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ICT IMPLEMENTATION IN COLLEGES OF EDUCATION: A FRAMEWORK FOR TEACHER EDUCATORS

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ABSTRACT

Aim/Purpose	The study aims to evaluate Information and Communication Technology (ICT) implementation in academic colleges of education. The article offers a conceptual framework for ICT implementation within teacher education in the information era, which combines an array of frameworks and addresses the needs of teacher education.
Background	The study examines the components of ICT implementation within the training as perceived by teacher educators in these colleges, their attitudes towards the contribution of ICT for teaching and learning, and the available conditions and resources in these colleges for ICT implementation in teaching.
Methodology	A mixed methodology of quantitative and qualitative nature was utilized. A questionnaire was developed including a set of sequential steps. The sample that responded to the questionnaire included 615 faculty members, which were approximately 25% of the population of lecturers in 8 colleges of education.
Contribution	The results enabled insights regarding success and challenges in the implementation of the computerization program. It supplies policymakers as well as practitioners with updated data and enables evidence-based decision-making.
Findings	Use of ICT by faculty shows two key factors: basic ICT use and advance collaborative use. Use in teacher training was divided into 5 factors: information management, advanced technological methods, project-based learning, display of information, and learning organization. Two factors were related to the students' use of ICT in their teaching: integrating ICT in classroom activity, and usage for distance learning.

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Recommendations for Practitioners	Recommendations for practitioners include empowering the efficiency of ICT implementation, thereby transforming teaching and learning; training pre-service teachers to utilize advanced ICT tools that encourage collaboration, problem-based learning; utilization of the tool developed and used in this study for decision-making and assessing ICT implementation in teacher training; and highlighting the role of the teacher educator as a major factor in translating educators' beliefs and modelling for students.
Recommendation for Researchers	Recommendations for researchers include identifying the possibilities of utilizing the proposed tool in their research and development plans within their teacher training institutes, as a means of assessing the nature of ICT implementation in their teacher education programs.
Impact on Society	ICT implementation in education has an impact on the future generation of students, as citizens of the knowledge society and lifelong learners. Teacher educators are at the heart of this process; hence, developing and implementing a tool to measure as well as encourage a paradigm shift in teaching and learning is of utmost importance.
Future Research	Future research should include examining the utilization of the developed tool in diverse contexts, as well as using it as an indicator for comparing ICT implementation processes and models between institutes, and for examining the implementation process from a longitudinal point of view, from pre-service education throughout the TPD (Teacher Professional Development) as an in-service teacher.
Keywords	ICT implementation, colleges of education, models of implementation, ICT literacy, online questionnaire, pre-service teachers

INTRODUCTION

Technological changes have challenged teacher educators to re-evaluate their teaching and to reconstruct their teaching methods (Forkosh-Baruch, 2018). They have also enforced them to adapt training programs to the requirements of the information era, in terms of teachers' changing roles, understanding how students learn in a technology and information-saturated environment, and implementing new pedagogical models and modelling best practices by means of clinical preparation – to name a few (Darling-Hammond, 2006, 2014; Howe, 2014). Consequently, colleges of education examine skill acquisition for ICT (Information and Communication Technologies) implementation in their teaching (Kay, 2006). The changing nature of knowledge and the changing capabilities of technologies require faculty in higher education to implement ICT in their teaching and training (Burden, Aubusson, Brindley & Schuck, 2016). This is a complex endeavor, requiring allocation of time and resources, as well as constructing a comprehensive support system (Gomez, Sherin, Griesdorn, & Finn, 2008). Research reports meager ICT implementation by faculty in educational contexts, as a result of a variety of difficulties and barriers (Göktaş, Yildirim, & Yildirim, 2009; Turan & Göktaş, 2018).

In light of the changing roles of teachers in the information era, teacher educators are also required to address contemporary issues in training pre-service teachers. This study focuses on a population that is, in many cases, overlooked when discussing the issue of preparation for ICT implementation: those who train pre-service teachers. The teacher educators' role in the implementation of ICT within the education system is yet to be resolved. The success of ICT implementation in the education system highly depends on the attitudes and practices of teacher educators (Rana, 2016). Hence, the goal of this study is to develop and examine a research tool that focuses on perceptions of teacher educators, attitudes towards ICT in education, and ICT conditions and resources within colleges that facilitate or hinder ICT implementation. The importance of the study is twofold: to empower the

teacher education system by developing and implementing a tool to measure and facilitate a paradigm shift in teaching and learning; and by modelling, to learn about ways of empowering pre-service teachers as future teachers. By exploring teacher educators' attitudes regarding ICT implementation, we can promote ICT utilization by modelling.

THEORETICAL BACKGROUND

Learning experiences in the digital era assist students in adopting cognitive, social, cultural, and technological skills and competencies for functioning as adults in a 21st-century setting. These inevitably involve effective utilization of ICT. The required competences for ICT integration are related to the utilization of technology, but also to pedagogical aspects of the ways in which technology is used for teaching and learning (Becuwe et al., 2017). Nonetheless, teachers are not as prepared as can be expected to implement technology as a lever for novel pedagogy, although professional technological pedagogical content knowledge is required to support this proficiency (Koh, Chai & Lim, 2017).

Unfortunately, teacher educators also lack the competencies needed for best practices in ICT implementation in education (Tondeur, van Braak, Siddiq, & Scherer, 2016). Research on the preparation of pre-service teachers for ICT implementation revealed that teacher educators are not adequately equipped with the pedagogical and content knowledge to utilize technology in their teaching. Hence, while teacher educators are expected to effectively and wisely use ICT, thereby modeling effective ICT implementation, de facto they cannot fulfill these expectations. Consequently, they fail to provide pre-service teachers with the required skills to implement ICT in their teaching. Professional development and support are therefore needed to prepare teacher educators for this task; however, existing workshops and training are shown to be insufficient (Becuwe et al., 2017).

The institutional level also supplies conditions for ICT implementation. These encompass components such as internal support (e.g., institute policy, workshops) external support (e.g., national policy), conditions (e.g., time and funding allocation, infrastructure), and capacity of the organization to create sustainable conditions for the successful transformation of practice (Lawrence & Tar, 2018).

Teacher educators are considered role models for their students, the pre-service teachers, portraying the role of technology in their teaching (Nelson, Voithofer, & Cheng, 2019). Teacher educators are expected to develop and attain beliefs regarding ICT and develop skills that allow them to utilize technology effectively. In addition to institutional support, this requires extensive evaluation by the institute and follow-up assessment that leans on conceptual models. ICT implementation in teacher education programs that are linked to features portrayed in the following theoretical models may promote better ICT implementation and quality practices.

