Chapter

The Learning Situation in the Computer-Oriented Centers for Children in Tunisia, Interchangeability, and Interdependence: Contexts, Challenges and Experience's Building Ethnographic Approach

Abdessatar Rejeb

Abstract

There are several non-formal learning experiences related to the use of computer technologies. Tunisia presents one of these experiences that merits study. I have devoted part of my research to this matter, non-formal education. In this chapter, I have studied the experience of the computer-oriented centers for children. The study was conducted in the educational year 2002–2003. The importance of the data in this study remains reliable to this day. The goals of this chapter is to examine (1) the impact of elements of non-formal learning situation to the informatics project realized by children in its centers, and (2) the impact of the problem situation to social reality shaping, and (3) the impact of the use of computer technology in a learning situation that is different from the formal learning. I consider that a careful constructivist analysis is required to achieve this objective. The results show that an organizational context that operates according to a logic in which social knowledge is interconnected. So, to attain these results I proceeded with an ethnographic approach. I observed 60 children in 67 sessions; each session lasted 1h: 30 mn. I analysed interactions between children and between children and their educators, its are the product of a cognitive and affective commitment, that oriented by the principle of reciprocity.

Keywords: non-formal learning, pedagogy, strategy, child, computer, technology, informatics, interactive competence, ethnography, situation, context, socio-cognitive, negotiation, socialization

1. Introduction

The topic of learning invites us to think about schools, colleges, and universities; what is called formal learning. But learning is very large than this signification. It recovers different fields, like, informal and non-formal learning. In Tunisia, this diversification of learning framework had a long time, experiences have started

since 1964s when the youth, childhood and sports affairs secretary has implemented the first non-formal institution [1–3]. Throughout its history, this educational experience has been impacted by the factor of technological innovation. In 1996, child-oriented computer centers were created [4].

These centers offer computer training (informatics, multimedia, internet, technical maintenance…) to children aged between 5 and 15 years. I studied this experience in my doctoral thesis that I obtained in 2006 at the University of Tunis, and one of the dimensions I studied was the ethnographic analysis of the non-formal learning situation. I'd like to say non-formal learning each activity of learning organized as elective after-school time or extra-curricular activities or even scholar vacancies [5–7]. I'd like to mention that the results of this study remain reliable to this day. To my recollection, there has not been a similar study in the Tunisian context in this degree.

The empirical work allowed us, to follow how the social dimension intervenes in the elaboration of the cognitive and to see the relationship between cognition and social configuration [8]. Focusing on this reciprocity helps us to better understand the impact of computerization on learning and the context of training and education [9].

The reciprocity marked the experience of these institutions and allowed them to acquire a learning identity that went beyond the conditions of activity in the non-formal context (framework of leisure/free time), without coming close to the determinants of formal teaching practice. I am facing a different model of leisure/free time institution that gives a non-certifiable but solid training service to attract children.

The diverse presence of the variable Computer-Culture in the daily life of children reveals a diverse presence of the spaces created to accommodate them. Although, studies are abundant which relies on this, problem and remains unexplored as required by the acceleration of the changes experienced in this period of history where the world has become a de-compartmented and inter-accessible space.

In this study, I adopted a social constructivist paradigm [10–14] for understanding how children can use experiences in informatics, multimedia and internet and other activities non-formal learning. This framework enables us to understand how interactions emerge in a situation where children are using computer technology, and how children's behavior reflects interpretative procedures, how this reflective process is progressively internalized the norms, habits, expectations, abilities, and understandings of community of practice become part of the identity of individual [15, 16].

My approach is socio-cognitive, aiming to identity the change achieved in spaces of socialization [17–19]. How does the child's social world (People, Objects, Symbols) appear through the process of constructing the reality of using the computer tool?

2. Aims of the study

This chapter aimed to gain understanding:

- The impact of elements (program, educator, children, informatic technology) of non-formal learning situation to the informatic project realized by children in child-oriented computer national centers (CNIPE/ COCNC) in Tunisia.

- The impact of the problem situation (non-understanding information, non-anticipation stimulus) to social reality shaping

- The impact of the use of computer technology in a learning situation that is different from the scholastic situation (formal learning).

