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Pedagogical Perspectives and Practices Reflected in Metaphors of Learning and Digital Learning of ICT Leaders

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ABSTRACT

This study examines the meaning attributed to the contribution of technology to pedagogical practices from the perspective of school ICT leaders. While previous studies use metaphors for bottom-up exploration, this study employs an innovative combination of bottom-up and top-down metaphor analysis based on two frameworks: (a) metaphors of general learning (Paavola, Lipponen, & Hakkarainen, 2004)—acquisition, participation, and knowledge creation, and (b) metaphors of digital learning (Shamir-Inbal & Blau, 2016)—toolbox, active player, creative mind, shared desktop, and inter-connected world. Semi-structured interviews were conducted with 13 ICT leaders, including eight elementary school ICT coordinators and five regional ICT coordinators. All three metaphors of general learning and five digital learning metaphors were found in perspectives and pedagogical practices reported by the interviewees. However, the prevalence of each metaphor and the intersections of general and digital learning metaphors were quite different. The analysis based on metaphors shed light on the perspectives of ICT leaders regarding the meaning and nature of learning processes and on pedagogical practices in their schools.

KEYWORDS

Metaphors of learning; acquisition, participation and knowledge creation metaphors; metaphors of digital learning; toolbox, active player, creative mind, shared desktop and inter-connected world metaphors; added value of technology to pedagogy; metaphors-based analysis of pedagogical perspectives and practices

In recent years there has been a significant increase in the integration of Information and Communication Technologies (ICT) in elementary schools and secondary schools in Israel (Blau & Hameiri, 2017; Israeli Ministry of Education, 2014; Shamir-Inbal & Blau, 2017a) and around the globe (Chan, Tam, Li, & Pow, 2016; Malagón & Pérez, 2017; Zhang, Yang, Chang, & Chang, 2016). Since 2010, the national ICT program Adapting the Education System for the 21st Century has been implemented in hundreds of elementary schools in Israel. The program aims at integrating ICT tools for pedagogical, social, and organizational needs in order to prepare the schools and their teaching staff to provide 21st-century students with relevant learning skills and digital competencies. The program started with 200 elementary schools in the north and south districts of the Ministry of Education (MoE) and gradually spread to schools in other districts.

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Two types of new positions offered by the MoE aimed to help schools in the integration process: (a) *school ICT coordinators,* who are responsible for both implementing in their school the top-down ICT policies and standards defined by the MoE and providing pedagogical-technological support for bottom-up initiatives of their teaching staff, and (b) *regional ICT coordinators,* who are responsible for the implementation of the MoE policies in a cluster of five schools. Regional coordinators provide pedagogical-technological guidance to school ICT coordinators and consult school principles on this topic (Israeli Ministry of Education, 2014).

One of the important questions related to the integration of technology in schools is how to increase pedagogically meaningful use of ICT in class and out of class that promotes teaching and learning appropriate for needs of 21st-century students. In order to answer this question, the current paper analyzes examples of learning activities and insights arising from interviews with ICT leaders (both school and regional ICT coordinators) who are involved in technology integration in a variety of Israeli elementary schools.

The use of metaphors to describe teaching and learning processes can reveal implicit perspectives and provide fundamental insights to learners, educators and researchers (Elmholdt, 2003). For example, according to the pioneer work on learning metaphors conducted by Sfard (1998), discourse on teaching and learning reflects two main metaphors, acquisition and participation, and the commitment of educators to only one of them can lead to undesirable teaching practices. Thus, metaphors are not just linguistic features or poetic tropes but also basic units of conceptual development that can help educators and educational researchers narrow the gap between tacit and explicit knowledge about teaching (Martinez, Sauleda, & Huber, 2001). Moreover, learning metaphors can be useful for analyzing integration of technology in schools and in higher education as well as for research on the perspective of educational practitioners who lead these processes (Blau & Presser, 2013; Blau & Shamir-Inbal, 2017a; Dziuban, Moskal, & Hartman, 2005; Shamir-Inbal & Blau, 2016; Swan, Day, & Bogle, 2016).

To shed light on the pedagogical approach of the interviewees, ICT leaders in schools and teachers who designed and delivered the learning activities analyzed in this study, we use two sets of metaphors—metaphors of learning in general (Paavola & Hakkarainen, 2005; Sfard, 1998) and of digital learning in particular (Shamir-Inbal & Blau, 2016). The following section conceptualizes these metaphors and reviews related literature.