Diffusion of innovation

The diffusion is basically a process through which a novelty – in this case, ICT implementation as a game changer in teacher education – is implemented within a system or an organization – in this case, colleges of education – highlighting the role of faculty members and their impact in this process. This theory encompasses the characteristics of the novelty to be diffused (ICT in this case), decision process regarding ICT implementation, and characteristics of the adopters. Personal as well as institutional factors affect the decision to implement ICT as part of the change process within the organization. The most quoted approach for implementing innovation is the 'Diffusion of Innovation Theory' (Rogers, 2003), a process by which a novelty is distributed and sustained within a system. Five relevant stages are identified in this process: knowledge, persuasion, decision, implementation and confirmation; then, ICT, in this case, becomes part of the everyday routine of the innovator. ICT in itself is not considered an innovation, but rather its usage to empower teaching and learning.

Concerns based adoption model

The CBAM (Concerns Based Adoption Model) model identifies seven levels of implementing novel practices: orientation, preparation, mechanical use, routine use, refinement, integration and renewal (Hall & Hord 1987). Contradictory to Rogers' model, the CBAM model reflects an ongoing process, in which novelties are iterative in nature. Hence, the adoption of technology is perceived as a continuous process driven by personal as well as institutional factors, portraying a combined bottom-up and top-down process. Each stage is characterized by a specific behavior. The orientation stage is characterized by non-use of innovation; the preparation stage, learning and preparing for the utilization of the innovation takes place; the mechanical stage focuses on simple utilization aimed to improve current practice; in the routine stage, frequent usage of the innovation is exhibited; the refinement stage focuses on usage of innovative ICT application aimed to enhance outputs; the integration stage includes sharing and peer collaboration in the usage of ICT (i.e., the innovation); the final renewal stage in the CBAM model includes empowerment and improvement of the innovation in a novel, creative, ongoing and sustainable manner, i.e., ICT utilization as a lever for pedagogical change and innovation. This model was chosen for our study as a theoretical pillar since it allows us to identify the ICT implementation stage in which the teacher educator is located; this also allows us to pinpoint the pitfalls and difficulties within this process from a personal as well as an institutional perspective (Hall & Hord, 2015). Still, this model presents a process-related perspective on innovation implementation, which lacks a) specific reference to Information and Communication Technologies, and b) a more pedagogic orientation; therefore, there was a need to further utilize a model that identifies factors that may be involved in ICT implementation, rather than a process that faculty members undertake.

RIPPLES model

In the RIPPLES model, the seven factors affecting ICT implementation are related to organizational aspects on the one hand, and to technological aspects on the other hand, thereby adding value to the CBAM model. The model is comprised of seven required components for best ICT implementation: a) Resources and financial planning, including allocation of resources for ICT implementation; b) Infrastructure development, including planning of robust means of ensuring ICT as a major player for teacher education ; c) People factor, including faculty motivation to implement ICT (e.g., beliefs, attitudes and values); d) Policy that addresses vision and ICT implementation plan for wide dissemination of ICT-based initiatives; e) Learning power of technology-based education within the curriculum, turning it into an innovative and creative means of preparing future teachers; f) Evaluation of the effect of technology on learning outcomes, e.g., research-based decision-making and planning of ICT implementation; g) Support and encouragement of faculty in terms of technical and pedagogic support, which may include several types of incentives for implementing innovative ICT utilization aimed to create novel modes of training (Ensminger, 2016; Surry, Ensminger, & Haab, 2005). These factors are a vital component regarding factors facilitating or hindering ICT implementation among teacher educators.

TPACK model

The TPACK model (Technology, Pedagogy and Content Knowledge) illustrates ICT integration in an educational milieu, and more specifically, within the curriculum (Koehler & Mishra 2005), including three types of knowledge: technological, pedagogical and content knowledge (Bull & Bell 2009; Niess, 2008). It has been one of the major theoretical models widely utilized by researchers for examining and developing pre-service and in-service teachers' knowledge regarding the integration of technology into teaching (e.g., Martin, 2018; Pamuk, 2012). TPACK has also been used in designing and examining teacher education and professional development programs aiming to integrate digital technologies in teacher practice; for example, a new model was developed to assess ICT implementation in science teachers' professional development processes (Jimoyiannis, 2010). Moreover, a survey instrument was developed to examine teachers' beliefs about learning, their design dispositions,

learning design practices and TPACK (Chai, Tan, Deng, & Koh, 2017). Existing research on TPACK implementation sheds light on pre-service training. This model can predict teachers' ability to effectively cope with challenges of 21st-century teaching and learning presented by ongoing integration of changing technologies (Foulger, Graziano, Schmidt-Crawford, & Slykhuis, 2017). However, teachers also encounter organizational challenges that are less emphasized in the TPACK model.

ICT implementation – UNESCO framework

Hence, we leaned on yet another conceptual framework for understanding the ICT implementation process, which is described in detail in the UNESCO report (Hine, 2011), emphasizing that ICT competencies are a prerequisite for ICT implementation, but it does not ensure that a teacher is able to implement ICT in teaching. The offered framework addresses all aspects of teachers' professional conduct, in three successive approach types to teaching: Technology Literacy; Knowledge Deepening; and Knowledge Creation. This framework encompasses aspects related to producing productive adults who contribute to society; in the case of pre-service teachers, productive future teachers who are relevant in their teaching to students of the knowledge society.

ICT INTEGRATION IN COLLEGES OF EDUCATION

Innovative use of technology in education is still lacking, as technology is vastly utilized to support existing practices and less as a lever for transforming teaching practices. Teacher education institutes also rarely meet the required demands from teachers to integrate ICT in their training programs; this is specifically relevant to requirements from teacher educators, who educate student teachers. They are expected to promote pre-service teachers' technological literacy. However, in order to prepare student teachers to integrate technology in their practices, they have to justify their own practices in terms of the underlying pedagogical reasoning. Research on teacher educators' ICT integration in pre-service teacher training is to a lesser volume than that of teachers in the K12 education system. Studies regarding these issues are searching to integrate adequate professional standards for this goal. These indicate that while it is imperative to promote pre-service teachers' ICT competences for better integration of technology in teacher training, ICT implementation is not reflected as expected in the teacher education de facto (Uerz, Volman, & Kral, 2018).

Consequently, researchers, as well as professionals, continually contemplate regarding the means of encouraging ICT implementation in colleges of education. This is not a goal in itself, but rather a means of encouraging pre-service teachers, in turn, to utilize ICT for promoting quality educational practices (based on their teacher educators' modeling). For this purpose, there is a need to provide comprehensive data regarding the current state. For example, several teacher ICT professional development courses have been structured to promote teacher educators' ICT and pedagogical skills; however, they seem to fail in pinpointing specific needs (Peters, Cowie, & Menter, 2017). Hence, an examination of ICT implementation in teacher education requires an overview of diverse models of implementation and several aspects on multiple levels, with a clear emphasis on pedagogical needs and goals required for the information era in 21st-century context (Ertmer & Ottenbreit-Leftwich, 2013). Utilizing the described models for ICT implementation in colleges of education serves this purpose best, as it encompasses all factors and aspects into one comprehensive and manifold structure.

