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Technology-Enhanced Parent Involvement in Science Education

Keisha Varma

Abstract

Parent involvement is a critical facet of academic success. Empirical studies and meta analyses highlight that it can increase students' motivation, self-efficacy, and academic performance. Even though they recognize the importance of being involved, minority and immigrant parents are likely to have lower levels of parent involvement than white parents. This could be a contributing factor to the academic gaps that exist between white students and minority and immigrant students. Technology can provide new ways to increase parent involvement and can address equity issues by providing more innovative and flexible opportunities for parents to be involved in their students' academic experiences. This chapter summarizes ideas from (ESPRIT) Fostering Equitable Science through Parent Involvement and Technology, a National Science Foundation funded project that utilizes a technology-rich social learning environment (SLE) to engage middle school science teachers and student-parent pairs in culturally responsive, science-related activities. A new model of parent involvement is presented, followed by a discussion of the roles parents play as they participate in the SLE activities with their children.

Keywords: social learning environment, parent involvement, parent roles, computer supported collaborative learning, science education, technology

1. Introduction

When students know that their parents are invested in their education experiences, they understand the importance of education and the expectations their parents have for them [1]. When parents are engaged in students' academic experiences they are more likely to know what is being taught in students' classes and can to find ways to support their learning at home. As the significance of parent involvement becomes more evident school leaders, teachers, and policy makers are exploring ways to expand parent involvement. There is a motivation to move beyond traditional approaches such as parent-teacher conferences to more dynamic, engaging approaches where parents' knowledge is valued and leveraged to create culturally responsive education experiences. Even though the structure of formal K-12 schools creates more opportunities for parents to participate in young elementary students' education experiences, middle school students still show great benefit when their parents participate in school-based events and academic experiences [2].

If parents can engage in academic tasks with their students, it extends students' instruction experiences. Students have more opportunities to discuss content, relate it to real world contexts and make meaningful connections to their lived

experiences. These experiences could improve students' science, technology, engineering, and math (STEM) knowledge and lead to increased learning outcomes.

This chapter summarizes some of the work being done on the Fostering Equitable Science through Parental Involvement and Technology (ESPRIT) Project that focuses on the ways that parents participate in activities designed to increase their involvement in middle school students' science education experiences. In the ESPRIT project work, ethnic and racial minority and immigrant parents are invited to create video responses to questions and activities assigned by their middle school students' science teachers.

ESPRIT leverages a technology-enhanced social learning environment (SLE) called Flipgrid™ (flipgrid.com) to engage science teachers and student-parent pairs in discussions and activities designed to create connected learning experiences [3] that prompt middle school students to connect their personal interests and cultural knowledge with their academic science learning experiences. The Flipgrid social learning environment is available via an app that works on laptops, tablets, and smart phones. In a typical sequence of events, teachers create a video or text based question or assign a brief activity within the SLE and share the question via a secure link sent to students and parents. Then parents and students create a video-based response between 90 seconds and 5 minutes long. Teachers can show the video responses during class, respond to them individually, or ask students to engage in an online discussion by responding to each other's videos. This project is well-situated to examine the rich affordances of computer supported collaborative learning experiences as we focus on how teachers, students, and parents form a dynamic knowledge building community via interactions with the SLE activities [4].

A major facet of the ESPRIT project research is to understand the ways in which participating in the SLE activities increases parent involvement. This chapter presents a new model intended to expand the notion parent involvement to focus on behaviors and activities that shift and adjust as teachers, students, and parents participate in a range of constructive, collaborative activities. The chapter also highlights roles that parents take on as they participate in an online social learning environment. These ideas are relevant for researchers, teachers, and curriculum designers interested in new ways to support parent involvement and incorporate technology into science education experiences.

2. Conceptualizations of parent involvement in education

Parent involvement is broadly defined as the behaviors that parents engage in with their children at home and the activities they participate in in school contexts. In their conceptualization of parent involvement, the authors in [5] describe parent involvement as having three dimensions related to behavioral, affective, and cognitive behaviors. They further specify that in order for children to experience the positive benefits of parent involvement, they must actively process information related to the involvement behaviors and incorporate it into their attitudes, motivations, and school-based schemas.

