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A narrative of meeting a computer: A cognitive-ethnographic study of self-directed computer learning

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Abstract

In this study, the self-directed learning (SDL) processes of children who have never used a computer before were examined within the cultural context they live in. In accordance with the subject of the research, a village, located in a rural area of the Southeastern Anatolia region in Turkey, where crucial digital divide and low socioeconomic conditions exist, was chosen to reach the children who have not used a computer before. By using a "cognitive ethnography" research design, the cultural foundations of cognitive processes were evaluated and authentic data were obtained. The research includes a long-term participatory observation over a period of two summer terms in accordance with the nature of ethnographic studies. The research group consists of 46 children, ages 6 to 11. Throughout the research, the children were elaborately observed on how they managed to organize their SDL process without any guidance when they were left with computers. In the process, children's learning and how they had been affected by the guidance and collaborative work were examined by giving them simple clues, asking them questions to foster curiosity, and allowing them to form groups. The observation process has spread to many moments of the day, such as students' social environments, living conditions at home, and learning processes at the computer. Open coding and axial coding methods were used in data analysis. As a result of the study, it was observed that demographic variables, guidance, and ethnocultural characteristics have a significant impact on children's learning behaviors. The research findings show that: (1) In the SDL process, unconscious explorations and trial and error gradually give way to conscious reasoning, (2) The SDL process becomes more effective with some guidance focusing on the needs of a student and collaborative learning, (3) Girls mostly preferred word processing and drawing applications, while boys preferred games and research on the Internet, (4) Although boys display a more confident and dominant attitude towards computers, girls have used applications effectively throughout the process, and (5) The older age group, especially accustomed to the cultural and classroom authoritarian approach, had difficulty in getting used to the SDL autonomy at the beginning. Details in research findings present

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vital data within the context of the impact of cultural background on the educational processes and evaluating this impact in terms of education programs.

Keywords Self-directed learning (SDL) · Cognitive ethnography · Cultural psychology · Sociology of education · Disadvantaged group · Human-computer interaction

1 Introduction

> The child saw a computer for the first time in his life, apart from the one he had seen on television. He stared at the screen, the keyboard, and the mouse for a long time in amazement, and started making random mouse clicks on the desktop and pressing the keys on the keyboard. He opened up a few windows by mistake.
> ….
> Having spent almost twenty minutes on the computer, he was now making random mouse clicks on the chess game he accidentally opened.
> Following a few attempts, he realized that he was leading the piece while his finger was pressing the left click, and he immediately carried the piece to the place he wanted. He was surprised when the computer made its move just as he was about to make his next one.
> Child: Who is the one playing?
> Researcher: The computer.
> Smiled with a puzzled face.
> Child: So, who is in it?
> Researcher: No one.
> Child: I mean, not inside, but who taught it?

The child mentioned above is 11 years old. In today's circumstances, where we have instant access to technological opportunities, it seems almost impossible that there are children who have not yet used or even not seen a computer before. In several studies, regardless of their access to technological opportunities, young people born after the year 1980 (Prensky, 2001a, b) are considered to be digital natives (Janschitz & Penker, 2022). However, the disadvantages of the digital divide are still seen in rural and low socioeconomic regions of many countries (Salemink et al., 2017). This study, which was conducted in the digital age, supports the argument that immigrant-native concepts should be interpreted correctly (Akçayır et al., 2016; Bax, 2011; Flynn, 2021; Kirschner & De Bruyckere, 2017) and examines the learning-technology relationship on the basis of cultural context (Kincl & Štrach, 2021; Surry & Baker, 2016).

Within the scope of the study, the SDL process of children who had never seen a computer before was examined using the cognitive ethnography method. Examining SDL processes is at a critical point in understanding the complex dynamics of individual learning journeys. The concept of SDL, which emphasizes its positive impact on students' motivation, metacognition, and lifelong learning skills (Candy, 1991; Knowles, 1975), is frequently discussed in the literature along with the autonomy of technology and developing personalized learning experiences (Kirschner et al., 2006). The majority of these studies have been conducted in urban, formal educational and digitally saturated environments, and have not filled the gap in understanding of SDL in rural settings. This research aimed to focus on a collection of rural children who have never encountered a computer, providing a different and in-depth perspective through which to explore SDL in its purest form.

The cognitive ethnography method used in the research is a process that blends information obtained from cultural anthropology and cognitive science (Hutchins, 2010). This method responds to recommendations for the use of more ecologically valid research methods in educational research by allowing us to reveal the complex interaction between individual cognitive processes and the socio-cultural context in which learning occurs (Cole, 1998). As the use of technology in educational settings becomes more widespread, concern about potential inequalities in access and opportunities between urban and rural students increases (Howley & Howley, 2010; Warf, 2019). It is thought that this study, which focuses on the SDL processes of children in rural areas, will also provide information to the discussions on the fair sharing of educational technologies.

2 Related literature

While examining the concepts of digital native and digital immigrant based only on age continues to be questioned in the literature (Kennedy et al., 2008; Kirschner & De Bruyckere, 2017), it is emphasized that technology education needs deeper and more detailed analyses (Akçayır et al., 2016; Bax, 2011). With the emergence of technology in distance education during the Covid-19 pandemic, the assumption of every student with an Internet connection and technological opportunity as a digital native has also begun to be questioned (Flynn, 2021).

It has been determined that there is a need for technology education studies (Damarin, 1998; Gyabak & Godina, 2011; Phalkey & Chattapadhyay, 2015), especially in regions far from educational opportunities, and the academic achievement and self-efficacy levels of children are lower than their peers in the city (Li & Ranieri, 2013). In the "*Hole in the Wall*" study in which computers have been placed in outdoor kiosks in India (Mitra, 2000; Mitra & Rana, 2001), it has been found that children began to learn how to use computers after a while (Inamdar, 2004; Mitra, 2005; Padmakar & Porter, 2001; Wullenweber, 2001). However, the study could not be sustainable due to vandalism towards the computers, difficulty in providing a continuous power source, and the fact that parts of the computers were damaged because of dust (Mitra, 2009). This system, which recommends children to be almost completely unleashed, has been criticized due to the fact that self-directed learning should not be a process that proceeds exactly "self-directed" (Arora, 2010). Many children have been given the chance to use computers on their own in the project titled "One Laptop Per Child (OLPC)" organized so that children particularly in the developing countries of the world could have access to technology (Quadir & Negroponte, 2009;

Warschauer & Ames, 2010). OLPC is considered one of the utopian improvement plans that failed to resolve complex social problems (Ames, 2016; Warschauer & Ames, 2010) since its educational dimension lacked strength, it did not thoroughly investigate the local context and was not sustainable (Cristia et al., 2012; Kraemer et al., 2009; Warschauer et al., 2012).

