

“Put me back in my skin!”

Children’s Perceptions of Mixed Reality Play

Linda McConnon*, Craig Vear**

* School of Arts, De Montfort University, Leicester, United Kingdom

** School of Arts, De Montfort University, Leicester, United Kingdom

Abstract- This article reports on child-focused reflections from research findings of a year-long investigation working with primary school aged children and young people in England exploring mixed reality play. 58 children and young people were engaged in the project and actively participated in 29 focus group interviews over time. Thematic qualitative analysis revealed five broad features of mixed reality play from a child’s perspective: dimensional embodiment, creating worlds, dramatizing and gaming, agentic action and inside and outside spaces. Through the adopted lens of children’s reflective engagement, this article hypothesises that mixed reality presents an environment for digital natives (Prensky, 2001) to play openly and creatively, and puts forth an argument for new technological opportunities and transformations of pedagogic practice.

Index Terms- Mixed reality, digital play, creative learning, children’s voice, technophenomenology

Funding Acknowledgements- This work was supported by the Digital R&D Fund for the Arts, Nesta, Arts & Humanities and public funding by the National Lottery through Arts Council England.

I. INTRODUCTION

This article reports and analyses the reflective discussions of primary school aged children and young people in England participating within a year-long investigation exploring mixed reality play. This is based on a larger body of work conducted at De Montfort University (Al-Salloum, et al., 2015; Vear & McConnon, 2015 forthcoming). The focus of this paper is to probe more deeply and report children’s understanding and perceptions of mixed reality play, thus the capturing of their authentic voices by engaging them as active participants was an essential part of the research. Children’s voices are legitimized as windows into their realities; their ideas and interpretations about play and physical activity are grounded in lived experiences that adult researchers often assume to know, but rarely access in a meaningful manner (Anthamatten, et al., 2013). Through the adopted lens of children’s reflective engagement, this article hypothesises that mixed reality presents an environment for digital natives (Prensky, 2001) to play openly and creatively, and puts forth an argument for new technological opportunities and transformations of pedagogic practice.

What is *Pop Up Play*?

The genesis of this research project was in response to a national call from the Digital R&D Fund for the Arts. The aim of the fund was to bring together an arts organisation, a technologist and a research partner in a co-operative partnership. De Montfort University, together with The Spark Arts for Children and Dotlib Ltd created an immersive learning environment for children using a mixed reality system titled *Pop Up Play*. *Pop Up Play* has been developed, tested and designed for use in schools, arts venues, libraries and museums. The system works by capturing images (live and still) relating to museum exhibits, theatrical productions, children’s books or curriculum topics and using *Pop Up Play*, projects them into a space. Video cameras and motion-tracking then place the participants into these projected worlds for creative play and open-ended learning. *Pop Up Play* engages children and young people physically, kinesthetically and emotionally. As the play advances possibilities broaden when tracking systems replace the children’s image with that of an avatar, a self-drawn puppet, a film or book character, turning their actions into those of the Gruffalo for example. Through carefully managed workshop activities the participants become invested in these imaginary dimensions and the possibilities of digital play. This enabled an investigation into how the mixture of augmented and virtual reality can be used as a tool to engage young minds in creative play within immersive technology and to understand their perspectives of this experience.

Play for education

However difficult play is to define, it remains a core feature of many educational curricula, and is considered key to teaching and learning in a wide variety of classrooms and arts education contexts. According to McInnes, et al. (2013) ‘the construct of playfulness is argued to be an attitude of mind which indicates the approach taken to an activity. It is thought to be important for development and learning by promoting enthusiasm, motivation, willingness to engage in an activity and flexibility of thought (Dewey 1933; Lieberman, 1977)’. Anna Craft coined the concept of ‘possibility thinking’ (PT) to denote the shift from ‘what is’ to ‘what might be’. She argued it is therefore at the heart of all creativity and that in the case of young children involves their transitioning from ‘what is this?’ to ‘what can I or we do with this?’ as well as imagining ‘as if’ they were in a different role (Craft, 2011). Play is thus proposed as ‘logically necessary’ to PT (Craft, 2001). In digital play children’s creative imagery is built on what is noticed, valued, and understood within engagement and participation in culture and complex social

relations between peers and practitioners. A key consideration for creative practitioners, and a necessary component of the enabling environment, is the opportunity for exploratory, combinatory play. Therefore, new technology needs to work flexibly to address old forms of interaction and springboard transformational practice and digital pedagogy in the classroom, rehearsal room, gallery space or library (Al-Salloum, et al., 2015). Children are engaging with a greater degree of sophistication in digital platforms; DSI consoles, Wii, iPads etc., irrespective of economic, social or cultural contexts. The gaming industry has exploded into the mainstream and this brings with it an online community that engages in conversation, learning, skills sharing and problem solving. In 2010 Jane McGonigal posed the question: 'what if we could harness gamer power to solve real-world problems?' According to McGonigal gaming can 'make a better world'. Through mass collaboration and a social fabric weaved through shared experience of 'missions' gamers adopt urgent optimism to take on challenges which enthralls and empowers them to be able to succeed. Similarly, interactive books are hugely popular with children as it makes story reading active rather than passive. In a recent *Pop Up Play* stakeholder consultation, one Head Teacher said that "teachers will soon be moving away from teacher white boards to use tablets and interactive TV and there will be a need and desire to push the technical boundaries further - making the visual experience more engaging by drawing on all of the senses. The trend clearly defines a space where children exist and demonstrate an appetite to engage in mixed realities to enhance learning and personal experiences" (Vear & McConnon, 2015 forthcoming).

