite conditions needed for integration of ICT at schools.

The second questionnaire included 25 questions of which six related to background information. The variables of the questionnaire were concerned with: components of pre-service teacher training for teaching with ICT, attitudes towards the contribution of educational technology to teaching and learning, access to computers, and existing technical support. The components of training included modeling by faculty members, modeling by school mentor teachers, pre-service teacher training to teach with ICT, and field practice in teaching with ICT.

Modeling by lecturers was measured as the number of courses (on a scale ranging from *1-in none of the courses* to *5-in 8 courses or more*) in which ICT-based assignments were integrated (for the purposes of inquiry, problem-solving, case-study analysis, project-based learning, use of learning management systems (LMS), synchronous meeting environments, social networks, and more). The average of these 15 items was used as a variable named "modeling by lecturers." Modeling by school mentor teachers was measured by requesting pre-service teachers to indicate if their mentors integrated ICT in teaching (with *1-no; 2-yes*). In the case of a positive response, the respondents were asked to choose the ways of ICT integration from a list of 10 options (ICT use for demonstration, exercising, gaming, searching for information, web-quest, problem-solving, online discussion, communicating, word-processing, and preparing power-point presentations). The average of these 10 items served to estimate the diversity of ICT integration in teaching by mentors and was used as a variable "modeling by mentors."

Data on pre-service teacher training to teach with ICT were collected using three items: the number of courses in which they were instructed to plan ICT-based lessons in schools, the number of courses devoted to instruction on how to teach such lessons, and use of LMS or a web-portal of the school. The average of these three items was used as the "training for ICT integration in teaching" variable. Field practice was measured using two variables: the number of ICT-based lessons the pre-service teachers taught in schools (on the scale of *1-I did not teach ICT-based lessons* to *5-I taught more than 8 lessons*), and the degree of diversity of ICT integration in teaching measured by items similar to the variable "modeling by mentors." The averages of the items regarding the diversity of pre-service teachers' teaching methods were used as the variable "methods of ICT integration in teaching by pre-service teachers." Questions about the diversity of ICT integration were examined in the second round only and served the purposes of predictive statistics.

The pre-service teachers' attitudes towards ICT integration in teaching and learning were examined using six items (based on a five-point Likert scale: of agreement from *1–strongly disagree* to *5-strongly agree*): the contribution of ICT to learning regarding the pre-service teachers themselves and the school pupils; the contribution of ICT to the teaching skills of the respondents; relevance of ICT integration in teaching their area of expertise; their opinions on the advantages and disadvantages inherent in ICT integration in teaching in schools. The average of these items served as the variable "attitudes."

Prerequisite conditions required for ICT integration in teaching in the colleges were measured using three items (on a scale ranging from *1-nonexistent* to *4-exist to a great extent*): access to computers, access to the internet in the college, and availability of technical support. The average of these items was used as a "conditions in the college" variable. The respondents were asked about access to computers and the internet in their homes (on the same scale), and the average of these two items was used as a "conditions at home" variable. Prerequisite conditions in the schools were measured by six items (on a scale of *1-strongly disagree* to *6-strongly agree*): the degree of encouragement from the mentor teacher; the degree of support from the staff; the availability of a computer; the availability of a projector; the availability of the internet; the availability of technical and pedagogical support. The average of these items was used as a "school conditions" variable. This variable was used in the second round only.

Quantitative data analysis was conducted using SPSS software. Reliability and validity of the first questionnaire were evaluated for content and construct validity and found satisfactory. The content validity was established by five ICT coordinators from five colleges of education and six research

experts in the fields of ICT integration in education. The clarity and accuracy of the formulation of the questions were examined by 22 pre-service teachers from the participating colleges. The reliability of the questionnaire was examined by measuring the internal consistency (Cronbach's alpha) of questions which included several statements. The convergent validity of the questionnaire was examined by a principal component factor analysis using varimax and oblimin rotations in questions containing several statements, and the calculation of correlations between the average values of statements included in these factors. These tests showed that the questionnaire used to collect data in the first round was valid and reliable (Oster, Goldstein, & Peled, 2015). Reliability and validity of the second questionnaire were evaluated in a similar manner in the current study and were also found satisfactory. The answers on the open-ended questions were analyzed through content analysis using the Grounded Theory Approach (Glaser, 1992).