Conceptual framework and literature review

Metaphor is an expression that describes a person, object, or idea by referring to something else that is considered to have similar characteristics (Sfard, 1998). Lakoff and Johnson (1980) have argued that metaphors shape the way we think and act. The nature of the human conceptual system is fundamentally metaphorical—metaphors refer to objects or ideas that are familiar to users in order to convey more abstract

ideas and concepts. In this way, metaphors enable humans to discuss abstract concepts in familiar terms (Kupferberg, 2010). Kupferberg also emphasizes the role of conceptual metaphors in illuminating emotionally charged experiences.

Using the tools coming from literature studies, such as metaphors, can deepen understanding of perspectives and underlying beliefs of participants in qualitative or mixed research in the field of learning sciences (Abrahamson, Sánchez–García, & Smyth, 2016; Paavola, Lipponen, & Hakkarainen, 2004; Sfard, 1998). This idea underlies the use of metaphors in the analysis of interviewees' statements: "Metaphors are the most primitive, most elusive, and yet amazingly informative objects of analysis" (Sfard, 1998, p. 4). Discussing the use of metaphors in cognitive sciences, Lakoff and Johnson (1980) claimed that metaphors reflect different aspects of reality. Some authors (e.g., Wan & Low, 2015) argued that through metaphors one can understand implicit beliefs; reflect, explain and critique them; and even change different aspects of teaching and learning processes.

However, despite the promises of metaphor analysis, few studies have used this methodology in order to explore educators' perspectives on teaching-learning processes (e.g., Farrell, 2016) or teacher professional development (e.g., Tait-McCutcheon & Drake, 2016). While scientists are looking for a consistent set of metaphors that fit a wide range of educational phenomena, ordinary people continue using a variety of learning metaphors to express their perspectives on teaching and learning processes (Blau, Peled, & Nusan, 2016).

Three commonly used metaphors that relate to general learning processes are acquisition of knowledge, participation, and knowledge creation (Paavola et al., 2004). The acquisition metaphor (Sfard, 1998) describes the transfer to students of "objective" knowledge from any source—a teacher, analog content (e.g., textbook, printed learning materials), or digital content (e.g., etextbook, digital learning materials, educational videos). The widespread term *knowledge acquisition* and the constructivist term *concept development* both refer to a perception of knowledge as an objective material entity that exists outside the human mind. Memory is perceived as a container that, after initial processing, will store the knowledge (Paavola et al., 2004). The assumption that learning involves acquisition—gaining ownership of knowledge—is common in a variety of learning theories, from behaviorism to sociocultural theories and various constructivist theories (Sfard, 1998). In addition to the nature of knowledge, this metaphor emphasized the direction of its distribution—from expert or content prepared by experts, such as textbooks, to novice. This metaphor is reflected in technology-enhanced teaching and learning by the use of technological tools as whole-class technologies that are used mainly for presentation, illustration, and information accessing, while the main activities of the students are to absorb the information by watching, listening or reading (Peled, Blau, & Grinberg 2015; Blau & Shamir-Inbal, 2017a). The recent exploration of metaphors in pedagogical approaches in massive online open courses (MOOCs; Swan et al., 2016) revealed patterns that cross content areas of the courses and are related to both metaphors suggested by Sfard (1998)—acquisition and participation.

The participation metaphor emphasizes the social and cultural processes as fundamental to the construction of knowledge and learning (Sfard, 1998). This pedagogical approach, which is particularly relevant for online learning, is based on the principles of socio-constructivist theory of learning (Vygotsky, 1978), which assumes that learning is an active process of constructing knowledge by information exchange and interpretation through social interactions. ICT tools expand the opportunities for constructivist learning (Bower, Hedberg, & Kuswara, 2010) and play a major role in creating collaborative learning processes (Blau, 2011; Blau & Shamir-Inbal, 2017c; McCormick, 2004). Technologies enable ubiquitous collaborative learning unlimited by the boundaries of classroom space and lesson time (Kumpulainen, Mikkola & Jaatinen, 2014). This technology-enhanced learning in teams and communities can be conducted at different levels of complexity—sharing information, cooperation, or collaboration (Blau, 2011; Blau & Shamir-Inbal, 2017a).

More recently, Paavola and colleagues (2004) emphasized the knowledge creation metaphor that highlights the dynamic nature of knowledge created in the learning process when the learner is an active participant in this creation. This metaphor describes learning as an active, individual or joint effort to generate new ideas and outcomes. According to this metaphor, learning takes place in communities. However, unlike the participation metaphor, the emphasis of the knowledge creation metaphor is not on social interaction and expression of personal perspectives regarding the learning topic but rather on specific activities through which this creation is expressed (Blau & Shamir-Inbal, 2017b; Paavola & Hakkarainen, 2005) or on preparing tangible learning outcomes (Roberts, 2007). Digital technologies enable preparing learning outcomes ranging from presentations and videos to programmable artifacts, applications, and simulations (Blau & Benolol, 2016). Thus, Roberts (2007) suggested evaluating learning in digital environments through assessing learning outcomes, rather than in terms of participation in learning communities.

