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## Challenging makerspaces

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# CHALLENGING MAKERSPACES

By Klaus Thestrup and Kjetil Sandvik

## 1. Introduction

*We will start of be giving you these statements: Play is a way to be a human being in the world, to examine it, experiment with it and to act into it being a child or an adult or groups consisting of both. Participants in play activities have the opportunity to reflect upon and change their conditions taking their departure in emerging spaces where learning can't be avoided. Or put more bluntly: The crucial question in regards to play and learning may not be to learn to be playful but to learn NOT to be not-playful. Makerspaces seems to be an excellent way to do the latter.*

This paper takes its departure in the EU-project *MakeEY - Makerspaces in the early years – enhancing digital literacy and creativity*, which is a part of a RISE-program and is running January 2017 - June 2019. Here digital literacy and creative skills of young children between the age of 3-8 will be developed through participation in creative activities in specially-designed spaces termed 'makerspaces'. This paper discusses, develops and challenges this term in relation to Danish pedagogical traditions, to expanding makerspaces onto the internet and on how to combine narratives and construction.

The Danish part of the project will be undertaken by a small network of partners: *DOKKI*, a public library and open urban space in Aarhus, that is experimenting with different kind of makerspaces, spaces and encounters between people, The *LEGO-LAB* situated at Computer Science, Aarhus University, that has developed a number of work space activities on children and technology and finally *Katrinebjergskolen*, a public school that has built a new multi-functional room, that among other things are meant for makerspaces and new combinations of media and materials.

This group will work with the notion of *Next Practice Labs*, a combined pedagogical and research method to engage children, staff and researchers, where the focus is the joint development of the next practice based on mutual play and experiments. These labs can be in pre-defined spaces or erected momentarily according to needs but include in principle all media and all materials in combinations, where new uses of technology and narratives or new technologies and narratives can be invented. The laboratory itself is open to new combinations and open to the surrounding world through digital and global communication (Thestrup, Andersen, Jessen, Knudsen & Sandvik 2015).

In these Next Practice Labs the idea of the makerspace will be used and taken to the next level and include communication, play and experimenting to create a situation, where the participants can use any emerging technology and continuously unfold and develop digital literacy and creativity across different makerspaces. This will happen in a process, where DOKKI, Katrinebjergskolen and the LEGO-LAB in the first phase each will develop and run

locally functioning Next Practice Labs, then in the second phase start exchanging and producing with each other and in the third and final phase communicate out towards other makerspaces. The Robot technology, programming and other actual digital production and communication technologies will be part of the experiments.

During the project the very notion of makerspace will be expanded. It will be discussed how and when makerspaces can use synchronous and asynchronous communication as part of the very creative processes inside and between makerspaces. These maker spaces can be based in the same physical space or virtually or a combination. There already exist vital examples of how this can be done (Peppler, Halverson & Kafai 2016). Narratives and construction will be combined in ways, where both sides support each other as technologies for experimenting, telling and discussing important questions in life. Processes of narrating and constructing will be deconstructed and re-mixed in principle to new narratives and constructions. The already existing tradition in Denmark where kindergartens, after school clubs and also schools conduct practical activities in informal pedagogical settings, will be used as part of a renewed framework for future makerspaces.

## 2. About the project

The MakeY-project runs for two years funded by the Horizon2020 RISE-program. The project consists of partners in 7 EU countries (Denmark, Finland, Germany, Iceland, Norway, Romania, UK) and Australia, Canada, Colombia, South Africa, USA. Partnership consists of researchers, makerspace staff, early year practitioners, museum educators and librarians. The projects aim (see website) falls into four parts: 1) Further research and innovation in the area of young children's digital literacy and creative design skills in order to contribute to Europe's future competitiveness and growth; 2) Develop project participants' skills in research and knowledge creation and thus increase research capacity and enhance career prospects; 3) Develop a network of researchers, creative industry professionals and educators who can collaborate to develop educational materials and tools to foster children's digital literacy and design skills; and finally 4) Offer recommendations for research, policy and practice (in industry and education) about the way in which makerspaces for 3-8 year-olds can be developed in both non-formal and formal learning spaces in order that young children can develop the skills and knowledge required for the digital age.