3. Research design

3.1 Research method

The methodology framework is based [20–23] on the ethnographic survey. I used a grid to observe the learning situation and consider the learning situation in which children obtain knowledge and skills in the computer field. The training location was equipped with computers and organized in a semi-circle where computers are adjacent to the wall and the screens face the center of the room or as a classroom. A blackboard is placed in the middle of the classroom. This is a space of negotiation where each child or group of children presents their work in form of computer production to peers and jury.

3.2 Sample

The research groups of my study were formed by children who had to participate in the session of training that planed from Mars 2002 to December 2002. Each session has been formed by children between 9 and 14 years old, which was been distributed among the training rooms according to the training modules. The average number of children in each group is about 15. So, I observed 60 children in 67 sessions; each session lasted 1 h: 30 men; hence the total number of hours of observation is 100 h 50 mn. The program has been determined according to the following calendar:

1. Module from Mars 22nd, 2002 to Mars, 30th,2002 (8 sessions/ 15 children)

2. Module from June 04th, 2002 to June 30th, 2002 (26 sessions/ 15 children)

3. Module from July 01st, 2002 to July 27th, 2002 (26 sessions/ 15 children)

4. Module from December 23rd, 2003, to December 31st, 2003 (8 sessions/ 15 children)

The sample of this work was complex. Its complexity comes from the complexity of the social reality. Since my research is comprehensive, I focused on the quality of the information I received. So, the essential thing was to respect the principle of saturation and the principle of diversification and the principle of repetition [24].

3.3 Analysis and evaluation of the data

The ethnographic description of the learning situation allowed to follow up in detail the children's use of computers (actions and practices). The children's actions in such a situation should describe:

- The child's posture (actor): social, cognitive, bodily ability, and behavioral consent

- The child's engagement as an actor

- The child as an actor

- Types of practice: conceptual, discursive, written.

- Elements of the situation: space, persons, groups, ideas, texts, designs, objects, tools, organization, regulatory instances.

• The temporality of the activity

• Construction of dialog: discourse structures, significations, contextes, situations

• Interactions: form, realization, models, processes

All observations were related to the educational period 2001–2004. I used the following observation framework:

4. Results of the study

The use of computers by the child in a learning situation is considered as a collective experience where the child changes position, from individuality to participation and interchangeability. The observation of the children's actions verbal, interactions, allow to reveal the process of constructing the reality of the computer utilization and to observe the impact of the pedagogical approach of the instructor.

Journal
Session N°: .....
Date: .....
Subject of training: .....

Time context	Observation	Commentary/explanation/ interpretation
Indicate the chronological progression of the lesson.	In this column I Note all details according to the criteria: • The child's posture • The child's engagement as an actor • The child as an actor • Types of practice: • Elements of the situation • The temporality of the activity • Construction of dialogue contexts, situations • Interactions: form, realization, models, processes	explain and interpret data according to the criteria: • Communication with the educator • Communication with the child • Exchange of information • Exchange of experiences • Assimilation of information • Common use of the computer • Work execution • Quality of work • Understanding • Mobility in class

4.1 Starting situation, challenges, and significations

The activity session of the children's computer center starts by welcoming speech and organizing them into workstations in which they choose their team partner. In the first session, the educator reminds of the rules of work and stresses the importance of cooperation and participatory work, then presents the program and writes on the board the specific goals (**Figure 1**).

The instructor asks questions to motivate the children to interact and cooperate in answering. This method helps to establish forms of interdependence and cooperation [25]. At the moment of the session, there was no use of computers. The instructor noted that it is necessary to give the children time (1/2 hour) to familiarize themselves with the learning situation. I have noted that this waiting period gives children the feeling of frustration. Therefore, they start using and making a connection with the computer. This behavior was expected and interpreted by the opposition of two positions and two roles, the role and position of the instructor and the role and position of the computer.

