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ANALYSIS OF CRITICAL FACTORS
INVOLVED IN USING INTERACTIVE ROBOTS
FOR EDUCATION AND THERAPY
OF CHILDREN WITH DISABILITIES

IROMECA
Interactive RObotic Social Mediators as Companions
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REVISION OF THE ENGLISH LANGUAGE

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GLOSSARY OF ACRONYMS

ADL:	activities of daily living
AT:	Assistive Technology
CARS:	Childhood Autism Rating Scale
CF:	Critical Factors
COMP:	Canadian Occupational Performance Measure
CSBS–DP:	Communication and Symbolic Behaviour Scales Developmental Profile
FIM:	Functional Independence Measure
ISO:	International Standards Organization
ICF:	International Classification of Functioning, Disability and Health
ICF-CY:	International Classification of Functioning, Disability and Health (version Children and Youth)
ICIDH:	International Classification of Impairments, Disabilities and Handicap
IDEA:	Individuals with Disabilities Education Act
MATCH:	Matching Assistive Technology and CHild system
MPT:	Matching Person and Technology
OT FACT:	The Occupational Therapy Functional Assessment Compilation Tool
PIADS:	Psychosocial Impact of Assistive Devices Scale
RCPCH:	Royal College of Paediatrics and Child Health
SIB–R:	Scales of Independent Behaviour Revised
QUEST:	Quebec User Evaluation of Satisfaction with Assistive Technology
UD:	Universal Design
WHO:	World Health Organization

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INTRODUCTION

a. Some definitions of play

What is play? It is seriousness and frivolity. Reality and make-believe. Rules and freedom. Within these antinomies lies the human experience of play, which must cope with a frustrating dichotomy that is always resolved through action.

Poetic expressions have been used to describe the condition in which a child plays: if Fink (1992, orig. ed. 1960) talks about *dense* reality, where life is highly concentrated and children appear to be totally absorbed by it, Huizinga (1979, orig. ed. 1938) talks about *tension*, of the desire to achieve, to be successful, and to interrupt that same tension. But these are conditions that are both powerful and knowledgeable: «Play demonstrates that two different attitudes co-exist: to be fully involved in what one is doing and to be aware of the fact that we are within a relative, delimited and conditioned dimension» (Staccioli, 2004).

It's difficult to find a definition accepted by various scholars, especially in different environments. A now old but fascinating definition is provided by Fink: «Play resembles an oasis of happiness that we happen upon in the desert of our Tantalus-like seeking and pursuit of happiness. We are abducted by play. By playing we are released a bit from the mechanism of life – as if we were transported to another celestial body, where life appears easier, more ethereal, happier» (Fink, 1986, orig. ed. 1957).

Play is undoubtedly an instinctual need, of the child and of man. It is Vygotskij who cautions us on this subject: «To me it seems that refusing to consider the problem of play in terms of the satisfaction of a child's needs, of the reasons that drive him or her to take action and of his or her affective expectations, would lead to a negative intellectualization of play» (Vygotskij, 1981, orig. ed. 1933). The driving force behind play, the transition from one stage to another, are determined by a necessity to satisfy needs and by the change in these same needs...

Its substantial connection with instinctuality is demonstrated by the fact that it is not only a part of the human species, but also of others – and mammal and birds in particular – in which its nature of being without any serious and immediate purpose is confirmed (Pellegrini & Smith, 2005): it always seems to start from an internal trigger and desire, no one can be forced to play.

Bruner, in his autobiography, focuses on the concept of play on a much broader philosophical level: «I found two implicit theories of the conscience; the first was a theory of affliction, the other a theory of enjoyment. The first was fine to tackle problems, to make difficult decisions: the second, from Huizinga, was the first that involved enjoyment» (Bruner, 1984). With his *Homo Ludens*, Huizinga influenced all the literature in the sector, proposing the theory that play *is* culture. The underlying idea of his approach is original, and is not specifically linked to pedagogic, psychological or sociological interests: he asserts that our culture arises *before*, like play, i.e. that the relationship between play and culture is a fundamental relationship. «I've been absolutely convinced for some time that human civilisation arises and develops in play like play» (Huizinga, cit.); he also states that one of the primordial underlying factors of play is struggle, as can be identified in the social type of play, that ends with the defeat of other(s).