Students face economic inadequacies and cultural lag in terms of using technology efficiently (Burger, 2013; Chen, 2007). There is a misperception with reference to the fact that the digital divide that occurs as a result of cultural lag could be overcome by simply procuring physical and digital services (Pearce & Rice, 2013; Warschauer vd., 2012; Warschauer & Newhart, 2016). However, the important issue here is to not only overcome first level digital divide by providing technological means (Gonzales, 2016), but to focus on the second-level digital divide related to technology education (Hargittai, 2002; Ma et al., 2018), and on the third level digital divide that investigates the advantages of the process (Van Deursen & Helsper, 2015).

Further digitalization changes the attitudes, values, and behaviors of individuals all around the world, which brings about the need to thoroughly evaluate intercultural differences (Kincl & Štrach, 2021). "Culture" is an important variable to be investigated in terms of the concept of technology in education (Chen, 2007; Chisholm, 1995; Chisholm & Wetzel, 2001; Damarin, 1998; Lorenzo et al., 2007; Markus & Kitayama, 1991; Surry & Baker, 2016). Gender (Purushothaman, 2013), ethnic origin, and class in the use of technology create significant differences in all age groups (Chen, 2007; Chisholm, 1995; Hargittai & Dobransky, 2017; Neill & Mathew, 2009); however, what has caught the eye is that studies have not included minorities and marginal groups (Maric, 2018) and racial/ethnic demographic characteristics (Marri, 2007; Rogoff, 2003). Historically, cultural history in technology has been *"under the dominance of white men"* similar to the history of education, and has not progressed in comprising diversity (Chen, 2007; Chisholm, 1995; Damarin, 1998; Yu et al., 2016). Racial and ethnic minorities fall behind majority groups in accessing and using technology (Yu et al., 2016). As in many domains, considering that the future of educational pedagogy is connected to technology, there must be different implementations supporting digital spread by taking advantage of current technologies while designing pedagogy (Onye & Du, 2016).

In the digital age; teachers, who are digital immigrants and used to printed resources, have begun having difficulties in teaching technology to students who have developed *"hypertext minds"* (Oblinger & Oblinger, 2005; Palfrey & Gasser, 2008; Prensky, 2001a, 2009, 2010; Tapscott, 1999; Zur & Zur, 2011), and it has led them to make radical changes in their teaching methods (Evans & Robertson, 2020). Nowadays, with children's access to information is almost as easy as adults; the use of the "Self-Directed Learning (SDL)" approach, which was born from the basis of constructivism and whose pioneers were Dewey and Montessori (Brooks & Brooks, 1999; Knowles, 1975; Jonassen et al., 1993) has become prevalent in pedagogy (Brockett & Hiemstra, 1991; Gibbons, 2004; Merriam et al., 2012; Nor & Saeednia, 2009; Teo et al., 2010). As in the example of the Covid-19 pandemic, which is especially in times with sudden changes in socio-contextual conditions requiring new reactions, adaptability to SDL has gained importance (Mustafa et al., 2019; Morris, 2019; Morris & König, 2020). Using technology in educational processes enables individuals to generate their own learning experience and supports teachers (Ferdig et al., 2007; Kennedy et al., 2008) to see what kind of arrangements are needed for the learning habits that have developed (Gureckis & Markant, 2012; Hyland & Kranzow, 2011).

In addition to the students' efforts in SDL, it is emphasized that help can be received when needed (Arora, 2010; Demir et al., 2014; Wiggins, 2015). A lecture plan based on constructivism and integrated with technology is designed to provide the transition between "teacher-directed learning" and "student-directed SDL" processes (Ferguson, 2001). From this point of view, a process based on social interaction (Simons, 2000) and guided inquiry activities (Llewellyn, 2005) was planned in line with the constructivist approach in the later stages of the study.

Considering the points emphasized in the literature, the current study sought answers to the given research questions in line with the purpose stated below:

2.1 Purpose

The study aims to examine students' computer SDL processes in a cultural context based on the cognitive ethnography method and to analyze which dynamics affect the learning process. For this purpose, answers to the following Research Questions (RQs) were sought:

RQ1. How do SDL processes progress when children using computers for the first time are left alone with computers?

RQ2. How do students organize their self and collaborative learning processes when they are left alone with computers individually and in groups?

RQ3. What are the effects of giving students simple clues and asking questions to foster curiosity in the learning process?

RQ4. How do children's computer SDL processes shape within the context of their demographic characteristics?

3 Methodology

Cognitive ethnography, a method that plays an important role in cognitive science (Hutchins, 2010) and investigates how cognitive activities are performed in the authentic world (Williams, 2006), was employed in the study. The relationship of humans with technology has been studied in a contextual way using ethnography (Duque et al., 2019), focusing on cultural elements that include social behavior and values (Ball & Ormerod, 2000; Dubbels, 2011; Vidich & Lyman, 2000). By using the cognitive ethnography method, which helps understand the mental background of a person while learning, it is aimed to determine the problems experienced and develop the necessary interventions (Aslan et al., 2019).

In the study, a cyclical research process (Dubbels, 2011), in which the hypotheses reached were tested repeatedly in the light of continuous observation and obtained findings, was followed. Within the scope of the research, the purposive sampling method was used by considering the personal characteristics that are frequently used in cognitive ethnography and are believed to provide the most information for the study (Fraenkel et al., 2012). Convenient places and participants were reached to carry out the implementation in the authentic environment of the participants, as required by cognitive ethnography.

While students were selected and divided into groups; an evaluation was made by examining the demographic characteristics, performances of the students in the interviews, and the students' course grades from the previous semesters following the document analysis method. Thanks to the preliminary implementation, which is one of the important steps of the cognitive ethnography method, the comprehensibility of the learning task was tested with a sample with similar characteristics, and revisions were made on the problematic issues (Aslan et al., 2019).

3.1 Selection and features of the research context

Within the scope of the study, it was aimed to reach children in rural areas deprived of educational and technological resources, who could not find the opportunity to use a computer and even did not see a computer before. Although a context for the purpose of the study is available in any region of the country, a city in Southeastern Anatolia of Turkey was selected since it was known in detail by the first author thanks to her intermittent visits for 16 years. This situation provided an advantage in the more in-depth interpretation and transfer of cultural characteristics, which is a necessity of ethnographic research. For the feasibility of the study, a convenient selection was made among the research site options in city in the direction of minimum resources. The first village examined was not found suitable for research due to constant power and water outage, whereas the second one was considered to have challenges in terms of transportation. The third village was detected to fulfil most of the required criteria. Hence, it was selected as the site to conduct the research. The village is by the Dicle River located on a flat and arid land. In the village that has approximately 150 households, the people live off agriculture, husbandry and labor outside the city. The general structure of the village consists of mostly mudbrick houses as seen in Fig. 1.