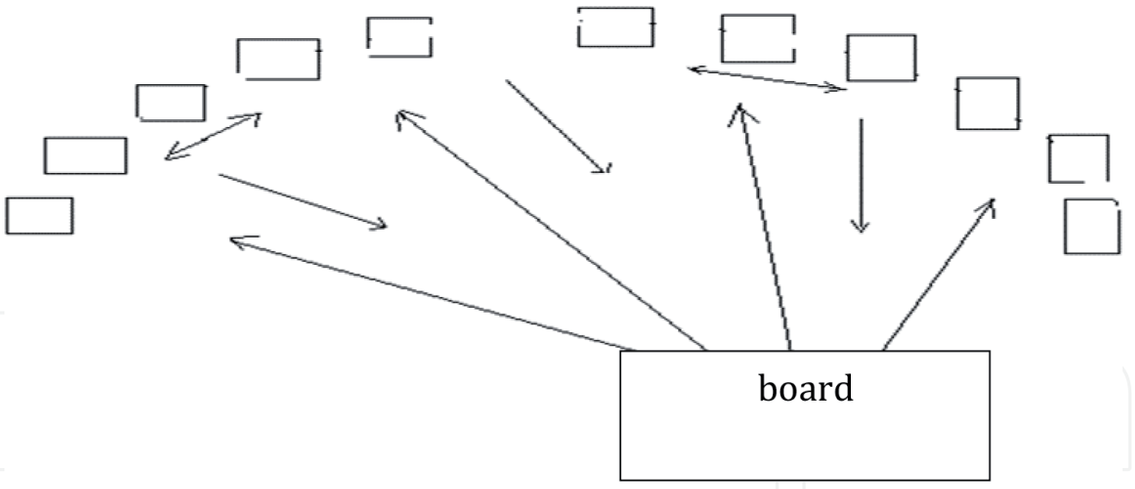

Figure 1.
Design of the learning space.

The interactions' process gradually develops the position of children on the workstations during the instructional activity. The interactions are extended to the dyads that are placed in proximity. This extension to the workstation in proximity can be realized by a verbal or sensory-motor action and then it is translated into the common use of computers.

The information is transmitted through this interactional process and is transformed from the abstract to the realization. The realization takes two forms:

- Realization using the tools of computer writing.

- Realization via the transmission of information from the perceptual to the praxeological level (**Table 1**).

The starting situation leads to common challenges linked to the content of the training and generated through the interactions at the time of learning. The child manifests a need to go beyond the level of acquisition proposed by the instructor. Through the various interactions, he or she will try to find ways to satisfy this need. Self-affirmation appears to be one of the major challenges at the time where a child starts looking at computer. The object takes on an instrumental dimension and allows the child, to realize the overcoming of self. Through this practice, the child has transformed the computer into a resource that can be used.

This transformed attitude was reinforced by the instructor's interventions and by the children's prerequisites. The capacity of knowledge plays an important role in appearing other challenges. It is through the building capacity process that the child reinforces their knowledge and skills. The reinforcement of knowledge becomes in itself a goal for the child, even when exchanging with peers. The repetitioned exercise provides children the opportunity to gain skills and become familiar with this new information.

This exchange confirms the existence of interdependence where information technology is transformed into links through the intermediary of experience transmitted between children or dyad to other. These spontaneous interactions, resulting from the informal relationships between children, contribute to develop the exchange. The symbolic violence of the educator might refrain from the fluidity of the exchange.

Homogeneity and equity that represent a referential for inclusion and fruitful participation for the children, were found among the major challenges. Incompatibility of skills between peers can lead to difficulties in achieving the learning objectives. If children are allowed to move freely in the classroom, they

	Starting situation		
	Situation	**Challenge**	**Signification**
1	One of the children tried to find access to the internet by going beyond the instructor's directives.	• Acquisition of knowledge that is different from that which is the subject of the learning process. • A form of distinction and excellence • A way of self-affirmation where the child has used the computer	**Value of overcoming**: • The value of overcoming the self is its importance in the life of the child • Objects (computer tools) are transformed in a situation of self-affirmation into a relay of overcoming
2	The screen goes off. One of the children panicked. The second was able to solve the problem with a confident attitude. They repeated the same manipulation	• Knowledge acquisition • Self-affirmation • Complementarity between pairs • Inculcation of knowledge	**Value of cooperating:** • Objects are transformed into a link of transmission of expertise • The repetition of the exercise appears as an act of familiarization with the acquired knowledge • Spontaneous interactions develop exchanges between pairs
3	One child changed dyad; he justified his behavior by the fact that he did not find his chance to work with his older female classmate. With his new male classmate, he found more opportunities in the use of computers.	Adequacy and equity	**value of equity**: • The incompatibility of the pairs' skills can create learning obstacles that negatively influence the apprenticeship. • The freedom to move between the dyads allows the child to find optimal alternatives to solve difficulties.