Embodiment in mixed reality play

Moving in physical spaces when interacting with digital image can provide greater embodiment for the user into these worlds and thus enhances their personal experience. Rogers, et al. (2002) state that 'embodiment refers to immanent presence, compared with interacting with more abstract representations such as interface metaphors that conventional computer-user interactions provide (Dourish, 2001)'. This duality means that when learners participate in a virtual environment, they are simultaneously interacting in two worlds - the online (virtual) environment and the offline (real-world) environment (Feldon & Kafai, 2008). According to Rogers, et al. (2002):

From a theoretical point of view, we can consider a potential distinction as being that between (i) the "real" world in which spaces and artefacts are acted on by conventional physical actions and where the user's understanding is, therefore, in terms of general causal models of the world, and (ii) the "virtual," in which a different, set of causal models operate and action is arbitrarily coupled to the properties of the perceived world.

Pop Up Play's focus within this area of discourse was to understand the affectual processes of being taken (incorporated) into the mixed reality realm, and simultaneously, having it meet the learners own 'real-world' play reality. This manifest itself through stimulating a sense of liveness between the in-screen image and in-space body, in such a way as they were perceived as coexisting in the here-and-now (Auslander, 2008). Andy

Lavender describes this as the 'experience of being submerged in an environment, which we know is not actual but which nevertheless feels 'real'', and presents the participant with a 'frisson of perceptual instability' (Lavender, et al., 2011). Additionally, these factors offer the learner a unique experience by presenting an opportunity for the embodied participant to witness themselves in-play in an-other world - such as under the sea, or on the moon - which is none-the-less felt or emotionally engaging as a "real" experience (Morie, 2007).

Impact and perspectives

Acknowledgement is made to studies that concentrate on the effective use of technological tools in learning to enhance cognitive development (e.g. Sternberg & Preiss, 2013). However there is not scope in this article to broaden this review beyond the focus of the research project which specifically focused on children's perspectives of mixed reality play. Currently, the literature researching the impact and perspectives of new types of mixed reality play with children and young people is scant as issues of time spent online and digital safety have dominated the field. In the USA, focus group interviews with children and young people about perceptions and awareness of digital technology highlighted four themes: (1) an awareness of digital devices; (2) a sense of temporal displacement; (3) social functions; and (4) a palpable sense of risk associated with using them (Hundley, 2010). In the British classroom, Hall and Higgins (2005) examined students' perceptions of interactive white boards (IWBs) on the premise that since 1997, the UK government has invested huge amounts of money in ICT in the education sector, including IWBs, in the belief that their use in the educative process will raise attainment among British school children. They found that students seem to enjoy in particular the multi-media capabilities of the technology, especially the visual aspects (colour and movement), audio (music, voice recordings, sound effects) and being able to touch the IWB. All pupil groups mentioned the multi-media aspects of the IWB as advantageous especially in engaging and holding their attention. In Hong Kong, Ahn, et al. (2013) also reported capturing the attention of the children during robot-assisted augmented reality play and demonstrated improved learning effects when compared to conventional play in language and creativity. This was attributed to the operational flexibility, novelty, and robotic mediation as well as capturing the attention of the children. From the children's perspective, they reported that their listening ability seemed to have been strengthened and focused by the robotic narration ("it sounded as if coming from the robot"), and special sound effects synchronized with the actor's actions. In terms of language expression, seeing themselves in the screen augmented as different story characters encouraged the children to actively participate, imagine their roles, and verbalize such feelings, even as an audience (Ahn, et al., 2013). A common notion in the literature is that the digital environment is especially important for engaging and encouraging co-operative and collaborative pupils. Through digital play, learners are afforded more control over their environment (Larsen McClarty, et al., 2012). Without such agency, behaviours and attitudes to school and learning appear to decrease; in reality pupils have less control over their environment and hands on practical application, the negative impact of which leads to disengaged learners (e.g. Kettlewell, et

