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6 Guidelines for parents, professionals, designers, makers and researchers on toys and technologies for play for children with disabilities: How to take usability and accessibility aspects into consideration?

Abstract. Many toys, board or videogames, apps and even robots are nowadays available in many countries for play for children. However, a lot of these are not appropriate for children with disabilities. Instead of enabling play opportunities, frustration and withdrawal can be the case. Parents, siblings, therapists, teachers are often searching quite some time for the most suitable play object. Designers and engineers are interested in creating play objects with a universal design. Nevertheless, daily practices show challenges for these different persons involved in supporting children with disabilities' play. As the review of scientific and grey literature presented in Chapter 5 gained only 10 guidelines on usability and accessibility of toys and technologies for play for children with disabilities and no tools for measuring usability or accessibility. Working Group 2 of the COST Action TD1309 "LUDI – Play for Children with Disabilities" has developed guidelines for taking usability and accessibility of toys and technologies for play for children with disabilities into consideration. The guidelines for parents, professionals, designers, makers and researchers have a pragmatic character and aim to support reflections and decision-making processes for choosing, adapting, designing or studying a toy or technology. The guidelines have references to the new gained knowledge about creating play for the sake of play opportunities and evaluating usability and accessibility of play tools. Further evaluation of the presented guidelines is needed to support the adults in their efforts creating play opportunities for children with disabilities.

6.1 Introduction

Toys and technology have great potential to elicit play for all children. However, different questions regarding usability and accessibility are emerging about toys and technologies for play for children with disabilities. In Chapter 5 of this publication we have described the review process and outcomes about guidelines and tools about usability and accessibility of toys and technologies for play for children with disabilities. The results of this review showed 10 guidelines on usability and accessibility of different play objects with and without technology from which 4 especially developed for children with disabilities. Some of these guidelines, listed

below, are entirely, usable for a specific group of stakeholders, some just partly. Most of the included guidelines concern apps or games for developers and designers. The 10 included guidelines are not always developed with a focus on play or children.

Table 6.1: Guidelines on usability and accessibility of toys and technologies for play of children with disabilities.

Nr	Name of guideline Documents available via https://www.dropbox.com/sh/8gtyowaokfbzeo3/AABm6TwGBOLoczDjU6VWZqsYa?dl=0	Targeted users	Goal
1	Game accessibility guidelines http://gameaccessibilityguidelines.com/	Game developers	To support the development of games for people with disabilities
2	Highlights of Inclusive Design for App Development https://tech.beitissie.org.il/en/highlights-of-inclusive-design-for-app-development/	APP developers	To support the development of accessible apps for people with disability
3	APPLICATION guidebook: 7 easy steps to making your app accessible http://en.beitissie.org.il/kb/item/7-easy-steps-to-making-your-app-accessible/	Mobile app developers	To support the development of accessible apps for people with visual impairment
4	The Principles of Universal Design https://projects.ncsu.edu/design/cud/about_ud/udprinciplestext.htm	Architects, designers, engineers. It can also be used by researchers and professionals.	To evaluate existing toys, products, already available on the market and to check if they are accessible and usable for all children
5	Toys, games and disabilities. The importance of a universal design. Costa et al. (2007) See Dropbox link	Toy industry, for parents. Is also useful for designers, professionals working with children for choosing and adapting toys.	To inform about problems that persons with disabilities have to face when accessing and playing with toys
6	Includification. A practical guide to game accessibility Drumgoole & Mason (2012) Retrieved from https://accessible.games/includification/	Game developers	For developing accessible games for persons with mobility, vision, hearing and cognitive disabilities

Continued **Table 6.1:** Guidelines on usability and accessibility of toys and technologies for play of children with disabilities.

Nr	Name of guideline	Targeted users	Goal
	Documents available via https://www.dropbox.com/sh/8gtyowaokfbzeo3/AABm6TwGBOLoczDjU6VWZqsYa?dl=0		
7	Inclusive indoor play: An approach to developing inclusive design guidelines. Mullick (2013)	Designers	For designing indoor playthings and environments
8	Designing universally accessible games Grammenos et al. (2009)	Designer of computer games, apps	To apply unified design to the development of universally accessible games followed by recommendations for universal accessible games
9	Guidelines to promote play opportunities for children with disabilities (n.d.). Let's play projects. http://letsplay.buffalo.edu/ not available but see Dropbox link	Adults as play partner and facilitator of play for children with disabilities.	To give recommendations about positioning, communication and social support, selecting or adapting toys, play strategies, and play strategies to switch toys
10	Game accessibility: A survey. Yuan et al. (2011)	Developers, parents, caregivers, and users	To survey the current state-of-the-art in research and practice in the accessibility of video games and providing information about input devices, selected games and identified strategies for players with motor, hearing, visual or cognitive impairment

Scrutinizing the outcomes from the perspective of an adult involved in creating play opportunities for children with disabilities, the potential of each guideline can be described as follows in Table 6.2.

Table 6.2: Overview of potential of the included guidelines regarding creating play opportunities for children with disabilities with toys and technologies by different stakeholders.

Parents	Professionals	Designers/engineers	Researchers	Policy makers	Others
Nr 5 for choosing or adapting toys.	Nr 5 for choosing or adapting toys.	Nr 1, 6, 8 for game developers.	Nr 10 can be an example of research about accessibility of games.	Not available	Nr 4 for education about inclusive design.
Nr 9 for creating play opportunities with toys for children with disabilities.	Nr 9 for creating play opportunities with toys for children with disabilities.	Nr 2 and 3 for app developers. Nr 5 for toys developers. Nr 7 for developers of play things and environments.			
Nr 10 for games and strategies for specific disabilities.	Nr 10 for games and strategies for specific disabilities.	Nr 10 for games and strategies for specific disabilities.			

Red lines explicitly related PLAY with toys and technologies; black lines not explicitly related to PLAY with toys and technologies

All outcomes were guidelines, no tools for evaluating usability or accessibility emerged from this review. Most of the guidelines aimed at analysing or developing games and apps, some of them toys, none of them robots. The guidelines were mostly addressing persons with disabilities and not specifically children or youngsters. Guidelines developed for a specific health condition or impairment were mentioning motor, hearing, visual or, in just one case (nr 3), cognitive impairments. One of the guidelines (nr 10) takes play objects as well as the play environment into consideration.

In conclusion, there is not much information or support available for adults designing, making, choosing, adapting, evaluating toys and technologies for play for children with disabilities. Reviewed guidelines have a rather strict focus, either on specific objects for play or on particular groups of children with disabilities.

Studies and experiences from participants of the COST Action TD1309 “LUDI – Play for Children with Disabilities” (2014-2018) showed the need for more attention on usability and accessibility aspects of toys and technologies as these are important

elements for creating inclusive play. Therefore, LUDI Working Group 2 decided to develop guidelines for different stakeholders in the sense of supporting a particular group when facing questions and issues to make choices regarding the development, adaptation or application of toys and technologies. The intended guidelines are a source of information to advice a specific group of stakeholders, not a protocol of standardized way of working. The results of the scoping review have been incorporated in these guidelines as they can be of important use for a particular stakeholder at a precise phase of his involvement in creating play opportunities.

6.2 Method

The development of the guidelines on usability and accessibility of toys and technologies for play for children with disabilities took part in two different phases. First, the objectives and features of the guidelines for a specific stakeholder group was discussed in a LUDI meeting in September 2017 that took place in Gdansk in the presence of more than 20 participants of Working Group 2. Secondly, the structure of the guidelines was discussed related to the intended overall objectives regardless the characteristics of the stakeholder. One of the elements of this discussion was how to make optimal use of the outcomes of the scoping review on guidelines and tools on usability and accessibility of toys and technologies for play for children with disabilities (Jansens & Bonarini, 2019). Secondly, LUDI wanted to get feedback on the first version of the guidelines in a small feasibility study. Due to time limitations these first versions were evaluated in a straightforward way.

6.3 Designing guidelines on usability and accessibility of toys and technologies for play for children with disabilities for different stakeholders

6.3.1 Objectives of guidelines on usability and accessibility of toys and technologies

More than 20 experts in the field of toys and technologies for children with disabilities have discussed the objectives for different stakeholders. They are based on the research and clinical practice experiences with them. The objectives should answer the questions described below, in part different for main types of possible users of the guidelines.

A. Parents, relatives, informal caregivers.

How to evaluate whether a toy, game, robot or app is usable and accessible for a specific child with disabilities? What features are important when choosing an appropriate toy? Where to look at for sustainability of a toy which will be

interesting for a child over time? Which toys or technological products can be interesting to play with siblings, peers, or the whole family? What kind of toys or technological products are normative?

Objective: The main objective of a guideline on usability and accessibility of toys and technologies for play for children with disabilities for parents is to support in choosing a suitable toy, in getting ideas for variation in play objects, being inspired for new toys and technologies, possibly exploring the possibility to have different play experiences with the available toys.

B. Professionals, working with children e.g., teachers, occupational therapists, physiotherapist, speech language therapists, pedagogues, psychologists.

How to evaluate usability and accessibility of toys and technologies for play for children with disabilities? Which toy is suitable to enable a variation of play activities? Can the toy stimulate the child(ren) to take control and direct the play situation? How can a toy or technology enable inclusive play with siblings or peers?