RESULTS

The findings relate to two major issues: the impact of the National Program on pre-service teacher training concerning ICT integration in teaching, and the factors influencing the integration of ICT in the practice teaching of the pre-service teachers.

THE IMPACT OF THE NATIONAL PROGRAM ON PRE-SERVICE TEACHER TRAINING OF ICT INTEGRATION IN TEACHING

The findings show a meaningful impact of the National Program on pre-service teacher training concerning the integration of ICT in teaching. In all the variables, except for the variable "conditions at home," there was a statistically significant increase in mean values between the two rounds of data collection (Table 2). The greatest change was found in the number of lessons taught by respondents in teaching practice at their field schools. The effect size of the change in this variable ($\mathbf{d_{Cohen}}$= 0.49) indicates the considerable change: it reached almost half of the standard deviation of the variable. In the second round, 35% (compared to 20% in the first round) of the pre-service teachers taught more than eight ICT-based lessons, 30% (compared to 25% in the first round) taught between three and eight lessons, and 35% (compared to 55% in the first round) taught only one lesson or did not teach any lessons in ICT integration.

The increase of the mean value of the variable "modeling by lecturers" (the mean number of courses in which respondents were offered different ICT-based assignments) is statistically significant, but the size effect is small: that even in 2015, an average of the integration of the entire range of ICT-based assignments was in only one or two courses. Of the 15 types of ICT-based assignments examined, there were more common types and less common ones (Table 3). The most common assignment was submitting learning outcomes using electronic tools. Information processing, visualization and simulation, case studies, online discussions, and web-based inquiry were required on an average in 3-4 courses. The less common assignments were related to integration of project-based learning, creativity assignments (wiki, blog or site development), online synchronous activities, social networks, virtual worlds, and mobile learning.

A slight statistically significant increase was found in the means of other variables: training for ICT integration in teaching, pre-service teachers' attitudes towards the use of ICT in education, and conditions in the college required for ICT integration in teaching. Regarding the contribution of ICT to teaching and learning, the respondents expressed positive attitudes in the first round of data collection, and their attitudes improved slightly in the second round. As for the college conditions required for ICT integration, the respondents estimated them in both rounds as moderate with a slight increase of the mean of the variable in the second round. In contrast, the change in conditions in the home was not significant and, in both rounds, the conditions were assessed as having been largely fulfilled. It is important to note that the two-year period between the two rounds of data collection was too short to show all the systemic changes promoted by the National Program, and therefore the findings of this study can show only the trend of this change.

Table 2. Changes in the components of student training for ICT integration in teaching from 2013-2015

Variable and its scope	Round	Mean	St.Dev.	F	Sig.	Effect size d_{Cohen}
Modeling by lecturers (1-5)	2013	2.09	0.69	18.80	0.000	0.27
	2015	2.28	0.72			
Training in ICT integration in teaching (1-5)	2013	2.16	0.97	11.69	0.001	0.22
	2015	2.37	1.02			
Number of ICT-based lessons taught in school (1-5)	2013	2.10	1.81	59.30	0.000	0.49
	2015	2.99	1.82			
Attitudes (1-5)	2013	3.85	0.69	7.30	0.007	0.17
	2015	3.97	0.72			
Conditions in the college (1-4)	2013	3.40	0.70	5.09	0.024	0.14
	2015	3.49	0.58			
Conditions at home (1-4)	2013	3.78	0.57	2.08	0.150	0.09
	2015	3.83	0.50			

Table 3. The frequency of ICT-based assignments offered to pre-service teachers in the courses

Mean frequency	ICT-based assignments offered to pre-service teachers
5-6 courses	Submitting learning outcomes using electronic tools
2-3 courses	Information processing, visualization and simulation, case studies, online discussions, web-based inquiry
Less than 2 courses	Project-based learning, creativity assignments (wiki, blog or site development), online synchronous activities, social networks, virtual worlds, mobile learning