Oxford et al. (1998) suggested a different typology of metaphors related to four general perspectives on teaching:

1. *Social order*, in which education is viewed as a production line where the teacher is in full control of the classroom and seen as a "technician … in the process of social engineering" (p.8).
2. *Cultural transmission* that views education "as a process of enculturation or initiation into the historical practices and achievements of a given society" (p.8).
3. *Learner-centered growth* refers to a sharing of classroom control between the teacher and students, and "student interests replace discipline as the central focus of schooling" (p.27).
4. *Social reform* refers to the teacher and students as miniature democratic communities with shared learning processes for a better society.

Although Oxford and colleagues use a different set of metaphors, their typology is similar to the perspective suggested by Sfard (1998) and Paavola et al. (2004). Namely, the underlying idea of social order and cultural transmission metaphors

by Oxford et al. is associated with acquisition of knowledge metaphor by Sfard and Paavola et al.: learner-centered growth, with knowledge creation metaphor, and social reform, with participation metaphor.

Research literature also presents studies that explore metaphors of learning in order to understand epistemological thinking and conceptions of students or instructional design of learning interfaces. For example, Wegner and Nückles (2016) used metaphors to study learners' epistemological beliefs in relation to their learning motivation, regulation processes, and learning strategies. They identified four types of metaphors: regulation-related metaphors, learning as knowledge acquisition, learning as problem solving, or as personality development. Firat and Yurdakul (2016) use metaphors in order to analyze and improve instructional design of interfaces for e-learning and distance education. Since our study aimed to understand metaphors of learning that underlie pedagogy, these studies based on analysis of learning metaphors seem to be irrelevant to our research and consequently are excluded from the literature review.

Increasing use of digital applications for information sharing and creation of digital outcomes opens new possibilities of integrating these applications in teaching (Roschelle, 2013). Metaphors are useful for understanding social, behavioral, and cognitive aspects of integrating educational technologies (Jackson, 2016). Beyond the previously mentioned metaphors that describe learning processes in general, technology-enhanced teaching-learning processes can be represented through a set of more specific metaphors. These metaphors can reflect the way technologies support students in finding, evaluating, collecting, managing, creating, representing, and sharing information and outcomes in digital environments (Kurtz & Peled, 2016).

The potential of technologies to enhance learning processes and outcomes can be explored by analyzing metaphorical representations of teachers (Carenzio, Triacca, & Rivoltella, 2014). In tablet PC-enhanced learning, 30.5% of the teachers in Carenzio et al.'s study perceived technology as a toolbox, an aggregator of apps for education and recreation (e.g., camera, voice recorder, networks, writing tools), while 28.1% of the participants perceived learning with tablets as a creative mind, emphasizing preparation of original outcomes. In addition, teachers considered tablets as effective tools for increasing student participation and teacher-student e-communication, as well as for promoting collaborative learning. Shamir-Inbal and Blau (2016) expanded the typology of digital learning metaphors reported by Carenzio and colleagues. Based on bottom-up analysis in the sample of an elementary school principal, teachers, students, and parents, they reported five metaphors of digital learning:

1. *Toolbox* metaphor describes the use of apps appropriate for reaching learning goals. Technology is perceived as a repository of learning tools: a word processor, voice recorder, digital camera, social networks, or video conferencing.
2. *Active player* metaphor refers to the potential of technology enhancing active participation of students in the learning process. Technology increases students' active engagement in learning, for example, using a smartphone

application for answering questions to receive immediate feedback during lessons.

3. *Creative mind* metaphor describes learning processes and outcomes in which students use technologies to express their ideas in creative ways, such as collecting information by taking pictures, filming videos, or editing information from the internet and integrating it in their original artefacts.
4. *Shared desktop* metaphor refers to the use of digital tools for face-to-face technology-enhanced collaborative learning in teams or as an environment for remote collaborative learning, for example, teams that connect concepts and ideas by editing cloud applications, shared documents, spreadsheets and slides, or students that work on shared screens in synchronous learning.
5. *Inter-connected world* metaphor describe the connection of classroom to the world through technologies for conducting remote interactions with teacher and classmates in online learning communities, contacting experts in different subjects, as well as communicating with peers around the globe.