Objective: The objective for a guideline on usability and accessibility of toys and technologies for play for children with disabilities for professionals is to support them in evaluating the usability and accessibility of toy or technological product in the perspective of the intended objectives for given child(ren), in selecting an appropriate play object, in critical analyzing the play situation in the preparation phase, in having arguments for shared decision making process with parents, possibly in inter-professional meetings.

C. Designers, makers, engineers, technicians.

How can issues about usability and accessibility be taken into consideration for designing and constructing toys, games, robots and apps for play for children with disabilities? What does it mean for children to have a disability? What kind of play does a group of children like? How can the toy elicit their strengths rather than focusing on limitations? How can a play object enable inclusive play with peers? How can a toy or technological product be interesting for playing over time?

Objective: The objective for a guideline on usability and accessibility of toys and technologies for play for children with disabilities for designers is to stimulate them to apply aspects of usability and accessibility in the design and producing process of a play object and experiences for given children, to support the realization of user-centred design process, the inter-professional cooperation with users or their representatives, the importance of qualitative and quantitative user experiences' evaluations in different phases.

D. Researchers investigating the usability and accessibility of toys and technologies for children with disabilities.

How can research be done about usability and accessibility for toys and technologies for play for children with disabilities? What kind of tools are available to measure usability and accessibility aspects?

Objective: The objective for a guideline on usability and accessibility of toys and technologies for play for children with disabilities for researchers is to stimulate them to investigate (aspects) of usability and accessibility of toys and technologies for given children, to support them in finding the right research question, to stimulate to connect to former research, to use suitable tools in investigating usability and accessibility of toys and technologies.

E. Policy makers or persons in charge of taking decisions about innovations in society, in educational or health care organizations.

What is necessary to know about children with disabilities, what is necessary to know about play, what does it mean creating play opportunities which are accessible and usable by children with disabilities, what are the possible benefits about creating inclusive play opportunities for children themselves and for others?

Objective: The objective for a guideline on usability and accessibility of toys and technologies for play for children with disabilities for policy makers is to stimulate them to incorporate usability and accessibility of toys and technologies for play for children with disabilities in their policy about creating inclusive play opportunities for all children.

6.3.2 Features of guidelines on usability and accessibility of toys and technologies

The results of the discussion among the LUDI Working Group members are listed according to different stakeholders, first starting with some general characteristics:

- The guidelines should reflect that play for the sake of play is the overall aim.
- Educational, therapeutic aspects should be able to be embedded as well.
- The guidelines should address characteristics of stakeholder groups e.g. parents are concerned about safety, cleaning and sustainability besides the play aspects.
- The guidelines should have clear aims. These objectives should be leading the guidelines.
- Clear description of target group should be added, with respect to both the users of the guidelines and the children with disabilities.
- The guidelines should be described to the point and as short as possible.
- Evidence to support the content of the guidelines should be incorporated.
- The validation of the guidelines is important.
- In the guidelines the context of play should be taken into consideration.

- The guidelines should address also the aspects about how to make changes in the application, how to adapt the toy.

A. Features of guideline for parents, relatives, informal caregivers:

- Is easy to read and to follow.
- Is activity oriented, not focusing on underlying components e.g. cognitive, motor skills.
- Supports to select the use of a toy and/or a technology.
- Has clear information, is short.
- Has a selection matrix for child's play → how to use toys, technologies, different kind of use depending on goals, ...
- Has practical information.
- Incorporates icons on the boxes of toys.
- Mentions also the icon or symbol indicating single and multi-player gamer.

B. Features of guideline for designers:

- Is product oriented.
- Contains background information for the developmental process e.g., characteristics of impairments and the possible impact of play, of age-appropriateness.
- Fits to the known design process.
- Addresses evaluation topics e.g., of the concept, of the prototype.
- Addresses also detailed physical characteristics related to specific target.
- Guideline has to follow the safety and ethic procedures.

C. Features of guideline for professionals:

- Focus on play situation, not only on the child, not only on the product (toy-technology), not only on the activity.
- Considers consequences of choices.
- Is activity oriented, not focusing on underlying components like motor, cognitive, social skills.
- Guideline should support the selection process of an appropriate toy or technological product as well as how to use the toy/technology.
- Should incorporate also the preparation of the setup of the play situation.
- Stimulates to take a short course if technology is new/high tech.
- Emphasizes to test the toy or technology out before playing with children.

D. Features for a guideline for researchers:

- Contains detailed and specific information regarding research about usability and accessibility of toys and technologies.
- Emphasizes that background information, gap of knowledge and the added value of the research should be mentioned.

- Stimulates for looking for possible improvements for the child and others involved regarding play.
- Stimulates to describe a kind of theory.
- It should be clear which are the goals of playing with the toy or technology.
- Stimulates to carry out a validation process.

E. Features of guideline for policy makers

- Should be short and described to the point.
- Can be a standard with icons or symbols.

The features for a guideline for policy makers are limited as the expertise in this area was lacking among Working Group 2 members. Neither the review emerged a guideline for this stakeholders group (see Table 6.2). Therefore, developing a guideline to support policy makers in their work of pleading and realizing inclusive play opportunities with toys and technologies for children with disabilities, was not taking forward.

Children with disabilities often cannot rely on commercially available (technological) toys or (digital) games. Creative parents and relatives, and sometimes also therapists and teachers, tend to make or adapt an existing toy or technological product, possibly adding an input or output device to create an accessible and tailored-sized play object. These groups of persons could be considered as bricoleurs or makers and can be very important in realizing play opportunities. Therefore, it was decided to develop a guideline for this group of stakeholders as well. The aim is to support them in analysing the features of the toys or technology, in discovering play opportunities, transforming play wishes of children into features of a toy or technology.

6.3.3 Structure of the newly developed LUDI guidelines

The general objective of a guideline on usability and accessibility of toys and technologies for play for children with disabilities is to support a particular group when encountering questions, dilemmas for making choices regarding choosing, developing, adapting and/or applying toys and technologies. Bearing this in mind, the structure of a LUDI guideline is outlined in two parts:

1. Reflective questions related to different themes for creating play opportunities for children with disabilities. Existing guidelines, definitions about concepts, tools and classifications, developed by LUDI and related to usability and accessibility of toys and technologies could be added to support clarification and application.
2. Decision tree with different steps to be considered, resulting in a usable and accessible toy or technological product for a given child(ren).

An important feature of the LUDI guidelines is to be clear, concise and having a good flow so easy to be used by different stakeholders. Therefore, extra information about concepts, classifications, existing tools and guidelines will be added via links to the original sources. It is up to the user to go deeper into it.

6.3.4 Evaluation of the first version of the guidelines on usability and accessibility of toys and technologies for play for children with disabilities

This evaluation was carried out with a small-scale qualitative approach by answering the following questions:

- Are the questions/comments clear?
- Is the flow of the guideline working for you.
- Can you imagine using this guideline? When, how.... describe the possible occasion.
- Other comments.

Participants were recruited via the LUDI network: participants of the network as well as colleagues, acquaintances were involved. Data were summarized and a straightforward content analysis was carried out.

The evaluation was given by 31 persons from 11 countries: 10 professionals working with children with disabilities, 13 designers or engineers, 6 researchers, 1 parent and 1 maker.

We obtained feedback from different points of view:

- Feedback regarding clarity was about clarification of some terms e.g. hygienic rules, the need to add the safety aspect, the wish to emphasize play for the sake of play.
- Feedback regarding the flow of the guideline concerned practical aspects, such as the fact that not all hyperlinks in the presentation were working, about the fact that the document is inspiring, but it is not a real guideline in the sense of a standard, about the length of the guideline, generally considered as too long.
- Feedback regarding seeing possibilities for use gave mixed answers some yes, some doubts, some no as there was nothing new in it. Several persons emphasized the potential for using the guideline with students. Comments referred to the common knowledge about user centred design, the importance to incorporate European Standard EN 301 549.

The feedback was processed into the version of guidelines for different stakeholders presented in the next section.

6.4 Guidelines on usability and accessibility of toys and technology for play for children with disabilities for different stakeholders; parents, professionals, designers, makers and researchers

This paragraph presents the adapted guidelines for each group of stakeholders. The reviewed guidelines on usability and accessibility as found in the literature review were incorporated in the LUDI guidelines on accessibility and usability of toys and technologies for play for children with disabilities. A critical approach was taken into considerations about the added value as the current developed guidelines aim to support the reasoning and considerations process in a pragmatic and inviting way tailored to the specific stakeholder.

The guidelines on usability and accessibility of toys and technologies for play for children with disabilities for different stakeholders: parent, professional, designer, maker, researcher are as well available via <https://www.dropbox.com/sh/hwf0pw96cqu3ecn/AAAy9wATfGO9uBt3SSuxodLna?dl=0>

Guideline for parents, relatives, caregivers

How to evaluate whether a play tool is usable and accessible for your child with disabilities?