The qualitative analysis of the responses on the open-ended questions gathered in the first round allowed the identification of ten different methods of ICT integration by pre-service teachers and their school mentor teachers. Hence, we could expand the questionnaire in the second round to quantify data on methods of ICT integration in teaching by both pre-service teachers and their school mentor teachers and examine relationships between these variables. Of the 642 participants who responded in the second round, only 239 indicated that their instructor integrated ICT in teaching, meaning that only about one-third of the respondents had the opportunity to be exposed to modeling by their mentor teachers. In addition, these respondents noted which of the ten methods of ICT integration in teaching were used by their school mentors, and 412 respondents mentioned which of these ten methods were used by themselves in teaching in their field practice schools. The comparison of the methods of ICT integration in teaching by respondents and their school mentor teachers is represented in Table 4. As can be seen in Table 4, the most popular methods of ICT integration in teaching used by both pre-service teachers and mentors were for demonstration and illustration, and for preparing PPT presentations (used by 80% of respondents and mentors). The less popular methods included the use of educational games, information searching, word processing and

online peer communication, which were used by about two-thirds of pre-service teachers and mentors. Half of the pre-service teachers group as well as mentors integrated online drill and practice exercises, ICT-based inquiry and online discussions. The least popular methods were complex problem-solving, used by one third of the pre-service teachers and mentors.

Table 4. Methods of ICT integration in teaching by the school mentor teachers and pre-service teachers

Methods of ICT integration in teaching	**The percentage of pre-service teachers attesting that their school mentor teacher taught lessons using specific methods of ICT integration in teaching**	**The percentage of pre-service teachers attesting that they themselves taught lessons using specific methods of ICT integration in teaching**
	N=239	**N=412**
Demonstration and illustration	84.2	91.8
Online drill and practice exercises	47.2	54.2
Educational games	66.9	72.8
Searching for information	62.7	59.7
ICT-based inquiry	47.9	46.8
Complex problem solving	38.0	35.0
Online discussions	47.0	42.8
Preparing PowerPoint presentations	75.8	81.2
Word processing	64.1	63.8
Online communication with peers	57.3	46.9

An important finding is that there is a similarity in the distribution of ICT-based assignments used by mentors and pre-service teachers. This finding suggests that pre-service teachers tend to adopt the methods to integrate ICT in teaching used by their mentors while the most popular methods support traditional teaching approaches. The mean values of ten items describing the use of different methods of ICT integration in teaching by pre-service teachers and mentors were used as two variables named "pre-service teachers' methods of ICT integration" and "modeling by mentors" respectively. These variables reflect the degree of integration of various ICT-based teaching methods (traditional as well as more innovative). Their values range between 0 (no method used) and 1 (all methods used). We found a considerable correlation between the variables "modeling by mentor teachers" and "pre-service teachers' methods of ICT integration" ($r = 0.62$, $p<0.001$) that supports the conclusion about the role of the mentor teachers in forming teaching practices of pre-service teachers.

The analysis of the responses on the open questions in the first round allowed the identification of the main barriers encountered by respondents when trying to teach ICT-based lessons in their field practice at school. The barriers concerned six issues: support by mentor teachers, support by school stakeholders, access to computers, access to the internet, the possibility to equip pupils with computers or tablets during lessons, and pedagogical support by the school ICT coordinator. These issues were added to the questionnaire used in the second round of the data gathering. The data collected

from the sub-sample of 412 respondents who taught ICT-based lessons at school is presented in Table 5.