According to Huizinga, freedom and seriousness are the distinctive features of play and hence, in this sense, acquire a universal value for all of humanity. These ideas can be supported by the fact that there are models of games that cross all cultures and are present in all peoples. Other authors agree with him in stating that there is a bond between a certain game and the culture that produced it, and even a tie between the way that game is handed down and the culture itself. This position however was authoritatively called into question by Eco, who asks why these processes of creation and transmission of culture cannot still be found today in everyday life (Eco, 1979).

But play is also a dominion of the daily experience of adults: «We play when we are serious and authentic, we play in the real world, in work and in our daily struggle, we play with love and death. And we even play when we play» (Fink, 1986, orig. ed., 1957). The reasons for

this propensity, widespread among man and over time, were identified perhaps in the most convincing manner by Nietzsche: play has the power to make levity counter the weightiness of daily experience. By moving us away from the usual codes and rules, play creates a distance that is also relaxation and happiness, exhibiting an irradiating power toward a “celebration of our dailyness”, that one can also learn to reproduce voluntarily (Nietzsche, 1965, orig. ed. 1882).

Described over the centuries by pedagogists, psychologists, educators and doctors as an expression of the highest synergy between knowledge, relationality and emotion, the play activity would thus appear to be indispensable for man’s well-being, and an «existentially original right, that cannot be derived functionally from anything else except from the human interiority, and that has been sanctioned for some time in the many declarations concerning the rights of children. In fact, in this sense, to claim the right to play is equivalent to the claim that man does not need to react or conform to the interests of the world of consumerism but to be productive and act in a real manner and thus be congruent with that spirit of freedom which play continuously yearns for» (Bobbio, 2007).¹

It is this specific content of the revolutionary and irreverent play act, that generates in who plays «a spontaneous need to be a protagonist and for self-transcendancy, not very inclined to be conformed by practices and social conventions that are specified as unchangeable and unalterable» (ibidem). In fact, to play is to change, it is to transform oneself, and it is to acquire awareness of oneself and of oneself with others.

b. Play and education: a brief historical overview

According to Fénelon (1994, orig. ed. 1687) there are three major lines of thought from which to take a critical and comparative look at the types of games we would like to propose: games for education of the body, games for education of emotions, and games for education of the mind. These viewpoints, as briefly described below, will then be linked to the total education project of modern pedagogy.

b.1. *Education of the body*

Children and adults of all periods have played and have made toys. However, specific historical attention has been focused on children’s toys only during a more general consideration of childhood and, in this case, important educational values are attributed to play. The Egyptians made dolls from cloth or majolica, as well as wooden or stone toys while the Romans made sweets in the form of letters, and invented games involving imitation and comparison.

Play was used by the Greeks and the Romans as a prize following educational activities, and the close link between school and play is also etymologically demonstrated by the two words *skholé* (fun, leisure time but also school for the Greeks) and *ludus* (fun but also school – *ludus schola* – for the Romans); an ambiguity that in many contemporary languages can be found in the use of the word *play* to indicate sports competitions, and the specific and very diverse activities of both children and adults.

It’s perhaps interesting to recall that according to Plato, to be educational, play involving children had to: favour movement, be done in a group - in a place consecrated to the gods - mix males and females, and be supervised by nursemaids to moderate the liveliness. Play also must have a set of fixed rules, which make it possible to test and specify socialisation processes. This is a very modern attitude and within the experimentation of these mutual relationships among play participants lies the core and possibility of moral growth.

Basically, however, in ancient times educational attention on play focused mainly on the development of gymnastic and sport skills and to prepare for war.

¹ The right to play for each child on the Earth is recognised by the Universal Declaration of the Rights of Children launched by the United Nations in 1989; and is defended and supported by the International Play Association (IPA), www.ipaworld.org.

In more modern times, motor play has been studied mainly by Parlebas (1990) who emphasised its relationship with specific cultural models including rules (for example, the game of tag). It combines affectivity and the fantasies of the child and not only the motor coordination abilities, and is capable of reaching conscious and unconscious levels.