Table 1.
Starting situation, challenges & significations.

create other alternatives. This attitude reveals impressive creativity that helps to optimize human and material resources.

Moreover, if children do not feel integrated into the group, I am not surprised to see their disengagement. This attitude of the children is observed when the educator does not give importance to the principles of dyad formation at the beginning of the session (homogeneity and equity). A feeling of strangeness may affect this category of children and be expected to become disengaged. I might consider that the lack of challenge is itself a challenge that is relevant for learning and integration needs.

4.2 Engagement situation, challenges, and significations

How are the dyads formed? In the beginning, the peers are formed arbitrarily, sometimes the instructor intervenes to change some peers. At this stage, I cannot consider that these partnerships present dyads with challenges. When the child agrees to continue working with his partner or tries to change him, it is noted that the dyad has been formed. It takes some time for the two partners to get to know each other and become familiar with each other. Learning sessions can start with theoretical content or with a practical exercise. If the session has opted for the first approach, and then application, it is noted that computer technology does not play a role in the exchanges established by the children. The (theoretical) informatics

knowledge encourages the emergence of a form of exchange that I can describe as "interchangeability that prepares the children to enter into an expected context of the application, a context for acquiring practical informatics skills".

The theoretical activity in this training is a way of furnishing the learning time in which the instructor continues to drow attention to the new knowledge using the pedagogy of asking questions and consolidation. The board is the main medium for transmitting information. Children's participation starts partially with short answers charged with technical words and then evolves through interdependence that is enriched by the content of their short answers. Distance plays a decisive role in the process of building common knowledge. The closest children bond over the contribution of the last participation.

I noted massive participation especially from those who are in front of the instructor. Distance plays a role in establishing interchangeability between children and it motivates competition and develops a sense of belonging to a psychological sphere of activity. Proximity has an impact on perception [26]. Distance influences perception, which improves the child's ability to observe.

The direction of the sensory-motor interactivity changes every time the instructor changes the orientation at his/her view. This attitude of the instructor generates a dynamic participation of children based on anticipated want to hear the answer to their questions. This environment encourages interaction based on interdependence within children and allows the development of newly exchanges between dyads. The ability to memorize and the appropriate use of the board allows the child to acquire information better. The common method used by the instructor to help assimilate the information is to make the children responsible and give them the role in explaining the contents. In this situation, the child becomes the transmitter of technical knowledge to others.

In case that the theoretical section takes a long time, children's concentration might decrease, and they turn to use the computers without looking at the instructions. This attitude of the instructor is considered a disturbing factor. Computer resources can offer the instructor the opportunity to provide this theoretical content without boring and stressing children When moving to learn practices, the dyads take the same division as at the beginning of the session. At this stage of the learning process, the computer screen is transformed into a field of execution and experimentation. And so, the peers make a decisive contribution to the development of the exercises and the work. Readjustment of achieved tasks is influenced by proximal interchangeability. The computer skills transmitted by the instructor are not limited to the achieved application of but enriched though peers' exchanges. This type of exchange seems to help those who have not been able to complete their work. It reveals that knowledge of computers can be transmitted between children.

At an advanced stage of the project, the instructor requires the children to be stable in the workplace. The objective is the sustainability of the execution and achievement of the work. The rhythm of the application evolved, and the children manifested an affective engagement, and exchanges between individuals and between stable dyads increased. The challenge for the children was to present quality products.

This full engagement affects [27, 28] the children's choices to the extent that they expressed their willingness to sacrifice time for recreation. At the time of the recreation, I noted that the dyads that had been close together expanded to form quartets. This reconfiguration is explained by the impact of the proximal exchanges that were established throughout the first part of the session. The focus of the children's discussions in the recreation confirms this explanation. The children continue to discuss their work and compare their productions.

The degree of involvement reveals the quality and profit of the participants. The issue was that they could finalize their projects with the desired standing. The importance of this point appears in the relationship identified between the variable

interchangeability and the variable stress of the learning situation. The more interaction and exchange there is, the more it helps them to get rid of the pressure of the starting situation. A competitive atmosphere starts to develop as soon as the instructor announces the start of the presentation. The presentation is of considerable importance to the pairs. The image of the expert who has provided them with the act of exposition consolidates their self-esteem.