al., NFER 2012). However McInnes, et al. (2013) state that ‘studies have repeatedly shown that many teachers are not comfortable with play and child-led activities, and that play is held in low esteem compared to activities which are seen as work (Bennett, Wood, & Rogers, 1997; King, 1978)’. A far cry indeed from the experiences and viewpoints expressed by *Pop Up Play* practitioners and teachers who evaluated children and young people’s engagement as intuitive, describing it as ‘of their world’ (Vear & McConnon, 2015, forthcoming). Indeed several *Pop Up Play* stakeholders discussed this phenomenon using the digital-natives epistemology, in so far as they felt that ‘the children took control’, and that ‘they were teaching us’. The findings from Vear and McConnon’s (2015) research also suggest that a new ontology of practice has been developed in order to accommodate the innovative nature of digital creative play. This was particularly apparent when experienced practitioners were asked to describe the transformational practices within their delivery of the case studies; they were adamant that it was a new practice with its own signatures and propositions. The implications for practice are clear insofar as this new and innovative form of mixed reality play calls for a greater understanding of the impact on its users and definitions of their experience. Indeed according to McInnes, et al. (2013) ‘traditionally definitions of play have been based on adult perceptions of the observable play act. However, play may be most beneficial when it is considered as an approach to a task, and based on a definition of play from the child’s perspective’.

II. METHODOLOGY

The project adopted action-research methods from two different perspectives: in-vitro (outside looking in) and in-vivo (inside looking out). These methods were chosen in order to gain knowledge through action, and were concerned with the nature of the action as a thread of investigation leading to new knowledge that has operational significance for the field. As such, this method tested the *Pop Up Play* system, whilst exploring and measuring the transformational affect upon its (real-world) users.

Sample

The sample consisted of six settings from our stakeholder research partners ranging from schools to libraries, museum and art gallery partners, specifically: Mellor Community Primary School, Leicester; Three Ways Community Special School, Bath; Dovelands Primary School, Leicester; Braunstone Library at the BRITE Centre, Leicester; New Walk Museum and Art Gallery, Leicester; and Embrace Arts, Leicester.

Participants

Throughout the project the team worked with 58 children and young people, both boys and girls. The youngest participant was 4 years old and the eldest participant was 11 years old. Table 1 shows the breakdown of participants. The children from Three Ways School were from mixed age and mixed ability classes with moderate learning difficulties. The children who participated at Braunstone Library and New Walk Museum were taking part in a series of summer workshops, and the children who participated in a partnership with Embrace Arts were all home educated.

Table 1: Participants

Setting	Number of Participants	Age Range
Mellor School	8	8 to 9 years old (Year 4)
Three Ways School	21	6 to 11 years old (Year 3-6)
Dovelands School	8	9 to 11 years old (Year 5&6)
Braunstone Library	8	6 to 10 years old
New Walk Museum	5	4 to 8 years old
Embrace Arts	8	7 to 11 years old

Ethics

Ethics were negotiated between all parties and agreed with the University of De Montfort Research Committee and adhered to the Ethical Guidelines for Educational Researchers (BERA, 2011). The procedures included issuing a plain language statement and written parental consent form to all participants informing them of the aims and anticipated outcomes of the research. The right to abstain or withdraw from the project at any time was upheld. Both raw and analysed data material was participant anonymised and stored in a secure project-specific data system.

Process

The *Pop Up Play* project was split across nine work packages (March 2014 to March 2015). They were composed of four phases of testing and consisted of a combination of workshops or one-off residencies (see Table 2):

- Case Study 1. June - July 2014
- Case Study 2. August 2014
- Case Study 3. November - December 2014
- Case Study 4. January 2015

Table 2: Sessions and residencies

Setting	Sessions & Residencies
Mellor School	6 weekly sessions
Three Ways School	2 x 6 weekly sessions
Dovelands School	3 day residency
Braunstone Library	1 day residency
New Walk Museum	1 day residency
Embrace Arts	3 day residency

The Sessions

The sessions lasted between 45 and 90 minutes on average, with 45 minutes defined as a suitable duration for the SEN learners. Using a range of practitioners, these sessions presented a variety of themes throughout the workshops, with media and pedagogic design varying throughout and across each session (see Table 3 for examples).

Table 3: Examples of media themes, workshop styles and pedagogy

Media Theme	Workshop	Pedagogy
War Horse	Drama Play	Actor
Alice in Wonderland	Being in the Story	Narrator
City, Underwater, Space	Paper Play	Orchestrator
Pirates	Shoe Box Worlds	Demonstrator
The Art Gallery	Puppetry	Facilitator
Words and Letters	Gaming	Co-Constructor

Data Collection Methods

Data was collected by the following methods:

- Pupil feedback - voice recorded
- Still photographs
- Video film footage - capturing action and narrative (for reflection)

After each *Pop Up Play* session, the participants were given the opportunity to discuss their thoughts and feelings about their experience. In total 29 focus group interviews were conducted, and documented using a variety of styles and conventions; e.g. voices were recorded and photographs taken of any drawings, diagrams and written notes made.