Table 5. Prerequisite conditions in schools needed to pre-service teachers for ICT integration in teaching

Conditions in school	Mean*	St.Dev.	Percentage of agreement**
My mentor teacher encourages me to integrate ICT in teaching.	4.54	1.51	78%
The school stakeholders encourage me to integrate ICT in teaching.	4.53	1.36	80%
The computer and projector are available for me at school.	4.50	1.69	76%
The school has a good wireless network.	4.03	1.68	65%
Pupils can be equipped with computers or tablets during lessons.	3.25	1.83	45%
I have pedagogical support in planning ICT integration in teaching (for example, by the school's ICT coordinator).	3.47	1.71	52%

* The scores ranged from 1–strongly disagree to 6–strongly agree.
**Total of different degrees of agreement: tend to agree, agree and strongly agree

About three-fourths of the respondents in the sub-sample agreed (with different degrees of agreement) that they were supported by their mentors and stakeholders, and computers and projectors were available at the school. Only about half of the sub-sample agreed their school had a good wireless network, could equip pupils with computers or tablets during lessons, and provided pedagogical support to respondents in planning ICT integration in teaching. Thus, the conditions in schools were more suited to integrating ICT in teaching in traditional ways using the teacher's computer and projector and less to actively involving pupils in learning using individual computers or tablets. The average of these six items served as a new variable named "conditions in school."

Factors Influencing ICT Integration in Teaching by Pre-service Teachers

To examine which factors predict ICT integration in teaching by pre-service teachers, a multiple linear regression test was conducted. The independent variables included the different components of pre-service teachers training in accordance with the conceptual framework of the study: modeling by lecturers, direct training of ICT integration in teaching (guided by the college lecturers or supervisors), modeling by mentors, pre-service teachers' attitudes towards ICT integration in education, conditions at home, college conditions, and conditions in the school. The first model focused on the extent of pre-service teachers' practice, taking the variable "number of ICT-based lessons that pre-service teachers taught in field practice in school" as the dependent. The second model focused on the pedagogical aspects of ICT integration, taking as the dependent variable "pre-service teachers' methods of ICT integration in teaching." We suggested that this variable is also dependent on the extent of teaching practice since the more pre-service teachers' practice teaching, the more they will be able to diversify their teaching methods. Hence, the second model includes the "number of ICT-

based lessons that pre-service teachers taught in field practice in school" as the independent variable. The results of the regression for these two models are presented in Table 6.

Table 6. Results of the multiple linear regression tests

Dependent variable, explained variance and the model's significance	Predictors	β	Sig.
Model 1 Dependent variable: The number of ICT-based lessons that pre-service teachers taught in field practice in school Explained variance 14.9% F (3, 193) =11.3, p<0.001	Constant		0.538
	Conditions in school	0.21	0.002
	Attitudes	0.24	0.000
	Training of ICT integration in teaching	0.16	0.020
Model 2 Dependent variable: pre-service teachers' methods of ICT integration in teaching Explained variance 37.1% F (4, 190) =28.0, p<0.001	Constant		0.000
	Modeling by mentors	0.39	0.000
	The number of ICT-based lessons that pre-service teachers taught in field practice in school	0.23	0.000
	Modeling by lecturers	0.25	0.000
	Conditions in school	0.14	0.015

* β - standardized coefficients
**Sig. – significance of the coefficient. Only significant variables are presented.

The factors that predict the extent of pre-service teachers' practice in ICT integration in teaching are the attitudes, the conditions in the school, and the direct training of ICT integration in teaching. The factors predicting the pre-service teachers' methods of ICT integration in teaching are the modeling by mentors, the number of ICT-based lessons that pre-service teachers taught, modeling by lecturers, and conditions in school. The conditions in colleges and at home were not found as significant predictors in either model. These variables are the least varying of all the components of pre-service teacher training for ICT integration (see Table 2). A possible explanation may be that these conditions were rather satisfactory for most of the respondents. The results of the second model emphasize how important the modeling by mentors and lecturers for forming pedagogical knowledge and practice of the pre-service teachers are.

DISCUSSION

In the colleges that participated in the study, we found a positive impact of the National Program on preparing pre-service teachers to integrate ICT in teaching. In the final year of its implementation, the pre-service teachers had more practice in ICT-based teaching; they gained more learning experience from the modeling of their college lecturers, and expressed more positive attitudes regarding ICT integration in education. At the same time, there is a need to increase pre-service teacher training of ICT integration in teaching, because there is still a third of the respondents who finish their studies without practical experience in teaching ICT-based lessons. It is extremely important that the colleges of education define field practice in ICT-based teaching as an obligatory component of teacher training programs for all pre-service teachers.