The examination of possibilities of implementing a research tool developed for teacher education contexts is consequently crucial to ICT implementation in education altogether. The theoretical foundations which we base our research upon are based on the detailed theoretical models for ICT implementation in educational settings, which have been studied extensively in K12 (kindergarten to grade 12) education but to a lesser degree teacher education contexts. Moreover, we did not find evidence of studies that utilize such a comprehensive framework including various models that complement each other as a basis of assessing ICT implementation by faculty members in colleges of education.

GOALS AND OBJECTIVES

The overall goal of the current study was to collect information from faculty members in teacher training institutes that would help us understand ICT implementation in colleges of education which train future teachers. The objective of our study was to identify ICT models and implementation processes in colleges of education, and to detect best practices, as well as facilitating and hindering factors, of ICT implementation in teacher education, based on the theoretical models which served as pillars for the computerization program in teacher education.

Hence, our research questions were stated accordingly:

1. What were the main uses of ICT tools of teacher educators for personal or professional needs?
2. What were the main uses of ICT tools given to students by teacher educators during courses?
3. What were teacher educators reported attitudes towards ICT use?
4. What were the factors facilitating or hindering ICT implementation among teacher educators?
5. What did teacher educators perceive as success in ICT implementation in teacher education institutes?

METHODOLOGY

THE STUDY

Based on components from the models mentioned above, a questionnaire was developed for this study, combining items that produce quantitative as well as qualitative data, thereby utilizing a mixed-methods methodology. Specifically, we based the questionnaire on a combined theoretical framework of the model defined by UNESCO for skills required by teachers in the information age (Hine 2011), the Technological-Pedagogical-Content Knowledge model (Mishra & Koehler 2006), as well as the RIPPLES model of factors influencing ICT implementation in educational institutes (Surry, Ensminger, & Jones, 2002). The chosen models are the ones that emphasize pedagogical aspects on the one hand and organizational aspects on the other hand – together portraying an ecosystem in which teacher education is nurtured.

THE CONTEXT

Our study examines ICT integration by faculty in colleges of education in the initial stages of implementing the National Program for Adapting the Colleges to 21st Century Education in Israel (i.e., the Computerization Program for Colleges of Education). First, we constructed and examined the validity and reliability of the questionnaire developed. Then, an inter-collegial annual mandatory course was established. Six faculty members of each college participated in the course. These representatives served as arrowheads of change in a gradual fan-like manner rather than a revolutionary implementation process (Kirkup & Kirkwood, 2005).

The National Program had begun its course as far as 1994, followed by a recent upgrading of the program (the fifth round). As a result of a 3-year study focusing on the integration process of ICT in teacher education in Israel between the years 1993-2008, in light of theories of innovation and organizational change, since the year 2012 teacher pre-service education was included in this initiative. The program was titled: “The National Program for Adapting Teacher Education Colleges to the 21st Century”, i.e., within 3 years all colleges were granted a sum of approximately \$150,000 each (altogether a sum of approximately \$3,750,000) for executing ICT-based educational initiatives in teacher education (Ministry of Education Israel, 2011).

As part of a holistic view of the education system, the Ministry of Education created a continuum of professional development, beginning with pre-service and creating ongoing in-service TPD. In 2012, nine colleges of education received the desired funding on a competitive basis (according to the quality of the programs they submitted), and began implementing their three-year computerization plan. This process was accompanied by research, led by a research group including representatives from these colleges as well as from the Israeli MOE's Department for Teacher Training and Professional Development. To this day, this is the major and so far only study regarding ICT teacher education in Israel. Since then, the Ministry of Education has not carried out another round of such a comprehensive initiative, and no additional comprehensive research was conducted in teacher education programs. However, the results of this study and their publication may serve as a lever for a comparative study, which may be conducted as a longitudinal study. Furthermore, this study may serve as a model for developing countries, for assessing ICT implementation in their teacher education systems.

DEVELOPMENT OF THE QUESTIONNAIRE

The development process of the questionnaire included a set of sequential steps. First, three of the members of the research team examined existing questionnaires in the field, drawing a draft questionnaire. Then, a discussion was facilitated with all nine research team members, in which there was reference to the scope of topics and their relevance to the field, the structure of the questionnaire and to the phrasing of the questions and items. Then, a pilot study was launched with 24 faculty members as participants who were invited to fill in the questionnaire and measure time. Some of these participants were also interviewed to attain a wider perspective on the issues referring to the study. The questionnaire was adapted in accordance with participants' remarks regarding the clarity of the wording of some items, which were re-phrased or omitted. All comments were embedded in the new version of the questionnaire following consultation including members of the research group until a final version was reached.

SAMPLE

The sample included 615 faculty members, approximately 25% of the population of lecturers in 8 education colleges in Israel which carried out a computerization program in the year 2012. In general, the response rate ranged from 9% to over 43% of faculty members; however, the distribution of participants from each college was balanced, ranging from 8.9% to 16.4%. The sample of teacher educators included 72% female and 28% male participants. About 80% belonged to the [main] sector, while about 20% to the [minority] sector, i.e., religious and Arab population. The questionnaire was distributed via mailing lists within each college, and responses were acquired based on faculty willingness. The background data of faculty indicated that most participants were full faculty members with a full position in their colleges, with promotion tracks. About 45% were pedagogic instructors.

TOOLS

The questionnaire developed for this study was based on a previous questionnaire (Goldstein et al. 2012), built based on Rogers' Diffusion of Innovation theory (Rogers, 2003), the CBAM model (Hall et al. 1998) and the RIPPLES model (Surry et al. 2002). In the renewed version the number of items was reduced. We also added open-ended questions regarding facilitating factors and factors hindering ICT implementation by faculty.

The questionnaire in its current version included 24 questions (79 items altogether). Open-ended items included reference to personal aspects of ICT implementation in the college: a) What encourages faculty to implement ICT in their teaching in the college? b) What hinders ICT implementation of faculty in their teaching in education? c) What would the faculty member's definition of success in ICT implementation in the college? Content analysis enabled to identify patterns of facilitating vs

hindering factors in ICT implementation and to develop a taxonomy for defining what would be considered successful in ICT implementation in education colleges from the faculty point of view.