Data Analysis Procedure

Focused analysis of the children’s perspectives was achieved through systematic qualitative thematic examination derived from the source material gathered during each feedback session. The inductive process consisted of combining open and axial coding elements. The early stages of the process formed an open coding strategy through searching the data for emergent categories. The open codes were clustered into themes and refined by axial coding seeking relationships, links and associations between them. Full details of this process and the findings can be found in the full research report <https://www.dora.dmu.ac.uk/handle/2086/10769>.

Rigour

The project team sought to maintain quality and trustworthiness in terms of credibility and dependability by triangulating findings. The team upheld protocols and procedures making each stage of the project transparent by sharing weekly insights and findings via a blog. Cross-reference between blogs validated that the data was an accurate and true reflection of the facts and narratives as presented to the researchers.

III. FINDINGS

At the core of the design of *Pop Up Play* is a new software innovation which is made up of three main components: visual system, audio system and lighting system, as such the participants found it “amazing”, “fun” and “cool”.

Children were excited and enthused about the possibility of exploring and playing with new technology:

“We want to explore different stuff – we want more than the everyday basics”

“Today I felt happy and lucky that we are the only ones in the entire school doing the Pop Up Project”



Figure 1: Multiple components used in live play

This section will present a thematic qualitative analysis of the child-centred experience of mixed reality play using their authentic voices, thus getting to the heart of what is meaningful within the fun, amazing and cool. This process of critically analysing the children’s recorded understandings and perceptions of a mixed reality play experience exposed levels of authentic evaluation, pointing to epistemological appropriate language and areas of interest (i.e. the values our digital natives find in mixed reality play). Engaging the children and young people as active research collaborators, and valuing their perspectives, revealed five broad features of mixed reality play: dimensional embodiment, creating worlds, dramatizing and gaming, agentic action and inside and outside spaces. The purpose of this process was to understand how these foci could provide a framework for future investigations in mixed reality creative play (discussed in detail below in Section 4, Discussion).

Dimensional Embodiment

Dimensional embodiment is a term applied to this research to discuss the learner’s phenomenological transformation of the sense of Self (Merleau-Ponty) and Being (Heidegger) within the multiplicity of experience afforded within the mixed reality realms of *Pop Up Play*. It focuses on the incorporation of the sense of self within these realms and acknowledges a non-hierarchical co-operation of being simultaneously situated between the virtual and the real. In gaming theory Gordon Calleja suggests that ‘incorporation operates on a double axis: the player incorporates (in the sense of assimilation or internalization) at the same time as being incorporated (in the sense of corporeal embodiment) through the avatar in that environment’ (Calleja, 2011 p:211) and that the difference between ‘embodying as a state of being’ and ‘embodying as an act’ is a useful way to frame the multitude of experiences within the *Pop Up Play* world. Through this thematic qualitative analysis, children described experiencing mixed reality play across three levels of dimensional embodiment: mirror, connector, and avatar. Mirroring was manifest when children recognized their image as their own when it appeared in the screen. They took time to study their reflections and engaged

themselves by experimenting with different movements, each time examining the image's reaction to action. One child described their mirror image as "a shadow of me" following them wherever they went, and others took pleasure in exploring what it felt like to see themselves in different places:

"I want to see myself, my real self"

"I liked being myself"

"That's me playing on the screen on my own – I was in the war"



Figure 2: Mirror

Connector was recognized by the children as the next level of dimensional embodiment affording them a deeper level of engrossment (Brown & Cairns, 2004 in Farrow & Iacovides, 2014). In this level, digital play was extended by attaching objects, such as a bird or moving fish, to a limb of the player's mixed reality image, thus children saw themselves as interacting with something else, e.g. making the fish swim around the ocean. Children described this mode as "getting attached to things that are actually on the screen and making them move – when you move they move." Children used 'on, in and with' to talk about their connective experiences.

"If you have a sword on the screen someone can hold it and like actually do it" [waves arm around]

"I wanted to be in the bubble"

"I enjoyed playing with the bird"



Figure 3: Connector

The final level of dimensional embodiment was found as being an avatar. Children described experiencing "being something different" and "not myself" when deeply immersed in this form of digital play. The *Pop Up Play* technology, complete with full biped puppet controls of skeletons, monsters and animals (utilising the sophisticated Kinect system for full-body tracking) thus gave the children the perception that they had fully disappeared and had become something or someone else in the screen.