1 Introduction

This guideline aims to support a parent or relative in evaluating the usability and accessibility of a play tool. The findings of this evaluation facilitate the choice for an appropriate toy, game, robot, app or other play tool for the child. This guideline starts with reflective questions eliciting the reasoning, followed by a checklist and an advice for choosing a play tool for a child with disabilities. Extra information about concepts, classifications with the number of document, can be consulted at this link: <https://www.dropbox.com/sh/wii2si50apcgglu/AAAQCBFS1UQ2KGbKOEw8Kr2Ha?dl=0>

[Check out this Dropbox link for document: 1) definitions guideline, usability, accessibility]

2 Reflective questions

CHILDREN WITH DISABILITIES *[Check out the Dropbox link above for document: 2) definition children with disabilities, and document 4) challenges in play of children with different disabilities]*

- What is appealing for your child when playing? (discovering an object, getting a reward, getting the attention of a playmate, the (sensory/motor) experience itself, the result of playing, etc.)
- What is motivating your child? (try to look at his/her personal motivation, when and with what does s/he show autonomous initiative, when do you recognize his/her personal motivation, what is the possible influence of playmates?)
- How can your child be in charge, what are his/her possibilities for directing the play situation?
- With what kind and to what extent of self-direction do you feel comfortable with as a parent/relative?
- What are important aspects for a safe play situation?

FAMILY LIFE

- Does the playing take place on a certain time during the day? Or does it start spontaneously?

- Do you want the play situation fit in your family routines? If yes, what does this mean for the play situation? (with others, kind of play, choice of play tool, timing, play space, etc.)
- Do you want the play situation to reflect some family values? If yes, which?

PLAY TOOL [*Check out the Dropbox link above for document: 3) definition of play and play tool*]

- Do you prefer a toy, board game, computer game, TV game, app on tablet/phone or a robot? Or isn't it that important?
- Is the toys, game, robot or app accessible for your child? Can the child reach it, can the child reach from different positions? Can the child push, pull, grasp, release, manipulate it? Can the child change position of the play tool? Can the child use buttons or switches to cause an action?
- If it is needed, is it possible to connect the play tool to other input/output devices?
- Can the play tool be used when using other assistive devices?
- Does the play tool fit your child's motivation, interest for play?
- Does the play tool give your child opportunity to self-direct?
- Is it easy to understand how to play? Can the child understand different elements, steps of the play tool?
- Is it comfortable, usable to play?
- Is the play tool easy to control, to interact with? Are there variations in the interaction?
- Does the play tool enables/exploits interactions with playmates?
- Can the play tool be customized or personalized?
- Can the play tool evolve with the player?
- How much the play tool can engage the player? In the beginning? Over time?
- Does the play tool provide enough clear and motivating feedback and reward?
- How easy is it to learn how to use the play tool?
- Does the play tool exploit multimodal interaction and stimulate different senses (e.g., sounds, lights and vibration)?
- How the behaviour of the play tool is predictable (clear cause-effect relationships)?
- How the play tool has the ability to repeat its behaviour?
- Is the play tool safe?
- Is the play tool sustainable, if important for you?
- Can the play tool be cleaned easily?

PLAY [*Check out the Dropbox link above for document: 3) definition of play and play tool*]

- Do you have an objective for creating the play situation? (e.g., stimulate the child playing alone, stimulate playing together with siblings, therapeutic/educational goals, stimulating your child to take initiatives/being in charge, stimulating play

development, etc.) [Check out the Dropbox link above for document: 3 definition of play and play tool, and document: 5) classification of play]

- Are there possibilities to have some variation in the play situation (e.g., play itself can be varied, the play situation can be changed)
- Is the play very structured or rather unstructured, what is fitting best to your child?
- Is it possible to perform free play with the play tool?

ENVIRONMENT [Check out the Dropbox link above for document: 7) definition environment and environmental factors]

- Should the play situation be indoors or outdoors?
- Is the physical environment suitable for using the play tool?
- Can your child have a comfortable appropriate (seating, lying, standing) position?
- Is the room suitable for the play activity, for your child? (e.g., distraction, space wise, etc.)
- Who should be involved in the play situation?
- What should be the role of the involved person? As a play mate, an assistant for the child, as a controller?

3 Checklist for parents, relatives, caregivers to evaluate whether a play tool is usable and accessible for your child with disabilities

Your child's interest in playing is mostly related to:

- o discovering an object or environment
- o getting a reward
- o getting the attention of a playmate
- o experiencing the play experience itself
- o the result of playing, the final product
- o other _____

You want to address the following abilities of your child:

- o curiosity
- o social interaction
- o running, walking, jumping, crawling, grasping, manipulating, seeing, smelling, hearing
- o storytelling, imagination, fantasy
- o learning new skills or knowledge
- o other _____

You want your child or your child wants him/herself to play

- o alone
- o with peers

- with a sibling
- with a playmate (age doesn't matter)
- with an adult who can assist in the play situation
- other _____

What is your child's or yours goal when playing?

- having fun
- possibility to take initiatives, to be in control
- playing alone playing together with siblings
- achieving results (improving his own abilities, result of the game, winning from playmates)
- curiosity, wish to discover new play tools, new activities
- other _____

What is the context of play?

- spontaneous play everywhere
- structured play in a predetermined place
- fitting in family routines
- indoors in a room
- outdoors: in garden, in parc, _____
- Safety rules to be taken into account: _____
- Hygienic rules to be taken into account: _____

4 Advice for choosing a play tool for your child with disabilities.

You need an in-depth **understanding of the children**, their development and the impact of the disabilities which is for you as parent quite evident

1. You can consult websites from toyshops, assistive technology, libraries where you lend toys, etc. You can talk to other children/parents, to teachers, therapists, etc. to get inspiration for a toy, game, robot or app.

Assessing usability and accessibility of play tools must be **user-centred**! Children with disabilities, no matter what age or disabilities, should be involved!

2. If it's important for you, choose whether it has to be a toy, board game, computer/videogame, robot or app.

3. Select possible a specific play tool.

You can **analyse a play tool**. But it is still very important afterwards **to observe child(ren) using** the play tool in a play for the sake of play situation

Toys, games and disabilities. The importance of a universal design (2007) <https://www.dropbox.com/s/4h60tom16buxxOf/Nr%205%20Toys%2C%20games%20and%20disabilities.pdf?dl=0> is a guideline for selecting and adapting toys for children with (physical and sensory) disabilities

4. Check if the selected play tool meets the items you have marked at the checklist above. The information at the box of the play tool are important as they address usability and accessibility. Try out the toy yourself to get a better understanding of the play tool
5. Try out: give your child and yourself opportunities to try the toy, board, videogame, robot or app several times. Observe your child responses, personal initiatives.

Be aware of the elements of **play for the sake of play** (self-direction – intrinsic motivation – fun)

Guidelines to promote play opportunities for children with disabilities (n.d.) <https://www.dropbox.com/s/ncmc185bfntxa6/Nr%209%20Guidelines%20to%20Promote%20Play%20Opportunities%20for%20%20Children%20with%20Disabilities.pdf?dl=0> provides in layman language questions and suggestions for positioning, communication and social supports, adapting toys and play strategies.

6. Consider the play situation: where does the child want/can play? Who is involved? What are important environmental factors to take into consideration?

Environmental factors are complex, consider **all** aspects, as they can influence the play situation

The following chapters can be useful as well (Encarnaç o, Ray-Kaeser, & Bianquin, 2018):

Chapter 5: How can I, as an adult facilitate play?

Chapter 6: What assistive technologies exist to enable participation in play?

Chapter 7: Which toys and games are appropriate for our children?

Chapter 8: Which digital games are appropriate for our children?

Encarnaç o, P., Ray-Kaeser, S., & Bianquin, N. (Eds.). (2018). *Guidelines for supporting children with disabilities' play. Methodologies, tools, and contexts*. Warsaw: De Gruyter Poland. Retrievable at <https://www.degruyter.com/viewbooktoc/product/507228>

Guideline for professionals

How to evaluate usability and accessibility of toys and technologies for play for children with disabilities?

1 Introduction

This guideline aims to support the professional (therapist, teacher, pedagogue, etc.) in his/her professional reasoning and in the decision making process about whether a play tool is usable and accessible for given child(ren) with disabilities.

This guideline starts with reflective questions eliciting the reasoning. Followed by a decision tree. Extra information about concepts, classifications with the number of document, can be consulted at this link: <https://www.dropbox.com/sh/wii2si50apcgglu/AAAQCBfS1UQ2KGbKOEw8Kr2Ha?dl=0>

[Check out this Dropbox link for document for: 1) definitions guideline, usability, accessibility]

2 Reflective questions

PLAY *[Check out the Dropbox link above for document: 3) definition of play and play tool, and document: 5) classification of play, and document: 6) Possible goals of play]*

- What is the intended goal for the child(ren) for playing with the play tool?
- Is it play for the sake of play?
- Is the focus on achieving rehabilitation or educational goals?
- What kind of play is intended to enable?

PLAY TOOL

- Is the play tool safe for the given child(ren)?
- How can a play tool be accessed? Can the child reach the play tool from different positions? Can the child push, pull, grasp, release, manipulate it? Can the child change position of the play tool? Can the child use buttons to cause an action?
- Is it possible to connect the play tool to interfaces or input devices? *[Check out the Dropbox link above for document: 10) definition input and output devices, interface]*
- What can you do with the play tool (functionalities)?
- Can the child(ren) interact with the play tool, i.e. can the play tool react or propose activities to the child(ren)?
- Is it possible to connect the play tool to output devices, to make it usable?

- What kind of physical adaptations can be made on the play tool to make it usable for the given child(ren)?
- Is it possible to create different ways of playing? Can you create new challenges in play with the play tool so that it becomes more usable, or it can engage the child(ren) for a longer time?
- What are the materials of the play tool and supported device? (texture, looks, smell, sound, etc.)
- What are the costs?
- Are you satisfied with the hygienic rules for the play tool and connected devices? E.g. cleaning, maintenance.
- Is the play tool reliable? Does it work when and how you need it? Can it be repaired when broken?
- Is the play tool sustainable, is it robust?