The metaphors of digital learning (Shamir-Inbal & Blau, 2016) enrich the metaphors of general learning (Paavola et al., 2004; Sfard, 1998) and can be integrated with each of them. Figure 1 illustrates the pedagogical connections between general learning metaphors and metaphors of digital learning in the 21st century. As can be seen, these two sets of metaphors are not directly linked, but rather the general learning metaphors capture the digital learning ones. For instance, the metaphors toolbox and inter-connected world are pedagogically neutral and thus can be associated with learning according to each of the three general metaphors—acquisition, participation, or knowledge creation. In contrast, shared desktop, active player, and creative mind are associated mostly with the participation and knowledge creation metaphors.

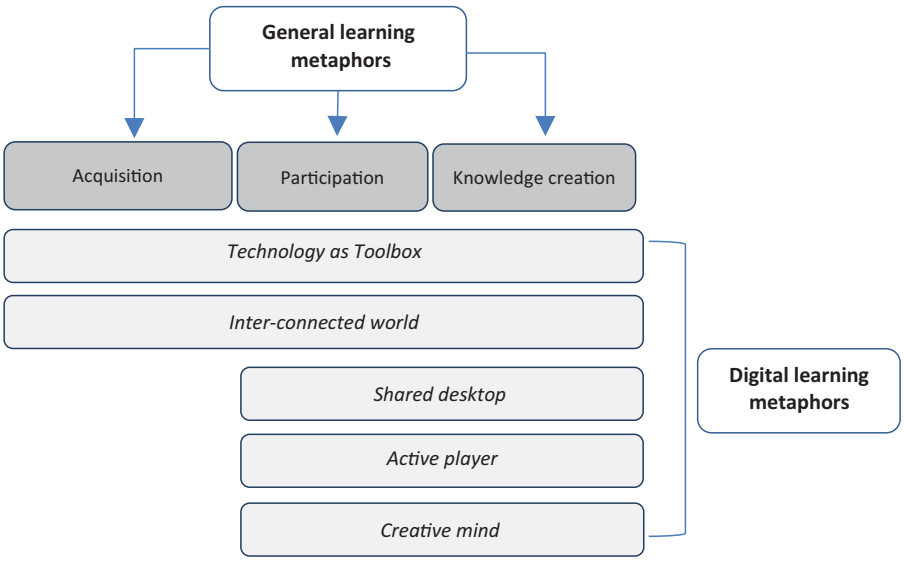

Figure 1. General learning metaphors and metaphors of digital learning.

Research goals and questions

This study examines the contribution of ICT integration to pedagogy as perceived by ICT leaders—school and regional ICT coordinators. We explore the meaning that ICT leaders attribute to teaching-learning processes and outcomes using three metaphors of general learning and analyze the reported technology-enhanced learning activities through five metaphors of digital learning.

The study explores the following research questions:

1. What general metaphors of learning (acquisition, participation and knowledge creation; Paavola et al., 2004; Sfard, 1998) are reflected in the meaning attributed by the ICT leaders (school and regional ICT coordinators) to the technology-enhanced teaching-learning processes?
2. How are the five metaphors of digital learning (toolbox, active player, creative mind, shared desktop, and inter-connected world; Shamir-Inbal & Blau, 2016) expressed in the teaching practices of ICT integration in learning activities described by the interviewees?

Method

Participants

The participants in this study were 13 ICT leaders; eight of them were ICT coordinators in elementary schools, and five were regional ICT coordinators who each provide ongoing technological-pedagogical guidance to five school ICT coordinators. Thus, we combine the perspectives and reports of two types of ICT leaders—school ICT coordinators and regional coordinators.

All school coordinators and four out of five regional coordinators were women. The minority of male participants in the study corresponds to a very small percentage of men among ICT leaders in Israeli secular elementary schools.

All the participants were experienced in teaching, with seniority ranged between 10–34 years and an average seniority of 21 years. The participants worked in a large district of Israeli Ministry of Education and their schools had been part of the National ICT Program for at least the last four years.

Instruments and procedure

The study was approved by the institutional ethics committee and the participation was voluntary. Semi-structured interviews were conducted in order to shed light on the interviewees' pedagogical perspectives and their practical expressions in the context of ICT integration in schools. The interviews lasted from 40 to 56 minutes, 45 minutes on average. The interviews were conducted by phone during the 2014–2015 academic year; they were audio-recorded and transcribed.