A description of motor play may contain the following indicators: roles, space, times, way to determine points, way to use objects and relationships between players. There are interesting comparative studies, on the basis of previous criteria, between different types of games, for example between football and baseball, because of how they are structured from a motor viewpoint, the role that they identify, the type of relationships that they suggest and create, and not only because of their rules. In motor play Parlebas identifies the following recreational and motor behaviours: cognitive, social-relational, affective, expressive and decisional conduct.

b.2. Moral and spiritual education

In the Middle Ages, it was the Church instead that provided a strong orientation regarding the area of play, in particular for games involving adults – for example, chess pieces were considered demonic objects.² The prevailing tension focused on controlling this activity, since it was a possible source of moral promiscuity; around the 1400s, distinguishing features were making headway within the general attitude of condemnation: there was a focus on *ludus licitus*, *ludus tolerabilis*, *ludus indifferens*, *ludus ricreation*, up to *ludus laudabilis* that consists of the holy representations of the life of saints.

In any case, play was kept under control, so that it could carry out a clear moral type of function; if on one hand it was necessary to educate, on the other it was necessary to allow to vent itself because – as Fénelon asserts – children have their own innate «great heat». In the end, however, it must also be supervised because there are games toward which a certain distance must be maintained because they are dangerous for moral development.

Locke's educational project also tends to move toward moral education, putting particular attention on play, according to a plan that we could consider a precursor of modern pedagogy. Toys must not be purchased but made by the children themselves: «little stones, a pack of cards, a mother's keys, and other similar items that they can't hurt themselves with are fun for children just as much as those things that are bought such a dear price in stores and that go bad or break in a very short time» (Locke, 1918, orig. ed. 1693). He also recommends outdoor games since they strengthen the physique, and fun games, from which children however must slowly be «weaned»: study should be just as fun as play, and if a child wants to continue to play it's a sign that he or she is not yet ready to study... the obvious advantage for children offered by playing is the efforts they make to do this activity, and the fact that they get involved voluntarily, without saving energy.

For Fénelon (cit.) as well play is a basic opportunity to give a child a moral education: in fact, if play can be functional to the needs of education, making study more pleasurable («let's hide study behind the appearance of freedom and pleasure»), then from games we must remove everything that can make children overly excited, or that permits the simultaneous presence of males and females: in other words, play can make you lose your head or can be a source of sinful thoughts.

An authoritative member of modern psycho-pedagogical thought, Jean Piaget, in a similar manner, considered play to be the source of moral thought, because it leads to awareness of moral relationships in society: «Children's games are remarkable social institutions [...] If we want to understand something about the morals of the children it's obvious that we have to begin from an analysis of these facts» (Piaget, 1980, orig. ed. 1932). Piaget dedicated a part of his work to these very aspects: «The individual himself is unable to attain such awareness, the individual by himself remains egocentric. The solution lies in a comparison among children, in their playing and working together, in the negotiation of meanings and rules and in cooperation» (ibidem).

² Pietro Aretino, in his text *Le carte parlanti*, in a reprint from 1640, was able to provide convincing arguments that cards were not the work of the devil but, on the contrary, were desired by the heavens since they could teach human virtues.

b.3. Education of the mind

The great turning point in European history regarding education, and thus play's role within it, is the 1700s, the era of Illuminism, in which a kind of pedagogy arose that put the focus on creating citizens and disseminating social values. The task of the citizen, of the *cives*, must not be only that of understanding and adapting to laws but must be possibly capable of developing new ones: it is the educational process must move toward the illuminist project of man.

With the invention of the printing press, the first board games appeared and then the first family games that could be played around a table, such as the ancient goose-chase games. This is a game that includes extensive symbology, rules and possible relationships to be played.

Then, the educational utility of play is linked much clearer at this point. Basedow (1914, orig. ed. 1768) was the first to knowingly link play with educational activity, for example inventing school competitions – and many linguistic ones – in which children could try to beat the other peers in the group and with which they could have a lot of fun. Fun – conceived in this case as a joke – was an integral part of the education project through play. The author is keen on repeating and describing how much children involved in this activity laugh and giggle. In the author's opinion, games have two main characteristics: competition, considered as an indispensable means of triggering emotion and participation; and the use of symbolic and play-acting games with theatrical and narrative characteristics.