This results in research questions such as what characterizes the social interactions and learning practices that arise in the digital Makerspace; how do diverse children engage in the social interactions of the Makerspace; and how do the social and material resources of the makerspace support diverse children's engagement, digital literacy and creative design skills? These research questions focus on both the level of the individuals (the children) and the institutions (the professionals), the former posing questions like what are the beliefs and practices of makerspace employees and volunteers, and early years practitioners, across Europe with regard to the value and development of makerspaces for the 3-8 age group; what are the meanings and motivations children attach to their engagement in making activities in each of the case study settings, and how do these motivations interact with the demands of

the Makerspace; how are children's experiences in the makerspace reshaping their interests in and identifications with digital literacy learning and creativity; what kinds of digital literacy skills and creative competences do children develop through their participation in the makerspace; while the latter poses questions like what are the beliefs and practices of makerspace employees and volunteers, and early years practitioners, across Europe with regard to the value and development of makerspaces for the 3-8 age group; what are the meanings and motivations children attach to their engagement in making activities in each of the case study settings, and how do these motivations interact with the demands of the makerspace; how are children's experiences in the makerspace reshaping their interests in and identifications with digital literacy learning and creativity; what kinds of digital literacy skills and creative competences do children develop through their participation in the makerspace.

The Danish sub-project "Next Practice Labs – taking makerspaces to the next level" consists of researchers from two universities (Aarhus University and University of Copenhagen), one public school (Katrinebjergskolen, Aarhus) and one public library (DOKK1, Aarhus). The purpose of this project is to work with the notion of Next Practice Labs, a combined pedagogical and research method to engage children, staff and researchers with focus on the joint development of the next practice based on mutual play and experiments. These labs – which will be described in detail below - can be in pre-defined spaces or erected momentarily according to needs but include in principle all media and all materials in combinations, where new uses of technology and narratives invented or new technologies and narratives can be created. The laboratory itself is open to new combinations and open to the surrounding world through digital and global communication.

### 3. On open laboratories, experimenting communities and media play<sup>1</sup>

Some recent discussions and developments on open laboratories in Denmark can benefit the future development of makerspaces as an emergent place where tools, materials and processes are not defined in advance or can be changed according to decisions and needs by the participants in a makerspace. A group of researchers, consultants, teachers and pedagogues have over the years worked on what is framed as Next Practice Labs (Thestrup, Andersen, Jessen, Knudsen & Sandvik 2015), that again is based on the idea of Open Laboratories and Experimenting Communities (Caprani & Thestrup 2010, Thestrup 2013).

#### ***Next Practice Labs***

Next practice labs are laboratories for the next practice and are situated in the very practices they are there to change. The experimenting community has to do with the group of people involved. It has often over the years in different research projects involved children in both schools and kindergartens (Henningesen 2002, Henningesen, Jerg & Thestrup, K 2009, Støvelbæk & MediaPLAYINGcommunities 2009, MediaPLAYINGcommunities 2009, Thestrup 2014).

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<sup>1</sup> This section is previously published in Thestrup 2017.

These different projects can be mixed groups of all ages, but what they have in common is the experiment and that everybody involved participates and learn during the process, including teachers and pedagogues. The cultural center of an experimenting community is the ability to copy and change when wanted and needed. This way of understanding the experimenting culture is centered around play culture (Mouritsen & Qvortrup 2002), creativity and meaning making (Gauntlett & Thomsen 2013), pedagogical processes in kindergartens and afterschool clubs as informal spaces for play and learning (Jessen 2004) and where children's culture has an important part to play (Henningsen 2009, Thestrup 2013). The possible change of the use of different digital media through *mediaplay* (Thestrup 2012a, 2012b) is a certain area of interest. Mediaplay should be conceived as play activities in which media as content, language, discourse, aesthetic format create starting points for creating play. Here the activities are not only a matter of reproduction, but rather a matter of media content and formats being reshaped, transformed, and combined in order to be appropriated by the children into their play activities.