Recent research aimed at understanding home-school relationships asks that we reconceptualize parent involvement as parent engagement that is "a two-way interaction process between school and home, referring to a mutual exchange of values and knowledge. It places emphasis on reciprocity, empowerment, empathy, change and opportunities for both parents and the school" [6], p. 11.

Other perspectives of parent involvement discuss the distinction between parent involvement and parent engagement as a continuum of roles [7]. At one end of the continuum, parents participate in traditional parent involvement activities. They

are primarily recipients of information from teachers and participants in school-directed activities. The other end of the continuum represents more active parent engagement where parents have agency and participate in activities that directly support student learning. This continuum framing aligns with the call for schools to view families as partners who can play important roles that support students' academic success [8].

Many types of parent involvement have been shown to support students' educational experiences and increase student learning outcomes [9]. To build on this knowledge, teachers, curriculum designers and researchers can leverage technology to take advantage of the fact that parents are driven to be engaged in meaningful ways and are willing to take on significant roles in their students' education experiences. As we consider how technology can support student learning, we can also focus on how it can enhance parent involvement.

The ESPRIT project embodies this approach to broadening the impact of technology in education. In the social learning environment, teachers ask open-ended questions that allow parents and students to determine how they want to respond. Parents are asked to participate in activities that invite them to make cognitive, socio-emotional, or cultural contributions to the tasks. Parents also have more agency to structure the activities they engage in with their children. For example, as they record a video response, parents might share an experience from their lives that relates to an academic lesson their child is learning at school. In discussions with their child, they could share their ideas about how a particular content area relates to real world issues, or they could explain a scientific phenomenon and the factors that influence it. Prior to recording their video responses, parents and students are likely to have offline discussions to decide what they are going to say. After they post their responses, they may continue to discuss the content and ideas included in their response. The full cycle of parents and students creating responses that teachers can use during instruction creates the mutual exchange of knowledge that supports the type of parent involvement being called for in current educational research.

3. Supporting equitable parent involvement in education

3.1 Barriers to parent involvement

Multiple studies indicate that parents from diverse cultural and ethnic backgrounds recognize the importance of education and are keen to participate in their students' education experiences. However, there are barriers to participation that parents from minority, immigrant, and low-socioeconomic status groups are likely to experience [10]. For instance, parents from minority groups have expressed challenges related to transportation and scheduling issues. Immigrant parents who do not speak English may experience additional obstacles that prevent them from participating in traditional parent involvement activities [11]. Language and communication are among the most frequently cited variables that influence the ways that immigrant families participate in school events [12].

In an interview based study of Latino immigrant parents, participants summarized the communication and scheduling frustrations they experience when trying to participate in activities like parent-teacher conferences and open house night. Time was also mentioned as a barrier because some parents work evenings and cannot attend after school events. Communication was reported as a barrier because translators were not always available. Parents also expressed confusion about knowing the ways to best support their children's learning. A general frustration with not knowing what was expected of them created a culture of dissatisfaction and confusion [13].

In addition to these reported barriers, narrow views of parent involvement are likely to overlook ways that parents from diverse cultural and ethnic backgrounds are involved in students' education experiences [6].

3.2 Utilizing technology to support parent involvement

Parents have access to multiple types of technology platforms (i.e., laptop computers, mobile phones, tablets) and recognize that these tools can be used to broaden the ways that they are involved in their children's education [14].

In the ESPRIT Project, parents and students create video-based responses in their homes or other locations in their community, and they are able to do it in a fairly short timeframe that fits their schedules. In several cases, parents speak in Spanish, Somali, Hmong, or Karen. Members of our research team translate those responses, or the teachers ask students to translate as they show the response during class. By using the SLE environment, teachers emphasize and value the diversity of languages spoken in their students' families.

When teachers design prompts and activities for parents and students to complete together, parents are developing an awareness of the content being covered in their child's science lessons. In addition, parents are included in the school community when teachers show parents' recorded responses in their classrooms. Because teachers are able to use the SLE across multiple curriculum units, they create several SLE assignments throughout the school year and establish an expectation that parents and students should work together to discuss content being covered in their science lessons.