The fact that there was a sheltering, confined space for computers to be set up which would not be affected by sunlight and weather conditions (the research was conducted in summer months) was also influential in the selection of this context. The school building, where the primary and secondary schools are located together, has 8 classrooms, 1 administrator's room, 1 teachers' room, 1 kindergarten, 1 library, 1 cafeteria and 1 information technology laboratory. Having a school with a computer laboratory in the village provided an important advantage. However, the school's laboratory used in the study is normally kept locked since the school does not have an ICT/computer teacher. School administrators have found it more appropriate not to let children into the laboratory, fearing that providing students/children with computers would cause computer breakdowns. The majority of the study group did not have computer courses in their existing curriculum, except for some of the older age group. Because of a long time inactivity, some computers underwent maintenance, and consequently 16 of the 21 computers were made functional. Thus, a laboratory was used in this research, which included an informal learning process. Sixteen computers in the laboratory had an Internet connection, and the computers generally had

Fig. 1 A typical house from the village where the research was conducted

Intel Pentium 4 processors and 1–2 GB of RAM. Except for 3 LCD monitors, the computers had CRT monitors and Windows 7 and Windows 8 operating systems.

3.2 The creation of the study group and their characteristics

In the study group comprising children aged 6–11 years, the pedagogic developments of the children, the age to start primary education in the country, and the age range preferred in similar studies (Mitra & Rana, 2001; Kraemer et al., 2009) were taken into consideration when the age range was determined. Before starting the implementation, a call was made from the school and the mosque (the loudspeaker normally used for the call to prayer is used for announcements) to work at the school for kindergarten and primary school children. Parents were informed about the research and necessary permissions were obtained. It was aimed to reach as many students as possible. However, some of them could not participate in the practice regularly due to working on a farm or taking care of their siblings. During the preliminary research on the site, the effects of the variables including gender, age, and level of language were observed, and the cultural environment could be thoroughly investigated. The findings obtained from this process helped in determining the characteristics of the study groups for the main implementation, and the study group was divided into two different age groups (Table 1).

Almost all of the villagers were Kurds and they spoke their mother tongue Kurdish among themselves, including children. Since there was no computer anywhere in the village except for the school, and many houses in the area did not even own a TV, children had a very limited chance to see computers. Few children had the opportunity to see a computer in the hospital or in a relative's house when they went downtown, in the principal's office at school, or on television. While determining

Table 1 Distribution of the study group in terms of age and gender

	Preliminary research implementation (age 6–10)	Main research implementation (age 6–11)		
		Younger age group (age 6–8)	Older age group (age 9–11)	Total
Girls	12	11	4	27
Boys	3	4	12	19
Total	15	15	16	**46**

Table 2 Distribution of the groups in terms of Turkish proficiency and computer recognition

Mean Value	Turkish proficiency (speaking-listening*)	Turkish proficiency (reading-writing*)	Computer Recognition**
Preliminary group	3.07	2	2.6
Younger age group	4.13	3.07	3.6
Older age group	4.31	4.63	3.75

* 1:Very Low, 2:Low, 3:Average, 4:High, 5:Very High)

** 1: I've never heard the word "computer", I've never seen a computer on TV

2: I've heard of the word "computer" but not seen it

3: I didn't know its name was "computer", I saw it on TV

4: I heard the word computer, saw it on TV

5: I've heard the word computer, seen someone using a computer/smartphone

the demographic characteristics, level of Turkish proficiency (speaking-listening-reading-writing), and computer recognition of the participants, the self-report data were not considered sufficient due to bilingualism and the hesitant nature of the children, and different sources were consulted. It was preferred to obtain information by observing the children during their studies or by using writing and drawing on paper. The children were asked whether they had ever heard or seen of something called "computer", and they were asked to draw what it looked like with pencil and paper in the interview. In some cases, the photo was shown and, the question "Is this what you saw?" was asked and it was checked whether they had prior knowledge of a computer's functionality. As a result of the interviews conducted to reveal the children's prior knowledge, their Turkish proficiency and computer recognition level in terms of groups were distributed as in Table 2.

3.3 Research implementation and data collection

Children's SDL processes began in the preliminary research, and the findings obtained at this stage presented practical field data on how to organize the continuation of the research beyond the literature. In research implementation spread over two years and was carried out during the summer periods; it was aimed to make use of the inclination to disappear in time (Krendl & Broihier, 1992) the novelty effect (Clark, 1983) of computers, thanks to the long duration of the process, and to follow a participatory collaborative path, which is necessitated by the ethnographic method (Barab et al., 2004). The computers were offered to children's use every day between 9:00 AM and 5:00 PM, and the children were free to give up the study or have breaks whenever they wanted. During this process, the first author did not introduce herself as a teacher so that the SDL processes of the children would not be influenced and conducted an implicit observation (Hammersley & Atkinson, 1995; Glesne, 2016) in general. After individual and group studies, it was observed how structured children's learning by intriguing questions and small clues:

> The boy was interested in the game installed on the computer for a long time; but he seemed bored.
> Researcher: How do you do mathematical calculations with this (showing the computer)?
> Child: With this (pointing to the computer)?
> Researcher: Yes.
> Child: You mean the calculator. I know, I've seen it before.
> Researcher: No, it is done here, and all kinds of mathematical operations.
> Child: Really? I will find it.
> ….
> The children are arguing about where (in which province) Karacadağ is located.
> Researcher: From here (by showing the computer), it is learned which mountains are in the cities.
> Child: How?
> Researcher: I don't know, try to find it.

The process of the research procedure is summarized in Table 3.

3.4 Data analysis

During the implementation process, data sources and data collection tools were verified by using data triangulation (Merriam, 1998; Patton, 2014). In order to reach the data on the "intensely described cognitive processes" required by the cognitive ethnographic method (Merriam, 1998; Hutchins, 2010; Stake, 2003), all the stages of the implementation, which spanned 2 years, were analyzed in detail, especially the SDL processes that children spent in front of the computer. In this way, it is aimed to lose the effect of the researcher, which could be effective at the beginning of the interviews, thanks to the atmosphere of trust formed over time, and to reach more credible data through repeated and extended interviews (Yıldırım & Şimşek, 2013). Using participatory observation (Taylor, 1994), which is the key technique of the ethnographic method, the discovery of cultures in distant places that were considered "exotic" or "primitive" was made in accordance with the tradition of anthropology (Glesne, 2016).