### ***The Open Laboratory***

The open laboratory can both be a way to work and play activated wherever when needed and a certain space designed or chosen. In both cases all media, all materials, analogue as digital, and all narratives can be brought together in processes, that might result in new re-mixing or alterations (Robinson og Thestrup 2016, Thestrup & Robinson 2016). As The Open Laboratory originally is inspired by the open theatre where no kinds of theatre traditions are excluded in advance in production processes (Lehmann & Szatkowski 2001), then body, fiction and dramaturgy has an evident place in the encounter between tools. The openness also had to do with the communication with the digital world outside the laboratory itself. The internet represents both the possibility of inspiration, collaboration and investigation reaching out into the world using both synchronous and asynchronous communication.

### ***Recent developments***

Recent developments are two projects in 2016 and 2017. One is a project where pedagogues together with small children developed a practise around the use of digital media base on the use of body and play (Johansen 2017, Petersen 2017, Knudsen & Skjerris 2017). The other is a project where Danish kindergartens and an Italian kindergarten exchange narratives and cultural expressions (Lauridsen & Howard 2017). In both cases the development of new practice took place in the institution themselves using and transforming actual spaces and digital encounter to spaces of experimentation and reflection. This relates to the existing tradition in Denmark of designing the actual spaces inside the kindergartens to environments where tools, materials and creative processes play an important part in the everyday pedagogical life.

#### 4. The notion of Third Places<sup>2</sup>

Based on a research program, “Learning in the Making”, Litts (2015) describes makerspaces as a *third place*, which exists between work/school and home where people meet informally and offers people with a special and deep sense of worth. Similarly Lee, King, and Cain (2015) define makerspaces to be a self-identified “third space” where people can informally gather to engage in digital fabrication practices and produce digital or digitally-enhanced artifacts. Litts specifically focuses on three youth makerspaces - museum, afterschool, and mobile/library - and analyzes how young makers learn from making in those settings (Litts, 2015, p. 1), comparing the constraints and strengths of each makerspace and analyzing how young makers approach and complete activities in those makerspaces: “learning happens when one ‘makes’ rather than ‘gets’ both knowledge and artifacts” (Litts, 2015, p. 18). The empowering learning potential in the participatory and co-creative inherent in makerspaces (in processes of making and tinkering) echoes former pedagogical philosophies. As argued by Resnick and Rosenbaum (2013), “the ideas and practices of the Maker Movement resonate with a long tradition in the field of education – from John Dewey’s progressivism to Seymour Papert’s constructionism – that encourages a project-based, experiential approach to learning. This approach is somewhat out of favor in many of today’s education systems, with their strong emphasis on content delivery and quantitative assessment. But the enthusiasm surrounding the Maker Movement provides a new opportunity for reinvigorating and revalidating the progressive-constructionist tradition in education” (Resnick and Rosenbaum 2013, p. 163). This also relates Gauntlett’s reasoning concerning the educational role of making and doing contrasting the “sit back and be told” culture of western educational systems of schooling and teaching (Gauntlett 2011). As Gauntlett points out, the DIY and making culture connected to the new forms of media use, in fact comes in serious conflict with the formal learning approaches in current educational systems. As Reese et.al (2015) has it, makerspaces have the potential of expanding educational programs and methods for learning towards multimodal, flipped, entrepreneurial learning methods and practices.