As for the diversity in methods of ICT integration, we found that college lecturers, school mentor teachers, and many pre-service teachers mostly used ICT in ways that strengthen traditional teaching methods while innovative ways aimed at active engagement in learning (for example, project-based learning, inquiry, problem-solving) were rare. Other studies revealed similar situations with the development and adoption of innovative ways of ICT integration in teaching (Agyei & Voogt, 2014; Bai & Ertmer, 2008; Shah & Ulrich, 2017). There may be two reasons: reluctance of teachers to change their pedagogical approach, and lack of necessary conditions in colleges and schools. The transition

from traditional to innovative teaching that promotes 21st century skills is not simple and can take a long time. At first, teachers use ICT to strengthen their practice, and only after gaining experience and being exposed to innovative uses that other teachers make use of, can they be able to take risks and adopt or invent new ways of ICT integration in teaching (Hwee & Koh, 2013). A second reason why teachers tend to stick to traditional teaching methods is that most schools and colleges do not have adequate individual equipment to support active learning, apart from a computer and a classroom projector. The recent trend in the use of end-point devices (laptops, tablets, and smartphones) can provide good solutions for equipping students with access to the network and enable active, personalized learning for each student and collaborative learning for groups of students. Recently, schools in Israel have begun to equip tablets to classrooms and, hopefully, this trend can promote more meaningful integration of ICT in teaching. If the colleges of education choose these schools for the teaching practice, the pre-service teachers will have more opportunities to watch ICT-based lessons of their mentors, and will be able to practice a variety of teaching methods in their classes.

Several factors were found as predictors of pre-service teachers' practice in ICT-based teaching. Pre-service teachers' attitudes, conditions in schools, and training of ICT integration in teaching had a statistically significant impact on the number of ICT-based lessons pre-service teachers taught in their field practice at school. The importance of positive attitudes towards the contribution of ICT to teaching and learning was pointed out by numerous studies that examined ICT integration by teachers (Agyei & Voogt, 2014; Brun, 2012). According to Ajzen's (1991) Theory of Planned Behavior, positive attitudes are a necessary condition for a person's decision to perform an action. However, positive attitudes are not enough. Two other factors influence behavioral action: social norms in the environment and the estimated degree of difficulty in performing the behavior. For example, a pre-service teacher who has positive attitudes toward the contribution of ICT to teaching and learning can avoid using ICT in teaching if the environment does not encourage him or if he expects many difficulties in doing so.

The organization of an ICT-based lesson in a school is a complex task: a pre-service teacher has to coordinate the lesson with the school system, make sure the equipment works properly, arrange the pupils' transition to a computer lab or equip them with tablets in the classroom. Managing classroom behavior also becomes more complex. Therefore, it is clear that the pre-requisite conditions in school served as a predictor of the extent to which the pre-service teachers integrated ICT into teaching. Schools that provide infrastructure, technical support, and encourage the integration of ICT in teaching enable pre-service teachers to develop knowledge and skills in teaching with ICT.

Regarding the pedagogical aspect of ICT integration, we found that the diversity of teaching methods pre-service teachers used was dependent mostly on modeling by their school mentor teachers. The mentor teacher plays an essential role in building pedagogical, technological, and content knowledge of pre-service teachers. Her/his pedagogical and practical knowledge shapes the professional development of novice teachers. The mentor's behavior reflects the environmental norms in school, and thus influences the extent to which the pre-service teachers intend to realize their attitudes towards the integration of ICT in teaching (Ajzen, 1991). It is, therefore, important that the mentors of the pre-service teachers be skilled in using innovative methods of ICT integration in teaching. Unfortunately, only a third of the sample in the second round of data gathering had the opportunity to learn from their mentors to teach using ICT. In order to overcome this obstacle, colleges should choose field practice schools in which teachers are experienced in ICT-based innovative teaching. The training of school mentor teachers towards meaningful mentoring can also lead towards a positive impact (Ambrosetti, 2014).