"I'm disappeared"

"I felt like I was really a bird, we vanished and it was amazing"

"My favourite bit was when I was the monster because you get to be someone that you have never been before"

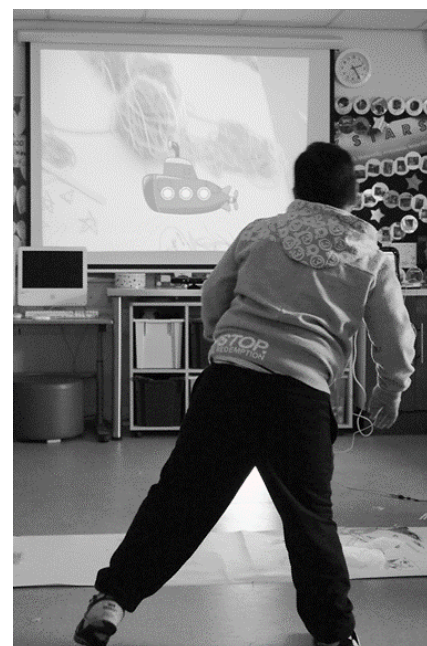


Figure 4: Avatar

Creating Worlds

Throughout thematic qualitative analysis, three strands were found relating to the theme of creating worlds in mixed reality play: unique places and spaces, self-made drawings and models, and realistic media, scenes and sounds. Children told us that they thought *Pop Up Play* means “to be able to pop up wherever you want.” During reflections a broad range of unique places and spaces were discussed by the children and the team made it possible to visit these during the project. Some children talked about the ability to visit family and friends who had moved far away, others said they would like to pop up in well-known landmarks, television studios and computer games, and others wanted to experience what it would be like to be able to visit places in their community on their own. The young people also discussed the future possibility of creating telematics engagement to enable collaboration across locations.

“I’d go to my brother’s house down in Bournemouth coz I ain’t seen him in ages”

“Iconic...like you know this place, a lot of people know this place but hardly anyone gets the opportunity to step foot inside this place”

“To the bus stop”

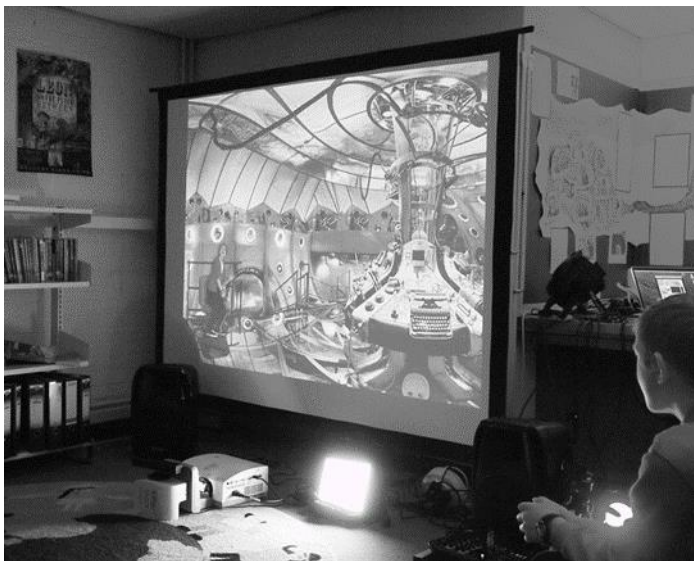


Figure 5: Inside the TARDIS

Creating worlds using self-made drawings and models was very popular with the children and widely discussed as a powerful tool for encouraging freedom of expression. However, some children said that they preferred working with just a white screen so that they could “add stuff into it” and imagine what they could put into their new worlds. Being inside self-created imagery featured strongly throughout the project as children thought of new ways to innovate with the technology and use it to explore their own creations.

“In my picture it’s all 2-D and flat, I would like to be in a space where everything was 3-D”

“I like the bit where we made the sculptures, seeing it in the screen, I pushed it forward and it came out of the white and appeared”

“I like doing this [making Lego]. You can build stuff. If you made a ship or a vessel you could place it on that thing [the web cam] then you could put yourself on it like you are actually on the boat”



Figure 6: Sculpture making

The realistic media, scenes and sounds loaded into the *Pop Up Play* system was featured as a key element of mixed reality play for the children in this project. Many children talked about the ways in which different scenes gave them ideas about their actions and behaviours and how they could construct the different visual and auditory elements to create their own games and theatre backdrops that enabled them to have an authentic experience.

“I liked the battle, the lamp and the sirens”

“I felt happy today because when we were on the board we got a bird and a horse with the sound effects. I liked the horse and tweeting sounds, it was like there was a real horse and a real bird”

“I found it interesting and a lot more fun because you can set the scene”



Figure 7: Experiencing the First World War with sirens and gunfire

Dramatizing and Gaming

When reflecting with the children about the uses of mixed reality play, all discussions included elements of interactivity – i.e. what can be done with the technology. One girl reported: “it’s helping you with your creative mind and making it expand to a whole other level.” Interestingly ‘uses’ seemed to be split between dramatizing (persona and narrative exploration) and gaming (defining and making rules). The physical and social nature of play was woven between both of these themes, with some children reporting “you have to pull together.” The use of drama in *Pop Up Play* is seen as promoting narrative, language, and encouraging enthusiastic readers of literature. The children elaborated on this adding in the elements of imaginative and dramatic story-telling and went further to suggest that they would like to use *Pop Up Play* to make their own creative products.

“We should make our own videos, like Frozen”

“I like being on the boat, the big boat, there was storm, rain, all the water was going on the boat and I got wet!”