The more the instructor respects the criteria of homogeneity in the age and prerequisites of the children, the more the exchange and regulation strategies adopted by the pairs optimize their impact on the quality of the computer production. The moment of exposition represents for the children a moment of exploration where they evaluate to what extent they have been able to exceed their limits and deepen their knowledge and skills. The act of self-evaluation will only be accomplished by comparing one's work with the work of other children in the group. This act of self-evaluation is like repositioning of the "expert-self" and thus the child identifies his or her status and capability.

It is considered that the achievement of 2/3 of the group in their required work is a criterion of success for the instructor. It is due to a differential pedagogy that he was able to adjust the achievement and correct the mistakes. The difficulties encountered during the exercise allowed the instructor to use regulation and facilitation strategies. This is a way of accompanying the children in their cognitive quest.

4.3 Negotiation situation, challenges, and significations

The informatics productions that are, given by peers, appear to be important for the evolution of the children's experience in this learning context based on the use of computer technology. This use permits the development of technical and interactive skills in the child. I also considered that this situation is a negotiation situation. This negotiation activity emerges from the fact that the child (or the dyad or the working group) gets bogged down in an exchange where verbal realization and computer realization fail to complement each other to produce a unified discourse, through which the child tries to convince the audience with his/her product. This negotiation situation requires the children to choose words that help more to explain the work and that allows them to answer the questions of the instructor or the examiners.

The following table presents empirical data related to the negotiation situation defined in the previous paragraph. This situation was seen as a critical incident/act. The ability to negotiate was exposed through a cumulative process of learning, exchange, and sharing that offered us the possibility of observing the conditions of construction of the relationship between technology and the child's socio-cognitive reality (**Table 2**).

The negotiated situation looks like a competitive situation where the child uses these linguistic, logical, and technical skills. Negotiation is a communication operation in which the two parties involved (children/instructors or examiners) present their views on a subject [29]. It is a form of bringing together two points of view or two representations. The children showed negotiating behavior about computer technology, which at the beginning of the negotiation appears as a response to a real challenge. At the beginning of the negotiation, this behavior appears to be a reply to a real challenge. The child is called upon to be confident of in his or her skills and expertise. This reveals the existence of a link between the child and IT, through which he or she manifests the desire to execute control of the machine. Sometimes the computer deprives the child of the initiative and fixes him/her in his/her limits and/or potentials. Therefore, it is sometimes found that the child attributes to the device a certain responsibility at the time when he/she will be handicapped to

Negotiation situation			
	Critical incident	**Challenge**	**Signification**
1	Presentation of a computer application that is about "how to consolidate global solidarity ". Practical use of local data to develop a discourse on the topic Access to the internet to get the necessary information Use of Arabic and French to present the work (the use of French was mostly in the technical content of the presentation) Collaboration to respond.	• Convincing • Valorize the effort • Complementarity	• The existence of real challenges in negotiation related to the recognition of effort, • the recognition of competence and expertise in the field of IT
2	Difficulty in starting the application Recourse to a member of the panel of examiners Attributing the error to the operating system Focus on the technical dimension and ignore language skills	• Surpassing the limits of one's abilities • Assigning value	• Recourse to the adult helps to overcome obstacles • Attributing the mistake to the technology helps to offload responsibility • Language is the basis for negotiation
3	Regulation and technical correction at the time of the presentation take time away from the speech Speech rebounds on what is being seen on the screen Fingers and clicks on the keys sometimes take the place of verbal communication	• Regulation • Manipulation • Alternation (with technology)	• Presentation within the framework of a dialectic of silence/pronunciation (to say). • The speech that the children produce ranges from digital to verbal to fill the time of the presentation. This time is made up of two moments: 1. Silent time (the time when the application speaks) 2. Time of speech (Time when the child speaks) • This situation is called "alternating with the technology".
4	Optimization of the time taken to realize the informatic application so as not to disrupt the interactions Giving importance to ergonomics	• Esthetics, ergonomics	• Any IT product that does not generate the possible interactions will not be convincing.
5	Attracting the audience's attention Feedback in an IT usage situation will only be easy if the social situation is real and not virtual	persuade	• The esthetic (ergonomic) part of the work seems like a socio-artistic scene-setting
6	Sometimes the child cannot justify one of these technical choices and so has resorted to uncertain speech to explain.	To Master of Computer	• The challenge is not a theoretical-cognitive one, but a technological one that requires the child to transform the computer from an intractable, impractical tool into a manageable, practical, and obedient tool • Capability is a result of the mastering of technical information and the mastering of technical information is a result of the application
7	The relationship with the computer is manifested through the desire to master and control it		