Based on the literature dealing with implementation of technology in education (Scherer, Tondeur, Siddiq, & Baran, 2018; Rogers 1995; Spector, Merrill, Elen, & Bishop, 2014), we listed a set of skills and proposed a framework for effective ICT implementation, enabling the mapping of faculty in terms of their stage of ICT implementation. The scaling includes questions examining attitudes and perceptions of faculty members on three levels: 1) with regards to themselves and their usage of ICT in education; 2) with regards to students on two levels – students' use of ICT, and their application of ICT in their practice within their training schools; 3) with regards to the college culture which should also include ICT tools and platforms offered to faculty, as well as reference to existing conditions and resources. The questions according to the theoretical variables are distributed as follows.

Two open-ended questions refer to the faculty level and include the following: a) What encourages ICT implementation in teacher pre-service teacher educational development in colleges of education? b) What hinders ICT implementation in teacher pre-service development in colleges of education? Another open-ended question refers to the systemic level: What would be considered a success in effective ICT implementation in a college of education?

The questionnaire was submitted anonymously. The data processing was conducted using SPSS software. Reliability and validity were examined using content and structure validity testing.

PROCEDURE

The questionnaire was distributed using a printed version (N=265) and a digital version (N=350). With regards to the open-ended questions, the number of teacher responding to these was lower. To the question regarding factors encouraging ICT implementation in teaching in the college we received 383 responses (62% of the sample); to the question regarding hindering factors we received 453 responses (74% of the sample), and to the question about what would be considered a success in effective ICT implementation in teaching 360 responses (58% of the sample) were received.

In some of the colleges, most participants filled in the printed version, while in others most participants filled in the digital version. In order to examine the connection between the paper and digital format of data collection via the questionnaire, we conducted a multi-variable Manova test. No statistical differences were noted between the two types of questionnaire formats (printed vs digital), in terms of ICT skills, attitudes, etc.

Analysis of the qualitative data collected from the open-ended responses referred to phrases, which are the N detailed in the relevant tables. Hence, some responses were composed of more than one phrase – each was assigned to the suitable category. The procedure altogether included sequential stages: (a) classification of responses according to the three research questions: facilitating factors of ICT implementation in the college of education, hindering factors, and success cases; (b) classification of statements according to themes or characteristics; (c) assignments of statements to categories; (d) segment-count within each category according to types (vs. tokens). Two researchers examined the statements and assigned them (or their segments) to categories. Segments under dispute were discussed until reaching agreement; (e) quantitative analysis of frequencies was conducted according to categories, with relation to the three research questions, e.g., facilitating factors, hindering factors, and measures of successful ICT implementation in colleges of education (Avidov-Ungar and Forkosh-Baruch, 2016).

FINDINGS

The quantitative data will be presented in three levels, according to the structure of the questionnaire: 1) the faculty level – ICT usage for personal and professional needs; 2) the student level – student usage of ICT in the courses taught by the lecturer, and ICT usage in pre-service teacher educa-

tional development; 3) the college-systemic level – faculty attitudes regarding ICT usage. The qualitative data will be presented according to the three open-ended questions: factors facilitating ICT implementation in a college of education; factors hindering ICT implementation in a college of education; and reference to what would be considered success in ICT implementation in a college of education.

QUANTITATIVE DATA

The study was conducted on 615 teachers from 8 colleges of education across the country and from 5 districts of the Ministry of Education. Findings reported below relate to the validity and reliability of the questionnaire.

The first research question addressed the use of ICT tools in personal or professional needs. The extent of use for each tool was measured using a 5-point Likert scale (5 - strongly agree, 1 - do not agree). Factor analysis was used in order to convene the items into variables. Table 1 presents the factor analysis findings.

Table 1. Factor analysis on the use of ICT tools for personal or professional needs

ITEM: I USE THE FOLLOWING TOOLS AND RESOURCES FOR PERSONAL / PROFESSIONAL	FACTOR 1 – ADVANCED TOOLS	FACTOR 2 – BASIC TOOLS
Blog	0.763	-0.056
Social networks (like LinkedIn, Facebook, interlocking)	0.717	0.126
Wiki	0.686	-0.114
Tools or collaborative workspace for documents (like GoogleDocs)	0.628	0.402
Application: smartphone / iPad / other tablets	0.6	0.226
Synchronous environments (such as Skype, Elluminate)	0.588	0.326
Media sites (like YouTube)	0.481	0.404
Simulations, games or educational software	0.425	0.403
Presentations (like PowerPoint)	0.059	0.789
Spreadsheet (like Excel)	0.301	0.634
Word processor	-0.06	0.537
Explained variance percentage	18.1%	28.9%
Reliability	$\alpha=.80$	$\alpha=.51$

The factor analysis presented in Table 1 shows two key factors were found: basic tools such as a word processor or spreadsheet that serve instructors for basic ICT use; and advanced tools that can be attributed to the more advanced tools of the digital era, and that reflect the activity of sharing or complex ICT activities.

The two key factors, referring to basic and advanced ICT tools, refer to an initial stage of ICT implementation in which the main emphasis is on holding onto familiar ICT tools, those encountered by participants on a daily basis. While these tools are basic, they can still entail pedagogical change; however, it seems that teacher educators do not use technological tools that are more complex and demanding in their utilization. Hence, any model of ICT integration requires addressing basic condi-

tions of ICT skills and competencies as a prerequisite for quality implementation in teacher education programs.

Factor analysis was also conducted for computerized tasks given to students as part of teacher educational development. In order to identify variables that arise from the items of this question, an exploratory factor analysis using Varimax rotation was conducted. The results of the factor analysis are presented in Table 3 and show a division into five factors, explaining 52% of the variance. Alpha Cronbach reliability for all items was $\alpha=0.82$. The results of factor analyses are presented in Table 2.