“I’m gonna do like get puppets with the monster, it will be funny. Like hey do you want to get married [told in a high voice] I’m going to kill you [told in a scary voice]”



Figure 8: Acting as pirates

In *Pop Up Play* a sense of gaming was manifest due to the technical hardware employed and the interactivity of screen and self. As such, the facilitators encouraged children to think about goals, rules, levels of participation and feedback. This built on work by McGonigal (2011) who discusses these as the defining traits of a game. The children in this project also said that for them it included excitement, skill and reward.

“I like N and J...when he went under his arm and looked sideways from there and it worked I pushed him away and got him, I like working with someone”

“I loved it when we were in the maze, the firewall; it made me feel like argh!”

“An animated background is impressive so that you can interact with it, so if you went like this [moves arm] and hit a balloon it would then pop”

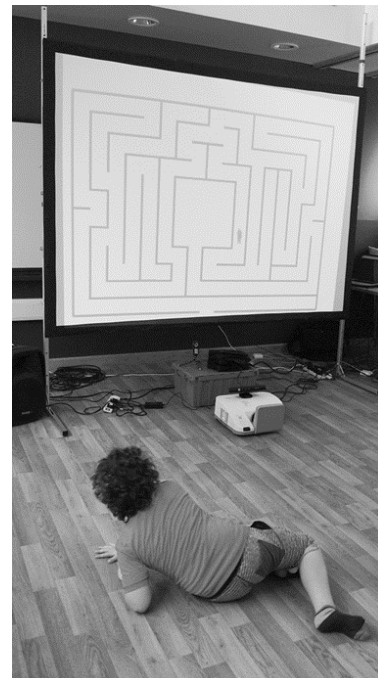


Figure 9: Playing the maze game

Agentic Action

Several themes relating to agentic action were embedded in the data from the thematic qualitative analysis. Agentic action refers to the individual making decisions in order to engage within the collective social structure, in *Pop Up Play* this is through the use of technology. Within *Pop Up Play* there is a degree of reflexivity constantly evolving between the individual and the collective and the children used the technology to carry out their agentic actions by exercising their control of the system, scale and animation. Children talked about the power of play through using the technology, and commented on the 'use-ability' of the system and in particular the ease of use of the iPad and the freedom that they felt they had been afforded in the project to explore its capabilities rather than being instructionally told what to do.

“I like controlling it”

“Simple to understand, hard to master”

“It’s like with these things you usually have to have someone there explaining it to you, whereas with this you can just explore and do it”



Figure 10: Controlling the iPad

Scale was reported by the children as a particularly strong aspect of *Pop Up Play*, and manipulating and controlling objects. For example, being able to control size and objects on the iPad - making their-selves bigger and smaller, or manipulating what their friends were seeing and experiencing when they were playing.

“You get eaten by a fish and the person with the tablet makes you so small it looks like you have been eaten by the fish”

“There is a tablet, then someone stands there and they can move left and right, but the person with the tablet can also move them around and change their size”

“All the pictures, I liked messing it around and making the rainstorms and making you teeny so you drown, drown in a puddle!”



Figure 11: Scaling down size

Children articulated their fascination about the live, moving visual elements in *Pop Up Play*, especially flying and animation. All of the children who participated in the project reported that these were new and exciting elements of digital play.

“I liked it when things were moving and it wasn’t just standing still”

“I liked flying because it’s not normally something you do everyday”

“I think the best thing is how we manipulated it so that I could be the animation”

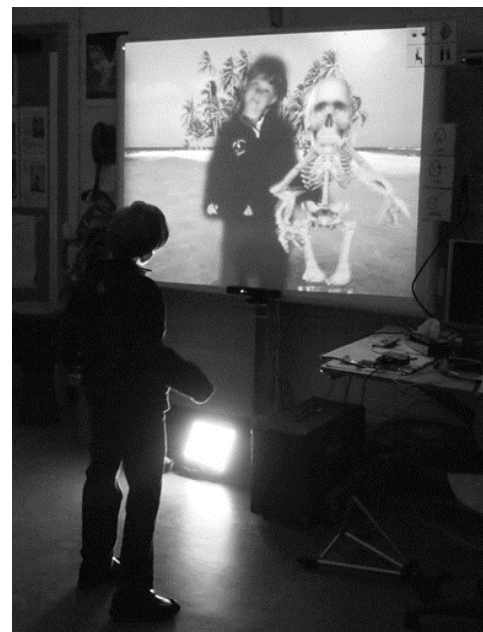


Figure 12: Moving a biped puppet

Inside and Outside Spaces

The children and young people that participated in this project grasped the concept of mixing realities with ease describing these as inside and outside spaces. They had a real sense of when they were immersed in the thick of the action and enjoyed combining 'real' and digital elements, using props, dressing up, or taking part in a sensory experience, e.g. tasting limes, anchovies and ship biscuits in a dockyard scene whilst seagulls screeched overhead. One boy came up with an idea for going into and out of the system:

"Reality when we switch it off and deality [sic] when we switch it on"

"I got to play with the iPad and make different creatures, different, sizes and different sounds. I thought that it was really good and fun because it can make you go out of reality and then you can just go back into reality whenever you want"

"We are outside but we are not actually outside, we are inside, it made me feel a bit weird at first"

Children also talked about *Pop Up Play* in class and at home. Some brought objects and ideas from 'outside' into the sessions, thus there was always a sense of inside and outside fluidity.

