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SCHOOL TECHNOLOGY LEADERSHIP AND THE MAKER MOVEMENT

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ABSTRACT

The developments and changes that have been made in the world affect the educational, health or economic systems of the countries. This situation requires the schools to renew themselves. In the recent year the Covid-19 pandemic that has been experienced all around the world has accelerated this process. It showed clearly that schools should be the places where real life experiences are taught and integrated with life. Regarding this, it was aimed to present a detailed perspective about maker movement and technology leadership that are closely related to the point of view that schools should be the life itself. Accordingly, a general perspective about leadership has been summarized shortly at the beginning of the study and then technology leadership and maker movement have been presented in a detailed way and reflections of technology leadership and maker movement have been discussed. Lastly, some suggestions have been proposed for both teachers and school principals.

Keywords: leadership, technology leadership, makerspaces, maker movement

Introduction

21st century has been the time when knowledge and technology has been changed at a dizzy pace. This time requires principals and employees to be more active, productive and innovative. Leadership which has been caught the attention of the scientists all along can be helpful for keeping up with the time. Leadership that was defined as “a process whereby an individual influences a group of individuals to achieve a common goal” (Northouse, 2007) has been a qualification that all principals need to have in this century.

When considered from the perspective of educational organizations and the phrase of leadership at schools are uttered, school principals come to one’s mind firstly because they are the head of the schools. Today school principals are not only assumed as the principal, but also as the leaders of the school. A lot of studies about different types of leadership (Aga, Noorderhaven & Vallejo, 2016; Anderson & Dexter, 2005; Author 1, 2013; Flanagan & Jacobsen, 2003; Rafferty & Griffin, 2004; Spillane, 2003; Taylor, Cornelius & Colvin, 2014) have been conducted. Nevertheless, the dizzy pace of change in the technology as well as the current period require the school principals to be technology leaders at the same time. That is, leadership and management should go hand in hand.

Since technology will be an inseparable part of our lives it would be nonsense to avoid it. Instead of that, one must learn and adopt the technology because besides our personal and social lives, working life necessitates that employee must have the technology knowledge as well. It looks for the employees and administrators who optimize their use of the existing technology. As in the other sectors, this is the same for the education as well. With its teachers and principals, it is a must to use the technology effectively. Especially, principal as the leader of the school needs to integrate the technology with the school and curriculum in 21st century.

Technology Leadership

Schools have been in existence as educational institutions at which educational technology is getting used more and efficiently day by day (Chen et al., 2020). The efforts of the school about using the technology more efficiently during the educational process do not only provide students the opportunities of having better learning experiences but also contribute to the skills they need to acquire. The one that enables emerging educational technologies to be used efficiently in education is the school principals- technology leaders- who formulate the policies, take decisions and try to implement these decisions on this topic (Flanagan & Jacobsen, 2003; Gibson, 2002; Gurr, 2004; Kearsley & Lynch, 1992).

School principals as leaders have direct and indirect effects on learning of teachers and students, participation of the students to the lessons and academic success by influencing the working conditions of teachers (Hallinger & Heck, 1998; Hitt & Tucker, 2016; Leithwood et al., 2004; Louis et al., 2010;

Richardson & Sterrett, 2018; Supovitz et al., 2010). Thus, school principals should have the skills that provide them to use the technology that will affect the quality of learning positively. This context is only possible with school principals being technology leaders (Sauers & Richardson, 2019; Sterrett & Richardson, 2017).

Technology leadership that provides educational technology being used effectively plays a vital role on school goals (Anderson & Dexter, 2005; Papa, 2011; Schiller, 2003). In recent years technology leadership in education has been a topic for extensive researches in a global context (Alenezi, 2017; Apsorn et al., 2019; Chang, 2019; Esplin et al., 2018; Gallego-Arrufat et al., 2017; Gonzales, 2019; Moreira et al., 2019; Raman et al., 2019; Thannimalai & Raman, 2018). In order to reveal what the studies conducted present exactly, two studies that can also be called as the current literature's tomography are like a road map for researchers within the context of technology leadership (Dexter, Richardson & Nash et al., 2016; Dexter & Richardson, 2020).