The interview questions explored the perceptions of the ICT leaders regarding technological, pedagogical, and organization aspects of their work in schools. We

asked the interviewees to explain how they lead teachers in integration of technologies in the classroom, provide examples of technology-enhanced activities designed by teachers in their staff, and report which of these learning activities they perceive as more traditional, which are more innovative, and why. In addition, we asked about the use of digital textbooks and other digital content prepared by digital content providers versus digital content designed by individual teachers or teaching teams in their school, as well as content designed by teachers in other schools that was adapted for the local needs. Finally, we were interested in deepening our understanding regarding e-communication among the teaching staff and between teachers, students, and parents as well as regarding the collaborative learning between teachers and/or students within the school versus collaboration with teachers and/or students from other schools.

Transcripts of the interviews were first analyzed using thematic analysis (Boyatzis, 1998) as part of the interpretive bottom-up approach, which enable us to understand the participants' perspectives and the meaning they attribute to their experiences. Following that, top-down analysis was conducted by the second author based on learning metaphors that, according to the research literature reviewed previously, connect explicit perspectives and implicit beliefs of the participants in a specific cultural context. Thus, analysis of metaphors enable us to glimpse into implicit pedagogical beliefs of ICT leaders on learning process in general and on the added value of technologies to teaching and learning in particular. Note that in studies reviewed in the literature review, metaphor analysis was usually used for bottom-up exploration. In contrast, in this study the participants' statements were also mapped top-down combining two frameworks: (a) general metaphors of learning: acquisition of knowledge, participation, and knowledge creation (Paavola et al., 2004), each of which highlights different major aspect of the learning process, and (b) digital learning metaphors that emphasize specific features of technology-enhanced learning (Shamir-Inbal & Blau, 2016). In both bottom-up and top-down analysis, every comprehensive statement was considered a content unit and counted (see Tables 1 and 2, Figure 2); a unit could be a part of a sentence, a sentence, several sentences, or a paragraph. Units were associated into categories. Coding was not exclusive, namely, a statement could be associated with different codes. For inter-rater reliability, 25% of the randomly chosen transcriptions were re-coded by another rater trained by the first author and high agreement was achieved (Cohen's $\kappa = 0.93$).

Results

This section first presents the analysis based on metaphors of the general learning processes. Following that, we report the analysis based on the metaphors of digital learning focusing on the specific contribution of technological tools to pedagogy. Both sections provide examples of technology-enhanced activities designed by teachers lead by the interviewees and explanations by the ICT leaders as to which of the reported learning activities they perceive as more traditional, which are more innovative, and why.

Table 1. General metaphors of learning processes in ICT leaders' perspectives.

General learning metaphors	Quotes
Acquisition metaphor (*N* = 21) This metaphor is prevalent in all grades and occurs primarily in the context of acquiring basic skills and knowledge.	"[ICT allows] a deeper understanding and a higher level of attention. When you present a topic, no matter how much you'll explain it, it's not like the vivid examples they see [on the screen] … When you present a topic and incorporate in your presentation videos, simulations, or other visuals, it makes it easier for students to understand your explanation" (B).
Participation metaphor (*N* = 11) The participation metaphor expressed as learning through social interactions during collaborative learning activities in which students interact with classmates in the learning community or collaborate in small teams on learning outcomes.	"We have lots of online interactions and collaborative learning taking place in the class learning community on Google Drive. Students work on group projects remotely from their homes, and then at school they continue working in teams" (A L).
Knowledge creation metaphor (*N* = 24) This metaphor is expressed in technology-enhanced learning activities, in which students engage in creating new information or designing artifacts.	"For example in geography lesson, we finished studying a chapter, and they had to present what they learned in a creative way. They could choose the tool and the format—from writing a newsletter to creating comics or designing a game in Kahoot. Here you really see how each child expresses himself or herself in a unique way"(V).

General learning metaphors in ICT leaders' perspectives

Table 1 presents three general metaphors of learning—acquisition, participation, and knowledge creation (Paavola et al., 2004; Sfard, 1998)—expressed by the interviewees. These representative quotes illustrate how each category manifests in learning activities and pedagogical perspectives of the participants. Some of the statements reflect more than one metaphor and thus appear in more than one code. Please note that in all of the following tables and figures, *N* refers to the number of content units of each category and not to the number of the participants. Letters in the quotes refer to the interviewees.

