



## ICT COORDINATORS' TPACK-BASED LEADERSHIP KNOWLEDGE IN THEIR ROLES AS AGENTS OF CHANGE

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### ABSTRACT

Aim/Purpose	The aim of the study is to examine what ICT coordinators perceive as the main elements of knowledge needed to implement ICT successfully into school culture.
Background	For the past few years, Israel's Ministry of Education has been running a national program of adapting the education system to the 21st century skills. Key teachers have been appointed as ICT coordinators. Their role was to implement technology in schools.
Methodology	The participants in this study were 130 ICT coordinators in Israeli Hebrew and Arabic schools. Those ICT coordinators had to attend a special in-service 60-hour course throughout an entire school year. The research tool was the reflection of the ICT coordinators who were asked to complete at the end of the in-service course. Narrative analysis was chosen as the main approach to data analysis.
Contribution	We claim that ICT coordinators maintain a complex perception of their role, based on broad personal and professional knowledge that enables them to lead the needed changes.
Findings	Based on the findings the coordinators revealed primary successful elements of their work: (a) technological aspects, (b) pedagogical aspects, (c) the organizational aspects, and (d) the ICT coordinator as a leader of systemic change. The first two elements already appear in the TPACK construct, while the others constitute organizational knowledge (OK) and leadership knowledge (LK) that enables the coordinators to facilitate ICT implementation in schools, and these are the unique elements of this study.
Recommendations for Practitioners	We recommend that when choosing ICT coordinators or ICT implementation leaders at school, one should check not only that they possess the familiar

Accepted by Editor Janice Whatley | Received: November 6, 2016 | Revised: January 7, 23; February 12; March 3, 24, 2017 | Accepted: April 3, 2017.

Cite as: Avidov-Ungar, O., & Shamir-Inbal, T. (2017). ICT coordinators' TPACK-based leadership knowledge in their roles as agents of change. *Journal of Information Technology Education: Research*, 16, 169-188. Retrieved from <http://www.informingscience.org/Publications/3699>

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	TPACK knowledge, but also organizational knowledge and leadership knowledge that was found essential to successful completion of the coordinators' role.
Impact on Society	This study has shed light on the nature and significance of leadership knowledge (LK) and its function as an additional expression of TPACK.
Future Research	We suggest that future research about educational technology leaders' TPACK be drawn from these results.
Keywords	ICT coordinators, TPACK, leadership knowledge, ICT implementation

## INTRODUCTION

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The education system is currently required to adapt itself to the spirit of the times and implement ICT (Information and Communications Technology) as a promoter of pedagogical innovation in teaching and learning (Avidov-Ungar & Eshet-Alkalai, 2011b; Cunningham, 2009). For the past few years, Israel's Ministry of Education has been running a national program of adapting the education system to the 21st century. To this end, certain key teachers have been appointed as ICT coordinators to help implementation in schools (Ministry of Education, 2014). This study seeks to trace the features of the developing professional knowledge among ICT coordinators in charge of implementing the change at school, which, in terms of pedagogy, involves integration of ICT in daily teaching activities, use of digital curriculum materials, use of an LMS (Learning Management System), maintaining a frequently updated school portal, and class websites connecting school activities with the home. On the administrative side, it also involves promoting digital communication among the staff and with the community, ensuring collaborative activities based on digital tools, and acquiring new digital skills (Blau & Shamir-Inbal, 2016).

Alongside the massive penetration of technologies into education systems (Wan, Fang, & Neufeld, 2007), and in the light of research findings, there seems to be dissatisfaction with the results of the implementation of these technologies (McGarr & McDonagh, 2013; Peeraer & Petegem, 2012; White, 2007). As we recognized in previous research, we saw that studies attempt to define the key factors impacting the effectiveness of the implementation of innovative technologies in schools (e.g., Teo & Noyes, 2011) and present the elements that enable successful ICT integration into the school culture (Blau & Shamir-Inbal, 2016). Unlike the formerly prevalent perception that change should be facilitated by outside entities (Avidov-Ungar & Eshet-Alkalai, 2011a; Fullan, 2000), previous research literature specifies that in order to lead significant change, key figures within the school must be involved in promoting this process (Halverson & Smith, 2009). Hence, previous research indicates that it is necessary to invest in people from within the school and support them in various ways in order to increase the chances of successful ICT implementation (Avidov-Ungar & Shamir-Inbal, 2013; Mioduser, Nachmias, Tubin, & Forkosh-Baruch, 2002). These leading teachers thus become the spearhead of change processes in general and of changes connected to ICT implementation in particular (Ertmer, Ottenbreit-Leftwich, & Tonduer, 2015; Hattie, 2009). In addition, it is acceptable to argue that the entities affecting ICT integration at school are supportive principals, teachers who are eager about ICT, and appointed functionaries who are chosen to be the school change agents (Avidov-Ungar, Fridman, & Olshtain, 2014). The ICT coordinators became the change agents and the "engine" driving the school to realize the inherent potential of the new technologies (Avidov-Ungar, 2010), and so the national ICT program creates a "window of opportunity" for the development and growth of these teachers. In other words, the ICT coordinators constitute a "bridge" between the demands of the system, the needs of the school and its accepted norms (Avidov-Ungar & Shamir-Inbal, 2013).

Earlier research studies stress the importance of the ICT coordinator as a significant factor in school ICT implementation, but, on the other hand, research points to a lack of the specific knowledge and skills required by this target population and the unique knowledge that enables them to put the desired changes into practice.

Accordingly, the aim of this study was to examine what ICT coordinators perceive as the main elements needed for successful implementation of ICT into school culture. Furthermore, we examined whether the components included in the TPACK index (Technological Pedagogical Content Knowledge) used by ICT coordinators are the main and the only elements they needed to fulfill their role successfully, or perhaps there are additional elements of knowledge that ICT coordinators need in order to do this.