While analyzing the data, the path of grounded theory (Punch, 2009), which focuses on the discovery of concepts, hypotheses, and theories, from descriptive coding to conceptual coding was followed (Glaser & Strauss, 1967; Strauss & Corbin, 1998). It was tried to reveal what the participants really felt and thought (Hollway & Jefferson, 2012) by paying strict attention to taking notes of all steps of the analysis and disabling prejudices (Schutt, 2011). "Open coding" was first performed where the data were opened and labeled and then "axial coding" was carried out where

Table 3 The process of the implementation and data collection

		Procedure	Explanation	Data collection
First Summer	Preliminary Research and Acculturation	Checking the feasibility of the research	Obtaining necessary approvals from the authorities of the Ministry of National Education by presenting the idea of the research	Observation, interview, field notes (Observation and research were conducted in the site by interviewing authorities and the local community)
		Deciding upon the location for the research	Selecting the village following the investigation of regional options	
	Preliminary Research Implementation	Conducting preliminary research with a participant group suitable for research conditions	Reaching preliminary findings that would shape the process of main research	Observation, interview (semi-structured), field notes, audio notes, audio records, audio-video records, researcher's diaries (Includes data obtained from the local community, parents, administrators, teachers, and children. A total of 240 h of participatory observation was completed in the research, about 140 h at the computer lab and 100 h in the social environment.)
Second Summer	Main Research Implementation	Selection of participants	Determining participants who have not used computers before	
		Determining participant characteristics	• Demographic information • Level of Turkish proficiency • Level of computer recognition	
		Establishing age groups	Younger age group (age 6–8) and older age group (age 9–11)	
		Introducing participants with computers	Individual SDL	
		Model on peer	More than one student being in the lab and modeling each other	
		Collaborative learning	Students forming groups and conveying what they have learnt to one another	
		Question and clues	Asking intriguing questions and giving small clues	
		Last interviews	Exploring children's thoughts on computers and their level of learning	

relations between the codes were established (Strauss & Corbin, 1998) by using the NVivo Program. In open coding, 'analytical codes', which were initially theoretically based, were created. Afterwards, 'thematic codes' generated from the data throughout the process were added to them. Among the thematic codes, there were also 'in vivo codes' that reflected the participants' discourse (Table 4).

The codes were combined to form subcategories, which in turn were combined to form categories. Based on the categories, themes and concepts were created and theories were reached (Strauss & Corbin, 1998). Defining person and source codes allowed the data to be organized in an orderly manner and the necessary queries to be made in NVivo. 'Person characteristics' suitable for each group's characteristics have been created under 'node classifications' for students, parents, and administrators. Students with kinship ties and parent-student connections were defined under 'node relationships'. At first, 853 codes and 75 individual codes emerged under 10

Table 4 Examples of 'in vivo' codes

'in vivo' code	Data it refers to
I did it and that's it.	Generally, operations that children discover by chance and that they do not know how they do or cannot explain.
Who's in it (computer)?	Personalize the computer
It went off	Situations of shutting down the computer without realizing it
Dropped down	Accidentally scrolling down or closing the application window they opened

categories. In order to profoundly describe cognitive processes, the codes that were formed were reduced to 174 codes following grouping.

In order to master the general theme of the speeches, the recordings were first listened from start to finish and transcribed while listening a second time. In the transcription of the interviews, the support of an interpreter was taken when necessary, taking care to make the speeches in the language of the data sources and in accordance with the dialect they used. While creating these transcripts, field notes, researcher diaries, which are commonly preferred to understand clues about cognitive or cultural patterns in a society (Duque et al., 2019), and think-aloud notes were checked in parallel and an attempt was made to proceed synchronously. Considering Goodwin's (2003) multimodal transcript, gesture-mimic, behavior, tone of voice, and emphasis in video recordings were taken into account. In this process, the privacy of the participants was taken into consideration, and pseudonyms reflecting the linguistic and cultural characteristics of their real names were assigned.

During the research implementation, necessary precautions were taken to ensure that the research meets the criteria of honesty, transferability, credibility, and confirmability (Creswell, 2013; Guba & Lincoln, 1994; LeCompte & Goetz, 1982). Thanks to the fact that the first author has been in the region for many years at various intervals and has learned Kurdish at a beginner level, the influence of the first author on the environment, and the number of people has decreased and more reliable data have been reached (Patton, 2014). It was aimed to prevent researcher bias by periodically sharing the data obtained during the research process with two experts from the study field and monitoring the records. The codes extracted were discussed with these experts who used qualitative research methods in their doctoral theses, and their suggestions were taken into consideration in data analysis. In addition, the study and the codes created were presented to an expert from outside the study field for review, and ideas were exchanged on the comprehensibility of the code naming and whether the code tree created in axial coding was logical or not.

4 Findings and discussion

Inference 1: At the beginning, the children had a difficult time embracing the "self-directed learning" process and awaited approval or guidance from an authority in general. As it has also been pointed out in studies in the literature (Cappelle et al., 2004; Mumtaz, 2002; Pearson & Somekh, 2003), the children had difficulty in learning "self-directed" and adapting to the autonomy of this method brings.

These children, who are accustomed to an authority figure in formal education, asked for permission in nearly all their actions like touching the computer, pressing a button, and clicking somewhere.

According to the technology acceptance model, it is suggested that individuals are more likely to adopt and use new technologies effectively when they perceive them to be easy to use and believe that others in their social environment approve of the technology (Davis, 1989). The initial need for approval from an authority figure observed in the research may reflect children's need for social approval and guidance while being introduced to a new tool.

Over time, as children absorbed new experiences and information, they became more exploratory and moved into a process where they actively constructed knowledge (Piaget, 1977). When individuals perceive autonomy in their learning processes, they become more intrinsically motivated on the basis of self-determination (Ryan & Deci, 2000). While seeking approval or guidance may be a natural reaction at first, as children become familiar with computers, their motivation increases, paving the way for independent exploration. Although it varies from child to child, it took an average of 3 days for the whole group to get accustomed to working autonomously in an environment, where culturally respect and anxiety to a teacher or an adult are felt heavily.

Inference 2: Children meeting computers for the first time, initially tried to understand them according to the schemes present in their minds. As a result of the contradiction of new and old information on occasion, the need to reach cognitive balance by configuring information has risen (Piaget, 1964, 1977). Some children were observed to be inclined to think that there was an individual inside the computer since they had difficulty comprehending the fact that a machine could perform such complex activities. For children, most of whom did not even have appliances such as televisions or washing machines in their homes, activities such as bringing in some questioned information, making calculations, viewing images and videos and even arranging them seemed extremely complex. Having used "personal language" for the activities, the children reacted with statements like "this does not know me" if there were no results when the children searched for their names on the Web. The personalization of the computer was observed in 6 children due to the personal language they used in the think-aloud data. However, it has been observed that two of them intellectually believed that the computer was an individual, a robot, or that there was someone in it.

The children, who drew similarities between the computer and the television, initially expected a broadcast stream on the computer, thought that they would watch a cartoon or series, and tried to watch it. Socioeconomic background of children affects the learning process by managing the time and manner of access to technological resources (Gros, 2007). Some children, who had seen computers thanks to films, series, and documentaries on television or commercials about computers, thought beforehand that they could read the news or talk to friends on computers and tried to do so. Students' experiences with smartphones were generally limited to see them once or twice. The reason was that no phone was always available for their own use. There were 5 children (2 sisters, 3 boys) who said that they saw the phones of their fathers, brothers, and uncles who work or study outside the village. When the children were asked what they were doing with the phone, answers such as "they didn't let me play it because it would break", and "I couldn't look inside" were received. Only one boy had the chance to use his brother's phone a few times with him and said that they were watching movies and looking at pictures (Because there was no Internet connection outside the school building in the village, and mobile phone signals were poor in the area, pre-downloaded/offline videos were watched and the photos were looked at). Children, who had seen others use smartphones in real life or on television, presumed that activities like making searches on the Internet or playing games could also be performed on computers or tried to choose the symbols with their fingers, thinking that the computer screen was a touchscreen. Thanks to the process in which the links between the old and new information were not established by guidance or dictation but by giving personal meaning to information (Brooks & Brooks, 1999; Cobern, 1993; Sherman & Kurshan, 2005), children's mental confusion has disappeared in time. Behaviors such as waiting for a broadcast to stream on the computer like a television, holding the mouse incorrectly, or frequently touching the screen even though the screen was not touchscreen were observed predominantly in the first few hours. When we look at the whole group, it can be said that these behaviors are seen more in the younger age group. However, after the first few days, it was observed that the entire group had a clearer idea of what kind of device a computer was.