Anderson & Dexter (2005) defined that technology leadership is about a group of decisions, policies and activities within an organization and also involving effective usage of ICT in education. Then, to be able to a technology leader, first of all, one should have a vision to use the technology effectively in education and educational administration (Richardson, Flora & Bathon, 2013; Richardson, McLeod & Sauers, 2015). School principals as the technology leaders have a vision that is innovative (Sharija & Watters, 2012), will contribute to the students' learning much better (Yee, 2000), and provide the school to achieve its goals (Wong & Li, 2008). Similarly, a school principal who is also a technology leader does not only content with having a vision but also s/he makes it visible throughout her/his professional life (Banoğlu, 2011; Stuart et al., 2009; Yu & Durrington, 2006), tries to be shared by the participants of school with the aim of being implemented (Davidson, 2003; Davidson & Olson, 2003; Dexter, 2011) and becomes a model (Afshari et al., 2010; Leonard & Leonard, 2006). Essentially this process is mostly about making this vision to be a part of a distributed leadership process (Richardson et al., 2015; Schiller, 2003; Sheppard & Brown, 2014).

Although researchers reveal the photos of qualifications that a school principal who is also a technology leader must have, a school principal requires specific standards to be able to use the educational technology efficiently (Redish & Chan, 2007; Yee, 2000; Yu & Durrington, 2006). International Society for Education Technology (ISTE), develops standards for school principals and updates these standards according to the emerging developments in technology. Within this context current standards for education leaders have been determined as advocates of citizenship and justice, visionary planner, strengthening leader, designer of systems and connected learner (Sheninger, 2019). Besides school principals must have some proficiency to be technology leaders, they must support the teachers for the effective integration of educational technologies. Regarding this, principals firstly should structure the time for teachers to learn how to use the educational technology (Gerard et al., 2010), formulate policies for sustainability of technology integration (Anthony, 2011; Richardson &

McLeod, 2011), employ staff out of school (Devolder et al., 2010; Robertson et al., 2006; Seong & Ho, 2012; Vanderlinde et al., 2012) and provide fund (Chang et al., 2008; Cuban et al., 2001). Technology and the development of profession shows a powerful impact on the principles and beliefs of teachers (Inan & Lowther, 2010). The research results show that school principals empower the teachers as a leader and coordinate a general leadership implementation that will make technology integration possible (Dexter et al., 2016; Levin & Schrum, 2013).

School principals' -including themselves as well- creating a building professional learning environment and opportunities is a supportive factor for teachers and students to use the technology efficiently (Gerard et al., 2010; Schrum et al., 2011; Wong & Li, 2008). However, the study results also reveal that both school principals and teachers need more professional development to have such an understanding (Author 1, 2013; Sharija & Watters, 2012). Similarly, school principals can also be an important part of developing curriculum processes in which educational technology is used efficiently (Chiu, 2017; Gerard et al., 2008; Glazer et al., 2009; Kafyulilo et al., 2016; Staples et al., 2015). Practices that have been combined with curriculum for technology integration in education and support the programme increase the efficiency of teachers (Allan et al., 2010; Courduff et al., 2016; Davidson & Olson, 2003; Harris & Hofer, 2017; McKenney et al., 2016; Svendsen, 2016), keep the expectations alive (Ritzhaupt et al., 2008; Wong et al., 2008) and strengthen the usage of educational technology (Divaharan & Lim, 2010; Jones & Dexter, 2014; Trust, 2016). In the last quarter century, the maker movement provides an innovative point of view about this topic.

The Maker Movement

Making is a term that was introduced in 2005 by the magazine -Make- publication (Dougherty & Conrad, 2016) and is a valuable learning activity which focuses on designing, building, modifying, and/or repurposing material objects, for playful or useful ends, oriented toward making a product of some sort that can be used, interacted with or demonstrated (Martin, 2015). The process involves the engagement of people within creativity, designing and with the development of things that are crucial to individuals personally or for their community (Bullock & Sator, 2015).

Making is a multi-dimensional - with its both individual and activity phase - notion. On the one hand making can also be associated with activities that may also be designed for the purpose of learning goals (Harron & Hughes, 2018) on the other hand it helps learners to shape their lives (Lindstrom, Thompson & Schmidt-Crawford, 2017). Making of which human takes place at the core (Hira & Hynes, 2018) is connected to constructivist philosophies and educational ideas (Halverson & Sheridan, 2014; Harron & Hughes, 2018). Another factor is to provide students to succeed by putting their work into a larger social context, develop higher level thinking skills, question and determine their own experience (Harron & Hughes, 2018; Martin, 2015).