### ***ICT IMPLEMENTATION IN THE SCHOOL***

Innovative technologies present the education systems with pedagogical, cognitive, and organizational challenges that require a paradigm shift in the organizational culture as well as in teaching-learning processes (Halverson & Smith, 2010; Wallace, 2004). Some studies have attempted to define parameters for teachers' ability to effectively implement new educational technologies in their work (e.g., Avidov-Ungar & Eshet-Alkalai, 2011a, 2011b; Halverson & Smith, 2009; Macfadyen & Dawson, 2010). These studies show that the implementation of changes in teaching methods using new technologies is highly complex and involves considerable difficulties, and that teachers' abilities, attitudes and beliefs are a significant factor in the success of the change (Cunningham, 2009; De Freitas & Oliver, 2005; Selwyn, 2010).

The role of ICT coordinators is defined according to criteria drawn up by the Ministry of Education. Their role involves advising school principals on the issue of instilling ICT culture into teaching and learning, training teaching staff to promote pedagogical innovation, building a curriculum that integrates computer literacy, setting up and running the school portal, and monitoring school assessment of the ICT integration (Ministry of Education, 2012). In other words, the ICT coordinator's role is administrative and constitutes a link between the school's, the district's, and the Ministry of Education's demands, but it is a significant pedagogical role as well (McGarr & McDonagh, 2013). In the context of implementing change, and as a result of the multiple areas of responsibility, the ICT coordinator has a complex role. This is because there is a gap between the maturity of personal use of ICT in daily life and the use of ICT as a pedagogical tool at school. Additionally, because there are many teachers who are opposed to the use of ICT, or lack the practical knowledge about how to use it wisely in class curriculum (Ertmer et al., 2015), it is the job of the ICT coordinator to convince the teachers to be brave enough to get on board with ICT implementation and to enable them to see the added value technology brings to teaching and learning (Shamir-Inbal, Dayan, & Kali, 2009).

### ***THE TPACK INDEX AS A MEASURE OF ICT IMPLEMENTATION***

Studies emphasize that effective implementation of innovative pedagogies requires teachers to master and integrate three types of knowledge: technological knowledge, pedagogical knowledge, and pedagogical content knowledge (Brush & Saye, 2009; Bull & Bell, 2009; Niess, 2008). The TPACK index (Mishra & Kohler, 2006) was found to be the measure that predicts teachers' ability to cope effectively with the challenges presented by new learning technologies (Doering, Scharber, Miller, & Vetsianos, 2009; Mishra & Koehler, 2006; Polly & Mims, 2009). On the other hand, contemporary studies indicate that alongside aspects of the mastery of technological, pedagogical, and content knowledge, teaching in technological environments presents the teachers with a broad range of organizational, affective, and cognitive challenges that are absent from the TPACK model (Avidov-Ungar & Eshet-Alkalai, 2014). Such challenges might include, for example, the willingness to actively participate in the implementation process and undergo the necessary paradigm shift to teaching in a technological environment (Sandy, 2010; Shamir-Inbal et al., 2009), the need to master the attention management skills involved in e-teaching, and the ability to communicate effectively in learning settings that are not face-to-face (Eshet, 2012). In this study, we will propose adding an organizational-leadership measure that expands the TPACK index in terms of professional knowledge that agents of change and leading teachers need in order to implement innovative technologies in education systems.

### ***TEACHERS IN THE ROLE OF ICT COORDINATORS***

The inclusion of ICT leaders in schools has been acknowledged as a key element in successful ICT implementation (Fishman, Marx, Blumenfeld, Krajcik, & Soloway, 2004). The person chosen for the position of ICT leader should have leadership qualities and be reliable and responsible. In addition, these individuals should be involved in decision-making processes, receive full support from their superiors, and be part of a professional learning community (Hadjithoma-Garstka, 2011). The incorporation of an ICT leader who serves not only as a technological guide, but also helps school staff to integrate ICT as part of their routine daily tasks and as a pedagogical tool, is of great importance. This function helps teachers to better integrate ICT in their classrooms and enables more teachers to be a part of this change, not only those considered as initiators (Newhouse, 2010; Shamir-Inbal & Kalli, 2009). This has created the need for the new position of school ICT coordinator (Rodríguez-Miranda, Pozuelos-Estrada, & León-Jariego, 2014).

The profile of the ICT coordinator should include up-to-date pedagogical-technological knowledge, awareness of ethical and safety issues pertaining to computer use, and personal and professional willingness to use computer applications frequently in their own teaching and learning, so they will be a personal example for their colleagues (Lai & Pratt, 2004). Moreover, the ICT coordinator must cope with the resistance typical of any organizational change, particularly one such as this, which obliges teachers to deal with innovative technology in an ICT-integrated environment (Underwood & Dillon, 2011). In addition to coping with issues inside the school, the coordinator must also deal with the demands of the national education system and function as its agent who must instill imposed 'top-down' changes. Consequently, the coordinators' personalities must radiate leadership and self-confidence, and they must have suitable personal and professional standing in the eyes of the principal and the teaching staff (Lai & Pratt, 2004; Vanderlinde, Dexter, & van Braak, 2012). A successful ICT coordinator must be independent and proactive, be able to offer current resources, and plan and apply strategies for computer integration into teaching and learning. In order to meet the demands needed for this role, the teacher-coordinator must be an expert who is able to adapt to changes in various teaching situations (Darling-Hammond & Bransford, 2005). Lai and Pratt (2004) examined the leadership of ICT coordinators in New Zealand high schools. They claim that about half of the ICT coordinators also hold senior management positions in their schools, have a high standing among the teachers, are enthusiastic about the use of information technologies at school, and are well-equipped in terms of background knowledge and skills to take the leadership role of promoting ICT integration. The role of ICT coordinator requires a special kind of professional development (Archibald, Coggshall, Croft, & Goe, 2011), and hence they must develop their online instructional abilities and acquire the prerequisite technical-pedagogical knowledge to effectively implement the innovative pedagogy in their school (Doering et al., 2009; Mishra & Koehler, 2006; Polly & Mims, 2009).