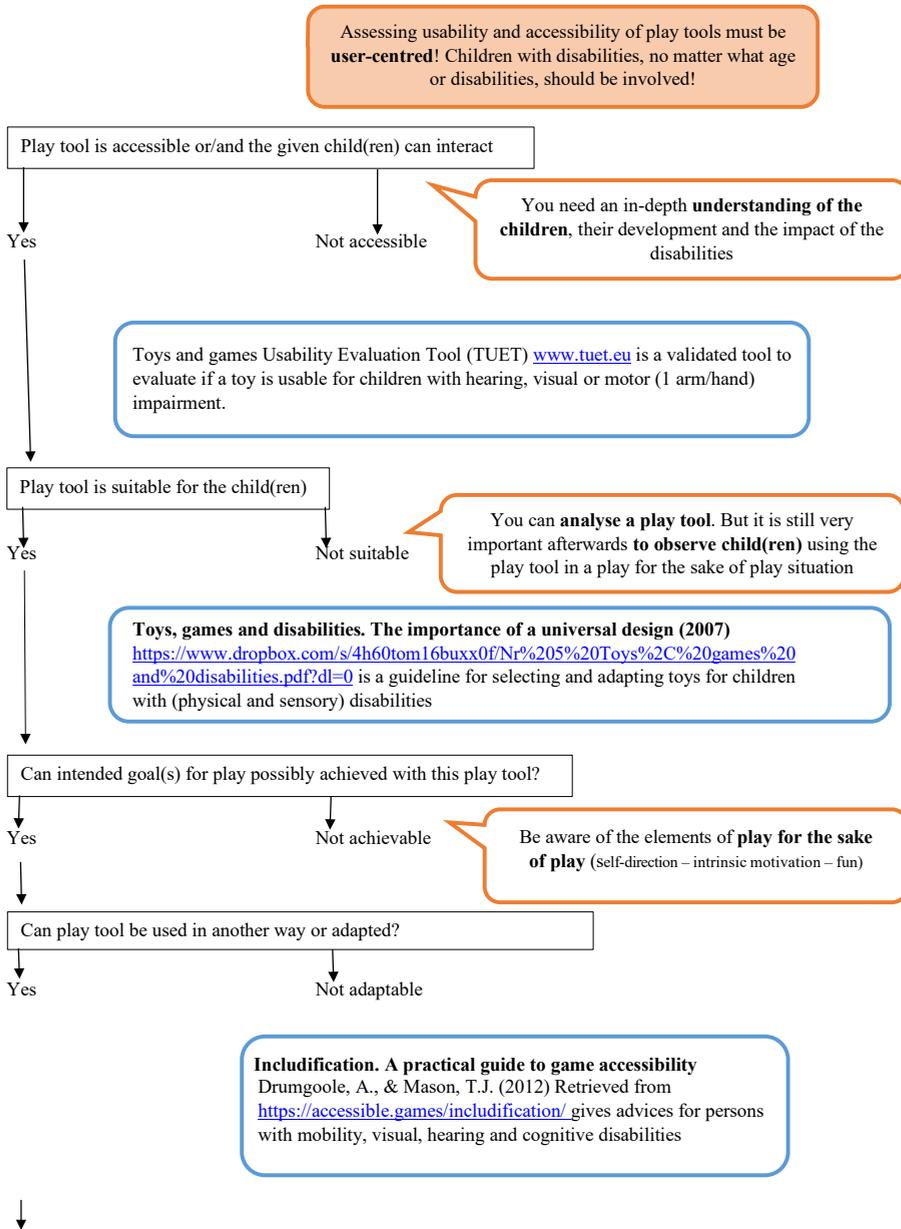
CHILDREN [*Check out the Dropbox link above for document: 2) definition children with disabilities, and document: 4) challenges in play of children with different disabilities*]

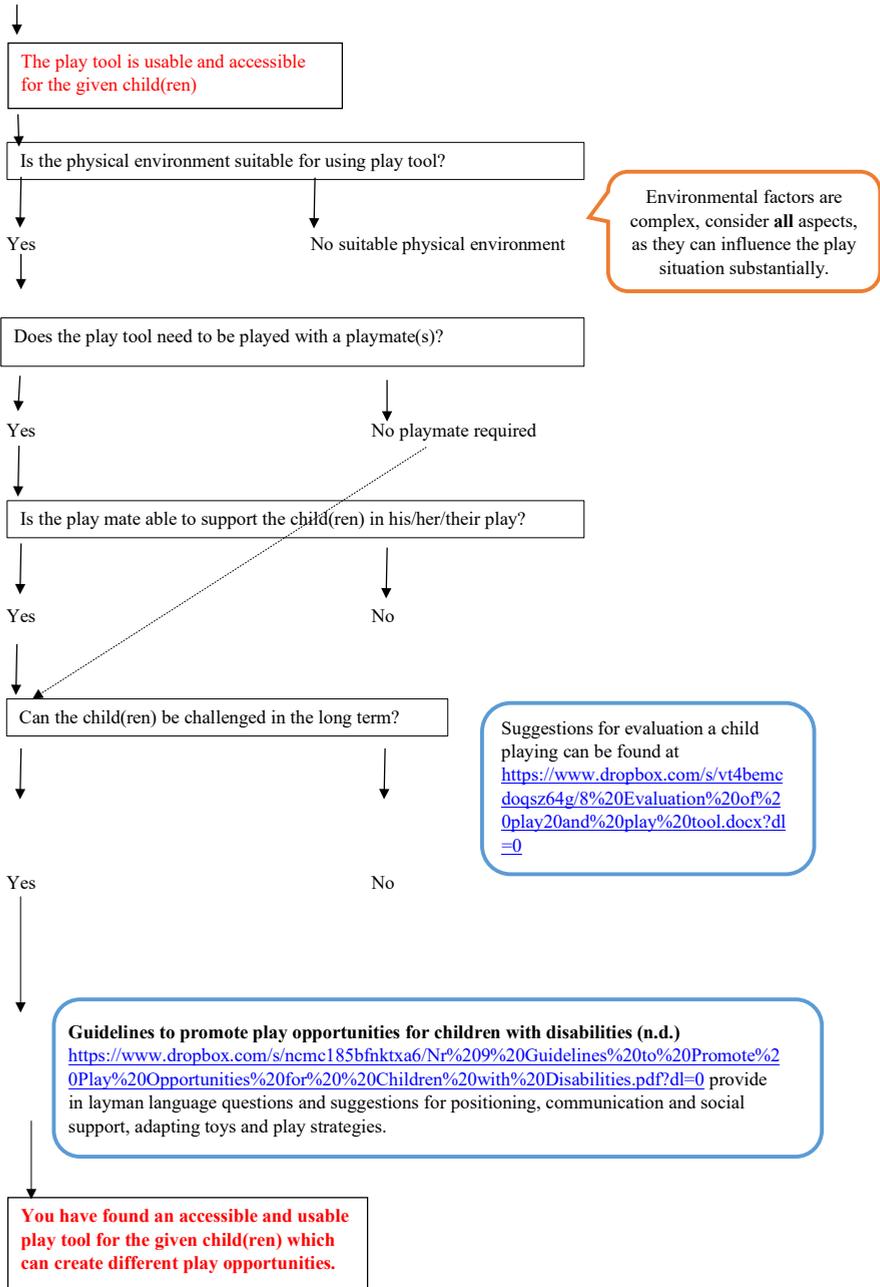
- What are the disabilities of the child(ren)?
- What aspects of the disabilities might influence the child(ren)'s play?
- What are strengths of the child(ren) which can be used to help or to compensate the limitations?
- How much time have the child(ren) available for playing? How often?
- Which subjective dimensions are important for the child(ren) when playing? [*Check out the Dropbox link above for document: 9) definition of subjective dimensions of occupational performance*]
- What will appeal the child(ren)?
- Can the child(ren) be challenged now as well as in the long term?

ENVIRONMENTAL FACTORS [*Check out the Dropbox link above for document: 7) definition environment and environmental factors*]

- Can the play tool be used at home, in school, in a playground, in a built and/or natural environment?
- Which characteristics of the physical environment are important for playing with the play tool?
- Could the child play alone with the play tool?
- What kind of persons [peers, adult, sibling, etc.] is needed to play with the play tool?
- What should be key features of the play mate?
- Are any cultural influences relevant for playing with the play tool?
- Are there organizational, service-related or attitude like aspects to be considered?

3 Decision tree to decide whether the play tool is usable and accessible for given child(ren) in the available environment





The following chapters can be useful as well (Encarnaç o, Ray-Kaeser, & Bianquin, 2018):

Chapter 4: Are our children playing?

Chapter 5: How can I, as an adult facilitate play?

Chapter 6: What assistive technologies exist to enable participation in play?

Chapter 7: Which toys and games are appropriate for our children?

Chapter 8: Which digital games are appropriate for our children?

Encarnaç o, P., Ray-Kaeser, S., & Bianquin, N. (Eds.). (2018). *Guidelines for supporting children with disabilities' play. Methodologies, tools, and contexts*. Warsaw: De Gruyter Poland. Retrievable at <https://www.degruyter.com/viewbooktoc/product/507228>

Guideline for makers

How making or adapting a play tool to be usable and accessible for play for child(ren) with disabilities?