One concept that is related to making is also maker movement. Maker movement is a cooperative problem-solving way that leads to new learning paths by using the ability of building/designing that is one of the basic human characteristics and includes the people of different profession groups who come together for both playful and useful purposes creatively (Dougherty, 2012; Martin, 2015; Peppler & Bender, 2013; Schad & Jones, 2019). It is also expressed as a kind of do-it-yourself (DIY) act and has been started to garnered attention all around the world with the declaration of President Obama in 2014 to encourage the studies that will be conducted especially regarding the creativity and innovation for 21st century (Halverson & Sheridan, 2014). The maker movement especially attracted the attention of the educators and researchers (Hsu, Baldwin & Ching, 2017; Peppler & Bender, 2013) who conduct studies about STEM.

Various explanations and definitions about marker movement which has attracted the attention of the researchers and educators have also been done. As an example, Peppler and Bender (2013) defined the term as a culture that consists of hands-on making, creating, designing and innovating. Dougherty (2012) expressed as a combination of fabrication and communication technologies; Halverson & Sheridan (2014) stated it as the increasing within the population of people involved in the production of creativity and introducing their products with others through physical and digital forums; Martin (2015) recorded the representation for the growing movement of hobbyists, tinkerers, engineers, hackers and those creative for designing and building artists; Kjällander et al. (2018) noted that the maker movement is an elevated version of the traditional do-it-yourself movement with the addition of digital fabrication, tools, materials which also includes techniques.

Halverson & Sheridan (2014) pointed out that the maker movement has three components named making, makerspaces and makers. Like Halverson & Sheridan, Martin (2015) also claimed that the maker movement has three elements as well. These elements are explained as follows: (1) digital tools which are about rapid prototyping tools and low-cost microcontroller platforms; (2) community infrastructure which is about online resources and in-person spaces and events; (3) the maker mindset which is about values, beliefs and dispositions.

Maker movement -with its all components- welcomes all types of making. It brings a wide range of activities such as cooking, wood-crafts, robotics, digital fabrication etc. (Kafai, 2018; Peppler & Bender, 2013) and provides an environment/ setting in which students engage in problem solving within the real world. The creation of meaningful products and valuable content information in the process are done by students (Rodriguez, Harron & DeGraff, 2018).

The maker movement which developed in out of educational institutions (Dougherty, 2012; Harron & Hughes, 2018; Lindstrom et al., 2017; Martin, 2015) has been embodied in the culture of school (Halverson & Sheridan, 2014) and combined the formal and informal learning processes (Vossoughi & Bevan, 2014). It has required reimagining school and fostered a mindset of creativity and innovation in educational settings (Peppler & Bender, 2013).

As the interest in maker movement increases at schools, the desire of combining the notion of maker-centered learning that was created by Claps et al. (2016) to define the learning of hands-on activity to the educational process started to emerge. In this process, maker-centered learning providing observable parameters to the educators to help has come to the forefront as an important factor (Schad & Jones, 2019). The process of maker-centered learning usually occurs in the places called makerspace (Bullock & Sator, 2015; Hira & Hynes, 2018; Martin, 2015; Peppler & Bender, 2013; Schad & Jones, 2019). These spaces are physical learning environments actively engaging students and teachers to transform ideas to projects through hands-on making activities (Bullock & Sator, 2015; Hira & Hynes, 2018; Schad & Jones, 2019) and so making and maker movement emerge concretely. They are the places where individuals actively engage in the physical creation of objects and use technologies to make physical artifacts within a community or make technology based projects (Hira & Hynes, 2018; Schad & Jones, 2019); where learners share their passion, connect them to historical and cultural traditions important to local families (Peppler & Bender, 2013); where people of varying backgrounds come together to tell others about their ideas, experiences, instruments and create a combination of people, means, tools, equipment and activities of designing and creating (Hira & Hynes, 2018; Bullock & Sator, 2015).