The aim of this study is to examine what ICT coordinators perceive as the main elements of knowledge needed to implement ICT successfully into school culture.

## **METHODOLOGY**

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### ***RESEARCH METHOD***

In order to investigate what characterizes the role perception of ICT coordinators in the framework of the national plan, we chose a qualitative approach according to the rationale of grounded theory (Guba & Lincoln, 1994). Having the subjects describe and interpret an experience, enables the researcher to understand the phenomena in question in the context of their occurrence. The knowledge the researcher seeks is found in the meanings that people give to their actions. In other words, the research tools offer an unmediated description in simple terms of events and incidents that the subject has experienced (Strauss & Corbin, 1998), in our case, the stories of the school ICT coordinators.

### ***PARTICIPANTS AND THE CONTEXT OF THE RESEARCH***

The participants in this study were 130 ICT coordinators, the first group out of 400 coordinators from the northern region in Israel. In this region, all elementary schools (for both Hebrew and Arabic speakers) are included in the national program for technology-integration in schools. These ICT coordinators hold this role for two years during which time they are committed to attend an ongoing professional development course designed to authorize and empower them as ICT coordinators throughout the entire period in which they hold this position in schools.

Sixty-five (65) of them came from schools in which the language of instruction is Arabic; of these 29 were men and the rest were women. The other 65 coordinators were from Hebrew-speaking schools, 9 men and the rest women. The overwhelming majority of the coordinators are not specifically computer teachers, but are defined at their schools as ICT leaders because of their well-developed digital literacy skills. They were chosen by the school principals for this role, according to detailed criteria defined by the Ministry of Education. These criteria included the following: a teacher with a BA degree and at least four years of teaching experience; a teacher who has taken professional development courses in ICT in the past five years; a teacher with expert knowledge of teaching-learning and assessment processes in an online environment who is familiar with the curricula and has the ability to train staff, has a systemic perspective of the school, and is familiar with the overall curriculum and how to integrate computers into it.

For this role, the ICT coordinators had to attend a special in-service course that would enhance their training about the essence of the job. This was a 60-hour course that lasted throughout an entire school year. It covered three main aspects of the coordinator's tasks: technology – getting to know a range of innovative web tools; pedagogy – understanding the added value of integrating ICT to enhance pedagogy and practice in preparing units of teaching based on technology; leading change – acquiring training, empowerment and leadership skills. At the end of the course, the ICT coordinators were asked to write a personal reflection describing their personal experience as leaders of the implementation during that year in their schools. For this study, we used reflections written by the apprentice coordinators during their professional development course.

### ***RESEARCH TOOL***

The tool through which the research questions were answered is the reflection the ICT coordinators were asked to complete at the end of the in-service course. The reflection was structured and contained a number of open questions in which the coordinators were asked to describe their role: the changes they were making in order to implement the use of ICT. Additionally they had to describe various types of pedagogical-technological knowledge they gained and the factors that were helping them to deal with their role. They were also asked about the challenges they faced and the personal and professional insights in the context of their position as agents of change in ICT implementation at school. The Appendix contains the reflection questions they were asked to respond to. The reflections were written as narrative texts relating to the guiding questions described above. The study is based on an analysis of these written reflections. Through writing the reflection, the ICT coordinators were able to take a retrospective look at their actions, perceptions, beliefs, and thoughts that influenced their ability to lead ICT implementation at their schools (Furman-Shaharabani & Tal, 2008). Data collection was non-intervening, as the researchers were not involved during the writing of the reflections. The advantage of a non-intervention research method is that the information gathered is authentic and not biased by any un-measurable influence of either the measurer or the research tool (Strauss & Corbin, 1998). It is also important to mention that in the analysis of the reflections, we took great care to maintain the privacy and anonymity of the respondents by keeping their names and other identifying information confidential.

### ***DATA ANALYSIS***

Narrative analysis was chosen as the main approach to data analysis (Chase, 2005), in accordance with the main aims of the research. The choice of narrative methodology derived from the strength of narrative in contributing to self-expression (Chase, 2005), and to recognition of practical experience and its manifestations in the work of the ICT coordinator on implementing technology at school (Connelly & Clandinin, 1988; Gudmundsdottir, 2001). The data analysis had three phases. The first involved reading each reflection in order to identify the roles the ICT coordinators fulfill while integrating the use of ICT at school, and mapping out the elements of knowledge required to do so (Lieblich, Tuval-Mashiach, & Zilber, 2008). This initial mapping made it possible to examine whether the elements of knowledge described by the coordinators are part of the TPACK index, or whether there are additional elements that they use in order to fulfill their role. Moreover, it should be emphasized that when mapping the elements according to the TPACK index we had no reference to the content components. This means that being coordinators is not related to a specific discipline and that ICT coordinators deal with varied content fields while they teach.

Accordingly, we analyzed the coordinators' reflections under logically and thematically connected topics. The categories we built anchored the data and testimonies of the ICT coordinators. The categorization process yielded four main categories: (1) perceptions of the essence of technological knowledge; (2) perceptions of the essence of pedagogical knowledge; (3) perceptions of the essence of the organizational knowledge needed to lead change; and (4) perceptions of the essence of the knowledge of the qualities and skills an ICT coordinator needs as a leader of change at school. In the second phase the stories were reread by each researcher. The discourse between the two made it possible to sort and classify the statements according to the primary and secondary categories found for each type of knowledge. Each main category was then subdivided into three subcategories: (a) activities promoting ICT implementation; (b) the challenges faced; and (c) personal and professional insights acquired. In the third phase, thought was given to recognizing significant statements that expressed the personal and professional experiences of the ICT coordinators, on the basis of the primary and secondary categories identified and described above (Clandinin & Connelly, 2000). These statements, each presented as a unit of coherent meaning, will be shown below as representative examples of each of the categories found. These comments enabled us to create a picture representing the voices of the subjects in accordance with our interpretation as researchers.