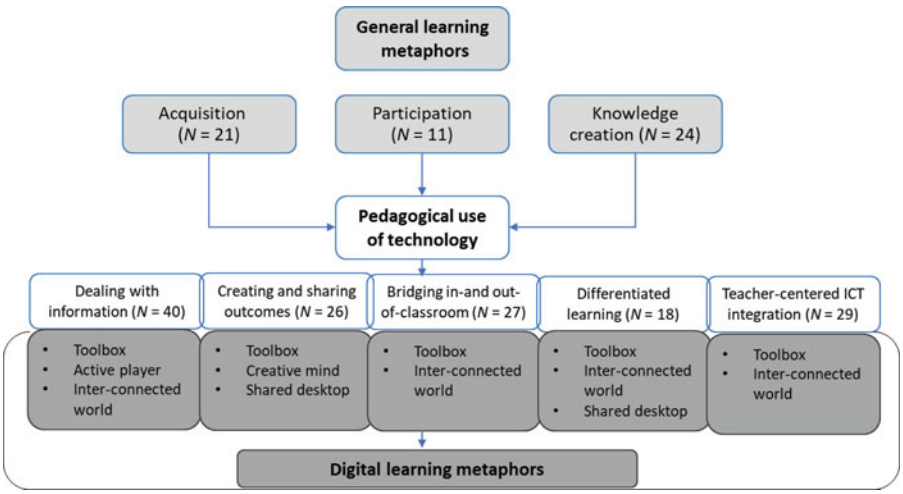

Figure 2. Contribution of technology to pedagogy in the perspectives of ICT leaders and reported learning activities.

Table 2. Metaphors of digital learning in the reported activities.

Pedagogical use of technology: categories and explanations	Quotes	Digital learning metaphor
Dealing with information (*N* = 40) Many statements were grouped under the sub-category of locating, gathering, organizing, and assessing information. The statements referred to both the information found on the Internet and the information that students documented using digital tools. Some of the interviewees emphasized the importance of developing students' digital literacy of searching and evaluating online information.	"When we learned the topic 'our region' we used Google Maps and students had to take pictures of their settlements. They had to search for information and write a digital story about their settlements. They searched for the relevant materials, evaluated them, and decided if they are appropriate for the task … This skill of searching for information from different sources, knowing what to choose and how to present it, is very important" (N).	The digital *toolbox* enabled students to be engaged in all learning phases. The metaphor that is conveyed in the quote is *active player*. Students in the classroom access information from the entire world, as described by the *inter-connected world* metaphor.
Creating and sharing learning outcomes (*N* = 26) Various ICT tools enable the creation, editing and representation of information or artifacts in a variety of forms.	"You can use every tool at your disposal and you allow children to express their creativity—'How am I going to represent and share with my classmates the process I went through?' One child will create comics, another one will film a video clip; some groups will prepare a shared concept map and others will create a shared presentation" (G).	Technological *toolbox* enables creating and sharing learning outcomes, emphasizes the expression of creativity according to the metaphor *creative mind.* It also enables sharing information and collaboration with peers according to the *shared desktop* metaphor.
Bridging in- and out-of-classroom (*N* = 27) The interviews revealed that bridging in- and out-of-classroom has two distinct realizations: by creating a ubiquitous continuum of learning and by connecting the classroom to the outside world. Both ways of bridging in- and out-of-classroom can apply any pedagogical approach. The first way—the ubiquitous continuum of learning—increases the amount of learning time, and more importantly, develops lifelong learning skills of students.	First way—ubiquitous learning: "Some of the work was conducted outside of classroom. There was an important continuity of learning process at home. The teacher communicated with the students and provided feedback through a shared document" (D V). Second way—connecting classroom to the world: "In 4th grade history curriculum, students prepared projects on the topic 'tales of my town/community'. They carried out the entire project as a digital storytelling. Students conducted video or audio interviews with adults from their communities and incorporated these documented stories in their outcomes. They also prepared presentations combining photos and personal comments. And finally, they published the stories so that people in their communities could access, enjoy the outcomes, and provide feedback" (S).	Using a shared document or digital storytelling are examples of perceiving technologies as a *toolbox*. In addition, these tools enable continuous learning, connect classrooms with the outside world and thus were also coded as the *inter-connected world* metaphor.

(*Continued on next page*)