Makerspaces enable people of all ages to address community problems through making and can be built in various settings like in museums, summer camps, online (Harron & Huges, 2018; Kafai, 2018; Kjällander et al. 2018; Peppler & Bender, 2013) or in educational spaces like schools and libraries (Hira & Hynes, 2018; Kjällander et al. 2018; Peppler & Bender, 2013). As it is the same for Making, the roots of makerspaces are based on constructionism, experimental learning, self-efficacy and agency. In makerspaces students are in the pursuit of knowledge and develop themselves. They do not focus on economic benefits (Martin, 2015) and learn through making. It supports learners to have a sense of self and helps them to shape their lives. (Lindstrom et al., 2017). Makerspace in which makers are quite free about the activities to be done (Martin, 2015) is the place where participants' hobbies are reflected through the tools and projects (Harron & Hughes, 2018). People make things that are meaningful to them (Hira & Hynes, 2018). Sharing ideas and projects (Harron & Hughes, 2018; Kjällander et al. 2018; Peppler & Bender, 2013) and collaboration are also important (Kafai, 2018; Martin, 2015).

Since the roles of the teachers and makerspaces' philosophy are totally different from each other (Lindstrom et al., 2017) it is possible to have some challenges during the process. The challenges that may be encountered are listed by Hira & Hynes (2018: 2) as follows: (1) Lack of diversity within the maker movement; (2) Ideological disconnects between the democratic ideals of human agency and change the capitalistic forces at play in some makerspaces; (3) The challenges associated with replicating successful exemplar spaces in different contexts (locations and cultures); and (4) Many of the activities that constitute Making have been associated with men. The values of carrying that are often associated with women are devalued by the movement.

Regarding the challenges, Kjällander et al. (2018) claimed that non-existence of girls in makerspaces and getting low access to maker spaces and tools are just two obstacles that will impact successful implementation. Another research worth noting about the challenges is the study conducted by Kafai in 2018. She discussed two challenges: cultural experience that is about the way of approaching and engaging with making and the lack of diversity.

In spite of the challenges, it is possible to make something in makerspaces to create a rich atmosphere and be successful. Since the focus of the maker movement is an effort to re-use and repair (Bullock & Sator, 2015) there is no need of providing very expensive materials. Peppler & Bender (2013) stated that you do not need a 3D printer or sewing machine. You can start by gathering recyclable materials. They suggested thinking less about the products that will be created, playing with materials and allowing more time for experimentation.

Another technique that can work in makerspaces is open-ended exploration (Peppler & Bender, 2013). This open-ended exploration works together with the community. Community is the component that people both in person and online share their work, read, socialize and watch videos together during the process (Martin, 2015). Peppler & Bender (2013) recommended that teachers/leaders to encourage the youth to make whatever they are interested in making and have an open invitation for all personal interests. They also highlighted that teachers should encourage multiple solutions as there is never just one correct way to do something. Unusual thinking is also supported during the process. Failure is welcomed and seen as a growth opportunity. It is valued as a starting point opening to a new winning (Martin, 2015; Harron & Hughes, 2018). The study conducted by Harron & Hughes (2018) revealed that the leaders who create an atmosphere with a vision of makerspace at the institutions where they work do more than they are expected.

Since it has caused the thought that it will empower the teaching and learning (Berry et al., 2010) and educators' need of gaining an appropriate pedagogy has come to the forefront (Bullock & Sator, 2015; Cohen, et al., 2017; Schmidt-Crawford, Lindstrom & Thompson, 2018) it is a must to educate pre-service teachers and leaders according to it. Teachers should get the education needed (Rodriguez et al, 2018; Schad & Jones, 2019) because teacher is the facilitator in the acquisition of knowledge through maker-centered learning activities (Schad & Jones, 2019), is the one who creates supportive communities of practice in designing classrooms (Lindstrom et al., 2017). Shortly, it can be said that schools need a change and guidance on how to construct it (Martin, 2015).

Conclusion, Discussion and Suggestions

In this study, technology that is an inseparable part of the 21st century and its reflection on the educational organizations were discussed in the context of technology leadership. First of all, it has been seen that school principals are expected to be innovative and proactive. They must use the technology effectively, integrate into the school, support the teachers to use it and provide the school with fund (Chang et al., 2008; Cuban et al., 2001). In addition to supporting the teachers to use the

technology effectively, they must support the teacher to develop themselves. In that sense, technology leaders become role models for others and lead them to use the technology (Afshari et al., 2010; Gächter & Renner, 2018; Leonard & Leonard, 2006; Sims & Brinkman, 2002). It can be said that school principal as the technology leader is the role model for the teachers in makerspaces. And so, together with teachers, school principals/technology leaders follow the developments and changes in the world and put into practice as the effective users of the technology. In another words, they do not confine their efforts; rather than, they keep up with the current events and changing world.