1 Introduction

This guideline has to support technicians, makers, retired engineers, skillful parent or relative who wants to make a play tool or wants to adapt an existing toy, game, robot or app so it will be accessible and usable for specific child(ren) for play. Usually these makers or so called bricoleurs face specific problems related to a specific child with disabilities.

This guideline starts with reflective questions, followed by a decision tree based on the User Centred Design Process. Extra information about concepts, classifications with the document's number, can be consulted at this link: <https://www.dropbox.com/sh/wii2si50apcgglu/AAAQCBfS1UQ2KGbKOEW8Kr2Ha?dl=0>

[Check out this Dropbox link for document: 1) definitions guideline, usability, accessibility]

2 Reflective questions

PLAYING USERS *[Check out the Dropbox link above for document: 2) definition children with disabilities, and document: 4) challenges in play of children with different disabilities]*

- Who is the child playing? Chronological and developmental age, disability related features, abilities and strengths, motivation and attention span, etc.
- What is the kind of play the user and/or play mate wants to play? (Note: sometimes, there may be more than one kind of play) *[Check out the Dropbox link above for document: 5) classification of play, and document: 6) Possible goals of play]*
- Does the child and/or a playmate has specific goals in mind for playing with the play tool?

PLAY TOOL (TOY, GAME, ROBOT OR APP) *[Check out the Dropbox link above for document: 3) definition of play and play tool]*

- Are there requirements on material? (Unbreakable, resisting to humidity, liquids, washable, etc.)
- Are there requirements on basic appearance? (to match specific disabilities or design for all like weight, grasping, sound, colors, movement of parts, etc.)

- What are the safety requirements to be satisfied for the specific toy, game, robot or app? (See *Toy Safety Directive 2009/48/EC* <https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:170:0001:0037:en:PDF>)
- How is the play tool accessible? Can it be connected to (input-output) devices if needed? Can the child reach, push, pull, manipulate it? Can an assistive product support the accessibility of the play tool? [Check out the *Dropbox* link above for document: 10) definition input and output devices, interface]
- How can the user interact with the toy, game, robot or app?

PHYSICAL ENVIRONMENT [Check out the *Dropbox* link above for document: 7 definition environment and environmental factors]

- Are there requirements regarding the physical environment for playing? (indoors, outdoors, features of the room, furniture, light, etc.)?

3 Decision tree to support the maker in the decision making process for making or adapting a play tool for children with disabilities

Based on General phases of the UCD process retrieved from <https://www.usability.gov/what-and-why/user-centered-design.html>:



Figure 6.1: User centred design.

3.1 Identify need

What are the issues to be solved? Does the child play alone with the play tool or together with a play mate? What is the role of the play mate (player, assistance, observer)?

Is there a problem in accessibility (reaching the play tool, interacting with the play tool)?

Is there a problem in usability? (Is there an effective and efficient interaction with the play tool? Is the user satisfied? Can the user play in the desired context?)

What is the problem, when does it appear, how often does it appear, where does it appear?

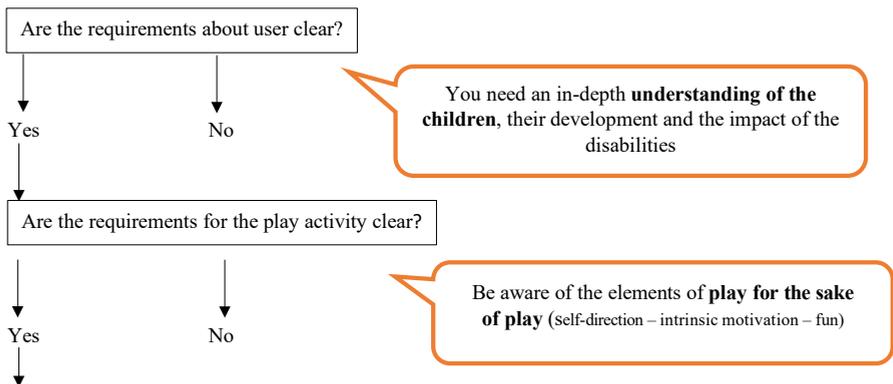
Assessing usability and accessibility of play tools must be **user-centred**! Children with disabilities, no matter what age or disabilities, should be involved!

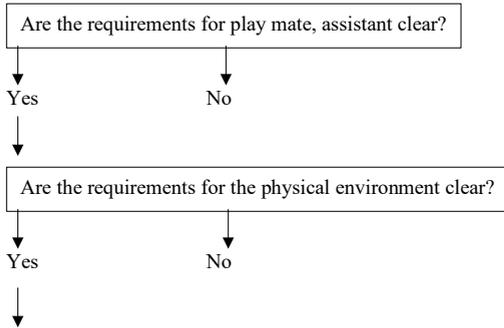
3.2 Specify context of use (describe in your own words)

.....[the user] should be able to play with.....[toy, computer game, video game, robot or app] during/when.....[time framework] with..... [playmate, siblings] at.....[physical context of use]

Environmental factors are complex, consider **all** aspects, as they can influence the play situation

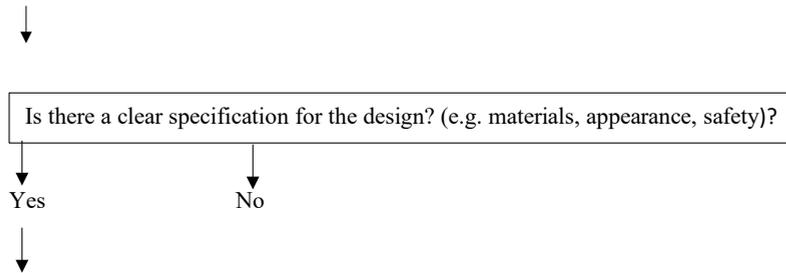
3.3 Specify requirements





After the functional requirements of the user, you will describe the technical requirements for the adaptation or making of the play tool. Following guidelines can support you:

1. <http://gameaccessibilityguidelines.com/basic/> describes at three different levels points of attention for motor, cognitive, vision, hearing, speech and general issues of **accessible games**. Same for “Includification. A practical guide to game accessibility” by Drumgoole, A., & Mason, T.J. (2012), retrieved from <https://accessible.games/includification/>. It gives advices for games for persons with mobility, visual, hearing and cognitive disabilities.
2. Application guidebook: seven easy steps to making your **app accessible** <http://en.beitissie.org.il/kb/item/7-easy-steps-to-making-your-app-accessible/>



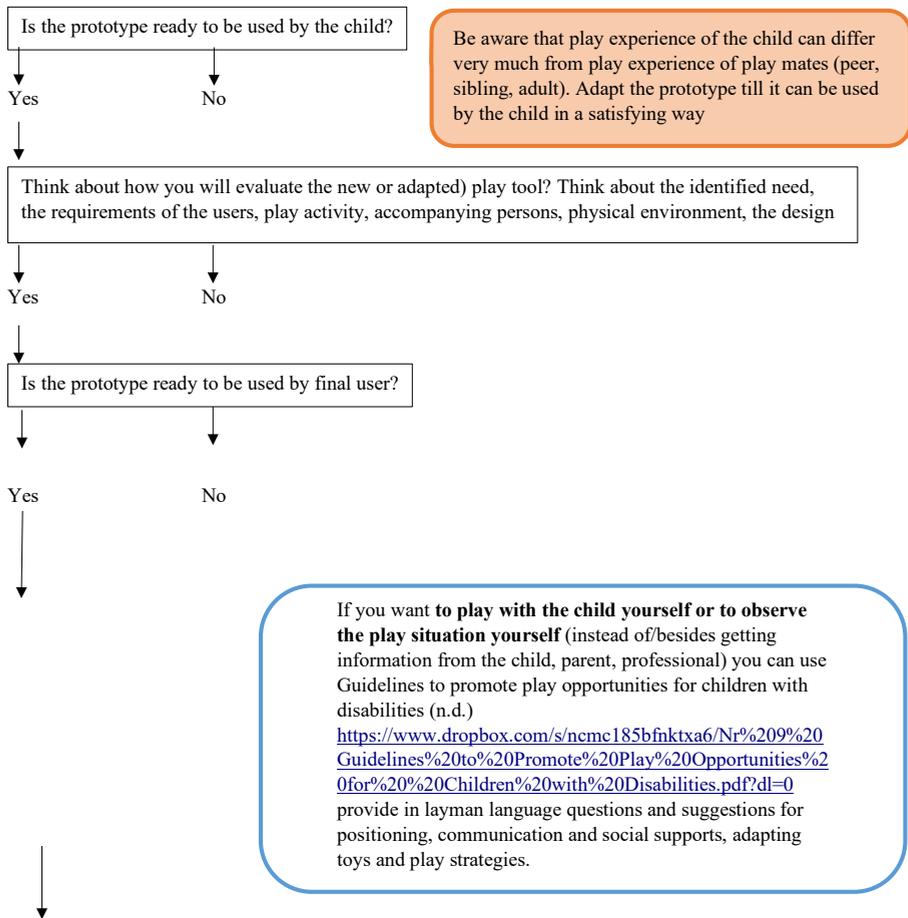
3.4 Produce design solutions

Design several prototypes

You can **analyse a play tool**. But it is still very important afterwards **to observe child(ren) using** the play tool in a play for the sake of play situation



3.5 Evaluate design solutions



3.6 User satisfaction

Check if the user (= child with disabilities and eventually play mate) is satisfied.