Table 2.
Negotiation situation, challenges, and significations.

mention a certain ability allocated to IT. The challenges at the time of exposure are multiple, theoretical challenges, technical challenges. This requires that the child can transform the computer from intractable and impracticable to a manageable and practicable and obedient tool. This is only possible because of the close link between the child's ability to manage the computer tool and the technicality he or she has acquired in converting his or her knowledge and skills into a useful and convincing computer. The technical norms of the evaluation of these productions only become advantages if they optimize conclusively and persuasively the syntactic, ergonomic, and symbolic registers of IT.

5. Discussion

(Support your results by citing the previous studies, if there are opposite results of the studies in this topic, please also cite them in the discussion part of the chapter)

In this chapter, I explore a new context in learning where the child becomes an actor who builds his learning experience. Interaction's child towards computer, peers and educator appears as a manner of shaping virtually through inter-exchange between there (child, computer, peers, educator). The development of learning influences the informatic project realization of children and other hand the progress of their work consolidates and accumulates their acquisitions. This result had different from the results of M.Rousso [30]. Roussou mentioned what she called a central thread in learning, play, as well as an essential characteristic of virtual reality environments: interactivity. While I have focused on the dynamics that contribute to the construction of learning as a product of interchangeability between children the computer and the educator the output of the learning situation where the child appears to be an actor in this learning experience. Although, we agree on the framework in which the child exercises his or her learning experience, which is informal and leisure time, my results differ from her that I give the child the status of an actor who impacts on the learning process and the work output through participation. Whereas, she explored a central thread in learning, play, as well as an essential characteristics of virtual reality environments. Which implies that she examined interactivity about learning, play, narrative, and to characteristics inherent in virtual reality, such as immersion, presence, and the creation of illusion [30].

In other studies, Shaffer suggests the concept of epistemic frames as a mechanism through which students can use experiences in interactive learning environments (video games, computer games ...etc) to help them deal more effectively with situations outside of the original context of learning. When computer-supported collaboration means computer-supported competition: professional mediation as a model for collaborative learning [31–33]. Although, I agree with him on the influence of the computer technology variable on the learning process, and on the use of almost the same conceptual background (Understanding frames, structures frames due to the inspiration of the same theorical referential: phenomenological theory, constructivist theory) but my hypotheses differ from his. He was interested in a formal context while I was interested in a semi-informal context that is managed by institutional rules that reflect an organizational reality that of the COIC (child-oriented informatics centers).

Tisza & al surveyed informal and non-formal learning activities in nine European countries. They investigated the relationship between the targeted age group and the gender of the participants in these activities and the gender of the activity leader experts and the content and the main goal of the activity. They concluded there is a difference between variables: gender/ activities; gender/ main

goal of activity; age/ activities, age/ main goal of the activity [34, 35]. I consider these results very important; but they cannot be compared to my study because of the difference in methodological approach. Nonetheless, I can serve as a basis for comparison for future studies when I adopt the same methodological design as the study by Tisza et al.

I note that the field of research is influenced by technological innovations. For example, two of these technologies have influenced learning, virtual reality, and augmented reality. It is important to see what impact these two technologies have non-formal and informal learning and to compare the results with those I have presented in this study. It is also important to see how the reality of the use of virtual technologies is constructed and to reveal the strategies of this social construction and the challenges of interchangeability adopted by the children in the non-formal learning. I can use as a starting point the article by Lewis & al [36], which presents an interesting literature review.

6. Conclusion

My study contributes to the growing literature in the following ways: a) I have provided a look at a non-formal learning experience in a Tunisian context marked by those cultural, socio-economic, and institutional variables. b) I shed light on the status of children and their role to manage this experience of non-formal learning. I have provided an opportunity to see how the challenges of using computer technology are generated and how the significations of this use are constructed. To know how computer technology has been integrated into a local context that has not contributed to its emergence and development is crucial to follow up on the individual, community, and institutional strategies adopted in the use and processing of this innovation.