#### 5. Makerspaces: formal learning and/or informal play spaces

Makerspaces (also known as hackerspaces, FabLabs etc.) are often defined as places where you can tinker, hack and make. Even though it is linked to the growth in the DIY, maker movements, makerspaces have roots in workshop-spaces found in daycare institutions, schools, after/off-school institutions etc. These have traditionally been spaces – equipped with workshop facilities for wood work, mechanics and music and media production (the latter dating back to the introduction of video cameras and editing systems in the early 1980ies) – for teacher-led or self-organized maker activities.

As pointed out above, makerspaces can be described as a third place – a particular space which is neither school nor home. The question is how this particular space is connected to the two and maybe in particular the former. In countries outside Scandinavia (and the tradition of informal play in early year institutions), the concept of preschool signal that there for the younger children exists institutions which are formalized, learning-goal focused places

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<sup>2</sup> Parts of this section and section five is previously published in Sandvik 2017

with the purpose of preparing children for school. And with the older children, we see that ‘third places’ in the shape of after-school clubs and the like very often are conceptualized as a continuation of the school day – particular spaces for other types of learning activities e.g. in the shape of making and tinkering but still in designed formalized learning processes, and less frequent – at least when consulting academic literature originating from the UK or US they are understood more in line of ‘out-of-school’ not just implying the change of localities from classroom to workshop facilities etc., but also a break from school: ‘off-school’ with focus on self-organized activities. Whereas the first understanding of ‘after-school’ is prevalent especially in US academic reports and research papers (focusing on STEM (science, technology, engineering, math) and how makerspaces enable and empower learners (and create e.g. equity) in these particular educational efforts, the latter is hardly present, even though some academic works criticize the emphasis on formal learning goals and objectives and point to the fact that making has also have more informal and playful features to it and others focus on the identity-making and communal aspects of makerspaces. E.g., in a research paper on how and why youth engage in making in an after-school, youth-focused, community-based makerspace program “Making 4 Change”, Barton, Tan, and Greenberg (2016) analyze four examples of how youth appropriate and repurpose the process of making. Their analysis unpack how the program attempted to value and negotiate youths’ ways of making from an equity-oriented perspective. The main bulk of academic works are typically based on (US) case studies and either seeing after-school makerspaces in connection to formalized learning programs or out-of-school settings with lesser focus on formalized learning and being more focused on self-organized activities, communities of interest etc. In their report Bevan et.al (2016) examine how afterschool educators at four different organizations in the US have integrated Making into their programs in order to more deeply engage participants with STEM concepts, phenomena, and practices. The report demonstrates how these programs “build on key characteristics of Making and Tinkering that have been extensively documented in the research literature (Peppler et.al 2016, Resnick & Rosenbaum 2013, Dixon & Martin 2014): it exercises students’ creative and improvisational problem-solving abilities; it builds students’ agency, persistence, and self-efficacy; and it helps students to deepen and complexity their ideas and understanding” (Bevan et.al 2016), p. 2). A substantial review of this type of categorizing literature within this field can be found in Vossoughi and Bevan (2014) dividing literature within the context of out-of-school-time STEM into three categories (p. 5): a) making as entrepreneurship and/or community creativity, b) making as STEM pipeline and workforce development, and c) making as inquiry-based educative practice. The review points to the fact at the majority of work published within this field falls in the third category. Martin (2015) argues that even though “The Maker Movement is a community of hobbyists, tinkerers, engineers, hackers, and artists who creatively design and build projects for both playful and useful end, there is growing interest among educators in bringing making into K-12 education to enhance opportunities to engage in the practices of engineering, specifically, and STEM more broadly” (Martin 2015, p.31). He points to three elements of the Maker Movement crucial to promise for education: “1) digital tools, including rapid prototyping tools and low-cost microcontroller platforms, that characterize many making projects; 2) community infrastructure, including online

resources and in-person spaces and events; and 3) the maker mindset, aesthetic principles, and habits of mind that are commonplace within the community” (ibid.).