"I liked drawing the pictures outside and then making them go on the screen"

"I liked it when you got the item from the bag and you went into the screen and played with the item it was really fun"

"I want to do like when we go outside we have a pirate ship that we could go in. Yeah coz we are pirates in here and we got a pirate ship outside"

from a Child's Perspective

The findings presented in this visual representation demonstrate that mixed reality *Pop Up Play* from a child's perspective manifests as a combination of overlapping elements. Found to be at the core was dimensional embodiment which held together the inter-relationships between the five broad features of mixed reality play. The fluid dynamics reflect a nature of play which affords multiple possibilities framed by inside and outside spaces.

IV. DISCUSSION

One of the most exciting outcomes of this period of investigation was the theoretical solutions the participants offered when they discussed their incorporation into the mixed reality world. Of course, these were not based on rigorously challenged discourse and evidence, but do offer an insight into the deep and meaningful workings of their minds, and their rationalisation of where, and how, they perceived their *Self* and *Being* whilst playing in *Pop Up Play*. Interestingly, the findings presented in 3.1 (above) have much in common with technophenomenological philosophy, especially the writings of Don Ihde, and address the heart of this philosophy that Amelia Jones discussed as the 'metaphysical transcendence of mind-expanding machines' (Jones, 1998 p:205). This was particularly prevalent during the in-action play where our participants were recorded saying:

"Bring her back!"

"Put me normal!"

"I don't want to be eaten by the fish!"

"Put me back in my skin!"

If we correlate the reflections of the learners with Don Ihde's argument that 'when we humans use technology, both what the technology "is" or may be, and we, as users undergo an embodying process – we invent technologies, but they "reinvent" us as well' (Ihde, 2007 p:243). Furthermore, taking into account Gallagher's description of 'embodiment as the 'property of our engagement with the world that allows us to make it meaningful' it is possible to consider that these participants understood mixed reality technophenomenal immersion as when 'the lived body is "in tune" with the environment' (Shaun Gallagher, 2004 p:277). Therefore, extending the thematic qualitative analysis of the child-centred play-experience, a taxonomy of mixed reality experience may look like this:

- Mirror Perception Stage: "I see myself, over there, now"
- Surrogacy Perception Stage: "That is me, over there, now"
- Hyper (Dimensional) Perception Stage: "I am this, here, now"
- Techno-phenomenological Being (after Amelia Jones): "This is me, here, now"

This, of course, needs further investigation and expansion especially if we are going to correlate this with further theory from gaming immersion, such as 'how, indeed, does one *suspend* disbelief when one is so *extended*, physically as well as affectively and imaginatively, into a game?' (Callija, p:181). One solution is offered by Callija's taxonomy of dimensions with

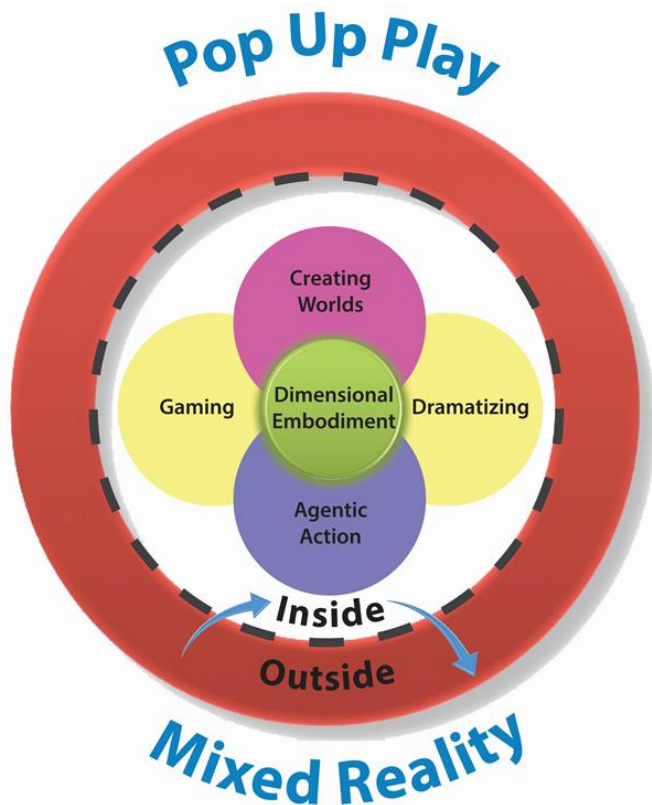


Figure 13: Visual Representation of Mixed Reality *Pop Up Play*

which to consider narrative/experiential trajectories through gaming, as it appears to be a perfectly suited solution to track mixed reality play over time, and traversing dimensional embodiment (discussed above in Section 3).