For example, in her lesson about scientific practices, a fifth grade teacher created a prompt asking parents to explain what scientists do. Parents recorded videos in the social learning environment. Their responses included ideas about discovering cures for illnesses, conducting experiments, and solving problems. During her lesson, the teacher quickly transcribed the responses on a post-it note while she played the parent video responses for the class. Then, she asked the class which scientific practice they thought the parent was talking about according to a chart in the classroom. Once the students agreed on the practice, the student whose parent was speaking in the video response took the post-it note and placed it in the section of the chart with the practice identified in the discussion.

In addition to the home-school connections that are being created, it is also important to note that because parents and students can view responses from other families, they are getting to know more about the families in the school community. Overall, using the social learning environment addresses some of the typical barriers immigrant and minority parents face and provide meaningful opportunities for all parents. These types of parent involvement are changing the ways that parents are engaged in their children's learning and enriching the ways that teachers are providing instruction.

4. A new model of productive parent involvement

Currently, the ways that parents are invited to participate in their children's learning are largely routine; whether they are asked to help them study for tests, complete daily homework, or assist with large project-based assignments. Still, these activities have been shown to have positive impacts on academic outcomes and are customarily offered as involvement opportunities in most K-12 schools in the US. The argument presented in this chapter is not that these types of involvement are not important and impactful. Instead, I am suggesting that there are ways to expand our thinking about parent involvement so that parents and students are

continually exploring ways to connect academic experiences to meaningful, real-world contexts and students' lived experiences.

Figure 1 presents a new model of productive parent involvement that illustrates the ways that parents participate in students' academic experiences. It builds on ideas related to adaptive expertise [15], and is meant to provide a framework for thinking about how parents experience parent involvement activities.

When parents are new to the school environment or are engaging in unfamiliar activities they are involved novices. They do not have enough experience engaging in the tasks to feel that they can be innovative or creative nor do they have enough practice so that participating in the activities feels familiar. If parents are unable to develop a comfort level and knowledge base so that the parent involvement activities become familiar, they may view it as a generally frustrating endeavor. They are also unlikely to advance from being novices.

In cases of routine involvement, parents become familiar with particular opportunities for involvement and are able to master particular ways of being involved. They may participate in a variety of activities ranging from attending parent teacher conferences and other school events to assisting their children with homework. These behaviors are largely unidirectional. School administrators and teachers create the experiences and have a fairly scripted role for parents to play. Parents and students may become bored, passive, and unmotivated in these instances of routine parent involvement.

In this model, productive parent involvement occurs when parents are invited to participate in a broad range of activities that support their child's education. They have the scaffolded support needed to try new activities and become familiar with them. Over time, they can further enhance their involvement by personalizing activities and connecting them students' everyday lived experiences. The model is intended to illustrate the idea that productive parent involvement requires multiple experiences that allow parents to become familiar with the activities. It also underscores the need for to challenge and inspire parents to engage in innovative thinking about their students' education.

Figure 2 presents the model with technology featured as a mechanism for supporting parent involvement activities and for promoting productive parent
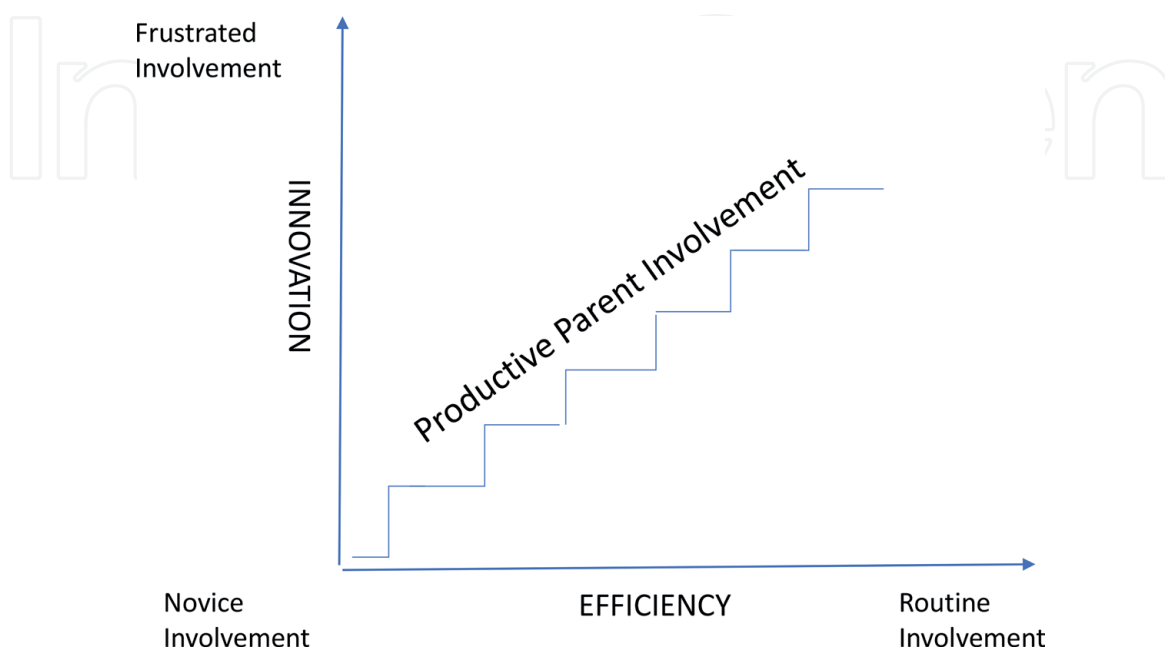