We found that modeling by college lecturers also influenced the diversity of teaching methods used by pre-service teachers, in accordance with other studies (for example, Admiraal et al., 2017; Tondeur et al., 2012). As teacher educators become more creative in integrating ICT in teaching, so will pre-service teachers adopt and implement more innovative teaching methods. Thus, the main challenge for colleges of education is to reconstruct teaching process towards innovative constructivist stu-

dent-centered teaching approaches with the use of ICT, such as problem and project-based learning, inquiry, simulations, gamification, location-based learning, peer-to-peer learning, personalized, and collaborative learning. The third factor affecting the diversity of teaching methods related to the extent of practice in ICT-based teaching. Teaching experience leads pre-service teachers to develop a sense of self-efficacy (Darling-Hammond, 2006) and enables them to apply the theoretical knowledge they have acquired in academia (Loughran, Mulhall, & Berry, 2008). Dorner and Kumar (2016) emphasized the importance of collaboration between college supervisors and school mentor teachers in promoting the effective practice of pre-service teachers in meaningful integration of ICT in teaching focused on innovative pedagogy. Even more effective strategies for pre-service teacher preparation for ICT-based teaching are related to the idea of college-school partnerships. Polly, Mims, Shepherd, and Inan (2010) analyzed numerous resources examining outcomes of the US National initiative "Preparing Tomorrow's Teachers to Use Technology" launched by the Department of Education in 2000. Within the framework of this initiative, more than 400 teacher education institutions received grants and developed various approaches to implement the goals of the initiative. The research of Polly et al. indicated that a college-school partnership was especially successful since it opened the way for developing collaboration between teacher educators responsible for field practice, school teachers, and pre-service teachers in planning and co-teaching ICT-based lessons. These efforts required additional workload of the staff which was funded by the budget of the grants. In addition, involvement of schools in such projects raised the level of their responsibility for providing the necessary infrastructure, administrative and technical support.

Conclusion

In conclusion, there is no doubt that the implementation of the National Program for transforming the colleges of education to meet the demands of the 21st century has contributed greatly to teacher training. The challenge facing the colleges at present is to advance innovative approaches to integrate ICT in education by college lecturers, school mentor teachers, and pre-service teachers as well as to provide proper equipment allowing for individual use during the lessons. Future studies should focus on evaluating strategies that promote pedagogical innovations as well as their implementation in teacher education.

Acknowledgements

This study was supported by the Research Authority of the MOFET Institute, Tel Aviv. We are grateful to Dr. Ainat Guberman for her support and to the research team for their cooperation in the process of data collection and discussion of findings: Dr. Merav Asaf, Dr. Orit Avidov-Unger, Dr. Osnat Dagan, Dr. Alona Forkosh-Baruch, Dr. Asmaa Ganayim, Dr. Anat Oster, Ms. Ruth Peled, Dr. Yehuda Peled, Dr. Miri Shonfeld, Ms. Orna Shternlicht and Dr. Eyal Weissblatt.

References

Admiraal, W., van Vugt, F., Kranenburg, F., Koster, B., Smit, B., Weijers, S., & Lockhorst, D. (2017). Preparing pre-service teachers to integrate technology into K–12 instruction: Evaluation of a technology-infused approach. *Technology, Pedagogy and Education*, *26*(1), 105–120.

Agyei, D. D., & Voogt, J. (2014). Examining factors affecting beginning teachers' transfer of learning of ICT-enhanced learning activities in their teaching practice. *Australasian Journal of Educational Technology*, *30*(1), 92–105.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*, 179-211.

Ambrosetti, A. (2014). Are you ready to be a mentor? Preparing teachers for mentoring pre-service teachers. *Australian Journal of Teacher Education, 39*(6). http://dx.doi.org/10.14221/ajte.2014v39n6.2

Bai, H., & Ertmer, P. (2008). Teacher educators' beliefs and technology uses as predictors of preservice teachers' beliefs and technology attitudes. *Journal of Technology and Teacher Education*, *16*, 93–112.