The following chapters can be useful as well (Encarnaç o, Ray-Kaeser, & Bianquin, 2018):
Chapter 5: How can I, as an adult facilitate play?

Chapter 6: What assistive technologies exist to enable participation in play?

Chapter 7: Which toys and games are appropriate for our children?

Chapter 8: Which digital games are appropriate for our children?

Encarnaç o, P., Ray-Kaeser, S., & Bianquin, N. (Eds.). (2018). *Guidelines for supporting children with disabilities' play. Methodologies, tools, and contexts*. Warsaw: De Gruyter Poland. Retrievable at <https://www.degruyter.com/viewbooktoc/product/507228>

Guideline for a designers, engineers

How can issues about usability and accessibility taken into consideration for designing and making toys, computer/video games, robots and apps for play for children with disabilities?



1 Introduction

This guideline aims to support designers and engineers in their professional reasoning and decision making process when (re)designing and making a play tool usable and accessible for children with disabilities.

It is assumed a scenario where the designer/engineer has to develop a play tool for a category of potential users, not a specific individual which is the case considered in the section guideline for a maker.

This guideline starts with questions eliciting professional reasoning, followed by a decision tree based on User Centred Design Process. Extra information about concepts, classifications with the document's number to be consulted, can be consulted at this link: <https://www.dropbox.com/sh/wii2si50apcgglu/AAAQCBfS1UQ2KgbKOEw8Kr2Ha?dl=0>

[Check out this Dropbox link for document: 1) definitions guideline, usability, accessibility]

2 Reflective questions

THE USERS

- Who are the intended users? Chronological and developmental age, disability related features, abilities and strengths, motivation and attention span [*Check out the Dropbox link above for document: 2) definition children with disabilities*]
- What is the kind of play that the toy is expected to be used to? Kind of play: functional play, symbolic play, etc. [*Check out the Dropbox link above for document: 5) classification of play*]
(Note: sometimes, there may be more than one kind of play)
- Are there specific goals for the play activity or is the play tool designed for play for the sake of play [*Check out the Dropbox link above for document: 3) definition of play and play tool, and document: 6) possible goals for play*]
- Where the play activity is expected to be performed? What are characteristics of the room, of the place? (floor or underground, furniture, walls, etc.) [*Check out*

the Dropbox link above for document: 7) definition environment and environmental factors]

- Will the play activity be performed autonomously or with playmates, or with assistants? [*Check out the Dropbox link above for document: 4) challenges in play of children with different disabilities]*
- How much time the play activity is expected to require? How often can the user play?
- Has the play activity to be adaptable, does it need different (motor skills, cognitive, multitasking) levels?

PLAY TOOL [*Check out the Dropbox link above for document: 3) definition of play and play tool]*

- Try to apply the **The Principles of Universal Design**
https://projects.ncsu.edu/design/cud/about_ud/udprinciplestext.htm
- Are you designing a toy, video game, computer game, robot or app?

Guidelines for game developers:

Game accessibility guidelines <http://gameaccessibilityguidelines.com/>

Includification. A practical guide to game accessibility. Drumgoole, A., & Mason, T.J. (2012) Retrieved from <https://accessible.games/includification/>

Grammenos, D., Savidis, A., & Stephanidis, C. (2009). Designing universally accessible games. *ACM Computers in Entertainment*, 7(1), 8:3-8:27.

Yuan, B., Folmer, E., & Harris, F. C. J. (2011). Game accessibility: A survey. *Universal Access in the Information Society*, 10(2011), 1 20.

Guidelines for app developers:

Highlights of Inclusive Design for App Development

<https://tech.beitissie.org.il/en/highlights-of-inclusive-design-for-app-development/>

APPLication guidebook: 7 easy steps to making your app accessible

<http://en.beitissie.org.il/kb/item/7-easy-steps-to-making-your-app-accessible/>

Guideline for toy developers:

Costa, M., Romero, M., Mallebrera, C., Fabregat, M., Torres, E., Martinez, M., . . . Martinez, P. (2007). Toys, games and disabilities. The importance of a universal design.

Guideline for developers of play things and environment

Mullick, A. (2013). Inclusive indoor play: An approach to developing inclusive design guidelines. *Work*, 44(2013), S5-S17.

- Are there requirements on material? (Unbreakable, resisting to humidity, liquids, washable, etc.)

- Are there requirements on basic appearance? (to match specific disabilities or design for all like weight, grasping, sound, colors, movement of parts, etc.)
- What are the safety requirements to be satisfied for the specific toy, game, robot or app ? See European guidelines on toy safety <https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:170:0001:0037:en:PDF>
Are there guidelines to be followed related to the products used? (ISO, CE?)
- How is the play tool accessible? Motor skills wise, cognitively, visually or auditory? Can it be connected to (input-output) devices if needed? [*Check out the Dropbox link above for document:10) Definition of input, output devices and interface*]
- How can the user interact with the play tool?
- Does the play tool sufficiently meet the following criteria [*Check out the Dropbox link above for document: 11) categories of design guidelines*]
 - o Clarity, readability, understandability
 - o Comfortability
 - o Controllability, affordability
 - o Cooperability
 - o Customizability, personalisability
 - o Evolvability
 - o Feedback, rewarding
 - o Inclusiveness
 - o Learnability, generisability
 - o Multimodality
 - o Multisensoriality
 - o Predictability
 - o Repeatability
 - o Safety
 - o Serendipity, motivation, engagement

3 Decision tree to support the designers/engineers in the decision making process for designing and making toy, game, robot or app for play for children with disabilities

General phases of the UCD process retrieved from <https://www.usability.gov/what-and-why/user-centered-design.html>:

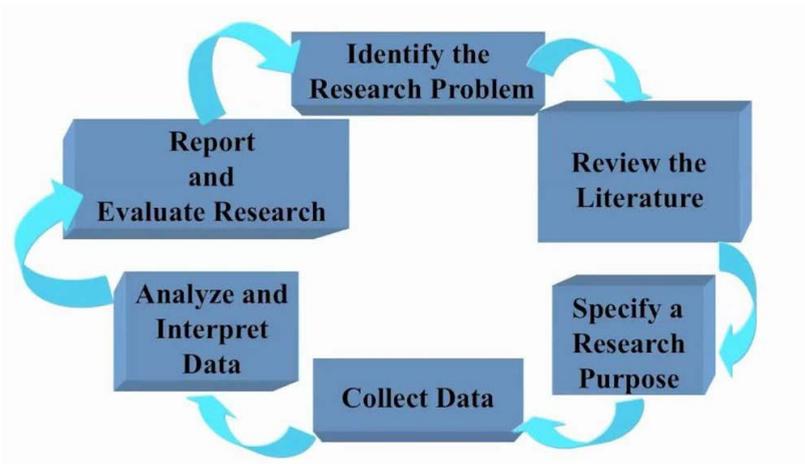


Figure 6.2: The process of research.

3.1 Identify need

Assessing usability and accessibility of play tools must be **user-centred**! Children with disabilities, no matter what age or disabilities, should be involved!

Will your design have an added value? Is there a need for a (re)design of play tool for play for children with disabilities?