Figure 1.
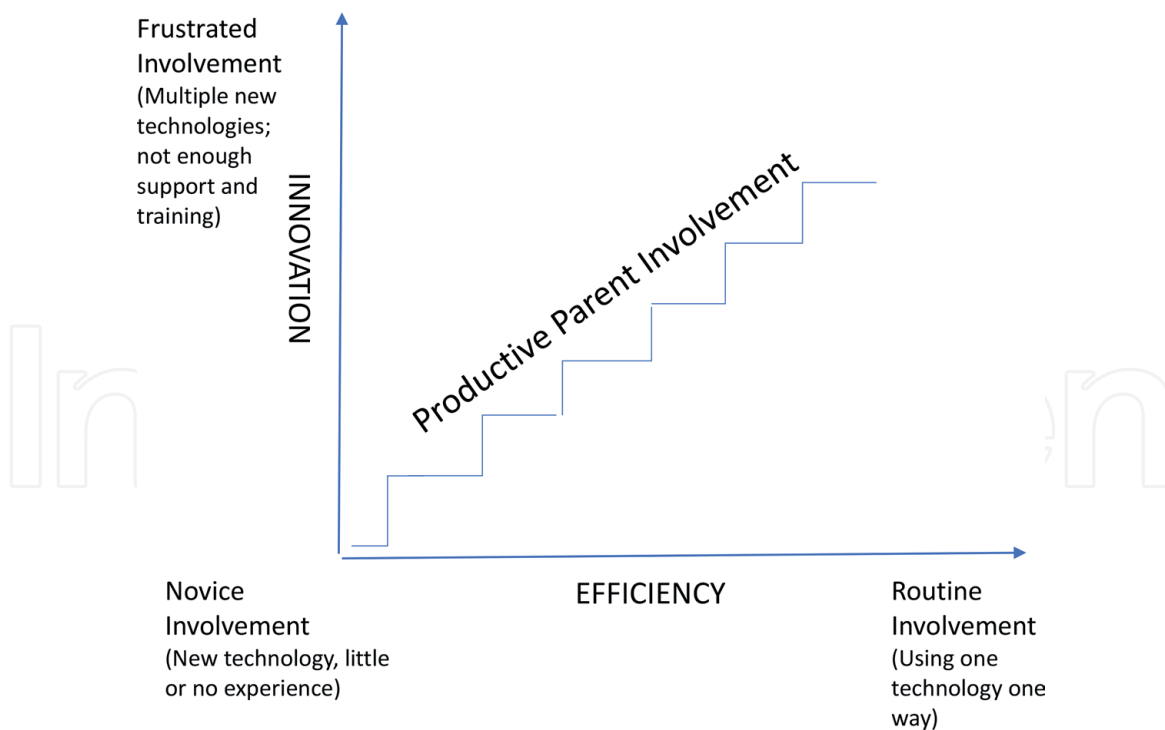*New model of productive parent involvement.*