Inference 3: In general, the SDL process was dominated respectively by "incidental discoveries made unconsciously", "trial and error", and "conscious reasoning". Incidental discoveries made by accidental clicking have been important factors in SDL processes (Dangwal et al., 2005; Gibbons, 2002; Mitra, 2000; 2012). Clicking right, using the scroll wheel, and opening applications or files when the speed of clicking accelerated were discovered accidentally or while trying to perform another activity. The children also made some discoveries by incidentally pressing buttons on the keyboard at first, but then they were observed to make reasoning about the task at hand by looking at the symbols on the key. The children who organized information while using computers gained effective computer skills by blending their discoveries and research (Dangwal et al., 2005; Downes, 1999).

Since incidental learning is based on individual discoveries (Forman & Pufall, 1988), it supports self-confidence, self-awareness, and sense-making (McFerrin, 1999) and paves the way for conscious reasoning. The fact that children's self-confidence increased over time made them speculate even more. Guessing through looking at signs and colors caught the eyes in many activities. The children speculated that the red X symbol on the interface closed the window, direction keys were used in the game, and Paint could be used for drawing purposes seeing the pencil box symbol.

More conscious learning was supported due to the "catch or miss information" nature of incidental learning (Leroux & Lafleur, 1995). As a part of the natural process in SDL, children began to make sense of what they did as they repeated their operations. Task management, solving the issue of disappearing windows, and finding solutions to emerging technical issues have developed over time. In the first stage of trying to discover the computer, it was observed that the children encountered the problem of getting lost between 20 and 30 open windows, and they proceeded incidentally, not by performing an action that was their target. On the third day of the implementation, it was observed that most of the children became more successful in task management by using the taskbar effectively and making moves toward the task they targeted.

During Internet use, the children who made choices among the suggestions of the Google search engine or veered off their target with typing completion options progressed with incidental discoveries. Veering off from their target, which was noticeable in the majority of children, was experienced frequently, especially in the first days. For example, it has been observed that a child who veered off from the target 8 times in his 1-hour study on the first day, veered off from the target 2 times during his entire daily work on the 3rd day. This was also related to their gradual improvement in keyboard usage. They gravitated to making conscious searches after typing correctly what they wanted to search for and to benefit from query options under the query "did you mean …" when they mistyped something or typed it incorrectly.

Children thought that the computer was broken down when they accidentally turned off the computer under the start menu, when the computer was frozen, or the Internet connection was lost. There had been behaviors that caused the computer to freeze, repeatedly opening applications/windows or clicking on certain places quickly and continuously. It was seen that the children panicked at first when the computer was shut down somehow or gave an error, and asked for help to start the computer again or demanded to change the computer that they were working on. However, when the computer gave any kind of error, the children tried to solve the issue by restarting the computer after learning this solution over time. Children who had been at the computer for a long time and had such a problem preferred to turn off the computer and take a break.

When the learning experience of the students was considered, while some preferred to use the trial-and-error method during the SDL process, some others preferred to read instructions and do research (Ni, 2013). The instructions that children used in the SDL process were; the description that appears when they hover over the cursor on an item, the menu names and button shapes/colors that provide clues to its task, Google - did you mean?, instructions and descriptions in games, and the Windows help menu. Even though it is claimed that incidental and intentional learning play an equally vital role in the learning experience (Kerka, 2000), it has been observed that the memorability of intentional learning was higher.

The novelty effect (Clark, 1983) in multimedia, like using a computer for the first time, cannot be controlled; however, the disappearance of this effect over time (Davies & Crowther, 1995) has been influential in children's tendency to conscious learning. In the research implementation, the children waited for the laboratory to open at the schoolyard or in front of the door early on and did not want to have breaks while working on computers. At later stages of research, the children's consistent interest in computers helped them preserve their motivation in situations they were unsuccessful at or had difficulty in. Computer games are one of the important areas where the novelty effect is seen. Consistent with the literature (Tüzün, 2004), it was observed in this study that interest and short-term motivation in games resulting from the novelty effect decreased over time.

Inference 4: The operations, which were initially carried out in a controlled manner in SDL, became automated over time. With the transition of knowledge from short-term memory to long-term memory; semantic coding, recalling, transferring, and automizing tasks become possible (Anderson, 2013; Coultas et al., 2008; Freedman, 1992). Upon having comprehended what the keys do on the keyboard, the children gained speed since they stopped searching for which key to press on. In the beginning, the behavior of holding the mouse upside down, holding it with two hands, or clicking the right mouse button with the index finger, and double-clicking the menus/buttons that can be opened/operated with one click was frequently observed. The children could not be successful immediately since they failed to adjust the speed of using the mouse or to realize that they should keep the left click pressed in operations such as clicking options in the menus that open with the right click, clicking drop-down and pop-up menus, and dragging the items. Particularly after having realized that the pointer is the marker of the mouse, the children improved themselves, some within hours and some within days, in using the left-click, right-click, and scrolling wheel, respectively. Of the children who were fast in automating these tasks within a few hours, 6 of them were from the younger age group and 4 were from the older age group.

As children gained experience in their interactions with the computer, the SDL process progressed rapidly, like the enlargement of a snowball, by ensuring balanced management of cognitive load (Sweller, 1988). The fact that the children learned some key instruments related to computers and updated the knowledge they received paved the way for new information and accelerated the learning process. Thanks to children starting to use the taskbar and start menu, their development in task management was effectively supported. Discovering the My Documents folder opened the way for them to process documents in different formats. It was noted that as they saw that they could figure out the programs and make new operations, they got motivated to continue and became more curious and willing to learn.

As children progressed to advanced phases in the tasks, they needed new information, and this increased their speed of discovery. For instance, while using the Paint program, when there was no space left to draw after filling the entire page with lines, the need to find out how to erase or reach a clean page arose, and the children turned to the researcher to learn how these were done. Something they learned about computers while browsing the Internet helped them gain awareness and do research on new topics. After the children had realized that they could write in Word, they began to look for how to do things like editing these texts or adding images to the text. It has been observed that many children became automatic in doing the following processes at the end of the implementation:

1) Simple computer operations (click, drag and drop, open/close file/folder/application, open new file/folder, rename old file/folder, move/size/minimize windows).
2) Restarting the computer.
3) Performing task management using the taskbar and start menu effectively.
4) Downloading, saving, and renaming files.
5) Downloading and installing files/applications.
6) Copy-cut-paste.
7) Browsing the Internet, reading news.
8) Listening to music and watching videos.