In a period during which technological changes come at a dizzy pace schools are not supposed to proceed in old order. Actually, schools are dynamic organizations that incorporate changes and developments. They cannot live independently. They get the world and society into the school. In one sense they make the schools into the real-life places. One of the ways to make this is the maker movement. Maker movement is a philosophy involving creating, designing and innovating. It is an act in which students put their experiences, ideas and projects into practice. It is a kind of a combination of real life and curriculum. With the leadership of their teacher students can integrate the technological developments with their projects for the life. So, they contribute both to the society and the world. In order to see the success of the students we should be sure that teachers have the necessary abilities. Besides teachers, principals must have the enough competence as well.

Teachers and principals should not avoid the technology. The convenient sides of it should be integrated in makerspaces. Preparing the student for the life in an integrated way with the world is one of the basic responsibilities of school. Teachers and principals have important duties and responsibilities while doing this. They should develop themselves, keep up with the latest technological developments, integrate the positive sides into the education and update their classrooms. In addition to these, school principals should firstly establish a vision and share it with the teachers. So, all participants can know the purpose of the action and what they are expected to do. As stated in the literature, a school principal as the technology leader is the visionary planner and system designer as well (Sheninger, 2019). The leaders who create an atmosphere with a vision of makerspace at the institutions where they work do more than they are expected (Harron & Hughes, 2018). When the vision is articulated clearly by the leaders and get accepted by the members and stakeholders then the success comes itself (Kebritchi, 2009; Stosic, 2013). As Rogers (1983) claimed when the purpose of an innovation is understood enough well, the innovation is adopted and implemented quickly. Similarly, Gadirajurrett, et al. (2018) pointed out that leaders should clearly articulate the vision because it may encourage the followers to take more responsibility. In creating a makerspace and sustaining its success, vision is both important and necessary (Collins, 2017; Kebritchi, 2009; Rouse, Krummeck & Uribe, 2020; Stosic, 2013) since it guides the process. So, school principal as the technology leader should firstly establish a vision and share it with others.

Furthermore, school principal/technology leader should be care about her/his attitude. When the leader has a democratic attitude then the success can emerge itself. For instance, planning with

teachers (Rouse et al., 2020) or inviting teachers to the decision-making process and gaining autonomy in makerspaces motivate and encourage them to work harder. Feeling free and comfortable in a makerspace setting are valued as positive in the context of the makerspace session (Collins, 2017; Paganelli et al., 2017). Hence, such an attitude can contribute to the motivation of teachers. That is, if the school principal as the technology leader has democratic attitude teachers can be more willing and determined. They can know what they are going to do.

Another point that school principal/technology leader notice is the implementer's competence. Competence is the ability that a person must have to do a specific task well. In this sense teachers' -as implementers- qualification is vital. If the implementers do not have enough competence then the vision goes to waste and becomes unsuccessful, no matter how strong the vision is. Being successful in makerspaces is possible with teachers' professional development (Collins, 2017; Guek, 2015; Kurti, Kurti & Fleming, 2014; Paganelli et al., 2017; Vuorikari, Ferrari & Punie, 2019) and professional development contributes to the competence and performance of the person. Administrative support is important (Collins, 2017; Kurti et al., 2014; Smith & Light, 2016) for developing competence and professional development because teachers may have some challenges (Hira & Hynes, 2018; Kafai, 2018; Kjällander et al., 2018). They may need to upgrade their skills (Guek, 2015) to overcome these challenges and to be successful in makerspaces. So, administrators as the technology leaders should invest in teachers, support and encourage them to develop themselves. Shortly, makerspaces require professional development of teacher and at this point. School principal/technology leader needs to encourage the teachers to develop themselves and support the teachers for effective integration of educational technologies.

As a conclusion, Covid-19 pandemic that the whole world has experienced in the recent year has demonstrated that schools and educational organizations should be real life places. In this sense, school principal as the technology leader and teachers as the leaders in makerspaces have some vital roles during this process. With respect to this, this study has been conducted. It has taken a photo of makerspace and suggested some practical implementations that will work in makerspaces to the school principals as the technology leaders. It has emphasized that a school principal has some important tasks for the success of makerspace. As an example, school principal as the technology leader should have a vision for the maker movement and share it with teachers who will work in makerspaces actively. Besides sharing the vision, administrative support for professional development, having a democratic attitude, being effective technology user, creating an environment for teachers and students to use the technology effectively are just some of them.

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