Figure 2.
Technology and productive parent involvement.

involvement. In this version of the model, novice involvement is that in which parents have little to no experience or knowledge of a new technology being utilized. As an example, imagine that schools and/or teachers are attempting to try new technologies to support parent involvement. However, parents are not receiving the proper guidance or support to experience the value of the technology. Parents may try the new tools, become frustrated, and then ultimately decide not use them. At the school level, this might include utilizing a new parent portal designed to provide information about school events and grades. At the classroom level, teachers may ask parents to help their students use specific apps to complete homework assignments. When parents are new to the technology, they do not feel comfortable enough to use it efficiently nor do they have enough experience with it to support their students' learning.

Frustrated involvement occurs when parents are asked to learn to use multiple technologies with little support. They might also be asked to use too many technologies (i.e., apps for homework, texting and email for communication, and portals for information). As more school districts adopt one-to-one device programs, parents are likely to see a wide range of technologies that their children are being asked to use. Without proper guidance and support, they may become frustrated and decide that they are unable to be involved as much as they would like. Parents are also likely to become frustrated when they are asked to utilize technology to increase home-school connections that are primarily unidirectional [16].

When parents use a particular technology one way without making adjustments based on the academic content, students' understanding, cultural knowledge, or personal interests and routine involvement becomes the norm. While this type of involvement may be fine in the short term [17], it does not hold much promise for sustained engagement.

By using a technology-enhanced social learning environment, we avoid frustrated and routine parent involvement because parents are invited to participate in students' learning in a variety of activities. They are asked to engage in familiar activities like discussing everyday ideas and explaining scientific phenomena. They are asked to complete demonstrations and experiments at home with their students

and they are invited to share their cultural knowledge and expertise. The social learning environment remains the same, but the activities that parents participate in with their students is ever-changing. Over time, parents are able to become active and engaged participants in students' academic experiences. They are more likely to understand what students are learning in their classes and know how to support them at home. They are empowered to engage in productive parent involvement where share knowledge, learn new ideas, and try new activities with their children.

5. Parent roles in a technology-enhanced social learning environment

In the ESPRIT Project, parent involvement occurs through discourse within a technology-enhanced social learning environment. By assigning prompts that students and parents complete together, teachers are inviting parents to take on a variety of roles that enhance students' learning experiences. In our work, one way that we explain the various participation dynamics is to characterize parents' participation by describing the roles they play. The roles could vary based on the structure and content of the prompt. They could also vary based on the parents' personality and experience with the project activities. We have observed four main roles that parents take on as they generate video responses with their children: [1] passive participant, [2] scientific knowledge resource, [3] cultural knowledge resource, and [4] co-learner.

Many parents begin as *passive participants*. They watch and listen as their children create responses or engage in activities specified in prompts assigned by their science teachers. Even though they are not speaking, parents show signs of being involved and attentive. They look from the student to the camera and smile and nod as the student talks. Although they are largely observing the student's response, parents who are passive participants are showing support and involvement, and the students and parents are experiencing positive benefits. When parents take on this role, students are aware that their parents have an interest in their academic endeavors, and parents are learning about the content students are covering in their science classes. An example of passive participation is illustrated in a response between a student and her father. The prompt asks, "What is one example of a chemical change you have observed at home or at work, and what evidence do you have that it was a chemical change and not just a physical change of matter?" The video response begins with the student introducing herself and her father. Her father says, "Hi.," smiles and waves and then looks at his daughter. The daughter proceeds to explain that there are chemical changes taking place when cornbread bakes while her father watches. In responses like these, the students are sharing scientific knowledge *and* modeling how to respond so that parents are more likely to actively participate in future responses.

Another SLE prompt asks, "What is the oldest thing you own? Do you know how old it is and where it came from?" In one of the responses, we can see and hear the student talking while her mother is off camera giving her details about the items she is describing and directing her to turn the camera around to show some of the items. Even when they are responding directly to the prompts, several parents' initial responses are voice only responses. They do not show their faces, but they provide information related to the prompt.

After observing their children creating one or two prompt responses, parents are likely to transition from being passive participants to engaging in more active roles. Once parents are actively participating it is possible to further characterize their roles by the type of information they share.