9) Changing the desktop background (18).
10) Playing educational/entertainment games (games opened from the web or installed on the computer) (26).
11) Writing using Word/PowerPoint, using menu tools, graphics, diagrams, tables, and SmartArt, changing designs (25).
12) Drawing, painting, and formatting photos in Paint (17).
13) Doing simple calculations in Excel (7).
14) Opening an e-mail account (2).

Although the frequency of using each of the first 8 tasks mentioned above varies among children, 37 out of 46 children became automatic in performing these tasks. Of these 37 children, 23 were from the younger age group and 14 were from the older age group (When the preliminary group is included, there are 28 children in the younger age group and 18 children in the older age group). The number of children who skillfully performed other tasks is given in parentheses. Although they did not reach a high level of automation in these higher-level tasks, it was observed that many children opened applications and performed these higher-level tasks. The majority of these higher-level tasks resulted from intra-group dynamics. For example, other children who saw their friend changing their desktop background also tried this and changed their backgrounds frequently for 2 days. But afterwards, they lost their interest in this subject. In some operations and the use of applications, children's use cases have changed depending on their gender (Detailed under Inference 8).

Inference 5: While some of the computer hardware and software components were particularly preferred by children, some tools were not used at all except for a few students. Individuals' preferences and acceptance of technological tools are affected by their perceived ease of use and usefulness of that tool (Davis, 1989). It has been observed that children turn to computer components that they find more useful while ignoring those that they perceive as less favorable. The use of a mouse was generally preferred over the keyboard, and some children even refrained from using it because they thought using the keyboard was more risky in damaging the computer. Primarily, in their orientation towards the mouse, what was effective was that they found the mouse remarkable or some saw the use of a mouse on television. Certain computer tools are more favored when they align with the cognitive and ergonomic preferences of children (Nielsen, 1993).

By improving themselves, especially in Word, the children gained high-level skills such as adding and editing SmartArt diagrams and tables, as well as writing. Word became an application that children used more easily and made conscious operations in terms of quickly deciphering and making sense of what it is used for. It was observed that the children needed guidance on Excel, and they did not tend to this program much. When they looked at the computer screen, they initially noticed the taskbar or the start button. However, if there was a remarkable image on the desktop background, the children frequently clicked on this image and after a while, they realized that it was dysfunctional and gravitated towards other parts. Children generally found pictures with prominent objects and vivid colors remarkable and thought that backgrounds with blurred color transitions or solid colors were dysfunctional by default. For example, on the computer with the emblem of a football club in the background, the child clicked on the stars on the emblem frequently, thinking it was some kind of clickable item. While this background was clicked 20–30 times, the classic Windows background consisting of green hills was clicked 4–5 times.

Using the start button, writing one's own name using different applications, drawing-painting, and doing research were the primary activities that children did when they learned computers by themselves. In the literature, it is documented that only a small number of children performed high-level tasks such as changing the desktop background, opening and editing photos in Paint, opening an e-mail account, and writing a text in Word (Cappelle et al., 2004). In the following days of this study, it was observed that high-level skills like changing the desktop background, editing photos in Paint, using Word and PowerPoint for many tasks were performed by approximately half of the group. It was noted that 13 children from the younger age group and 9 children from the older age group performed these tasks in a short amount of time (the first 1–3 days). Over time, many children have become capable of performing these complex tasks. However, opening an e-mail account and using Excel were performed by a small number of children in this group. 5 of 7 children "doing simple calculations in Excel" and all 2 children "opening an e-mail account" were from the older age group.

Some children were in search of games as soon as they met the computer. A few children who previously saw other people's use of computers and heard that games were played on computers when they went to metropolitan cities or while watching television led them to accept computers as a "game tool". Children played many educational/entertainment games that had already been installed on the computer or accessed via the Internet. It was observed that a few students who played games frequently preferred recreational/entertaining ones, while the rest of the group did not have a significant difference in the type of games they preferred. After the first few days of using the computer, it was observed that the children's interest in playing games decreased and they tended to explore other functions of the computer, except for 3 students. Of the 3 boys, who maintained their interest in the game throughout the process, two were 8 years old and one was 6 years old. Although the 6-year-old child was interested in applications other than games by switching to a different computer from time to time, it has been observed that he spent most of his time with games.

It is claimed that playing computer games can be an important building block for computer literacy by improving children's reading and visualization abilities in three-dimensional space (Dangwal et al., 2005). It was observed in this research that colorful and attractive interfaces in games increased children's interest and assisted them learn the interface of other applications.

The service that the children found most interesting and frequently used on the computer was the "Internet". Realizing that they could reach all the information they desired by browsing the Web, the children's Internet usage time increased compared to other applications and so did their motivation. It was observed that even children who initially showed great interest in games tended to surf the Internet over time.

Inference 6: Collaborative learning has improved the processing speed of children. Thanks to learning by observation, modeling, and instructing those who stayed ignorant in the group, the information learned started to spread rapidly, and it was no longer necessary for each child to learn every piece of information with her/his own effort. At this stage, it was observed that many practices were discovered among at least two or three students in both age groups and were taught to others. It was noted that boys in the younger age group were more willing and sociable to collaborate between each other. The child, whose individual learning develops through the creation of knowledge in interaction (Hoven & Palalas, 2011), sees that learning outcomes are valuable both personally and socially (Garrison, 1997). It has been observed that groups of children experiencing this kind of interaction can become computer-literate with minimal intervention when appropriate resources are provided (Cappelle et al., 2004; Mitra, 2005). The child learns by interacting with the surrounding social environment through language and experiences, and if this interaction is of good quality, the child's cognitive development is positively affected (Morrison, 2000). The terminology formed by the different names given to the parts of the computer and the operations they did on the computer among the children working together strengthened the communication between them. They used expressions such as light/television for the screen, box for the case, and messenger for the web browser; and typically preferred to use their mother tongue in the group.

It was possible to see the attention, remembering, transforming into behavior and motivation phases of social learning (Bandura, 1986; Henson, 2003) in situations where children learned from their other friends through observation. In particular, exchanging ideas about games and telling others what they know helped strengthen the interaction between children and increased the effectiveness of collaboration on other applications. It was also frequently observed that children corrected a wrong behavior by observing their friend. For example, a child who could not click properly because s/he was holding the mouse incorrectly learned and applied the correct mouse grip by looking at her/his friends (Fig. 2).

Fig. 2 Collaborative working among the children

The same gender preference in peer groups was highly seen, and this situation is thought to be caused by social norms. The fact that single-gender groups work more focused than mixed-gender groups (Lin et al., 2020) can also be explained by the different studying styles. While boys took action immediately and tried different ways to solve a problem, girls tended to act more thoughtfully/sensible/consciously/sophisticated/considerate. This attitude of the boys made them dominant in mixed-gender groups, which was rarely the case. It was noted in their comments and general tendencies that one gender generally found the practices that the other was interested in useless or boring.