Table 2. Continued

Pedagogical use of technology: categories and explanations	Quotes	Digital learning metaphor
Differentiated learning (*N* = 18) Technology allows adaptation of the level of difficulty of learning activities to individual needs of students, providing them with immediate personalized feedback. Personalized instruction based on the background assessment supports students' self-directed learning. Another expression of differentiated learning involves more advanced students helping and facilitating learning of their peers**.**	"Throughout the school year we use learning tasks by 'O' [digital content provider approved by the Ministry of Education], where the teacher can rank the difficulty level of each task, and assign tasks for individual students, depending on their level. Another content provider we were using is 'T' [name of the content provider], that also allows the teacher tracking of student progress and providing feedback in the classroom and remotely" (V). "Students teach other digital skills they already developed, such as preparing well-designed presentations, illustrating animations, etc. Children who advance more quickly have the opportunity and are encouraged to help their classmates" (N).	The learning environment of different digital content providers is perceived as a *toolbox* that enables individualized learning in terms of activity type and difficulty level. The *shared desktop* metaphor describes the contribution of technology (shared files and learning systems of digital content providers) to collaborative learning. *Inter-connected world* metaphor conveys the ability of teachers monitoring progress of each student by remote tracking as well as facilitation and feedback provided by both teachers and advanced students to their peers.
Teacher-centered ICT integration (*N* = 29) When a class has one computer and an overhead projector, it is often used for presentations; thus, students have no opportunity for active technology-enhanced learning. Even in one-to-one computing classrooms, when technology is used to watch, listen, and read, students are not necessarily engaged in the learning process. The use of screens, instead of blackboard and chalk, provides more reach and interesting presentations and visualization of learning materials. However, the pedagogy remains teacher-centered.	"I remember a teacher saying: 'I showed them a presentation.' So what? I told him that presentation does not transform the lesson to a truly technology-enhanced one"(Q). "ICT is still more used for traditional teaching; students are sitting in front of the board, watching a video clip on YouTube or another website or listening to teacher's presentation and learn that way. It has not produced the pedagogical change that we are looking for" (M).	The most prevalent model in elementary schools in Israel is the whole-class technology rather than one-to-one computing. The whole-class technologies afford more teacher-centered integration of technology. Such usage mostly conveys the ICT as a *toolbox* metaphor. It also connects classrooms to the world, as is expressed by the *inter-connected world* metaphor.

Often learning processes contained a combination of several metaphors. One example of such combination is a project in which students helped build a digital museum of local art and history. In this case, learning had a cultural context and was related to the real-world project (participation metaphor). In addition, students created original digital outcomes based on the cultural artifacts they documented and information they discovered (knowledge creation metaphor). When planning and preparing these outcomes, students acquired relevant knowledge by summarizing the information they read about (acquisition metaphor).

> Students understand the difference between the function of an object and its decoration. … They associated items with fables and stories, and categorized objects they brought from home or objects they photographed or documented. … The important thing was encouraging students to think by themselves, to discuss with peers and to search for information or evidence, rather than answering directly their questions. Let them consolidate their own perspectives and interpretations, decide by themselves how to express their ideas and how to design their outcomes, what technologies to use and how to make their representations tangible and interesting. (A I)

Metaphors of digital learning in technology-enhanced learning activities

Five metaphors of digital learning describe various pedagogical aspects of technology-enhanced teaching and learning. The toolbox metaphor was the most prevalent of the metaphors of digital learning. It describes the perception of technology as a collection of tools that enables diverse learning activities and thus appeared in all bottom-up categories of pedagogical use of technology (see Table 2). Other metaphors refer to more specific digital pedagogies.

Figure 2 summarizes the perspectives of ICT leaders on the contribution of ICT to pedagogy based on the analysis of general learning metaphors and digital learning metaphors. As Figure 2 shows, general learning metaphors (in light-gray background) convey categories of pedagogical use of technology (in white background), each of which includes several metaphors of digital learning (in dark-gray background).

As Figure 2 indicates, all metaphors of general learning and digital learning were present in technology-enhanced learning activities described by the ICT leaders. Among general learning metaphors, knowledge creation and acquisition were more prevalent. Digital learning metaphors were grouped in general categories describing pedagogical use of technology revealed through bottom-up analysis. The most prevalent of these categories were dealing with information and teacher-centered ICT integration.

Discussion

The aim of this study was to analyze perspectives and school practices reported by ICT leaders—school and regional ICT coordinators. The analysis was conducted based on general learning metaphors of acquisition, participation, and knowledge creation (Sfard, 1998, Paavola et al., 2004) as well as on digital learning metaphors—toolbox, active player, creative mind, shared desktop, and inter-connected world (Shamir-Inbal & Blau, 2016).

The findings showed that all three metaphors of general teaching-learning processes (Paavola et al., 2004) and all five metaphors of digital learning (Shamir-Inbal & Blau, 2016) were present in the technology-enhanced learning activities delivered in schools and reported by ICT leaders. The participants emphasized in their reflections the potential promise of ICT tools to create a pedagogical change in

teaching-learning processes. They highlighted the importance of changing prevalent teaching practices and underlying pedagogical beliefs to practices suitable for the needs of learners in the knowledge society.