### **FINDINGS**

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In this section, we will present the analysis of the ICT coordinators' reflections and present the knowledge elements they used to succeed in their role. We found four types of knowledge elements necessary for ICT coordinators to perform their role: (a) technological knowledge, (b) pedagogical knowledge, (c) organizational knowledge, and (d) leadership knowledge. Examination of the ICT coordinators' reflections shows that they not only reported on the ICT implementation process, but at the same time, they examined their degree of suitability for the coordinators' tasks. For example, they examined whether they had the necessary knowledge and skills, whether they had suitable attributes for leading teachers, and whether they were willing to support and guide their colleagues.

#### ***TECHNOLOGICAL KNOWLEDGE NEEDED TO CARRY OUT THE ROLE OF ICT COORDINATOR***

Analysis of the reflections shows that ICT coordinators see themselves as technology experts. This was expressed through a variety of tasks they perform while implementing ICT in the school:

- A. Guiding school staff in the use of innovative web tools.
- B. Giving general technical support when problems occur.
- C. Helping prepare a physical and digital base matching the requirements of the national program.
- D. Providing various ICT services to the school staff.

Many ICT coordinators think that their role is to provide staff members who lack technological skills with appropriate technical responses. Therefore, the ICT coordinator requires a variety of technology skills, including use of current web tools, which are prerequisite conditions for fulfilling the coordinators' role. Evidence has shown that ICT coordinators see themselves as professionals with broad technical knowledge in comparison to other teachers, and they also continue to enrich their knowledge about ICT. They reported that when preparing the school for the national ICT program they began to learn independently and to study in various frameworks in order to improve their knowledge and ICT skills. Table 1 presents a sample of quotes describing the complexity of technology knowledge according to the understanding of the ICT coordinators.

**Table 1. Technology knowledge needed to carry out the role of ICT coordinator**

Primary Category	Secondary Category	Representative Quotes
Actions carried out by the coordinator to advance ICT implementation	Participation in professional development program to gain needed technology knowledge	"I participated in courses and was helped by instructors of the national program sites. I spent many hours studying, looking for materials and watching instructional films. All this helped me work on the school website. (P.11)
	Practice and independent learning	"As ICT coordinator I dealt with lots of new information and spent much time on independent learning. I was helped by relatives working in high tech who taught me how to use basic tools efficiently and expand my knowledge in order to teach and assist other teachers." (P.2)
Challenges the ICT coordinator dealt with	Dealing with technical problems beyond their ability	"Receiving digital equipment was the most difficult phase for me. I felt like someone who had been thrown into the water with no swimming skills." (P.73)
	Dealing with poor infrastructure	"At first there was no internet in the computer room. I was helped by the city technician and bought a new modem for the school...it was important to me to find out who was responsible and the internet speed in order to know who to contact if a problem arises." (P.4)
	Gap between technician and pedagogical leader	"In the beginning the staff regarded me as a technician who fixes cables and internet. I always responded to the teachers, but clarified that my job is to be a pedagogical leader." (P.4)
Personal and professional insights I gained	Need to develop professionally in order to acquire the necessary tools and skills	"The ICT coordinator must have knowledge of all tools and skills in order to help the staff. He needs to be one level above his colleagues. I gained knowledge, skills and tools." (P.4)
	Understanding the complexity of the technology aspect, infrastructure support and providing ICT services to the staff	"The ICT coordinator needs extensive knowledge, not only of the use of technology tools, but also of how to establish a working infrastructure... I helped teachers build their class websites and at the same time I managed the school website and supported teachers needing help with technology issues." (P.5)

***PEDAGOGICAL KNOWLEDGE NECESSARY TO PERFORM THE ROLE OF ICT COORDINATOR***

The position of ICT coordinator as leading the digital pedagogical field has been set in the Ministry of Education job requirements. Hence, pedagogical issues in technology implementation are a major part of the responsibilities of the ICT coordinator. Thus, the coordinators see their position as important, responsible, and central to the school culture. From their point of view, leading on solving pedagogical issues is one of the most significant features of their role, the one through which the school's goals are reached. Moreover, they believe that their pedagogical abilities determine their success as innovative leaders. Because of this, ICT coordinators must be experts in the ever-changing field of digital pedagogy and in guidance skills. The analyzed reflections show that guidance skills are expressed through respect for previous knowledge of the teachers in training, the ability to accommodate teachers with different levels of knowledge, and the ability to listen, support, and encourage. Another finding we learned from the reflections was that ICT coordinators think they must be creative, flexible, open to new situations, and capable of lifelong learning. Therefore, they devote much time to their professional development in organized courses or in formal or informal independent learning. Table 2 presents quotes dealing with perceptions of the importance of pedagogical knowledge from the point of view of the coordinators.

**Table 2. Pedagogical knowledge needed for the role of ICT coordinator**

Primary Category	Secondary Category	Representative Quotes
Actions carried out by the coordinator to advance ICT implementation	Modeling, guidance and counseling	“Other teachers in the school came to watch an activity I taught. I presented a digital lesson using technological equipment in the classroom. My aim was that the teachers would understand the structure of the digital lesson, get to know the variety of possibilities in using technology and most important, not to be afraid to try it out on their own.” (P.6)
	Presentation of pedagogical issues to improve teaching	“During guidance time I expose new web tools to the teachers in training and explain to them how they can be helped by these tools and how they can aid them in improving lessons. In addition, I help them plan lessons using available resources, which enrich the lesson and create interest among students. (P.7)
	Colleague cooperation – establishing support groups	“In staff meetings teachers reported and gave examples of their online activities in classes. The staff began to be interested in new Web2 tools and their use of technology increased.” (P.108)
	Long term planning and follow up of staff progress	“It's important to prepare a work plan with the teachers which will assist them in presenting digital lessons. Even if the digital part of the lesson is small, I see that there is good progress.” (P.9)