Locke is also quite interested in the objective of developing the mind since he points out what pedagogical advantage can be gained from the efforts children make while playing: «I thus thought that if games were invented with a certain contrivance it would be possible to find many ways to teach kids to read in a way that would seem almost like playing to them» (Locke, cit.).

b.4. Mind-body-person: the complete educational project

However, it is only with Fröbel (1967, orig. ed. 1826) that play acquires its full educational value: it stimulates the imagination and allows the child to relate with himself/herself and with the world. To carry out these functions, play cannot be solitary, but with a group and must allow children to practice skills and roles that they can adopt and do as adults. As known Fröbel invented the mechanism of «gifts» to offer to children to favour their growth that is seen as total, of body and mind («the body and its parts must be made capable of obeying the spirit at any time»), growth that must take place at the same pace, following the same path. Thus, recreational education requires particular attention: movement and play must be developed together, and gradually at different ages: physical strength and moral and spiritual determination exist in a direct relationship that, through play, can be taught.

Fröbel's educational project is based on some fundamental features that are still quite interesting: a) play is a planned part of the school day, the adult must not act in an authoritative manner; b) the use of structured educational materials that carry out the explicit function of teachings; c) play must be correlated to the environment in which it is carried out and be open to contact with nature; d) the creative and cognitive aspects present in play must be safeguarded and nurtured at the same time; e) the link between play and life is explicit, the recreational behaviour can become a social behaviour.

c. The IROMEC project

As we will see in this document in greater detail, play is the essential means through which children develop: through play, they can learn, explore the social and physical environment and build fruitful social relationships. However, there are children that, due to cognitive, developmental or physical impairments, are prevented or inhibited from playing; the development problems of these children have been studied for many years in the scientific

literature, in the search for pedagogical, psychological and rehabilitative solutions and proposals.

Technology is playing an increasingly important role within this framework. This is also the result of the rapid changes taking place in this sector, paving the way toward innovative and interesting scenarios to find possible solutions to the problems of these children; the topic has already been studied on a stable basis in the recent literature, and mainly with regards to Assistive Technology (Besio, 2002a; 2004; Brodin, 1999; Mina et al., 2005), and to robotics (Prazak et al., 2003; Moor, 1998; Robins et al., 2004a).

The European project IROMEC (Interactive ROBot MEdiators as Companions) investigates how robotic toys can become social mediators, encouraging children with disabilities to discover a range of play styles, from solitary to social and co-operative play. These toys also provide opportunities for learning and enjoyment involving other children, as well as caretakers/teachers or parents, who “join in” the game with the robot.

The objective of the project is to develop interactive robotic systems that respond to the needs of children with severe disabilities, and motor, cognitive and relational impairments (autism) in particular, helping them to play independently and, as a consequence, also through play, to learn, to grow, to have fun and to emerge from social isolation.

The activities to develop by the IROMEC robot engineering project and the methodology for its efficient use focus on the secondary users (parents, teachers, rehabilitation professionals, experts, researchers, ...) who are also actively involved in the experimentation phases in order to:

- directly define the play scenarios;
- specify the robot's interaction skills and abilities;
- develop the methods to evaluate the quality and efficiency of play with robotic systems;
- develop a system that satisfies children's needs and market requests, along with possible commercial distribution of the developed product.

In IROMEC the following play contexts were considered after consulting with panels of secondary users involved in the first phase of the project:³

- home or elsewhere: solitary play;
- home: playing together with parents, brothers and sisters, other family members;
- school: playing together with classmates with or without disabilities; teachers;
- rehabilitation context: playing together with rehabilitation professionals and with other children with disabilities.

d. Individuals and their life contexts: IROMEC and the ICF-CY

The cultural background within which the IROMEC project was created and has developed is based on the process of integrating⁴ persons with disabilities – in this case children – in society as a whole: some functional limitations in restricting the participation of some children in play activities common for their peers, in fact also prevent them from fully participating in typical and age-adequate life contexts.