In some cases, parents serve as a *scientific knowledge resource*. They respond to prompts by primarily discussing scientific content. For example, in some video

responses, parents use scientific terms for rocks they have observed and weather events they have experienced. In other responses, they share their understanding of scientific practices and how they use science in their everyday lives and careers.

Parents take on the role of a *cultural knowledge resource* when they respond to a prompt by primarily sharing cultural knowledge and experiences from their everyday lives. For example, in one prompt, the teacher asks how parents use plants in their everyday lives. Parent responses include information about how they use plants for cooking, for decoration, and for medicinal purposes. In both of these roles, students are off camera or are seen watching and listening to parents. In response to a prompt asking parents and students to describe the most interesting rock they have seen, parents shared details about the rock and also explained why is it so interesting. They often mentioned family vacations, other family members, or their home countries. Students did the same. In some of the responses posted by Latinx families, the student speaks in English and the parent speaks in Spanish. Multiple teachers have mentioned that they use these "dual language" responses as powerful opportunities to connect home and school experiences.

When parents are involved in their students' learning as a resource the experience is largely passive for the students. However, students are benefitting from revisiting scientific information covered in their classes or hearing new scientific ideas. When parents share cultural knowledge, students see the value of their funds of knowledge [18] and make important home-school connections.

A fourth role we have observed is that of *co-learner.* In this role, parents discuss the content targeted in the prompt or activity *with their child*. The responses may focus primarily on cultural knowledge, scientific knowledge, or integrated ideas that include cultural and scientific knowledge. Parents and students engage in turn taking as both participants actively make contributions to the learning experience. For example, in a video response describing chemical changes, a mother and son take turns speaking as they present a lighted candle and discuss that there is evidence of a chemical change as it gives off heat and light. In this role, parents and students are actively engaged in sharing ideas. They are both likely to learn new knowledge. Students see that parents have knowledge v to their academic studies. In discussions with parents about their experiences in the social learning environment activities, several of them mentioned that they were delighted by the new appreciation their students had for them as they realized that their parents had knowledge relevant to what they were learning in school. Teachers highlight parents' knowledge and students' culture when they show the responses during class.

6. Conclusions

New understandings of parent involvement are necessary as more efforts are made to use technology to connect students' home and school environments. The work in this chapter expands parent involvement research by focusing on how parents are involved in academic tasks with their students. It also recognizes the power of technology to create new pathways for parent involvement and contributes to a growing body of work focusing on parent roles and outcomes [19].

The flexibility and accessibility of mobile technologies and apps allow parents who may not be typically involved in education to engage in a range of activities that can enhance their children's educational experiences. Technology can expand parent involvement from unidirectional, school-based, experiences to community-building experiences that encourage parents to discuss academic ideas with their children, their family members, and other families in their school community.

In the ESPRIT project, we have observed how technology can help parents from diverse backgrounds to engage in academic activities with their students and have an impact on their students' classroom experiences. Parents share their knowledge in their own voice and in their first language. In some instances, the teacher shows the video response in class and the student translates. This sends a powerful message that the students' funds of knowledge are valued in their classrooms. Even if teachers do not show all of the video responses in class, the act of being asked to engage in the SLE tasks, has impressive impacts. Students see that their parents have valuable knowledge to share, and parents feel validated as key advocates in their children's academic experiences.

The roles that parents play in the SLE activities illustrate that technology enhanced interventions can increase and sustain parent involvement so that parents are able to engage in productive parent involvement. The SLE is flexible enough that teachers can invite parents to participate in a multiple roles across a wide range of content areas. Parents and students are able to participate in academic activities that are culturally rich and personally meaningful.

There is evidence that when teachers enact technology-enhanced systems, parents are likely to use the system as well. Additionally, the more frequently teachers incorporate these systems into their classroom practices, the more they become a normative aspect of parent involvement [19]. Once this happens, a critical feedback loop can be created so that parents have a better understanding about what is happening in classrooms and teachers develop an awareness of the wealth of knowledge parents have that can enhance their instruction [20].