Primary Category	Secondary Category	Representative Quotes
Challenges the ICT coordinator dealt with	Computers are regarded as a mere technical tool	“Until the big change began, students learned basic Office skills or internet use as an information tool in the computer room. Teachers used computers for printing worksheets, searching the web and recording grades. The computer was not part of teachers’ class activity.” (P.81)
	Teachers are preoccupied with many tasks and overloaded	“The teachers are overloaded and not always willing to cooperate with me. I don’t always succeed in explaining to them why it is worthwhile for them to use these new tools. They prefer to continue teaching in a familiar and traditional way.” (P.104)
	Finding the balance between technological needs and the pedagogical role	“According to role’s definition, we are first of all innovative pedagogy leaders. But in practice we need to deal with a lot of technologies difficulties which sometime we don’t know how to deal with. I find myself involved in a lot of technical support and less with pedagogical factors that are needed to empower teachers and enhance their practice.” (P.71)”
	Need for continuous innovation	“The main challenge is to maintain enthusiasm over a period of time, to support, strengthen and encourage, inserting new enthusiasm from time to time and also new challenges.” (P.43)
Personal and professional insights I gained	ICT coordinator became a leader and a guide that can empower others	“I told the experienced teachers: Bring your professional knowledge with you ... This encouraged them greatly and they began to present ideas and try to integrate pedagogical knowledge into their basic technology knowledge. I began to search for what would be interesting to them in order to encourage them, which led them to be more positive about using technology in their classes.” (P.9)

### ***ORGANIZATIONAL KNOWLEDGE NEEDED FOR LEADING CHANGE BY THE ICT COORDINATOR***

In many reflections, ICT coordinators emphasize that they need to help the principal lead digital integration. Together with the principal, they see themselves as responsible for writing the school’s vision and instilling it into the entire school community as an innovative digital school, for creating an all-school technology implementation program, and for setting a timeline and course plan for guiding the staff. Table 3 presents quotes dealing with organizational knowledge the ICT coordinator needs in order to lead the desired change in the school culture regarding ICT use.

**Table 3. Organizational knowledge needed by ICT coordinator or leading the desired change**

Primary Category	Secondary Category	Representative Quotes
Actions carried out by the coordinator to advance ICT implementation	Elevating ICT into an integral part of the school	“As ICT coordinator I strive to constantly renew, preserve and develop ICT in the school culture, in staff and students.” (P.2)
	Advising school principal and creating implementation program	“We (principal and coordinator) thought about supportive ways to help the staff, presenting how to build lesson plans and how to include technology in them. We took care to provide professional development courses and created an individual mentoring program.” (P.84)
	Organizational management	“The principal and I began our work with several meetings, which dealt with preparing a work plan to implement the national ICT program in the school, defining steps, assigning roles and agreeing on procedures. We chose several teachers with advanced ICT skills and they became the ICT leadership team.” (P.6)
	Designing innovative school vision and its dissemination	“Together with the leadership team we developed our vision and operating strategy. We agreed on a vision that we believe in. Our strategy was based on short-term goals, such as: continuous updating of class websites and including learning materials and assignments for students through the class sites. The team and I spread this vision among teachers, parents and students...” (P.123)
Challenges the ICT coordinator dealt with	Handling resistance	“With teachers who resisted I let them observe what their colleagues did...then I held individual discussions with each one to try to increase their motivation to cooperate. For those lacking basic skills I proposed taking part in individual lessons and asked the principal to arrange this in school schedules. I also agreed to give help at home to those who were embarrassed to receive this help in school.” (P.98)
	Efficient time management	“As ICT coordinator you have two roles in school: teacher and ICT coordinator. As a teacher, you have a set schedule and tasks to perform. As a coordinator, you need to build a dynamic guidance timetable, because sometimes teachers cancel their guidance sessions. The hours devoted to guidance are too few for a staff of 40 teachers and the tasks are many...You need to guide the staff, find materials for on-line class activities and serve as a technician. (P.89)

Primary Category	Secondary Category	Representative Quotes
	Control and follow-up program to deal with problems	“In order to efficiently handle technical problems of computers and projectors, I initiated a form to report problems and because of this my management of problems was quicker and more efficient. When teachers see that the coordinator deals with their problems they are more willing to cooperate.” (P. 17)
Personal and professional insights I gained	Structured annual program	“I learned that each change or implementation can be made only through a structured annual work plan with full cooperation of the management and staff.” (P.43)
	Development of leadership and guidance skills	“I was concerned about the need to lead change. I was certain that my personality did not suit the role, but I was pleasantly surprised. My colleagues were happy to help and support me; especially because we had fruitful dialogues in our guidance sessions that contributed to the program in the school...I feel that I advanced greatly in my pedagogical abilities and also in my ability to lead the staff.” (P.2)
	Maximum availability in school	“I succeeded in making changes because of my attitude towards the teachers and my willingness to help them anytime, anywhere. I give them the feeling that they are not bothering me with their questions and that I am happy to help. This gives them motivation to try and to succeed.” (P.89)

### ***LEADERSHIP KNOWLEDGE NEEDED BY THE ICT COORDINATOR AS SCHOOL LEADER***

The reflections of the coordinators show that they view themselves as initiators and leaders of the school staff. Therefore, coordinators need additional abilities beyond digital pedagogy. That is, in order for them to lead they must possess characteristics of a leader. The coordinators' leadership is expressed in their areas of responsibility in the role they play. Coordinators brought out their position as leaders through use of significant expressions of leadership, such as: “direct”, “directing”, “encouraging teachers”, “guiding teachers”, “advancing”, “motivating”, “supervising”, “influencing”, “innovating”, etc. Some of the coordinators describe this leadership as being revolutionary – “changing technology into a central factor in teaching and learning”. Reflections also show that their enthusiasm, the endless giving of themselves and the true desire to grow and develop, are, in their opinion, the necessary qualities of a leading guide to make the leap into the digital age. Hence the qualities demanded of the ICT coordinator to be an innovation leader are self-confidence, assertiveness and enthusiasm, personal example, initiative, ability to plan and organize efficient time management, good teamwork, good interpersonal communication skills and the ability to make others follow, ability to manage technology and personnel resources, and accepting responsibility above and beyond what is formally required. Table 4 presents quotes describing the ICT coordinators' view of leadership knowledge evolving from their school leadership roles.