Dixon and Martin (2013) caution against “a reductive treatment of making as a set of component knowledge and skills” and argue that “efforts to tie making more narrowly to STEM outcomes or to assume uniform outcomes in any particular area of learning may limit the openness of maker definitions, leave less room for exploration and personalization, and erode the value youth see in participation” (p. 3). Based on their interviews with young makers, Martin and Dixon advocate for “a more holistic, youth-centered view of the role and value of making as an educative experience” (p. 1). This may be seen in relation to the Scandinavian countries, where after-school settings such as youth clubs [ungdomsklubber, fritidsklubber] - publicly funded institutions (often located in specific parts of schools or as extensions of daycare institutions)- traditionally have been ‘off-school’ spaces without outspoken and formal learning goals. They have been spaces – equipped with what we today call makerspaces (workshop facilities for wood work, mechanics (e.g. motorcycles) and music and media production (the latter dating back to the introduction of video cameras and editing systems in the early 1980ies) – for self-organized maker activities. An important feature within the Scandinavian context has been the prevalence of play as something with a value in itself (in the line of e.g. Huizinga, but even more in the tradition of Norwegian and Danish pedagogical theorists, see review on makerspaces in early year settings): Creation of informal play spaces – not just for the youngest, but also for older children and youth in after-school (or out-side-school/off-school) settings. Important work on play culture and its history as well as changes and challenges in today’s ‘technology driven world’ has been conducted in Denmark by scholars like Carsten Jessen (2003).

In her book on 'the making of the Maker Movement', Davies points to fact that participants in hacker- and makerspaces often refer to making as 'fundamentally playful' and to makerspaces as 'playgrounds' (Davies 2017, p.99). Mark Hatch refers in *The Maker Movement Manifesto* (2013) to play as an important driver in maker processes and environments; the creative powers embedded in the concept of playfulness when applied to these processes: we may be “playful with ideas, stretch them to extremes, and morph them ridiculously” (p.26). As argued by Resnick and Rosenbaum (2013), “sometimes, tinkerers [makers] start without a goal. Instead of the *top-down* approach of traditional planning, tinkerers use a *bottom-up* approach. They begin by messing around with materials (e.g. snapping LEGO bricks together in different patterns), and a goal emerges from their playful explorations (e.g., deciding to build a fantasy castle). Other times, tinkerers have a general goal, but they are not quite sure how to get there. They might start with a tentative plan, but they continually adapt and renegotiate their plans based on their interactions with the materials and people they are working with” (Resnick and Rosenbaum p. 165).

In sum: according to the literature, makerspaces in early years settings can focus on being places for creative learning and play. With specific regards to developing communities of learners, Vossoughi and Bevan (2014, p. 28) points to the specific affordances of makerspaces: develop collaborative relationships - learning to work together, share tools and