Creating instruments that support the play activities of these children and identify efficient methods of introducing these tools in appropriate educational activities may be a useful and innovative basis for creating contexts that are included from early childhood. In addition, these instruments can be effectively introduced within individualised rehabilitation projects, acting as a driving force in their cognitive, relational and psychomotor development. In fact, it is within the rehabilitative activity that the children can be provided with the contexts, the

³ Reichrath/Gelderblom (IRV). IROMEC. Deliverable D1.1., Phase 1, Orientation. Internal document.

⁴ The disabled person integration process is supported internationally by the main political and institutional bodies, in addition to research institutes and sector associations. Here, as the last act in the long path toward independence and integration, we cite the International Declaration of the Rights of Disabled Persons, issued by the United Nations on 13 December 2006 in New York and currently undergoing ratification by the various countries.

interpersonal relationships and the most suitable times to allow them to learn and stabilise an efficient use of technological tools, and to appreciate their advantages with regard to play. In this sense, the rehabilitative phase can be considered in some cases as preparatory to the educational one, and in other cases as a support for the exploration and training of new activity skills.

The International Classification of Functioning, launched in 2001 by the World Health Organisation, defined human functioning as an indispensable relationship between the health conditions of a person and his or her ability to take action and participate. However, these conditions are described in their decisive interdependencies by personal and environmental factors that allow, favour or determine their expression and development (Fig. 1).

The ICF assumes that disability is a natural and common experience of living, not necessarily depending on illness. Its language is value neutral and cause neutral; it also provides a taxonomy for coding all health-related experiences based on an interactive bio-psycho-social framework.

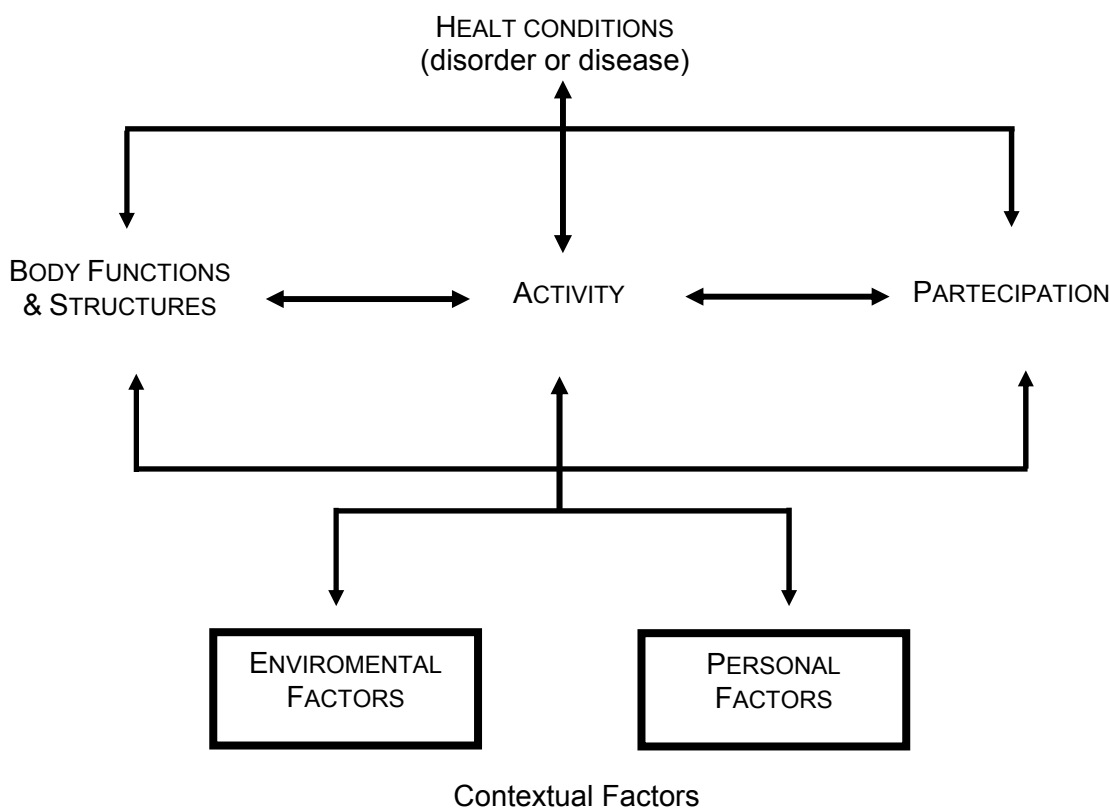


Fig. 1. ICF: Interactions between the components of ICF

The publication of the ICF represented an important advance in the classification of disability, however, it did not adequately capture the functional characteristics specific to the developing child; it was especially poorly suited for children 0 to 5 years old. Manifestations and consequences of impairments in children are different in nature, intensity as compared to adults. As stressed by Simeonsson et al. (2003) for a child the model of interaction between a person and the environment must be reconsidered, taking into account the mutual influences and development factors.