The fact that children shared with their friends the procedures they learned accelerated the process of dissemination of information. SDL processes of children contributed to the use of Internet technology for collaborative learning (Lee et al., 2014). For instance, if a child asked, "Have you ever opened a movie (they usually refer to the video in this way) on the Internet?", the other child wondered how it was opened and tried to learn, or the discoverer explained how it was done. Those who "knew well", those who "did not know", those who "explored fast", and those who "progressed more slowly" became evident within the groups over time (Mitra, 2000, 2012), and some of the children assumed the roles of teaching or asking questions. The first author only intervened in the rare cases where there was a conflict in the group. For example, a peaceful working environment has been provided by creating solutions for children who could not share a computer or mouse and carry this fight to a physical point. In such cases, each child was encouraged to use different tools in a fair amount of time, and directions were given such as 'Your friend will use this computer until noon, you in the afternoon.'

Inference 7: Giving students simple clues and asking them questions to foster curiosity enabled the SDL process to proceed more effectively. It is known that perceiving SDL as children's self-learning and leaving children alone in computer education cause some problems/deficiencies (Arora, 2010). Children learnt something on their own, but asking questions such as "how did they learn and how they could have more effective learning experiences" increased the efficiency of the learning process. Observing the instant results of the guidance given within the framework of these questions during the implementation provided important data.

In the learning process, which is structured in a social environment, the teacher or guide enables the child to increase her/his learning potential with the guidance and clues s/he gives (Cappelle et al., 2004; Pearson & Somekh, 2003). Namely, giving directions such as "maybe you can catch it if you move a little slower" when the child could not click on the drop-down menu options or "I think this article continues" when s/he could not go down to the bottom of the web page or giving clues such as "there is a lot of information about the history of [research site] in it" positively affected the learning process of the children. The little clues given helped children got out of the process through trial and error and incidental discoveries, and guided them to reason consciously. It was observed that when children were left completely alone in the learning process, some of them got stuck on playing games or they got bored with this activity and could not find anything else to do. At this point, the interventions carried out the children's learning process to different points and enriched them (Morris, 2020), and prevented the formation of possible anarchy and chaos.

The individual can develop her/his "self-direction" ability more rapidly, thanks to the influences in the social environment (Von Glasersfeld, 1989). Simple aids, especially when children needed encouragement and approval, helped them organize information in their minds and make semantic connections.

Inference 8: The SDL process varied between genders. Especially in developing countries, it is known that female are at a disadvantage compared to male in terms of access to technology (Acilar & Sæbø, 2023; Galyani Moghaddam, 2010), prior knowledge, education priority, and literacy (Huyer & Carr, 2002). This gender divide has its roots in social and cultural factors (Fauziah et al., 2023; Garcia-Holgado et al., 2022) that affect technology use by both female and male (Cooper, 2006; Goswami & Dutta, 2015). Students grow up in a social environment where computer games and educational content are mostly designed for male, and computer science is seen as a more masculine science like many other computational sciences (Cooper, 2006; Huyer & Carr, 2002). It has been observed that boys were more enthusiastic and willing to use computers than girls, and they dominated computer resources more (Shashaani & Khalili, 2001). Studies show that females exhibit more computer anxiety and feel uncomfortable, tense, and helpless while in front of the computer (Bradley & Russell, 1997; Broos, 2005; Gilroy & Desai, 1986; Shashaani & Khalili, 2001). During the study, in line with the literature, it was observed that female students were more hesitant and anxious, while male students were more courageous and dominant (Fig. 3).

It is indicated that using a word-processing program rather than a coding application is more effective in reducing computer anxiety (Gilroy & Desai, 1986). In the study, it was observed that girls mostly preferred to use word-processing programs. They showed behaviors of looking at the screen for a long time, reading texts, and focusing on symbols. Boys, on the other hand, showed the behavior of pressing the mouse and keyboard keys randomly, almost without looking at the screen. In addition, the boys showed more interest in calculation and used the Excel program. In

Fig. 3 A process in which the boy is more dominant than the girl

general, it was observed that boys preferred to browse the Internet and play games, while girls preferred to use Paint, Word, and PowerPoint programs.

It is noteworthy that male students' having high self-confidence or self-efficacy measures in computer technologies does not indicate computer literacy proficiency (Siddiq et al., 2016). Although studies in literature argue that boys are more talented in computers, this issue is controversial and there are also studies reporting findings to the contrary or that there is no such difference (Cappelle et al., 2004; Grover & Miller, 2014; Siddiq & Scherer, 2019). Towards the end of the study, it was observed that the girls were especially successful in making sense of and remembering the operations. At the same time, girls' hesitant approach to work enabled them to take firm steps by thinking in detail, and in general, they did not lag behind boys. Males are more willing to work collaboratively and seek help from their peers than females, while females participate in large group organizations rather than small groups (Grover & Miller, 2014). This can be supported by the observation that boys were more willing to work in groups and girls became more inclined to work individually by adopting the "self-directed learning" pattern over time.

Consistent with the view in the literature based on gender inequalities in the field of technology (Lucas & Sherry, 2004), it was observed that boys tended to be more enthusiastic and interested in computer games than girls. For instance, while the Minesweeper game was played among boys, it is noteworthy that none of the girls opened the game. Peer education and collaborative learning have more positive effects on games. Looking at group work, it was common for boys, who were more willing to work collaboratively, to play games together and browse the Internet. The reason for this situation may also be the types of games discovered. Numerous studies have consistently found gender differences in language and visuospatial skills. Female superiority is seen in language skills, and males have an advantage in visuospatial reasoning (Bonanno & Kommers, 2005). Females tend to logic and skill training games, and males, who outperformed females in mental rotation tests and have good spatial ability, tend to action and simulation games (Quaiser-Pohl et al., 2006). The reason why girls were not as interested in games as boys during the research period may be that they had not yet discovered the games that suited their preferences.

The technological gender gap (Canada & Brusca, 1993; Maric, 2018; Purushothaman, 2013), which includes situations such as females accept the roles of wife, mother, and employee as a full-time occupation due to religious and cultural reasons seen in many societies, and prevent them to spend a long time with technological devices (Galyani Moghaddam, 2010; Warf, 2019), draws attention. Females generally merge into the background in the study context and mothers who are unfamiliar with Turkish may be the reasons and results of the technological gender gap in the research context. The fact that girls face issues such as taking care of their siblings at home, going to school at a later age, and being married at an early age negatively affect their educational life. When parents in the research site were asked about the number of their children, the fact that they only counted boys is an important indicator of social neglect for female. Regular non-attendance to school due to reasons such as working in the crop field, which was seen in boys, is rarer and is not effective in all educational processes. It was observed that boys were more interested in political news than girls and they tended to research general and regional news on the Internet.