Table 2. Factor analysis on the use of ICT tools among students during the instructor courses

ITEM: IS AT LEAST ONE OF THE COURSES YOU HAVE TAUGHT YOUR STUDENTS: (ANSWER YES / NO)	FAC-TOR 1	FAC-TOR 2	FAC-TOR 3	FAC-TOR 4	FAC-TOR 5
Participated in an online discussion	0.768	0.076	-0.036	0.130	0.250
Synchronous remote meetings attended (with experts, professors or students)	0.611	0.214	0.268	0.064	-0.115
Cooperative tasks performed in an online environment	0.567	0.040	0.047	0.353	0.351
Conducted online portfolio using personal website or course site (digital portfolio)	0.442	0.060	0.268	0.282	-0.019
Built or managed a personal site (such as a blog)	0.434	0.371	0.426	-0.124	0.076
Performed tasks using mobile phones	-0.039	0.707	-0.136	0.200	0.038
Use social networks (such as interlocking, Facebook)	0.291	0.607	0.083	0.047	0.031
Were exposed to virtual worlds (like SecondLife, Ekoloko)	0.173	0.600	0.324	-0.049	-0.180
Used simulations, applications, or online games	0.002	0.558	0.117	0.402	0.236
Compiled or edited values on Wiki	0.394	0.420	0.038	-0.09	0.359
Learned (Project Based Learning	0.177	0.037	0.713	0.086	0.028
Solving authentic problems using ICT (Problem Based Learning)	0.159	0.211	0.628	0.155	0.164
Learned through exploration activities	-0.045	-0.141	0.609	0.274	0.186
Introduce products using digital means (e.g., presentations, videos prepared by the student)	0.215	0.057	0.117	0.719	0.096
Used video and / or audio	0.099	0.122	0.178	0.718	-0.081
Analysed events / incidents using ICT tools	0.025	0.171	0.362	0.37	0.291
Using other computerized tasks. Please specify which kind:	-0.019	0.176	0.218	-0.012	0.726
Used learning management systems (such as Moodle, HighLearn)	0.237	-0.13	0.066	0.092	0.626
Explained variance percentage	11.7%	11.5%	11.0%	9.7%	8.4%
Reliability	$\alpha=.66$	$\alpha=.58$	$\alpha=.58$	$\alpha=.51$	$\alpha=.37$

This question consisted of 18 items, which were divided into 5 factors using factor analysis. Each factor characterizes different kinds of ICT activities. Factor 1 refers to synchronous/asynchronous interactive activity and online information management and can be described as personal/ group information management. Factor 2 refers to advanced technological methods (mobile technology, social networking, and virtual worlds). Factor 3 refers to project-based learning projects and problem-based learning. Factor 4 refers to the display of information. Factor 5 refers to aspects of organizing and managing the learning process via online management tools and systems for better pedagogical outcomes; however, it is the weakest factor. Table 3 presents the percentage of variance explained and reliability for each factor obtained.

This question referred to ICT utilization as part of pre-service teachers' academic tasks. However, we did not have clear expectations regarding the results. On the one hand, these tasks were given to the students by their professors, whom we saw previously prefer basic tools. On the other hand, there was some possibility that the students would be creative in utilizing more advanced ICT tools since the tasks were academic and did not focus on the required technology to be utilized. Indeed, results here were more varied than those of Q1, emphasizing the potential pedagogical functions of ICT tools, e.g., project-based learning. This refers to the TPACK model, that includes intersections between the pedagogical and content, and the technological aspects of ICT utilization.

Another aspect was related to the students' use of ICT in their teaching methods, as reported by the instructors. Responses were dichotomous (yes/no). The data are presented below in Table 3.

Table 3. Factor analysis for students' use of ICT tools, as reported by instructors

ITEM: PLEASE MENTION IF AT LEAST IN ONE OF YOUR COURSES YOUR STUDENTS:	FACTOR 1	FACTOR 2
Planned ICT lessons for their class in school	0.874	0.208
Taught classes in school using ICT	0.857	0.284
Taught their class using exploration activities	0.764	0.068
Taught their class using remote online course	0.12	0.87
Taught their class using learning management tools (i.e., Moodle) or school site	0.231	0.814
Explained variance percentage	43%	30%
Reliability	$\alpha=.81$	$\alpha=.64$

The factor analysis found two factors with respect to this question. The first factor relates to the components of integrating ICT as part of classroom activity. The second factor relates to the use of teaching and learning platforms for distance learning. This analysis strengthens the need for involving pedagogical reasoning in the utilization of ICT, but also refers to the RIPPLES model, emphasizing the need for infrastructure and online platforms that allow appropriate conditions for comprehensive and systemic ICT implementation.

The next question addressed attitudes towards ICT use. Subjects were asked to rate their attitudes towards each item on a Likert scale ranging from 1=definitely not agree to 5=strongly agree. Inverse items were re-coded for the purpose of the analysis. Overall reliability for the whole question submitted was $\alpha=0.785$. Table 4 shows the analysis of the factors regarding faculty attitudes toward the use of ICT.

Table 4. Factor analysis for faculty attitudes towards the use of ICT

ATTITUDES TOWARD ICT USE	FACTOR 1	FACTOR 2
D. using ICT does not fit with my perception regarding the teacher role	0.847	-0.144
F. ICT does not fit to my field of teaching	0.810	-0.229
B. the use of ICT can alienate the teacher from his students	0.759	0.044
A. ICT use can improve my teaching	-0.647	0.520
E. ICT in education changes significantly my position as a teacher	0.072	0.891
C. using ICT can increase cooperation between scholars	-0.491	0.686
Explained variance percentage	43%	27%
Reliability	$\alpha=.77$	$\alpha=.70$

To identify the factors that characterize the attitudes towards the use of ICT among lecturers, factor analysis was carried out freely (without limiting the number of factors) using rotation type Varimax. Results of factor analysis presented in Table 4 above show a classification into two factors, explaining 70% of explained variance. The two factors match the division between positive and negative propositions, reflecting difficulties compared with challenges. These may relate to the open-ended questions in the section below, which in turn is linked to the systemic factors of the RIPPLES model, i.e., infrastructure, people and learning power of technology factors.

OPEN-ENDED QUESTIONS

The qualitative and quantitative (mostly descriptive) results are presented herewith according to the three open-ended questions. These refer mostly to systemic aspects of ICT implementation in accordance with the RIPPLES model, portraying the need for a comprehensive framework to capture the multiple aspects of ICT implementation in teacher education. In this sense, the CBAM model may serve our study in its ongoing and iterative nature.

Factors facilitating ICT implementation among teacher educators

Factors facilitating ICT implementation among teacher educators included 575 phrases. We herewith detail the distribution of phrases and percentages within this question. Examination of teacher educators' responses shows that technological-pedagogical support (31% of the phrases) is the major factor in facilitating ICT implementation in the college. For example, respondents mentioned: *"more available technical pedagogic support, workshops and assistance in learning new tools"*, *"personal advice for technical issues and pedagogic implementation"*. Professional development, including instruction and professional support as well as workshops (24% of the phrases) is also considered a facilitating factor of ICT in the college. Thus, *"assistance and experts' intensive guidance, workshops, tutoring and support in the institute in which I teach"* were the common facilitating factors mentioned. Also perceptions and beliefs of teacher educators about ICT and its implementation in teaching (19% of the phrases), and adequate rewarding for ICT implementation in their teaching (17% of the phrases) were major factors which may encourage and facilitate ICT implementation in teacher educators' teaching in colleges of education, from their point of view, e.g., *"to believe that ICT can contribute to my instruction and promote it"*, *"my personal beliefs about ICT implementation is the main thing, my perception encourages me, material incentives do not move walls"*. Accessibility and availability of technological equipment in the college (15% of the phrases) as well as allocation of time for dealing with ICT in teaching (10% of the phrases) were also mentioned as additional facilitating factors, but were perceived as of a lesser impact for ICT implementation in teaching, e.g., *"technological infrastructure allows students and faculty accessibility to advanced equipment"*. Other

factors, time for adapting to change (0.5% of the phrases), encouragement of the head of the academic division (0.8% of the phrases), situation of infrastructure within the college and in the training-schools (1% of the phrases) are considered by faculty as marginal for ICT implementation in faculty teaching in the college. The distribution of factors facilitating ICT implementation among faculty in colleges of education is presented in the following Table 5.