The main factor in this period of life is that the environments with which the developing individual comes in contact change radically in the transition from one phase to another (Fig. 2).

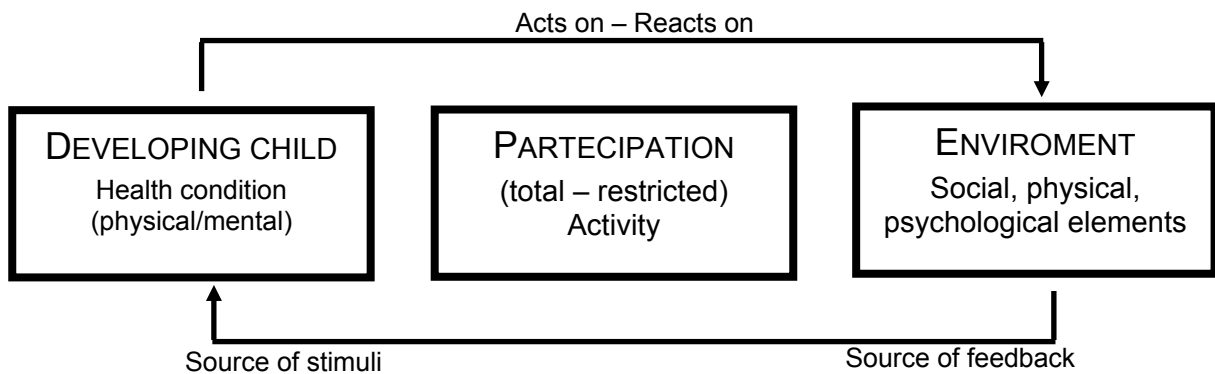


Fig. 2: From Simeonsson et al., cit.

Each of these environmental changes affects the child's interaction possibilities and opportunities, both by acting as a stimulus and offering various types of responses (*feedback*) with regard to his or her behaviour. These interactions are the framework around which increasingly complex abilities in the child can be created.

The development of ICF for children and youth (ICF-CY) was carried out by WHO as an adaptation of the ICF for universal use in health, education and social sectors for children and youth. The first release of the ICF-CY will be launched in October 2007.⁵

e. Objectives and rationale of the study

One of the first steps of the IROMEC project is the development of an exhaustive analysis of the Critical Factors involved in using interactive robots as play companions in education and therapy of children with disabilities.

The document is intended to be a background study for further documents that have been planned as end results of IROMEC. The purpose of this document is to be an exhaustive and updated scientific and methodological source for the following end-users: teachers, educators, rehabilitation professionals, researchers in the field, as well as IROMEC researchers during the project experimental phase.

This analysis focuses in detail on all the sensitive factors relative to developing, choosing and using robotic play for cases involving children with disabilities. Considering the subject matter, the factors to be analysed are extremely varied, since they involve numerous disciplines including medicine, rehabilitation, psychology, pedagogy, technology, robotics and many others. In addition, within these subjects, there is also a wide range of scientific fields, such as developmental and relational psychology, the pedagogy of play and special pedagogy, and methodological aspects regarding rehabilitation, design, the choice and use of technologies, and so on.

Within this rather complex scenario, the term "Critical Factors" refers to any aspect that deserves careful consideration when setting up learning and therapy play sessions and/or programs assisted by robots involving children with disabilities.⁶

Success or failure in introducing robots in education and in therapy effectively can depend on several factors. There are human factors, related to the disabling impairment, to the end-user's situation (his/her age, disposition, cognitive styles, previous life experiences, etc.), and to the educators and the professionals involved; there are social factors – related to the environment, its limits and possibilities, the play context, family hopes and participation, market opportunities and needs – and cultural factors, referring to the psychological, pedagogical and rehabilitation approaches used. And there are – of course – technological and methodological factors, related to the choice and the use of the robots – for example,

⁵ See on the WHO site, at the address: www.who.int/classifications/network/conferenceICFCY/en/index.html.