**Table 4. Leadership knowledge needed by ICT coordinator evolving from their leadership role**

Primary Category	Secondary Category	Representative Quotes
Actions carried out by the coordinator to advance ICT implementation	Establishing leadership role with school staff	“The ICT coordinator must demonstrate time management skills; work in partnership with staff and demonstrate organizational, management and leadership skills; improve interpersonal communication.” (P.105)
	Initiative and resource management	“The coordinator must utilize existing resources properly in order to help each teacher overcome individual difficulties. Therefore, in order to build self-confidence and modeling in the teachers I spent all my allotted hours in the classroom with them.” (P.128)
	Personal consultation with the principal	“We began working together in meetings (the principal and I) to create a work plan, to adjust the plan to the teaching staff, to set stages and assign roles, and to establish work procedures.” (P.45)
Challenges the ICT coordinator dealt with	Resistance of the teachers	“In the beginning it was difficult. I worked on myself in order to develop my ability to deal with resistance, I learned to accept different opinions and thinking.” (P. 64)
	Dealing with guiding my own colleagues	“At times I needed to set aside my role as coordinator in order to maintain good relations with my teacher colleagues.” (P. 23)
	Dealing with differences in teaching teachers	“Guiding is a field with much responsibility and I think it is more difficult to teach adults. Adults are more set in their ways and less open to change...the teaching staff is comprised of veteran and new teachers, digital and curious, together with hesitancy. Each is on a different level of learning and I need to adjust their exposure to technology, each one individually according to their willingness and ability to grasp.” (P.74)
Personal and professional insights I gained	Developing leadership skills	“My leadership ability enabled me to lead the principal and staff in the right way to change and growth according to the program...I learned to lead and to make them follow me.” (P.52)
	Personal example	“I see myself as the driving force in integrating technology in the school. I expect the staff to believe in me and to join me in this digital journey.” (P.12)
	View of role as a personal challenge	“As ICT coordinator I desire to create ongoing enthusiasm and innovation and always think of new ideas in order to maintain and develop technology use in students and in the teaching staff.” (P. 26)

In order to bring about a systemic change, ICT coordinators must be leaders of change. They must acquire new knowledge through practice. This knowledge is built on a view of the role as a personal challenge and includes skills such as: leadership, teamwork, guidance skills, tools for leading change and dealing with resistance.

## **DISCUSSION AND SUMMARY**

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Based on the findings we can see that the coordinators revealed primary successful elements of their work: (a) technological aspects, (b) pedagogical aspects, (c) the organizational aspects, and (d) the ICT coordinator as a leader of systemic change. The first two elements already appear in the TPACK construct, while the others constitute organizational knowledge (OK) and leadership knowledge (LK) that enable the coordinators to facilitate ICT implementation in schools, and these are the unique elements of this study.

Here, we are going to present a theoretical model that summarizes the insights we have achieved through our findings analysis. In view of what we found in the coordinators' reflections, we claim that the ICT coordinators maintain a complex perception of their role, based on broad personal and professional knowledge, including technological knowledge, pedagogical knowledge, knowledge of the organization in which they operate, and leadership knowledge that enables them to lead the needed changes. Findings suggest that ICT coordinators perceive their role as built of hierarchical levels of knowledge; where the acquisition of technological knowledge and its implementation in the organizational culture takes up significant amounts of time and resources, in addition to the other three roles, which consist of the acquisition and actualization of pedagogical knowledge in the technological context, the organizational knowledge through which they operate, and the leadership knowledge required for leading change. This perception of the characteristics of their role affects their conduct at work and their feelings as they perform that unique role. Changing the role of the ICT coordinator from technician and trouble-shooter to leader and policy-maker in schools raises questions about the nature of this newly defined role- What is meant by a pedagogical and technology leader?(McGarr & McDonagh, 2013)?

### ***THE ICT COORDINATOR AS AN EXPERT WITH TECHNOLOGICAL KNOWLEDGE***

The coordinators perceive the mastery of technological skills as a basic and necessary prerequisite for their job as ICT coordinators. They speak of their abilities and technological proficiency compared to other teachers, and most of them agree that this proficiency is a key component in their job requirements. However, as cited in previous studies (McGarr & McDonagh, 2013; Underwood & Dillon, 2011), this proficiency traps them and draws them into over preoccupation with technology. As ICT experts, the coordinators fulfill two roles: providing both technical support and ICT services to the school staff. As mentioned earlier, the partial support given to the school by qualified technicians and the helplessness demonstrated by many teachers when it comes to using technology require a considerable amount of time spent by the coordinator on dealing with malfunctions, solving technical problems, and tasks such as producing computerized report cards, and dealing with the construction and maintenance of the school websites. These findings are consistent with those of previous studies, which found that ICT coordinators demonstrated better computer skills compared to other teachers, and that they often used ICT to achieve professional enrichment and to prepare class material while performing their role as teachers (Lai & Pratt, 2004).