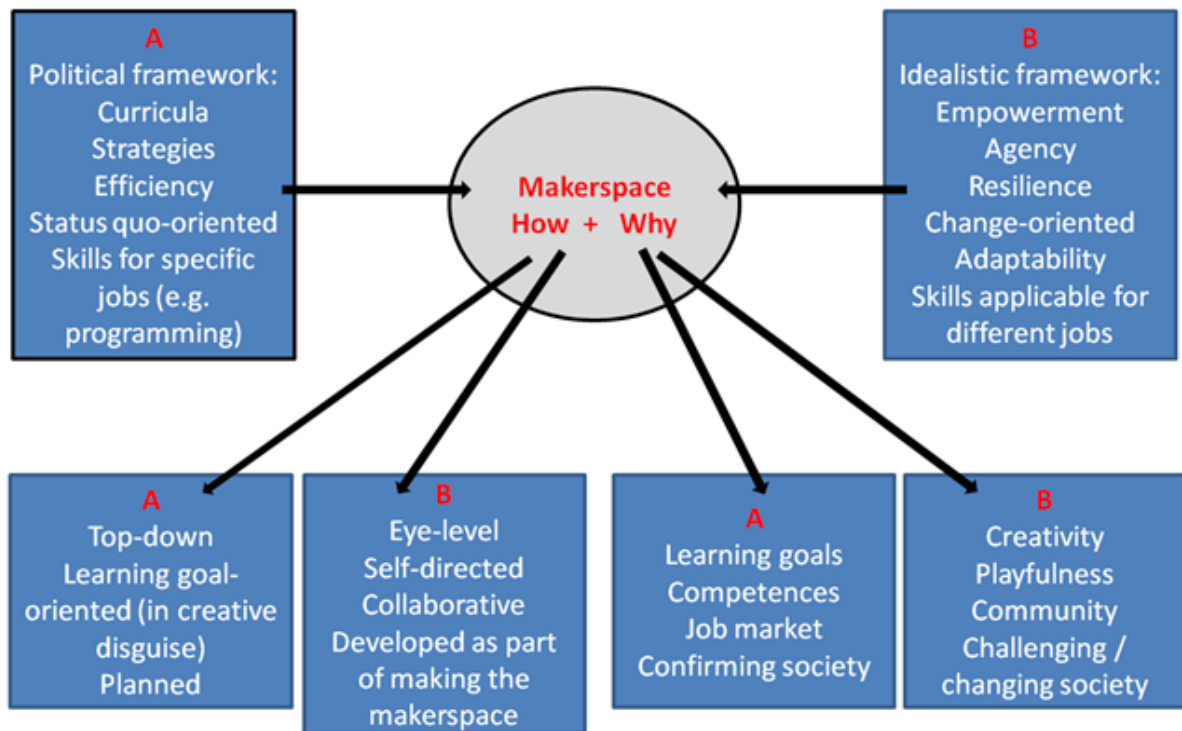
ideas, provide assistance to others and embrace intellectual diversity; develop skills and practices involved in audiencing and sharing projects (such as confidence, communication, drawing connections across artifacts, giving and receiving as tied to the deepening of authentic intellectual activity; develop community; take on new leadership and teaching roles.

We suggest that we understand a makerspace just as much as being an actual space where people meet to be *makeative* is a specific mind-set – *makerspaceness* – that we bring with us and that will code whatever physical space we may inhabit a specific *makerspaced* way. In our opinion the core of any makerspace is people collaborating, where meanings are made and shared and new skills and dispositions are developed (Potter & McDougal 2017). This takes some primary skills such as being creative, playful, imaginative, experimenting, seeing possibilities etc, and some secondary skills such as handling tools and technologies. Main Makerspace activities may be creating things from scratch, adjusting, adding to, pimping existing things; combining, mixing, bricolaging things, ripping things apart and reassembling them in new ways (hacking...), and repairing things (learning how things work and not just how to work them...). There are in this understanding of makerspaces no a priori demand for specific technologies such as the laser cutters and 3D printers which seem to be mandatory in some of the literature on makerspaces. This is not to say that technology should be avoided, rather that the focus on learning to operate, learning to program and so on – all very prevalent in today’s pedagogical research and debates – should be contra-pointed by ideas that technology primarily may serve as friendly helpers in the creative and playful processes. Technologies such as laser cutters and 3D printers are far too complicated for small children. But they can – by ways of teacher/pedagogue or tech-experts as interfaces – be turned into friendly helpers. Thus the children may be able to communicate with the technology (e.g. the laser cutter): the child may be describing what it wants the technological device to do (e.g. make a cutting of a drawing) and in doing so the child can be experimenting with how much and how detailed the technology must be informed to do what it is wished to do will urge the child to play with concepts such as shape, texture etc.