Table 5. Factors facilitating ICT implementation in teaching in colleges of education – teacher educators’ point of view

NO.	CATEGORIES: FACILITATING FACTORS	NO. OF PHRASES	% OF PHRASES
1	Technological-pedagogical support to teacher educators	123	31%
2	ICT professional development workshops, instruction and ongoing professional guidance	93	24%
3	ICT attitudes and beliefs	72	19%
4	Offering incentives	65	17%
5	Accessibility and availability of equipment for teacher educators and students	59	15%
6	Allocation of time	38	10%
7	College physical conditions and infrastructure	25	6.5%
8	Supportive and mandatory policy	21	5.5%
9	Students implementing ICT	20	5%
10	Collaboration between teacher educators	15	4%
11	Promoting efficiency at work	12	3%
12	Challenge, innovation, motivation	9	2%
13	Experience and practice in ICT implementation in teaching	9	2%
14	Don't know what encourages	5	1%
15	Support and encouragement of the head of department	4	1%
16	Physical conditions and infrastructure in schools and kindergartens	3	0.8%
17	Time to adapt to change	2	0.5%
Total		575	100%

Factors hindering ICT implementation among teacher educators

Factors hindering ICT implementation among teacher educators included 452 phrases. We herewith detail the distribution of phrases and percentages within this question. Following analysis of the data, three main factors were found as hindering ICT implementation among faculty in colleges of education, as perceived by teacher educators. The first is resources, especially time, technological infrastructure and incentives (50% of the phrases), e.g., *“the availability and time required for preparation for ICT implementation”*. A second factor refers to knowledge, skills and ICT competencies of teacher educators (21% of the phrases), for example: *“I lack the pedagogical technological knowledge for ICT imple-*

mentation, the applications change so fast, that when I acquire mastery in technology – it changes”. A third factor refers to beliefs and perceptions of teacher educators towards ICT (12% of the phrases), e.g., “*conservatism, lack of belief and technophobia, lack of will to do so [implement ICT] because I believe in a different learning style, which includes limited use of ICT*”. The competencies or readiness of students to implement ICT in their teaching was considered the lowest hindering factor (3% of the phrases). The distribution of factors hindering ICT implementation among faculty in colleges of education is presented in Table 6.

Table 6. Factors hindering ICT implementation in teaching in colleges of education – teacher educators’ point of view

NO.	CATEGORIES: HINDERING FACTORS	NO. OF PHRASES	% OF PHRASES
1	Resources, especially time resources	135	30%
2	Knowledge, skills, instruction	97	21%
3	Infrastructure and technological aspects	68	15%
4	Perceptions and beliefs of teacher educators regarding ICT and its implementation	55	12%
5	No hindering factors	31	7%
6	Institute policy regarding ICT implementation	29	6%
7	Adequate rewarding	24	5%
8	Competencies and readiness of students	13	3%
Total		452	100%

Perceived success in ICT implementation from teacher educators’ points of view

Perception of success in ICT implementation from teacher educators’ points of view included 377 phrases. We herewith detail the distribution of phrases and percentages within this question. Findings show that the mere usage of ICT tools within the courses is considered a measure of success in ICT implementation (38% of the phrases), e.g., “*regular usage of technological tools and their implementation within courses in teaching methods*”, “*meaningful online courses that practice collaborative technological learning within the teaching*”. Another measure of success was that students use ICT in their practice in teaching (15% of the phrases), for example: “*success is the moment the graduates will start using ICT wisely and without fear in their teaching in classes and kindergartens*”. Yet another measure of success in ICT implementation is the availability of resources, adequate infrastructure and appropriate funding for facilitating and leading change (10% of the phrases), for example: “*making technology accessible for faculty and students, massive and accessible support.*” Table 7 details the perception of success in ICT implementation from teacher educators’ points of view.

Table 7. Goals/measures perceived as success in ICT implementation – teacher educators’ points of view

CATEGORIES	NO. OF PHRASES	% OF PHRASES
ICT implementation in courses in the college	146	38%
Students implementing ICT in their teaching practice	55	15%
Resources, funding, infrastructure	35	10%

CATEGORIES	NO. OF PHRASES	% OF PHRASES
Perceiving ICT usage as a lever for change	32	9%
Input vs. output – ROI	34	9%
Supportive college policy	21	6%
Negative attitude	24	6%
Teacher educators' motivation	15	4%
ICT implementation of students as future teachers in their schools	15	4%
Total	377	100%

Examination of responses of teacher educators on the question of what would be considered success in ICT implementation in colleges of education and their analysis displays three major measures: 1. Success measures related to students, e.g., *“students will use ICT tools as an accessible means for in-class teaching according to pedagogical goals”*; 2. Success measures related to teacher educators, e.g., *“the teachers educators' ability to use various ICT tools in their academic teaching”*; 3. Success measures related to the institute's policy, e.g., *“to the attention of policymakers, colleges of education must invest in funding courses which implement personnel ICT expertise with a subject matter expert, to create meaningful practice. It is expensive but more effective than just talking about how to implement ICT in teaching.”* Table 8 displays the distribution of quotes into the three levels.

Table 8. Quantification of success measures according to three levels of ICT implementation: student level, teacher educator level and institutional level (N=377)

	STUDENT LEVEL	TEACHER EDUCATOR LEVEL	INSTITUTION LEVEL
No. and % of phrases	19% (N=72)	66% (N=249)	15% (N=56)
Measures of success for each level	ICT implementation in practice ICT implementation in schools as teachers	Teachers implementing ICT in teacher training courses Positive ROI ICT implementation as a lever for change Teacher educators' motivation	Institute leadership and policy promoting ICT Resources, funding and ICT infrastructure

Interestingly, the level noted by respondents as most meaningful to them and as such that will result in successful ICT implementation in the college is teacher educators themselves. There is an understanding among them that ICT implementation as a means of facilitating change to the educational development process altogether should begin in their practice and modelling.