### ***THE ICT COORDINATOR AS AN EXPERT WITH PEDAGOGICAL-TECHNOLOGICAL KNOWLEDGE***

ICT coordinators consider the enrichment of their technological-pedagogical knowledge an important issue, which requires the development of unique knowledge and skills. Findings show that they dedicate a lot of time to their professional development, taking in-service courses and learning independently in order to become experts at implementing ICT at school. This role perception en-

hances the pedagogical aspect of the coordinator's work. These findings are consistent with previous studies (Lai & Pratt, 2004; Rodriguez-Miranda et al., 2014), which indicated that coordinators aspired more than others to acquire knowledge and skills, and devoted a considerable amount of time to their professional development.

These findings show that ICT coordinators consider leading the professional development of teachers and assisting in implementing ICT into the curriculum their two most important responsibilities. But in fact they manage to do only relatively little in these areas, and this job perception is only partly implemented. The time and resources allocated to these guiding roles in the coordinators' jobs are limited. The coordinators are not happy with that, and they claim that more time should be allocated to training teachers and planning the curriculum and that technical support could be given by someone else. The coordinators' view that they should lead the planning of the curriculum rather than serve as technical maintenance people is supported by Lai and Pratt (2004), who claim that in many cases the provision of the school's immediate need of an ICT expert comes at the expense of long-term goals, such as training the teaching staff in computerizing the curriculum and guiding them through the ICT implementation process. Whereas the coordinators' view of themselves as leaders is prominent in their job requirements, they are allowed only scarce opportunities to demonstrate leadership in their actual areas of responsibility. The ability to influence others depends on authority, on backing up and empowering the coordinator. The importance of developing the leadership aspect in the leading of change as a rule and in the leading of change in the specific context of ICT implementation is supported in other studies as well (for instance, Mingaine, 2013).

#### ***THE ICT COORDINATOR AS AN EXPERT WITH ORGANIZATIONAL KNOWLEDGE***

Studies show the importance of maintaining a direct dialogue among all those involved in ICT within the school community, in order to allow the school administration to formulate an educational vision regarding the implementation of ICT at school (Cunningham, 2009). An organizational vision is defined as the optimal future picture of an organization, and therefore it is important that the vision be well designed and that it contains a clear rationale regarding the school's goals and how they will be attained (Shamir-Inbal et al., 2009). The success of implementing ICT at school depends on having a vision as to where you want to take the ICT. Such a dialogue between the management and the ICT coordinator allows inquiry, clarification, and distinction between the various perceptions regarding the coordinator's role, as well as mapping the operative goals that the coordinator has to achieve. The findings reveal that the ICT coordinators played an active part in shaping the school's vision together with the school management staff. To them writing the vision was not just one of their job requirements, but a testimony to the fact that they were playing a major part in structuring innovative organizational processes at school, from an overall systemic perspective (Lai & Pratt, 2004). Findings also indicate the need for management involvement, team work, and cooperation between the ICT coordinator and the teaching staff at school. Team work atmosphere and cooperation with the teachers help facilitate the workload of the ICT coordinators and help them take responsibility for leading the ICT (Avidor-Ungar, 2010; Shamir-Inbal et al., 2009).

#### ***THE ICT COORDINATOR AS A LEADER AND AS CHANGE AGENT***

Studies show that having an inside leadership at school is essential for carrying out innovations such as ICT implementation (Avidor-Ungar & Shamir-Inbal, 2013; Shamir-Inbal et al., 2009; Vandelinde et al., 2012). We maintain that this role perception requires additional capabilities to those of ICT skills and ICT-integrated pedagogy. In order to be able to lead, ICT coordinators must possess high levels of knowledge and mastery of both ICT and pedagogy, but are also required to have leadership skills, based on their status among their peers, their ability to provide a role model, their independence, willingness to assume responsibility, and motivation to initiate change. And indeed findings show that the ICT coordinator must be self-assured and assertive, have vision and initiative, planning and organizing skills, the ability to lead people, have good communication with teachers, and be involved in school life. These requirements are supported in additional studies claiming that leadership means

having effective communication with teachers as well as guidance skills and knowledge of how to lead change (Avidov-Ungar et al., 2014). Findings also show that the coordinators' leadership is mainly manifested at the stage of preparing the school for the national ICT program and preparing the staff for it, during which they take full responsibility and show a can-do attitude, especially with regard to equipping the school with computers. Lai and Pratt (2004) consider these roles a form of involvement in the school's organization, manifested by taking part in systemic planning, which they consider an essential part of the leader's role.