From this ethnographic analysis and this psycho-socio-cognitive diagnosis of the non-formal learning situation experienced by the child in a context of computer use, I can conclude that the experience of computer children utilization is a hypercomplex and multifactorial, and situation. Cognitive and social factors play a role on the experience and its socializing identity. The relationship between these factors ensures the different exchanges between children and the contents of this learning. The development of the child's interactive skills is attributed to this exchange. These appear as knowledge and know-how in charge of providing the child with a status that allows him/her to integrate into a socio and virtual lifestyle.

This study focused on the experiences of children who use computer non-formal learning at child-oriented computer national centers (CNIPE/ COCNC) in Tunisia. Understanding children's experiences and meanings of learning computer use can help educators, policy makers and researchers to develop interventions and guide children towards computer use desirable.

The experiences of child-oriented computer national centers (CNIPE/ COCNC) may influence the environment of education and suggest a new configuration of the different roles, status, and modes of participation in educational situations. I think that increasing these structures which would have a beneficial effect on (1) the diffusion of the scientific culture (2) building a proximal field to improve technical and social competencies (3) can have benefits on children's ability to exchange optimally with their peers.

Finally, it is important to compare our results to other results obtained in other contexts, which we have done in the discussion. The second important thing is to follow the effect of time, of technological innovation on non-formal learning in the local context. This is what we will do in our next studies.

IntechOpen

Author details

Abdessatar Rejeb
Carthage University, Tunis, Tunisia

*Address all correspondence to: rejebabdessatar@gmail.com

IntechOpen

References

[1] Rejeb A. Essay of the problem of free time and its relationship to social educational intervention. Journal of Childhood. 1999;**6 & 7**:82-75. Publications of the Higher Institute for Childhood Eucators, University of Carthage. (Article in Arabic: Taatir Ishqaliet al waqt al hor wa Alaqatouha bi tadakhol ak tarbawi al ijtimaii,)

[2] Rejeb A. L'institution d'animation socio-éducative et l'informatisation: De l'espace habituel à l'espace innové. In: Cahiers de l'Enfance Tunisienne. Vol. 10. Publication de l'Institut des cadres de l'enfance, Université de Carthage; 2001. pp. 19-26

[3] Law n° 96-73 of 29 July 1996. Establishing the national centre of informatics for children. Official Journal of the Republic of Tunisia; 2 August 1996. 1637-1638

[4] Pucci EL, Mulder I. Star(t) to Shine: Unlocking Hidden Talents Through Sharing and Making. In: Streitz N, Markopoulos P. (eds) Distributed, Ambient, and Pervasive Interactions. DAPI 2015. Lecture Notes in Computer Science. Vol. 9189. Cham: Springer; 2015. DOI: 10.1007/978-3-319-20804-6_8

[5] Christensen R, Knezek G, Tyler-Wood T. Alignment of hands-on STEM engagement activities with positive STEM dispositions in secondary school students. Journal of Science Education and Technology. 2015;**24**:898-909. DOI: 10.1007/s10956-015-9572-6

[6] Durães DA. Gaming and robotics to transforming learning, in: T. Mascio, R. Gennari, P. Vittorini, F. De la Prieta (Eds.), Methodol. Intell. Syst. Technol. Enhanc. Learn. Adv. Intell. Syst. Comput., three hundred and seventy Fourth ed, Cham: Springe; 2015, pp. 51-56. http://dx.doi.org/10.1007/978-3-319-19632-9_7.

[7] Vigotsky LS. Pensée et langage. Paris: Editions Sociales; 1984

[8] Cilesiz S. Educational computer use in leisure contexts: A phenomenological study of adolescents' experiences at internet cafés. American Educational Research Journal. 2009;**46**(1):232-274. DOI: 10.3102/0002831208323938

[9] Strauss AL. Miroir et masque: Une introduction à l'interactionnisme, Traduit de l'Anglais par Falandry M. Paris: Editions METAILLIE; 1992

[10] Berger P, Luckman T. La construction sociale de la réalité. Paris: Editions MK; 1986