Parent involvement requires innovative thinking about ways to provide opportunities for parents to participate in their children's education experiences. This type of thinking is especially important in order to include parents from underrepresented groups who are more likely to experience inequities and disadvantages that prevent them from being as engaged as parents from majority populations. Technology-enhanced parent engagement activities like those discussed in this chapter can elicit academic discourse that is culturally responsive and personally relevant.

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References

[1] Fan W, Williams CM. The effects of parental involvement on students' academic self-efficacy, engagement and intrinsic motivation. Educational Psychology. 2010;**30**(1):53-74

[2] Hill NE, Tyson DF. Parental involvement in middle school: A meta-analytic assessment of the strategies that promote achievement. Developmental Psychology. 2009;**45**(3):740-763. DOI: 10.1037/a0015362

[3] Ito M, Gutiérrez K, Livingstone S, Penuel B, Rhodes J, Salen K, et al. Connected Learning: An Agenda for Research and Design. Irvine, CA: Digital Media and Research Hub. BookBaby; 2013

[4] Zhang J, Scardamalia M, Reeve R, Messina R. Designs for collective cognitive responsibility in knowledge-building communities. The Journal of the Learning Sciences. 2009;**18**(1):7-44

[5] Grolnick WS, Slowiaczek ML. Parents' involvement in children's schooling: A multidimensional conceptualization and motivational model. Child Development. 1994;**65**(1):237-252

[6] Schneider C, Arnot M. Transactional school-home-school communication: Addressing the mismatches between migrant parents' and teachers' views of parental knowledge, engagement and the barriers to engagement. Teaching and Teacher Education. 2018;**75**:10-20

[7] Goodall J, Montgomery C. Parental involvement to parental engagement: A continuum. Educational Review. 2014;**66**(4):399-410

[8] Ferlazzo L. Involvement or engagement. Educational Leadership. 2011;**68**(8):10-14

[9] Jeynes WH. The relationship between parental involvement and urban secondary school academic achievement: A meta-analysis. Urban Education. 2007;**42**(1):82-110

[10] Karıbayeva A, Boǧar Y. To what extent does parents' involvement in middle school influence children's educational progress? Procedia-Social and Behavioral Sciences. 2014;**152**:529-533. DOI: 10.1016/j.sbspro.2014.09.222

[11] Turney K, Kao G. Barriers to school involvement: Are immigrant parents disadvantaged? The Journal of Educational Research. 2009;**102**(4):257-271

[12] Coll CG, Akiba D, Palacios N, Bailey B, Silver R, DiMartino L, et al. Parental involvement in children's education: Lessons from three immigrant groups. Parenting: Science And Practice. 2002;**2**(3):303-324. DOI: 10.1207/S15327922PAR0203_05

[13] Ramirez AF. Dismay and disappointment: Parental involvement of Latino immigrant parents. The Urban Review. 2003;**35**(2):93-110

[14] Özdamlı F, Yıldız EP. Parents' views towards improve parent-school collaboration with mobile technologies. Procedia-Social and Behavioral Sciences. 2014;**131**:361-366

[15] Schwartz DL, Bransford JD, Sears D. Efficiency and innovation in transfer. In: JP. Mestre (Ed.). Transfer of Learning From a Modern Multidisciplinary Perspective. Greenwich, Connecticut: Information Age Publishing; 2006

[16] Selwin N, Banaji S, Hadjithoma-Gartska C, Clark W. Providing a platform for parents? Exploring the nature of parental engagement with school learning platforms. Journal

of Computer Assisted Learning. 2011;**27**(4):314-323

[17] Lewin C, Luckin R. Technology to support parental engagement in elementary education: Lessons learned from the UK. Computers & Education. 2010;**54**(3):749-758

[18] González N, Moll LC, Amanti C, editors. Funds of Knowledge: Theorizing Practices in Households, Communities, and Classrooms. Mahwah, NJ: Lawrence Erlbaum Associates, Inc.; 2006

[19] Paiva JC, Morais C, Moreira L. Activities with parents on the computer: An ecological framework. Educational Technology & Society. 2017;**20**(2):1-14

[20] Blau I, Hameiri M. Teacher-families online interactions and gender differences in parental involvement through school data system: Do mothers want to know more than fathers about their children? Computers & Education. 2012;**59**(2):701-709