Ben-David, D. (2011). *The state of education in Israel and its implications: A visual road map* [Hebrew]. Report of the Taub Center for Social Policy Studies in Israel.

Black, G., & Smith, K. (2009). *Hot topic: ICT in pre-service teacher training strategic ICT advisory service*. Report written for the Australian Government's Department of Education. Retrieved from http://www.educationau.edu.au/sites/default/files/SICTAS_HT_pre-service.pdf

Blamire, R., Cassells, D., & Walsh, G. (2017). *ITELab monitoring report 1*. European Commission. Retrieved from http://itelab.eun.org/documents/452109/470959/ITELab_D2.1+Literature+Review+Report+vMarch2017.pdf/87819aa1-052b-4fb4-ac6d-60176465c3b5

Brun, M. (2012). Factors influencing pedagogical activities with ICT in initial teacher training in Mathematics in Chile. *Proceedings of Society for Information Technology & Teacher Education International Conference*, (Balanskat 2005), 2724–2730. Retrieved from http://www.editlib.org/p/39998

CERI. (2010). *CERI - ICT and initial teacher training*. Retrieved from http://www.oecd.org/edu/research/42421255.pdf

Darling-Hammond, L. (2006). *Powerful teacher education: Lessons from exemplary programs*. San Francisco: Jossey-Bass.

Dorner, H., & Kumar, S. (2016). Online collaborative mentoring for technology integration in pre-service teacher education. *TechTrends, 60*(1), 48-55. doi:10.1007/s11528-015-0016-1

Glaser, B. (1992). *Basics of grounded theory analysis: Emergence vs. forcing*. Mill Valley, CA: Sociology Press.

Goldstein, O., Waldman, N., Tesler, B., Forkosh-Baruch, A., Shonfeld, M., Mor, N., … Kozminsky, L. (2011). The current state of pre-service teacher training for ICT based teaching in Israel: 2008-2009. *Proceedings of Global TIME: Global Conference on Technology, Innovation, Media & Education* (February, 22-24, 2011), AACE.

Granston, N. C. (2004). *Technology and teacher training: The systematic design and development of a framework for integrating technology into Jamaica's teacher training programs* (Unpublished doctoral dissertation). Department of Secondary Education, University of South Florida, U.S.

Hwee, J., & Koh, L. (2013). A rubric for assessing teachers' lesson activities with respect to TPACK for meaningful learning with ICT. *Australasian Journal of Educational Technology*, *29*(6), 887–900.

Israeli MOE. (2011). *Transforming the education system to match the demands of the 21st century: the national plan* [Hebrew]. Retrieved from http://cms.education.gov.il/NR/rdonlyres/79B5A8CF-F812-4A63-89BE-3BEFEB887EC5/142454/12.pdf

Israeli National Education Measurement and Evaluation Authority. (2008). *Integrating computers and ICT in schools, SITES 2006* [Hebrew]. Retrieved from: http://cms.education.gov.il/NR/rdonlyres/A309E050-32FE-4213-83D8-D1357C4EFF77/70234/SITES.pdf

Johnson, L., Levine, A., Scott, C., Smith, R., & Stone, S. (2009). *The horizon report:* 2009 *economic development edition*. Austin, Texas: The New Media Consortium.

Kleiner, B., Thomas, N., & Lewis, L. (2007). *Educational technology in teacher education programs for initial licensure* (NCES 2008–040). Washington, DC: National Center for Education Statistics.

Kozma, R. B. (2008). Comparative analysis of policies for ICT in Education. In J. Vooght & G. Knezek (Eds.), *International handbook of information technology in primary and secondary education* (pp. 1083-1096). New York: Springer.

Loughran, J., Mulhall, P., & Berry, A. (2008): Exploring pedagogical content knowledge in science teacher education. *International Journal of Science Education, 30*(10), 1310–1320.

Meisalo, V., Lavonen, J., Sormunen, K., & Vesisenaho, M.(2010). *New millennium learners: ICT in initial teacher training, Finland Country report*. Retrieved from http://www.oecd.org/dataoecd/4/43/45214586.pdf

Melamed, U., Peled, R. Mor, N. Shonfeld, M., Harel, S., & Ben Shimon, I. (2010). *A program for transforming teacher education colleges to the 21st century* [Hebrew]. Ministry of Education, Israel.