[11] Coulon A. L'Ethnométhodologie, Que sais-je ? Paris: Editions Puf; 1992

[12] Mead GH. L'Esprit, le Soi et la société, Traduit par Caseneuve J et al, Préface Gurvitch G. Paris: Editions Puf; 1963

[13] Giddens A. La construction de la société: Eléments de la théorie de la structuration, Traduit de l'Anglais par Audet M. Paris: Editions Puf; 1987

[14] Lave J. Situating Learning in Communities of Practice. Washington, DC: American Psychological Association; 1991

[15] Lave J, Wenger E. Situated Learning: Legitimate Peripheral Participation, Cambridge. England: Cambridge University Press; 1991

[16] Stehr N. Le savoir en tant que pouvoir d'action. Sociologie et Société. 2000;**32**(1):157-170. DOI: 10.7202/001773ar

[17] Piette A. Ethnographie de l'action: L'observation des détails. Paris: Editions Métailié; 1996

[18] Fordham F. Introduction à la psychologie de Jung. France: Éditions Imago; 2010

[19] Madelaine S-P. Une approche pragmatique cognitive de l'interaction personne/système informatisé. Revue Apprentissage des langues et systèmes d'information et de communication. 1998;**1**(1):27-36. Available from: http://alsic.u.strasbg.fr

[20] Lefévre L. Méthode d'observation psychopédagogique. Paris: Editions ESF; 1973

[21] Dufour S et al. L'enquête de terrain en sciences sociales: L'approche monographique et les méthodes qualitatives. Quebec: Editions Saint-Martin; 1994

[22] Guibert J, Jumel G. Méthodologie des pratiques de terrain en sciences humaines et sociales. Paris: Editions Armand Colin; 1997

[23] Barab SA et al. Critical design ethnography: Designing for change. Anthropology & Education Quarterly. 2004;**35**(2):254-268. DOI: 10.1525/aeq.2004.35.2.254

[24] Mucchielli A. Dictionnaire des méthodes qualitatives en sciences humaines et sociales. Paris: Editions Armand Collin; 1996

[25] Hogue JP. Groupe, Pouvoir et Communication. Canada: Editions Presses de l'université Du Québec; 1988

[26] Hall ET. la dimension cachée, Traduit par Amelie Petita. Paris: Editions Le seuil; 1971

[27] Csikszentmihalyi M. Applications of Flow in Human Development and Education, The Collected Works of Mihaly Csikszentmihalyi. New York: Springer; 2014. DOI: 10.1007/978-94-017-9094-9

[28] Csikszentmihalyi M. Flow: The Psychology of Optimal Experience. New York: Harper and Row; 1990

[29] Deloffre G. Pédagogie de la négociation dans la formation des responsables. Revue internationale de psychosociologie. 2009;**15**(37): 161-172

[30] Rousso M. Learning by doing and learning through play: an exploration of interactivity in virtual environments for children. Computers in Entertainment. 2004;**2**(1):10. DOI: 10.1145/973801.973818

[31] Shaffer DW. Pedagogical praxis: The professions as models for learning in the age of the smart machine. In: WCER Working Paper No. 2003-6. Wisconsin Center for Education Research (NJ1); 2003

[32] Shaffer DW, Gee JP. Before every child is left behind: How epistemic games can solve the coming crisis in education. In: WCER Working Paper No. 2005-7. Wisconsin Center for Education Research (NJ1); 2005

[33] Shaffer DW. Epistemic frames for epistemic games. Computer & Education. 2006;**46**:223-234. DOI: 10.1016/j.compedu.2005.11.003

[34] Tisza G, al. Patterns in informal and non-formal science learning activities for children–A Europe-wide survey study. International Journal of Child-Computer Interaction. 2020;**25**:100184. DOI: 10.1016/j.ijcci.2020.100184

[35] Tisza G, Papavlasopoulou S, Christidou D, Voulgari I, Iivari N, Giannakor MN, et al. The role of age and gender on implementing informal and non-formal science learning activities for children. In Proceedings of ACM Fablearn Europe conference (FABLEARN EUROPE'19). 2019. DOI: 10.1145/3335055.3335065

[36] Lewis F, Plante P, Lemire D. Pertinence, efficacité et principes pédagogiques de la réalité virtuelle et augmentée en contexte scolaire: une revue de littérature. Médiations et médiatisations. 2021;**29**(5):11-27