Yes No

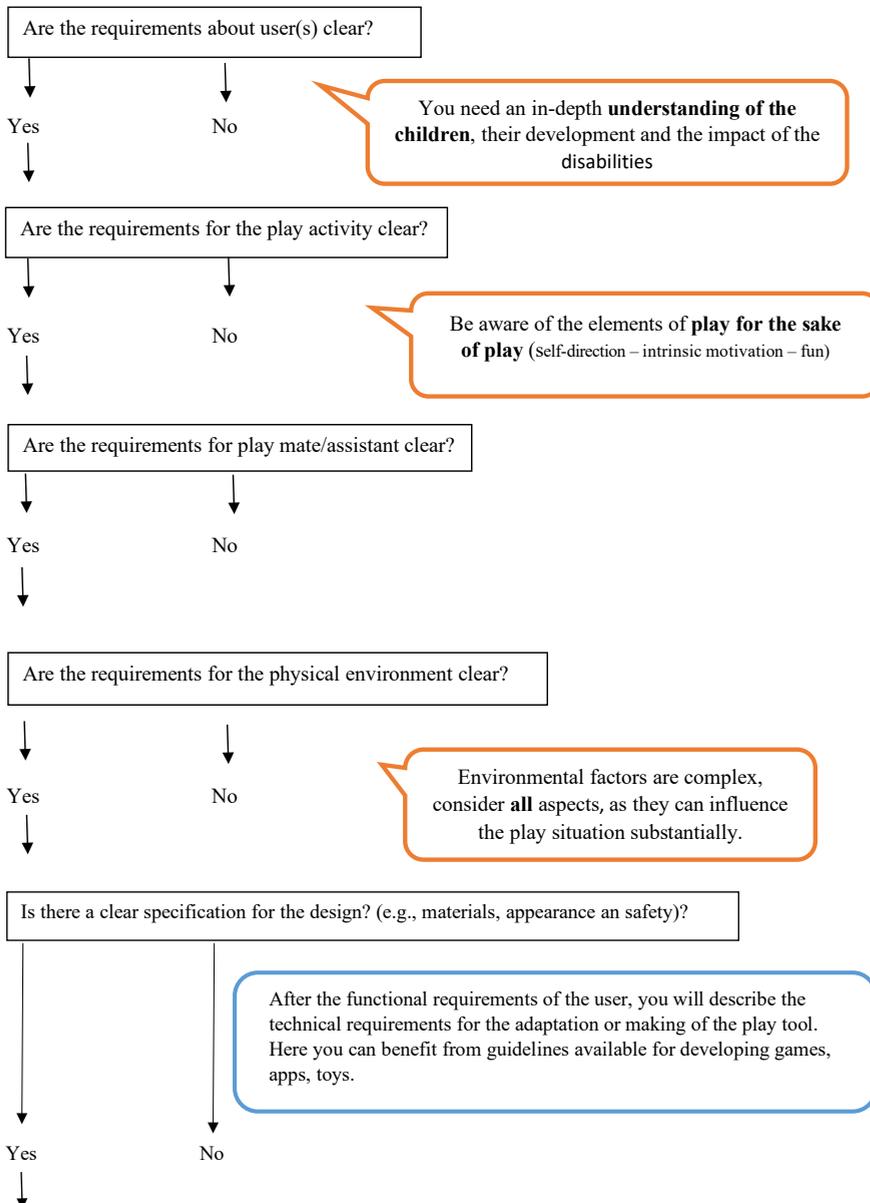
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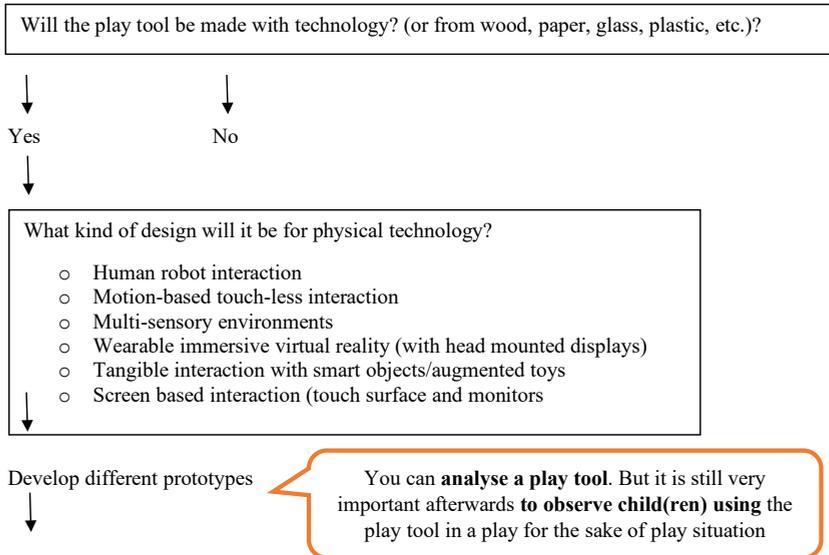
3.2 Specify context of use (describe in your own words)

..... [potential users] should be able to play with
 ↓ [play tool] during/when [time framework]
 with [playmate, siblings] at [physical
 context of use]

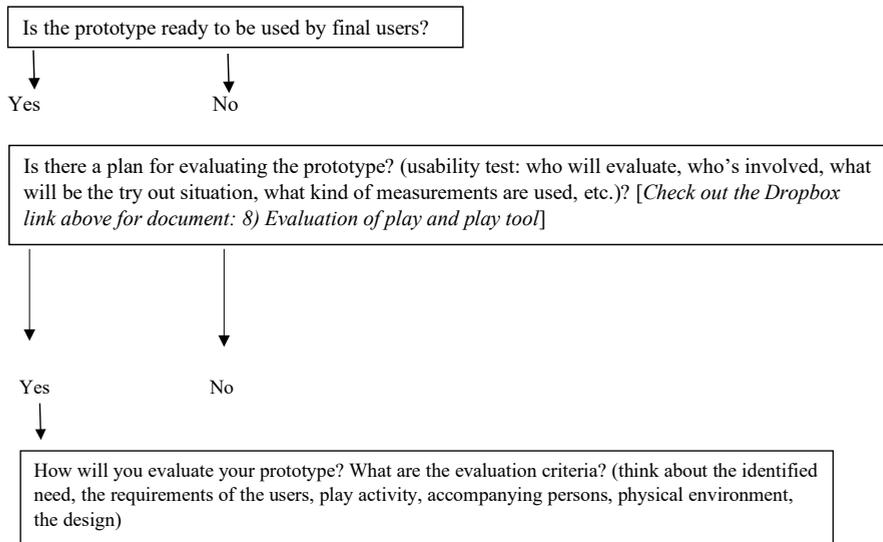
3.3 Specify requirements

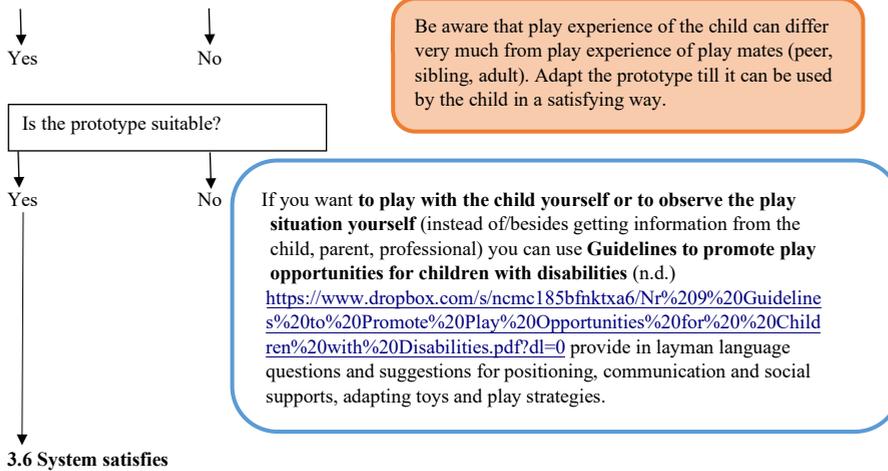


3.4 Produce design solutions



3.5 Evaluate design solutions





3.6 User satisfaction

If the prototype supports the play situation of the child(ren) as planned, consider to bring your prototype to an engineering production phase.

The following chapters can be useful as well (Encarnaç o, Ray-Kaeser, & Bianquin, 2018):

Chapter 4: Are our children playing?

Chapter 5: How can I, as an adult facilitate play?

Chapter 6: What assistive technologies exist to enable participation in play?

Chapter 7: Which toys and games are appropriate for our children?

Chapter 8: Which digital games are appropriate for our children?

Encarnaç o, P., Ray-Kaeser, S., & Bianquin, N. (Eds.). (2018). *Guidelines for supporting children with disabilities' play. Methodologies, tools, and contexts*. Warsaw: De Gruyter Poland. Retrievable at <https://www.degruyter.com/viewbooktoc/product/507228>

Guideline for researchers

How to investigate usability and accessibility of toys and technologies for play for children with disabilities?



1 Introduction

This guideline aims to support researchers when considering studying the usability and accessibility of toys and technologies for play for children with disabilities?

This guideline starts with reflective questions followed by some considerations. Extra information about concepts, classifications with the document's number, can be consulted at this link <https://www.dropbox.com/sh/wii2si50apcgglu/AAAQCBfS1UQ2KGBkOEw8Kr2Ha?dl=0>

[Check out this Dropbox link for document see link for: 1) definitions guideline, usability, accessibility]

2 Reflective questions

PLAY OF CHILDREN WITH DISABILITIES

- There are different definitions about play. Consider which definition suits your study LUDI has described these and adopted the definition of Garvey. *[Check out the Dropbox link above for document: 3) definition of play and play tool]*
- There are different kinds of play. Think about them. *[Check out the Dropbox link above for document: 5) classification of play]*
- LUDI distinguish play for the sake of play and play like activities. *[Check out the Dropbox link above for document: 3) definition of play and play tool]*. It's important to get clear which will be the focus of your research.
- Children with disabilities are challenged in play: try to get a clear picture of the group of children and their challenges in playing. *[Check out the Dropbox link above for document: 2) definition children with disabilities, and document: 4) challenges in play of children with different disabilities]*
- Consider the whole play situation: children – playmates – toys and technologies used for play – environmental factors *[Check out the Dropbox link above for document: 7) definition environment and environmental factors]*