DISCUSSION

The current study presents a new tool based on a framework developed from existing models. These models assess factors that facilitate or hinder ICT implementation in educational institutions (cf. Hine, 2011; Kozma, 2011; Labhrainn et al., 2015), pinpoint types of tools utilized by teacher educa-

tors, and include the human factor (i.e., attitudes) in the equation aimed to assess best conditions for teacher educators to implement ICT wisely and in ways that portray best practices in education. The model can be portrayed graphically in Figure 1.

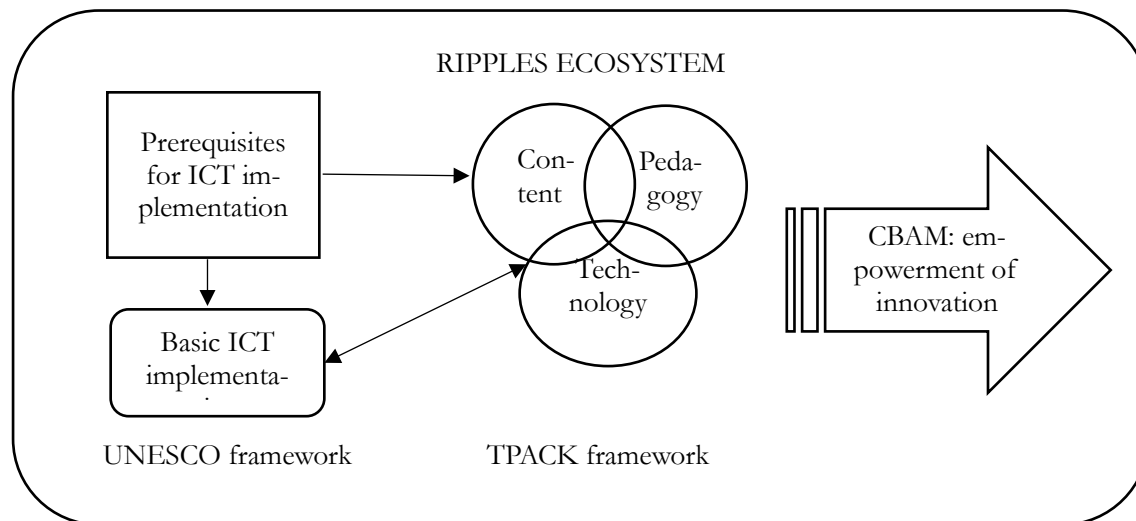


Figure 1. Conceptual framework for examining teacher educators' ICT implementation

The framework portrayed in the figure above includes the models mentioned in the literature review. The added value of our study is the integration of these models into one framework that had defined the structure of our questionnaire, constructed for assessing the diverse aspects of ICT implementation in teacher education. We further positioned teacher educators in the front of this vital issue, which reflects a shift in teacher education in the information era, since they are the arrowheads of training future teachers (Forkosh-Baruch, 2018).

The different components define the goal of the teacher education system in the current era as developing a generation of teacher educators who are knowledgeable ICT utilizers rather than merely consumers of tools. In this respect, ICT has a central role in achieving this goal within colleges of education that train future teachers. Within this framework, we further distinguished between levels of ICT integration. Technological literacy enables basic use of information and concentrates on knowledge consumption using ICT skills, while knowledge deepening copes with complex learning situations and knowledge creation refers to restructuring of information through the use of technology for producing multi-modal and collaborative knowledge. Indeed, our research findings align with this differentiation of integrating ICT in education, and exhibit a similar pattern of ICT implementation in colleges of education: the data from the questionnaire, based on theoretical models, enable to classify levels of ICT implementation – according to participant as well as programs or even institutions – into two major key factors: basic tools for elementary ICT use and advanced tools that reflect 21st century skills based on more multifaceted ICT activities that reflect a more advanced educational setting (Pellegrino & Hilton, 2013). The factor analysis conducted for students' computerized tasks refers to high-level ICT utilization, including interactive activity and online information management, advanced technologies (e.g., mobile technology, social networking, and virtual worlds) project-based learning and knowledge management – all representing 21st century skills, especially necessary for pre-service teacher training (Häkkinen et al., 2017).

The identified two factors that characterize attitudes towards the use of ICT among lecturers refer to positive and negative propositions, reflecting difficulties and challenges in this process (Voogt, Knezek, Cox, Knezek, & ten Brummelhuis, 2013). Factors and key themes that may facilitate ICT implementation as a lever for change were identified in each college on the institutional as well as the micro-level, in accordance with the relevant academic body of knowledge referring to teacher educa-

tion (for example, see Tondeur et al. 2012). Reports enabled us to evaluate the levels of ICT integration in teaching and teacher educational development using these levels of implementation derived from the data. Data referring to each college separately was analyzed internally by the college representatives in the study group. For ethical reasons, we presented an overview of the state of ICT implementation in all participating colleges. Results raise fundamental queries regarding the quality of teacher preparation in Israel in the information era.

The main goal of ICT, as defined by research worldwide as well as policy papers (e.g., Pellegrino & Hilton, 2013), is to promote deeper levels of constructing new ideas, as well as to pinpoint the challenges posed by this process. Hence, one of our main conclusions was that it is important to evaluate ICT implementation on multiple levels and help develop practical models to assist the process of higher levels of ICT implementation. Findings of this study validate the questionnaire as a tool for policymakers for examining the implementation of ICT in the teacher education system, according to which teacher development is an ongoing endeavor, beginning with pre-service educational development (Albion, Tondeur, Forkosh-Baruch, & Peeraer, 2015; Avidov-Ungar, 2016; de Vries, van de Grift & Jansen, 2014; Feiman-Nemser, 2001). Faculty members meet future teachers throughout their educational development, creating endless chances for ICT implementation as a facilitator of pedagogic change. By identifying their level of ICT implementation, as well as the factors promoting and hindering adoption of ICT, opportunities may be created for addressing barriers and overcoming difficulties.

However, findings raise profound issues regarding the efficiency of ICT implementation in colleges of education, aiming to facilitate pedagogical change (Wang, Hsu, Reeves, & Coster, 2014). Results show that ICT in pre-service education is not necessarily a lever for change as expected (see King, 2002), but rather justification for preserving traditional modes of teaching, utilizing word processing or presentation functions. Another example refers to ICT knowledge, skills and competencies of teacher educators, which is currently lacking; notwithstanding, they are expected to train the future generation of teachers to teach in a technology-saturated environment (Krumsvik, 2014). The literature provides evidence that this process is in motion, but still in its initial stages, portraying rather low proficiency in ICT utilization for teaching (Andan & Tondeur, 2018); McClanahan, 2017). Furthermore, much of the available research focusing on teacher educators portrays self-studies focusing on teacher educators' own practices, as opposed to comprehensive studies examining systemic aspects of teacher education (Olsen & Buchanan, 2017).