⁶ The methodology implemented is based on the European project EUSTAT, www.siva.it/research/eustat.

personalization, training, modularity, safety – but also to the R&D phase, as well as to the market exploitation of the product.

Clarifying all these processes is essential to understand how complex the issue considered really is and to implement effective and repeatable experiences in which children with disability play with robots.

The objective of this study is to identify, classify and describe the body of knowledge regarding robotics and children with disabilities. In any case, since the implementation of any educational activity and/or rehabilitation project should be adapted to the single child involved, the Critical Factors analysed in the following chapters will also become the key to understanding how such a process can be personalised.

The term “Critical Factors” refers to all those aspects influencing the implementation and accomplishment of educational and rehabilitation sessions in which children with disabilities play with robots. There may be Critical Factors that have a negative influence, others that yield a positive influence on the success of the initiative and on the child’s development; others may act positively or negatively when cross-related with other Critical Factors. The adjective “critical” is not used as a synonym of “positive” or “negative”; it just means deserving careful consideration.

e.1. Methodology

The first basis for the document was a discussion with the WP5 partners to determine the most important Critical Factors to be analysed, grouping them into five main clusters.

Factors that merit consideration were then analysed in detail, and discussed in terms of their relationship and involvement in influencing and determining how children with disabilities play. This led to a classification of Critical Factors, which was also organized in a final checklist of Critical Factors, in which each cluster was detailed in a three-level structure: X cluster of CF, XX Class of CF, XXX Critical Factor.

The aim of the checklist is to support the end-user (educator, rehabilitation professional, researcher, etc.) in considering all the Critical Factors involved when using a robot toy or developing a new one that children with disabilities can play with. By reviewing the classes and the described Critical Factors, the end-user should first decide whether or not such a factor is relevant in the specific case. If it is relevant, he/she should consider the attributes presented before making his/her choices.

Nevertheless, if a checklist is only used according to a top-down flow chart, some information about the complexity of the correlations between factors may be lost in this way. For this reason, another instrument has also been created, i.e. a conceptual map that shows all the possible interrelations among Critical Factors and at least some singled out classes. The conceptual map allows the end-user to become aware of all the possible relationships involved that may affect each step in the decision flow.

e.2. Contents

The topic to be developed includes: special individuals – children with disabilities –, main players in the educational and rehabilitative processes (family members, professionals, educators,...), contexts (school, recreation centres, rehabilitation centres,...) and instruments with an enhanced technological content. Owing to its complexity, this area must be considered in greater detail and be carefully analysed by sector experts.

Five main clusters, related to how children with disabilities play, mediated by robotic technology, have been singled out in this research document. With respect to decisions taken within the IROMEC Consortium, special attention has been devoted, all along the document, to the following types of impairment: autism, physical disabilities, mental retardation; children who happen to live in hospital for long time has been considered too.

The first cluster involves, naturally, those aspects pertinent to play: functions, typologies, development stages, activity mediators. It is based on the most recent and consolidated literature in the relative disciplines. The next two – involving respectively the individual and his or her life context – were developed on the basis of the ICF-CY structure. Thus, they are

widely inspired by the classification items that were considered useful to develop the topic being discussed here, in compliance with the declaratory statements. The decision to use the ICF would appear to be quite a natural one considering the power, comprehensiveness and authoritativeness of such a tool: in fact this classification can be used to refer in a stable manner to individual and environmental factors with the certainty of the universality of languages and of reference concepts. For each Critical Factor or Class of Critical Factors, the ICF declaratory statement has been included in these two Clusters, so that topic discussion can be more detailed. To the purpose of being more adherent to the needs of children, the Internet version of ICF-CY has been used, (the final official version is to be released in the next months).

In particular, by using ICF it is possible to place greater emphasis on the importance of developing technology and play activity tools that make it easier to achieve the inclusive objectives outlined by the main international organisms.