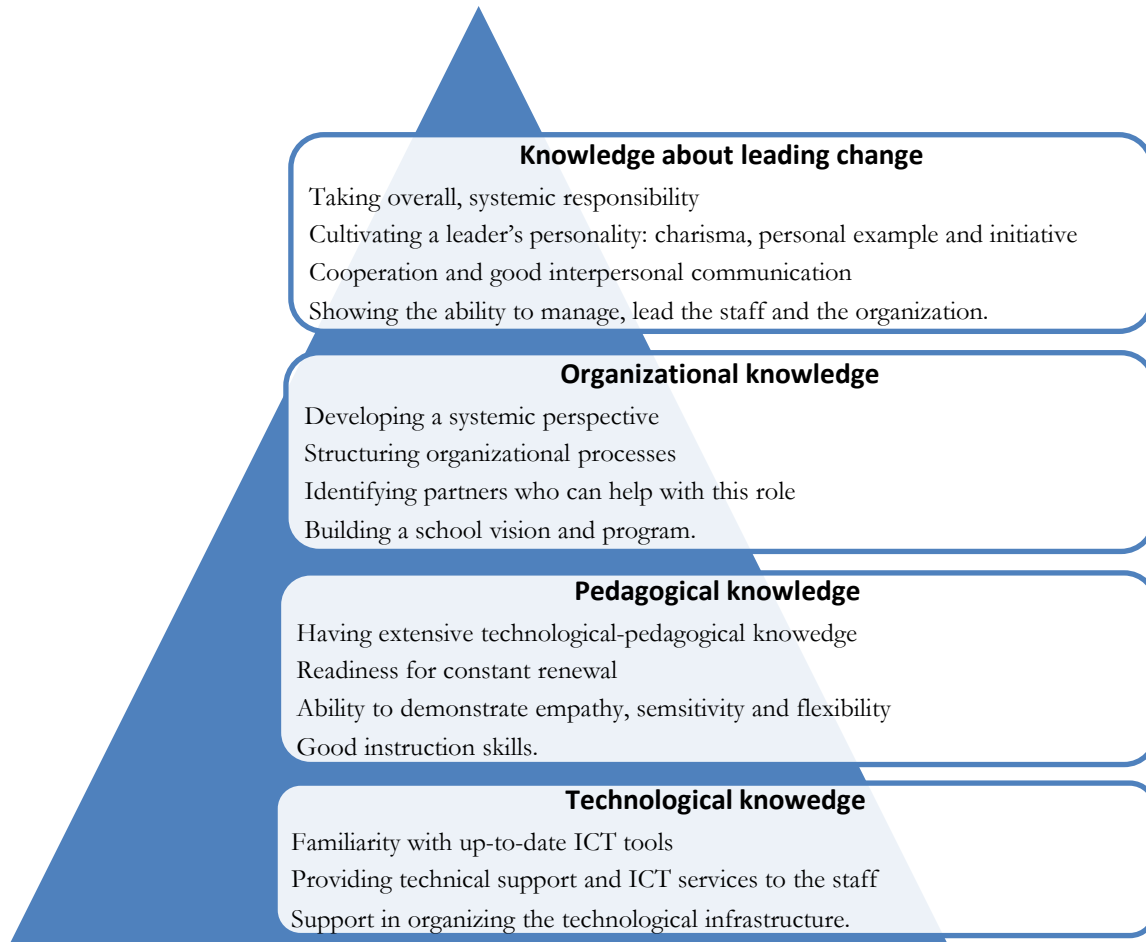
### ***THE HIERARCHY OF THE ROLES OF THE ICT COORDINATOR AS CHANGE AGENT***

Mapping the role perception of the ICT coordinators with its four dimensions outlines the various aspects that put together the knowledge required for the performance of their duty as change agents at school. The hierarchy of roles creates a taxonomy in which the fulfillment of a higher ranking role depends on the fulfillment of a lower ranking one. Therefore the ICT coordinators' role as "a technological leader" is based on their primary job requirements and areas of responsibility. Fulfilling the role of "a pedagogical-technological expert" is based on being a technological leader, but requires additional skills and pedagogical knowledge. So the perception of the coordinator as a change agent is based on his being a technological leader, a pedagogical-technological leader, and finally having organizational knowledge and being involved in organizing the school, as well as leadership skills and ability to lead change – these make the ICT coordinator an inner school change agent. Figure 1 presents the roles of the coordinator as a change agent in the implementation of ICT, relating to the hierarchical ranking between the four different roles.

In Figure 1 we describe the four elements of the knowledge we found according to the coordinators' reflections. We present these four elements of knowledge as a hierarchy that presents the knowledge required of all teachers in the digital age in general (as presented in the TPACK index) but mostly the knowledge required by the ICT coordinator as an agent of change in the implementation of ICT at school (LK and OK that may be added to enhance the TPACK index).

This concept clarifies that the ICT coordinators will be able to lead the staff to change only after having proved themselves and earned the trust of the staff and the school administration as expert in all the levels described above (Mingaine, 2013). In order for the changes to be introduced and firmly established, there has to be an overall change in the school culture, and so the training and in-service courses at the school constitute a bridge between the change process among the individuals that takes place during their development in individual training sessions and the systemic change at the school (Avidov-Ungar & Eshet-Alkalai, 2011b; Shamir-Inbal & Blau, 2016). The ICT coordinator is a kind of champion (Eyal & Yosef-Hassidim, 2012), defined as "the person who makes a decisive contribution to innovation by actively and enthusiastically moving the innovation process forward through its critical stages" (Curly & Gremillon, 1983, p. 205). In this manner, based on the findings of this study we may refer to the coordinator as the "agent of change possessing the unique knowledge that enables leading ICT implementation in the school".

This study has shed light on the nature and significance of leadership knowledge (LK) (Avidov-Ungar & Eshet-Alkalai, 2014) and its function as a suggested additional component of TPACK. We suggest that future research about educational technology leaders' TPACK be drawn from these results.



**Figure 1. The hierarchy of the elements of knowledge leading the roles of the ICT coordinator as an agent of change in implementing ICT in the school**

## CONCLUSIONS

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Following the aim of the study that was to examine what ICT coordinators perceive as the main elements of knowledge needed to implement ICT successfully into school culture, we recommend that when choosing ICT coordinators or ICT implementation leaders at school, one should check not only that they possess the familiar TPACK knowledge, but also organizational knowledge and leadership knowledge that was found essential to successful completion of the coordinators' role. Moreover, these elements of knowledge among ICT coordinators can develop during lifelong learning courses. Such professional development courses are important to the coordinators for successful implementation during these complicated tasks as agents of change at their schools.



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## APPENDIX

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### Reflection questions that ICT coordinators were asked to answer at the end of their professional development course

1. Describe the process of change taking place in your school in the context of ICT implementation.
2. Describe the steps you and the principal have taken to promote the implementation of change regarding the use of ICT in your school.
3. What factors helped you in leading the change? Who were your partners in this role? How did they contribute to the changes you are leading as the ICT coordinator?
4. Describe the challenges you face.
5. What personal insights have you gained while leading this change?
6. Describe the points of professional and personal development you have experienced during your work as ICT coordinator.
7. What kind of support would you like to have in the future as ICT coordinator?
8. In your opinion, what are the important points for next year in terms of the implementation of the ICT program?
9. How have you handled teacher resistance to the process?

## BIOGRAPHIES

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