So to recap: We will like to challenge the idea of a makerspace as concrete space and making as something special, disconnected, add-on (e.g. STEM as extra-curricular activity with makerspace as its educational device). Rather we will suggest makerspaces as a mode of doing things, implying that making may as the core method in any curricula focusing on learning as creation and play in all educational activities and subjects, be it science, technology, math or history, language, cultural subjects. So instead of seeing makerspaces as institutional, formalized, fixed formats oriented towards STEM, technology literacy and other learning goals, we propose that makerspaces first and foremost are user-centered, informal and emergent formats (the credo being ‘first we add people’) in which technologies are means not goals (technologies may be friendly helpers but not ends in themselves) and in which the *makeativity* is not strictly focused on learning goals, because whatever creative and playful activity children (as well as adults) engage in, learning cannot be avoided.

In this line of thinking, some considerations related to the dimensions of makerspaces, may be posed (the answers are, however, waiting for our research to be conducted). In relation to

*space/place* we may ask: Do makerspaces take place or create place/space: conquer and inhabit their own place/space? Are they specific spaces or is making a mindset we bring with us into a space and thereby code the space as a makerspace? In relation to *time* we may ask: Do making define to fixed amount of time (we will be *makeative* for one hour) or do making define its own time (the time needed for being *makeative*)? And finally, in relation to *movement/direction* we may pose the question: Do making define to linear processes (inherent in strict goal oriented design of maker-activities: we should make this or that, we should learn this or that) or does it – as most creative processes – define to multi-linearity, circularity, abruption, diversions, getting momentarily completely lost...? The answers to these questions depend on whether we conceive of makerspaces as specific and formalized places or as a mindset enabling us to be *makeative*, as we have attempted to visualize in the model below. This model is also hinting at specific political, societal, educational systems attached to one or the other makerspace concept.



## 6. New platforms of creativity

The open laboratory is open to a combination of constriction and narrative. As a matter of fact both sides are considered technologies to make meaning, investigate questions in the present society and act in it according to what the group of participants in the experimenting community see fit to do. The narratives about digital technologies as for instance robots, virtual reality and artificial intelligence as they take form in fiction and documentaries are just as important sources of material to examine in the makerspace as the actual digital technologies themselves.

The experimenting community is a community of practice (Wenger 1998, Wenger-Trayner 2011) developing a common practice, a common repertoire and a willingness to go into joint processes, where the participants want to interact with each other to know and be able to do more than before. The resolute power of situated learning is exactly to be in a specific context and intervene in the world from this position. In a globalized world situated learning through play is a question of playing being a node in a network of possibilities using new digital technologies, analogue ones and narratives told in multimodal and cross-media ways. It is simply not enough for instance to be able to code as a practical skill in a technological society. One also has to ask what technologies one wants to experiment with, use and develop for what purpose. This includes examining what actual technologies do, what they do not do and what they could be altered to do and possibly leaving them behind as not suitable for the task ahead.

Makerspaces in all its forms are situated in a global world with common challenges and all participants in these makerspaces are increasingly world citizens being aware of it or not. When makerspaces are placed in the world, play represents itself as a way of including children and practitioners in processes that are equal pedagogy and research in the sense that the experimenting community asks itself about what to do through doing it. We play unfolding culture and life and through that sketch out new possibilities re-mixing old ones. We do not only talk about being in the world and make together. We do make together using the digital communication systems as tools for exactly that: making. Doing this we might get to the point where as many citizens as possible for as long time as possible exchange ideas, expressions and questions with each other on a global scale constantly making emerging spaces to communicate, produce and play on new platforms of creativity.

## 7. Conclusion

To return to the two statements in the beginning of this paper, we will like to emphasize the importance of conceptualizing makerspaces not just as strictly formalized learning spaces, but as spaces for playful creativity with a high degree of self-organized activities. The basic principles of play (with various types of media technologies as well as other types of play technologies), open laboratories and experimenting communities will in our opinion enable communities of creative investigations and making in which participants (be they children, young people, grown-ups) can co-create both the makerspace activities and the very framework for these activities. The next level makerspace is not alien to learning, but resists strict focus on curricula, on fixed learning goals and learning objectives such as harnessing digital literacy or skills within the field of STEM.

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