The last two clusters – technology and methodology – were chosen because of their specific pertinence to the topic being discussed, in order to analyse them in greater detail, highlighting their specific features and aspects.

The five clusters, and the relative classes, are described here below.

1. Factors related to *play*.

These Factors include the main conceptual nodes correlated to the topic of infant play, as discussed mainly by pedagogy and psychology, which can describe, explain, facilitate and/or develop how a child plays. Hence, it can be observed and described from various viewpoints, which identify different parameters that are just as useful and interesting. In this study the following Critical Factors related to play have been identified: functions of play, types, development stages, contexts and mediators.

2. Factors related to the *individual*.

Within the ICF-CY two areas, *Body functions* and *Activity and Participation*, were selected as significant for this study. As can be seen, the severity and the type of any functional limitations have a direct impact on the child's capacity and performance. For this reason, specific attention was focused on analysing the functions that may be involved in play activities, such as motor, sensory, mental functions, etc. They are considered in relation to some of the most important activities in a child's period of development: general tasks, mobility, communication, interpersonal relationships but, above all, learning, that in turns includes play, for which the ICF-CY includes a specific and detailed description based on the most recent data from the world of psychology and pedagogy.

3. Factors related to the *context*.

The child who wishes to and intends on playing does so within an environment that has its own specific characteristics which may facilitate or obstruct that activity depending on the child's needs and possibilities.

Thus, the context may represent a fruitful «development niche» for the child's health and expressive potential (Harkness & Super, 1994). It consists of three factors: the first concerns the physical and social aspects in which the child lives. This refers not only to the natural and structural environment, but also to the social and cultural practices that may facilitate or complicate growth. The second factor involves the care and upbringing methods. The third factor concerns the psychology of the persons who care for the child, the values and the beliefs that define the upbringing methods.

Within the context of the Contextual Factors set out in the ICF-CY, the environmental factors and the changes introduced by man, social attitudes and the services present in society, among others, were considered as significant for this study. The technological products, which are obviously of fundamental importance for this study, were broken down and detailed in a specific cluster (number 4).

For what concerns the Personal Factors, for which the Classification does not provide a predefined list, leaving the choice up to the researcher, the following were identified as those that may affect a child's participation in play activities: sex, age, nationality and

culture, cognitive styles and adaptability, previous experiences, social background, education styles.

4. Factors related to *technology and robotics*.

Technology is undoubtedly one of the most Critical Factors directly correlated with the disability, as demonstrated by the studies and sector-specific research over at least the last thirty years. The development of technology, in the form of Assistive Technology, domotics, robotics, is being relied upon to create an autonomous and independent future for persons with disabilities.⁷ They are also recognised as an essential factor in developing the social inclusion process, as hoped for in the most authoritative international declarations.

Always described as the most efficient and reliable means by which disabled persons can carry out everyday activities and participate to the greatest extent possible in civilian life, technology is becoming, on a case-by-case basis, a tool that replaces functions, a support for carrying out deficit functions or a means for rehabilitative recovery.

Obviously, all this is true also for the case involving the child, even if Critical Factors must be correlated and described in relation to the specific needs of this development stage.

5. Factors related to *methodology*.

Introducing robotic technology in play or rehabilitation activities designed for disabled children involves numerous and important methodological aspects that are related to and depend on the disciplines involved and on the contexts considered. This is the reason why, for example, for what concerns the experimentation phase of this activity, that methodological aspects relative to research are involved (qualitative or quantitative approach, data collection, quality of measurement, sample, design development, ...).

Design development has been considered in depth since it is one of the most significant activities in creating and developing robotic toys.

For what concerns then the educational activities, methodological aspects relative to the pedagogical school of thought are also involved; similarly, as far as rehabilitative activities are concerned, corresponding methodological criteria are utilised. With these, we must also consider another important Critical Factor, meaning the ethical issue, that controls and determines the structure of the professional and personal interpersonal relationships established in these activities.

⁷ Adolf Ratzka, the chief exponent of the Movement for Independent Life, is a fundamental and authoritative member of this line of research, as well as a supporter of its consequences in terms of its political and financial outcomes www.independentliving.org