In a social environment with these conditions where the research was conducted, it was not surprising to obtain findings compatible with gender stereotypes based on social roles (Sheldon, 2004). However, these assumptions may cause the fact that girls in rural areas are left behind in education and may cause poor adoption of computer science as a career choice (Berg et al., 2018). Due to this reason, it is necessary to approach this with a nuanced understanding of individual differences, evolving societal norms, and changing dynamics over time. Recognizing and challenging gender stereotypes in technology-related interests is seen as important for fostering inclusivity and promoting gender-diverse/equivalent engagement in computer education.

Inference 9: The SDL process varied across age groups. Contrary to the common belief that older children may be more adept in an independent learning environment, findings consistent with Vygotsky's socio-cultural theory (1978) were obtained, especially in the initial phase of the study, and it was observed that younger children exhibited a more proactive approach. The enthusiasm and courage observed in younger age groups can also be attributed to their openness to social participation and collaborative learning (Vygotsky, 1978). Cognitive flexibility theory (Diamond, 2013), which describes the development of cognitive control processes and the adaptation of individuals to new and challenging situations, may explain the courage of young children, who have more malleable cognitive structures, to learn computers independently.

Although it was expected that the difference in the proficiency of Turkish, which was the language of education and computer software, would affect the children and that the older age group with better language proficiency would have a more effective SDL process; no such difference has been observed according to age. On the contrary, it was observed that the older age group behaved more hesitantly and was in a disadvantaged position due to the negative experiences they had at school due to bilingualism. Because the younger age group was generally unfamiliar with school discipline or had no anxiety of "the teacher might get angry", they were more assertive about tampering with the computer and clicking and pressing keys randomly. It has been determined that following the SDL process at a younger age has more positive results, because children are more accustomed to the teacher's management of the learning process in older ages (Ni, 2013).

It has been possible to see the effects of sociocultural environment more in older children. Children's preference for same-gender groups when forming their friendships and study groups was observed more clearly as they grew up. It was also often the older children who could not participate in the study whenever they wished, as they helped their parents with tasks such as taking care of siblings or working in the fields. The society in which the research is conducted is sensitive to social events. It has been observed that over time, older children made intellectual analyses and followed socio-political news, which were more complex cognitive issues. Older age group children tended to read news and watch videos on the Internet due to this effect. The fact that older children perform better in certain cognitive tasks due to the maturation of executive functions is a finding consistent with the literature (Best & Miller, 2010). However, while the older age group followed these activities, the younger age group generally tended to explore different features of the computer and different applications.

5 Limitations

The sample size of the study is small and not evenly distributed according to age and gender. This situation is due to the cognitive ethnography method, which is a qualitative research approach that is inherently characterized by a focus on in-depth exploration rather than large-scale representation. Qualitative studies often involve small sample sizes to facilitate a thorough examination of the complexities inherent in the phenomena under investigation (Creswell, 2013; Fraenkel et al., 2012; Yıldırım & Şimşek, 2013).

Patton (2014) has argued that qualitative research is effective when it allows for in-depth exploration within a specific context or setting. This study aimed to examine the cognitive processes within a particular educational environment in detail, where a smaller sample size is conducive to capturing the intricacies of the participants' experiences. Morse (1994) draws attention to the principle of saturation in qualitative research which justifies additional participants may not contribute substantially to the understanding of the phenomenon under investigation. In this research, the principle of saturation was considered to ensure that the data collected were sufficient to capture the diversity of experiences and perspectives within the chosen context. Future research, building upon our findings, could explore similar phenomena in different settings with larger and more diverse participants to enhance the external validity of the conclusions.

6 Conclusion and future work

During the research process, the positive effects of a free exploration environment were observed in children's SDL, and children could effectively learn to perform many operations on the computer. It was observed that during the SDL process, unconscious explorations and trial and error were gradually replaced by conscious reasoning. Activities that led from "accidental discoveries" to "conscious reasoning" in this process enhanced the retention of learning. Children's reasoning based on the use of certain interface elements such as affordances (Norman, 1988) or colors in the process shows that the interface elements they can make sense of play a positive role in their learning processes (Leroux & Lafleur, 1995). Conducting research that considers pedagogical and cultural factors (Chisholm & Wetzel, 2001), especially in learning for children will be beneficial in the effective development and use of designs. Including design elements in the interface design that children can easily understand and taking into account children's cultural characteristics will accelerate the transition to the conscious learning phase.

In the continuation of the process in which children learn completely by themselves, the SDL process became more effective with some guidance focusing on the needs of a child and collaborative learning. This result supports the view that SDL should not proceed completely “self-directed” (Arora, 2010; Morris, 2020). The positive effects on their learning experiences were observed when simple clues were given, and questions were asked during the disruptions and blockages. As children approach a technological device for the first time with the schemas in their minds, clues, either automated or human, can be given to help them construct mental connections (Sherman & Kurshan, 2005). While giving instruction, the important issue is to consider the needs of the child and not to turn the directions into “dictation”. This study was carried out in an extra-curricular context, but research can be conducted on how to integrate a similar practice into formal education within the curriculum. The fact that the roles of “master” and “novice” became clear over time in group work, children’s teaching each other about the issues they solved, suggested that peer learning and opinion leadership would provide effective results in such groups. Culture-based research studies on the design of expert systems and artificial intelligence tools that will provide the aforementioned direction or guidance is a potential area of study in this sense.

In the SDL process, it has been experienced that collaborative work contributes significantly to children’s learning. However, the limiting effects of cultural background were observed in the tendency of children to form groups with friends of the same gender. Although boys displayed a more confident and dominant attitude towards computers at the beginning of implementation consistent with gender stereotypes, girls used applications effectively throughout time. Girls mostly preferred word processing and drawing applications, while boys preferred games and research on the Internet. In contexts similar to this research area, where gender inequality is prominent, children can be supported to form mixed-gender groups. In this way, the whole group can have information about different applications that are especially preferred among girls and boys (Berg et al., 2018), and diversity can be provided in children’s learning areas.

In almost all cognitive processes of children, the effects of limited resources, bilingualism, social incidents, and gender inequality in the region were observed. As a result of the low educational awareness of the parents, the fact that they do not need education (Rogers, 1995) and that they think that education is useless for them stands out as the social dimension of learned helplessness (Seligman, 2006). Educators should consider students’ socioeconomic backgrounds, value judgments, religions, languages, attitudes, communication styles, customs (Spicer, 1952), and learning styles. There is a need for different studies on how to improve educational processes in regions with low socioeconomic levels or different ethnocultural settlements similar to the site in this research. In a globalizing world where “culture” has turned into a more dynamic and interacting structure with other cultures, it is considered important to evaluate the effects in the context of learning-technology by conducting studies within the scope of multicultural education (Banks, 2010; López, 2008).

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Data availability The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Declarations

Ethical Approval This study was approved by the Ethical Committee of Hacettepe University. Identifiable data were removed by researchers, and pseudonyms were used.

Conflict of interest There is no conflict of interest.

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