Concerning the first research question, we expected to find in the reports of the interviewees—ICT leaders—more statements associated with the knowledge creation and participation metaphors than with the acquisition metaphor (Table 1). Indeed, the metaphor that was most prevalent in the interviews was the knowledge creation metaphor ($N = 24$). This indicates that the participants understand the importance of exchanging ideas among students and sharing with classmates the learning artifacts they designed. These findings are consistent with the argument of Paavola and colleagues (2004) regarding the shift from an acquisition metaphor of learning to a participation metaphor and increasingly to a metaphor of creating knowledge. However, the ICT leaders also reported many cases ($N = 21$) that convey an acquisition metaphor, which is based on the assumption regarding the objectivity of knowledge and teacher's role as a person who transfers the knowledge to students. This finding is consistent with Sfard's (1998) argument regarding the coexistence rather than competition between different learning metaphors, since each of them refers to a different part of the learning process. The participation metaphor appeared in the reports of ICT leaders only half as much as metaphors of acquisition and knowledge creation ($N = 11$). The relatively small number of statements that refer to the participation metaphor are consistent with findings of previous studies regarding learning in online communities in schools (Blau & Shamir-Inbal, 2017a; Shamir-Inbal & Kali, 2007). Together these findings suggest that collaborative learning and learning in communities have not yet become an integral part of the schools' culture in Israel, resulting in relatively rare cases of technology-enhanced communal learning and teamwork.

Analysis of the pedagogical context in which the statements of each general learning metaphor appeared revealed a picture that is more complex than Sfard's (1998) argument regarding the coexistence of different metaphors. In our study (Table 1), knowledge creation and the participation metaphors were associated with descriptions of learning activities that realize the added value of digital technologies for pedagogy. Conversely, the acquisition metaphor appears in both types of learning activities reported by the participants: in activities that use ICT tools to enhance teacher-centered pedagogy and in activities that promote student-centered learning.

As for the second research question, bottom-up categorization revealed that digital learning metaphors are grouped into five general pedagogical categories: dealing with information, creating and sharing learning outcomes, bridging in- and out-of-classroom, differentiated learning, and teacher-centered ICT integration. While very few metaphors of general learning presented in Table 1 coexisted in one statement, each pedagogical category presented in Table 2 contains two or three metaphors of digital learning. For example, the category creating and sharing learning outcomes contains the metaphors of toolbox, shared desktop, and creative mind, while the category bridging in- and out-of-classroom includes the metaphors

toolbox and inter-connected world. This coexistence of different metaphors of digital learning in larger pedagogical categories is consistent with the findings of previous studies (Shamir-Inbal & Blau, 2016).

Digital learning metaphors that describe general pedagogical principles enabled us to differentiate traditional teaching practices from more innovative ones. For example, the toolbox metaphor was present in every general pedagogical category, but in a variety of ways. Toolbox could serve teachers for the presentation of updated information and illustration, for actively engaging students in the learning process, for searching information on the Internet, for collecting information independently by recording interviews and taking pictures, and for communication in the learning community or with experts on the learning topic.

The conjunction of pedagogical principles and digital learning metaphors provided the context of the learning activity and its underlying pedagogical approach. While the most prevalent general principle was dealing with information ($N = 40$), which included among others the metaphor of active player, the second most prevalent category was teacher-centered ICT integration ($N = 29$). Thus, the findings presented in Table 2 suggest that both more innovative pedagogy and more traditional technology-enhanced learning were prevalent in the activities reported by the ICT leaders. These findings are consistent with previous studies that, on the one hand, highlight the opportunities that ICT opens for constructivist learning (Bower et al., 2010) and for supporting collaborative learning processes (McCormick, 2004) but, on the other hand, report many cases of using technology to support traditional teacher-centered pedagogy (Blau et al., 2016; Peled et al., 2015).

Conclusion, implications, and limitations

This study discussed pedagogical aspects of technology-enhanced learning. Analyzing perspectives and learning activities reported by the ICT leaders in schools through three general metaphors of learning and examining the characteristics of technology-enhanced learning through five metaphors of digital learning shed light on the way ICT leaders understand the contribution of technology integration to pedagogy and promote the realization of its potential in teaching practices. Although all three metaphors of learning in general and five digital learning metaphors were expressed by the interviewees, the prevalence of each metaphor was quite different. Awareness of the learning metaphors can inspire introspection and reflection that draws attention to the importance of the participation metaphor, whose prevalence is currently relatively low. In addition, this awareness will encourage greater sensitivity to a duality of acquisition metaphor, which expresses both the use of ICT tools to enhance teacher-centered pedagogy and to promote student-centered learning.

However, it should be taken into consideration that although we combined the perspectives and reports of two types of ICT leaders—schools' ICT coordinators and regional ICT coordinators—the analysis was conducted based on interviews with a relatively small number of participants working in secular elementary schools

in a large district of Israeli Ministry of Education. Future studies should expand the research sample and investigate these issues in other cultural and educational contexts.

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