National Association of State Boards of Education. (2012). *Born in another time - Ensuring educational technology meets the needs of students today – and tomorrow*. NASBE, U.S. Retrieved from http://blogs.edweek.org/edweek/DigitalEducation/NASBE.pdf

Oster, A., Goldstein, O., & Peled, Y. (2015). Questionnaire for evaluating pre-service teachers' preparation in the Information era. *In the Circles of Education - Research, Study and Creation, 5*, 103-129 [Hebrew].

P21. (2010). *21st century knowledge and skills in educator preparation*. A collaborative project by the American Association of colleges of teacher education and the Partnership for 21st century skills. Retrieved from http://www.p21.org/documents/aacte_p21_whitepaper2010.pdf

PISA international survey. (2009). *PISA 2009 at a Glance*. Retrieved from https://www.oecd.org/pisa/46660259.pdf

Polly, D., Mims, C., Shepherd, C. E., & Inan, F. (2010). Evidence of impact: Transforming teacher education with preparing tomorrow's teachers to teach with technology (PT3) grants. *Teaching and Teacher Education*, *26*(4), 863–870.

Rizza, C. (2009). *ICT and initial teacher training – National policies*. Report for the New Millennium Learner project of CERI-OECD.

Shah, M., & Ulrich, S. (2017). Pre-service teacher education for technology integration: Professional identity, experiences, and knowledge. In P. Resta & S. Smith (Eds.), *Proceedings of Society for Information Technology & Teacher Education International Conference 2017* (pp. 2443-2451). Chesapeake, VA: Association for the Advancement of Computing in Education (AACE).

Sweeney, T., & Drummond, A.(2013).How prepared are our pre-service teachers to integrate technology? A pilot study. *Australian Educational Computing 27*(3),117-123.

Tømte, C., Hovdhaugen, E., & Solum, N. H. (2010). *ICT in initial teacher training, Norway Country Report*. Retrieved from: http://www.oecd.org/dataoecd/6/61/45128319.pdf

Tondeur, J., van Braak, J., Sang, G., Voogt, J., Fisser, P., & Ottenbreit-Leftwich, A. (2012). Preparing pre-service teachers to integrate technology in education: A synthesis of qualitative evidence. *Computers & Education*, *59*(1), 134–144. http://doi.org/10.1016/j.compedu.2011.10.009

UNESCO. (2009). *Guide to measuring information and communication technologies (ICT) in education*. Paris: United Nations Educational, Scientific and Cultural Organization. Retrieved from: http://www.uis.unesco.org/template/pdf/cscl/ICT/ICT_Guide_EN.pdf

Voogt, J., Valtonen, T., Sointu, E., Kontkanen, S., Kukkonen, J., Pöntinen, S., … Rosenberg, J. (2017). (Future) teachers' use of technology and development of TPACK: Insights from a global perspective. In P. Resta & S. Smith (Eds.), *Proceedings of Society for Information Technology & Teacher Education International Conference 2017*(pp. 2499-2502). Chesapeake, VA: Association for the Advancement of Computing in Education (AACE).

BIOGRAPHIES

Dr. Olzan Goldstein is the Head of the School for Advanced Studies at Kaye Academic College of Education (Beer-Sheva, Israel). Between the years 2007-2015, she led the intercollegiate research network "ICT in teacher education colleges" supported by the Research Authority at the MOFET Institute (Tel Aviv, Israel). Her research and publications deal with evaluation of teacher education programs, professional development of teacher educators, ICT integration in education, project-based learning, and implementation of innovations in organizations.

Bertha Tesler is a lecturer in mathematics and in quantitative research methods at David Yellin Academic College of Education (Jerusalem, Israel). Between the years 2007-2015, she was a member of the intercollegiate research network "ICT in teacher education colleges." Her research and publications deal with ICT integration in education, fostering mathematically talented students and spatial ability.