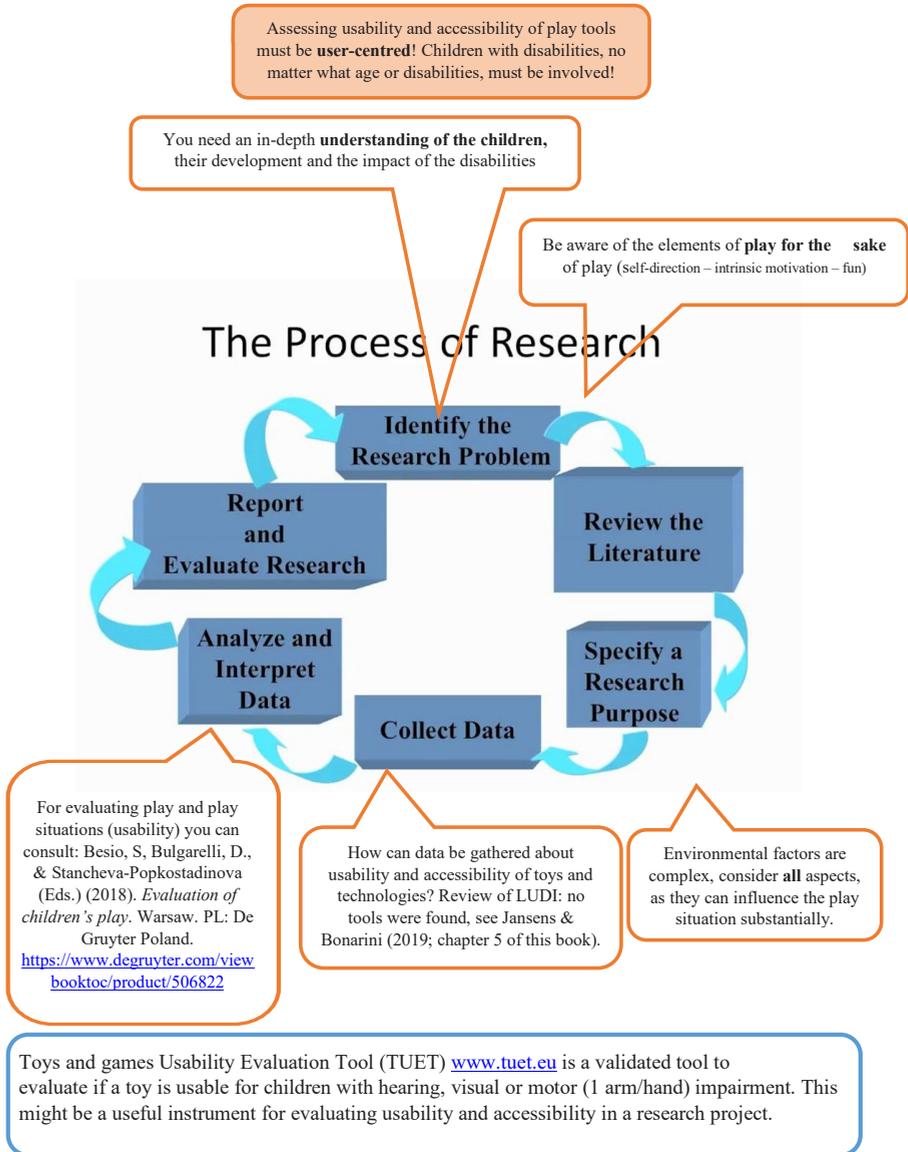
PLAY TOOL [*Check out the Dropbox link above for document: 3) definition of play and play tool*]

- Is the play tool to be used in research safe for the given child(ren)? Is it considered to be safe according to the EU Toy Safety Directive? <https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:170:0001:0037:en:PDF>
- How can the play tool be accessed? (reaching, grasping, letting go, manipulating, etc.)
- Is it possible to connect the play tool to interfaces or input devices? [*Check out the Dropbox link above for document: 10) definition input and output devices, interface*]
- What can you do with the play tool (functionalities)?
- Can the child(ren) interact with the play tool, i.e. can the play tool react or propose activities to the child(ren)?
- Is it possible to connect the play tool to output devices, to make it usable?
- What kind of physical adaptations can be made on the play tool to make it more usable for the given child(ren) when evaluating data proves this necessity?
- Is it possible to create different ways of playing? Can you create new challenges in play with the play tool so that it becomes more usable, or it can engage the child(ren) for a longer time?
- What kind of play situations can be created with this play tool? (think about environments, play mates, scenarios, etc.) [*Check out the Dropbox link above for document: 7) definition environment and environmental factors*]

RESEARCH ABOUT USABILITY AND ACCESSIBILITY OF TOYS AND TECHNOLOGIES

- **Analyse former research** with the specific play tool, for the targeted group of children. Here for you can consult LUDI database <http://ludi.utad.pt/>
- Have a clear picture of the **concepts of usability and accessibility** and its meaning in relation to toys and technologies
See also Chapter 5 in this publication: Usability and accessibility of toys and technologies for play for children with disabilities: Scoping review of guidelines and tools.
- **Examples of research about accessibility of usability of toy, board or videogame, robot or app are limited.** The review, carried out by LUDI Working Group 2 and presented in Chapter 5, showed this research about game accessibility:
Yuan, B., Folmer, E., & Harris, F. C. J. (2011). **Game accessibility: A survey.** *Universal Access in the Information Society*, 10(2011), 1-20.

3 Considerations for carrying out research about usability and accessibility of toys and technologies about toys and technologies for play for children with disabilities



3.1 Discussion

Although efforts were made to have a transparent and scientifically sound process, this research was challenged in different ways. Cooperation with experts from different countries, with different languages and cultures, with expertise in different professional and scientific fields demanded time for understanding, a common mindset and a methodological thorough work preferably in face to face meetings, whose availability was very limited.

The objective of developing guidelines for different stakeholders on usability and accessibility of toys and technologies for play for children with disabilities was huge and maybe even not feasible within the framework of LUDI. However, we believe that the current guidelines are an interesting first attempt that could be applied in daily practice and scientifically evaluated in the near future.

Incorporating clarification of concepts, classifications, existing (and reviewed) tools and guidelines while bearing the desired flow and feasibility of the guideline in mind was challenging. On the other hand, the authors were depending on the availability and the quality of different sources.

In the perspective of the fast technological developments and the challenges with implementation of innovations in practice there is an enormous need for further research in this field to support makers, designers, engineers and in making inclusive toys and technologies as well as to support parents and professionals in using these toys and technologies and to strengthen transparent professional reasoning and, if possible, evidence based practice. There is still a lot of work to be done by researchers, innovation managers and policy makers to support these processes, to cooperate and exchange expertise. As the last ones have an important role to support creating and using accessible and useable toys and technological products for play for children with disabilities, it's recommended to develop a guideline for the stakeholder group of policy makers.

3.2 Conclusion

This paper presents guidelines on usability and accessibility of toys and technologies for different stakeholders: parents, professionals, designers, makers and researchers. These guidelines support the reasoning and decision-making process for the play objects. Commercially available toys, adapted toys, board games, computer games, apps, robots, and other technological products are very important in play situations involving every child. They can enable intrinsic motivation, being in control and pleasure, components of play for the sake of play (Besio et al., 2017 p. 45-46). Above this, technology is promising in creating inclusive play (Jansens & Bonarini, 2019). Although the appropriate choice and usability of play objects will always be

important, there are still the impairment of the given child(ren), the role of the adults, the suitability of the environment to consider and shape it to an optimal match.

3.3 Acknowledgements

We would like to thank LUDI Working Group 2 members for their support in different phases of the development of the guidelines: (in alphabetic order) Ms Natalia Amelina UNESCO Institute for Information Technologies in Education in Russia, Ms Nan Cannon Jones Independent Consultant in UK, Ms Dana Cappel Beit Issie Shapiro in Israel, Ms Maria Costa AIJU – Technological Institute for Children’s Products and Leisure Alicante in Spain, Ms Tânia de Jesus Vilela da Rocha University of Trás-os-Montes and Alto Douro and INESCT/ UTAD in Portugal, Mr Pedro Encarnação Católica Lisbon School of Business and Economics Universidade Católica Portuguesa, in Portugal, Ms Silvia Giordano Institute for Informatics and Networking Systems Univ. of Applied Science and Arts of Southern Switzerland, Mr Raymond Holt University of Leeds in UK, Ms Iolanda Iacono Glitch Factory in Italy, Mr Antoni Jaume-i-Capó Universitat de les Illes Balears in Spain, Ms Malgorzata Jedrzejewska-Szczerska Gdansk University of Technology in Poland, Mr Jari Jessen Jari Due Jessen Digiplay in Denmark, Mr Vygaudas Juozaitis Lithuanian College of Democracy in Lithuania, Ms Hatice Kose Istanbul Technical University in Turkey, Ms Agnieszka Landowska Gdansk University of Technology ETI Faculty in Poland, Ms Patrizia Marti University of Siena in Italy, Ms Veronica Montanaro University of Malta & TAASC in Malta, Ms Lourdes Moreno Universidad Carlos III de Madrid in Spain, Mr Mati Mõttus Tallinn University in Estonia, Ms Noa Nitzan Beit Issie Shapiro in Israel, Ms Selda Ozdemir Gazi University in Turkey, Mr Suat Ozdemir Gazi University in Turkey, Ms Lucía Pérez-Castilla Alvarez Ceapat (Imsero). National Reference Centre for Personal Autonomy and Assistive Technology in Spain, Ms Odile Perino FM2J, Play training centre, Lyon in France, Ms Noemí Rando AIJU, Technological Institute for Children’s Products and Leisure Alicante in Spain, Mr Ben Robins University of Hertfordshire in UK, Ms Evelyne Thommen University of Applied Sciences and Arts, Western Switzerland, Mr Tim Vanden Hende Arteveldehogeschool in Belgium, Ms Renée van den Heuvel Zuyd University of Applied Sciences in the Netherlands, Mr Robin van Kampen NYOYN international in the Netherlands.

Special thanks to Mr Mirko Gelsomini, former PhD student at Politecnico di Milano in Italy, and Ms Manon van der Hoef, former student occupational therapy Zuyd University of Applied Sciences in the Netherlands for their significant contributions.

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