In the implementation process in colleges of education, the beliefs regarding preparation of pre-service teachers are of great impact. The added value of the study is in highlighting the role of the teacher educator as a major factor in translating these beliefs and modelling best practices, thereby influencing students' teaching practices (Fluck & Dowden, 2013), thereby equipping students with knowledge and tools for managing educational change supported by technology in their teaching as future teachers. The tool developed and used in this study may be used for decision-making at various levels (i.e., system-level, institute-level and lecturer-level) for assessing ICT implementation in colleges of education and in academic institutes that train future teachers for their role in the 21st century. It may be used as an indicator for comparing ICT implementation processes and models between institutes, and also for examining the implementation process from a longitudinal point of view, from pre-service education throughout the TPD as an in-service teacher. In addition, the tool in itself can be used for managing change facilitated by ICT in a process of self-examination, in an attempt to improve the change management process.

On a more practical level, the findings of this study validate the questionnaire as a tool for policymakers in Israel for examining the implementation of ICT in the teacher education system; notwithstanding, conclusions need to be viewed on a local level, but with a potential to reflect global and more general aspects (Ben-Peretz, 2009). This is especially emphasized by the contemporary concept developed in the Israeli education system, according to which teacher development is an ongoing endeavor, beginning with the first years of professional training in colleges of education (Feiman-

Nemser, 2001). The questionnaire developed for this study reflects this paradigm of continuum in training faculty as well as education students, by assisting them in overcoming barriers through the stages of adopting technology as an integral component of their teaching. Faculty members in colleges of education meet future teachers throughout their training, creating endless chances for ICT implementation as a facilitator of pedagogic change (Tondeur, Forkosh-Baruch, Prestridge, Albion, & Edirisinghe, 2016). By identifying their level of ICT implementation, as well as the factors promoting and hindering adoption of ICT, we are creating opportunities for colleges of education to address barriers and overcome difficulties.

The strengths of the current studies should not be overshadowed by its limitations, e.g., a national sample which is rather large but limited to 8 colleges of education. We therefore propose to further use the tool examined in this study in additional colleges worldwide, especially institutes which undergo systemic processes of ICT implementation. Also, we are currently adapting this tool for in-service teacher professional development in municipal centers as well as in academic professional development units. This is of utmost importance for understanding the ICT integration components and processes on a PD continuum, from pre-service to in-service (Niemi, 2015).

CONCLUSIONS

This comprehensive study in Israeli colleges of education is unprecedented in nature, for multiple reasons. First and foremost, participants included in the study are teacher educators from colleges who were chosen to participate in a process that was parallel to that of the K12 education system, only the target population was teacher educators. This required an evidence-based procedure, which allowed policymakers to identify points of strength and weaknesses in the program. This, in turn, allowed the colleges themselves to receive their own data, on which they based further steps of ICT implementation among their faculties. Second, by developing the questionnaire, we presented colleges of education with a tool which they may utilize in following years in local comparative studies. And third, we created a process that was parallel to that of the national computerization program, thus promoting the teacher education milieu as a major player in transforming education in Israel. Hence, the contribution of our study to the field of ICT implementation in teacher education and in education, in general, is fundamental. It identifies the difficulties and challenges of this process in terms of faculty attitudes, in terms of change in teachers' roles in the information era and the perceived loss of direct teacher-student connection as a result of ICT utilization as reasons for not using ICT; this sends a contradicting message to pre-service teachers, since national policy encourages ICT implementation in teaching. This, together with the data regarding basic ICT usage rather than advanced utilization of ICT tools to encourage novel educational paradigms, should concern policymakers and encourage them to actively promote ICT in teacher education. The twofold problem discussed in our article, namely ICT implementation in education as a lever for educational change, and the continuum between teacher pre-service training and teacher practices in the education system, is not typical only of the Israeli education system. Many education systems worldwide contemplate on these issues (Forkosh-Baruch, 2018). Hence, we believe that our study may serve additional teacher education systems as well.

RECOMMENDATIONS

Consequently, our recommendations arising from the reported study range from examining attitudes in future surveys through improvement of infrastructure, to training and monitoring educational change in ICT implementation among teacher educators.

Teacher educators' attitudes and beliefs regarding ICT implementation should be examined and monitored annually on the one hand, and shaped on the other hand. This is vital for the process of modelling quality education to pre-service students by incorporating ICT as an integral part of teaching. Pre-service teachers need this modelling in order to adapt their teaching to the digital era. Hence,

monitoring and promoting positive beliefs about the role of ICT for educational purposes, as a means of transforming educational practices, is vital.

The modelling process is a means for teacher educators to set an example for their trainees. As a result, professional development programs for teacher educators should include components which encourage peer training and even co-learning with pre-service teachers, who may contribute greatly to the training process from their experience in their practice schools. Pre-service students may be more proficient in their ICT skills than their educators; hence reciprocal and mutual learning from one another may be beneficial to both parties: pre-service teachers are more skilled in ICT utilization whereas teacher educators bring their pedagogical and disciplinary expertise. This also portrays the changing role of teacher educators in the information era.

Technological skills can also be mastered separately as prerequisites for attaining a position as a teacher educator. Collaboration between colleges of education by creating online courses combined with local technical support may assist teacher educators to reach a required threshold for their ICT proficiency. However, the focus of this process at large should not be on mastering ICT skills as a goal, but rather as a means to empower pedagogy and content knowledge and to upgrade programs for training teachers. Teacher educators need to be confident in the added value of ICT. For this reason, professional development of teacher educators should also focus on the benefits of utilizing ICT to empower teaching and to promote pedagogical change. In the “Israeli National Program for Adapting the Colleges to 21st Century Education”, each college was required to state its vision of 21st-century education. This vision should be translated into action items, revisited per semester, and assessed in terms of outputs and products.

Finally, factors encouraging and hindering the utilization of ICT in teacher education should be carefully monitored on a regular basis, in quantitative as well as qualitative measure, by surveys and also by focus group interviews. These factors are necessary to take into consideration as part of an ecosystem that promotes a shift in teacher education, adapting curricular design to 21st-century teacher training in the information era.

The above recommendations imply that future research is vital to examine a longitudinal perspective of ICT implementation in academic colleges of education. The proposed research framework can be utilized in future comparative studies; however, implications for future research include adaptation of the research tools according to emphases of teacher education programs in Israel and worldwide. For example, in developing countries, emphasis may focus on ICT skills of teacher educators, while in developed countries research focus would be on innovative ICT-based educational paradigms. We suggest adapting our research tool according to national and local needs while conducting a comprehensive examination of ICT implementation in teacher education.

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