Kinesthetic - all modes of avatar/media control including the foreground and background images. **Spatial** - spatial control, navigation, and engagement; how the process is internalized and perceived and then represented in the mixed reality. **Shared** - player awareness, relationships and interaction with other agents (human, embodied avatar and background texture). **Narrative** - engagement with the stories written into the game and those that emerge from the player's interaction. **Affective** - emotional engagement and development, understanding and rationalizing. **Ludic** - engagement with the choices that are in the game; the game design and mechanics and their ethical/moral perceptions (Calleja, 2011).

As reported by the children and young people in this project, the physical and social nature of play was woven between the main themes highlighted during discussions of the potential uses of *Pop Up Play*. Some children were noted as saying "you have to pull together." In live-action play children also said:

"Can we get more than one person in and see what it looks like?"

"My group has good ideas"

"We need more people to make a wall of fuzz! Can we make a chain?!"

"I want to work with Boy B"

Taking part in shared experiences in *Pop Up Play* affords children the opportunity to operate as a team, some with pens, others with cameras. Children pose questions and offer solutions to problems. Through co-operative and collaborative endeavours they develop ideas and progress explorative learning and reflection (see Vear & McConnon, 2015 forthcoming). Vear and McConnon also dispel the myth that digital play is not simply using a computer screen and a keyboard. *Pop Up Play* affords its users an opportunity to visit unique places and engage in a wide variety of roles and activities. Throughout the project Vear and McConnon took a very broad view of the roles and activities manifest when children engaged in *Pop Up Play*, and grouped those together through an inductive and deductive process (see Table 4).

Table 4: Roles within mixed reality play Vear & McConnon (2015 forthcoming)

Player	Constructor	Observer Silent & Vocal	Technologist
Play Director	Music Maker	Describer	Technologist- Assistant
Visual Director	Sound Maker	Distant -	Technologist -
Performer	Puppeteer	Director	Observer
Actor	Visual Artist	Visual - Director	Camera - Controller

Children's in-action play quotes when 'in role' were recorded:

"Can I be the technologist and the player at the same time?"

[Player]

"We are going to put some sound effects on!" [Constructor]

"He's moving the shark, but playing hide and seek" [Observer - describer]

"Copy me!" [Observer - visual director]

"I made you teeny!" [Technologist]

Vear and McConnon (2015 forthcoming) reflected on the manifestation of roles, noting that communications opportunities were present throughout. Through repeated testing it became evident that there were dual roles and mixed reality entry points, thus the taxonomy of roles was clustered into zones of activity: playing, constructing, observing and technologizing. Furthermore, as an extension of the inside-outside inter-relationship (discussed above) it is important to note that Calleja (2011) similarly refers to macro and micro engagements within game engagement as an essential perspective. Calleja, discusses the inside experience of play (micro) as the 'broader motivations that attract players to games to the moment-to-moment engagement of game-play' (Calleja, 2011 p:40). And outside (macro) as the 'factors that shape the player's opinion and disposition toward the game that derive from thoughts, plans, feelings, and expectations both prior to and following the game experience' (Calleja, 2011:39). With this in mind Vear and McConnon related this to mixed reality play as 'the macro world of looking in; a liminal world of transition into the particular zones; and a fluidity of individual engagement in and out and between each one of them' (Vear & McConnon, 2015 forthcoming). *Pop Up Play* therefore affords the opportunity for every participant's learning journey to be uniquely different.

V. CONCLUSION

This article examines how children and young people conceptualize mixed reality *Pop Up Play*; what aspects of this type of play are important to them, and how this offers possibilities in guiding their play-activities. Through the adopted lens of children's reflective engagement this work seeks to contribute to a view of mixed reality play as a manifestation of a combination of overlapping elements with dimensional embodiment at its core. The fluid dynamics reflect a nature of play which affords multiple possibilities framed by inside and outside spaces where a wide variety of places, roles and activities are experienced. According to Jung and Jin (2014) 'although studies have shown a close link between play in young children and children's learning in social skills, school adjustment, and language learning (Bodrova & Leong, 2003; Bredekamp & Copple, 2009), practicing and future teachers may feel uncertain about applying play in early childhood programs because of the increased demand for accountability and prescribed curriculum in today's educational settings.' The challenge faced by many teachers and practitioners is to move away from traditional adult definitions of play and understand play from the child's perspective (McInnes, et al., 2013). This article demonstrates the importance of understanding mixed reality play from a child's perspective and is documented to offer new technological

opportunities and transformations of pedagogic practice. *Pop Up Play* allows teachers, librarians, or arts practitioners to re-imagine their learning offer, creating packages to support learning, reader development, live performance or an art exhibition (Al-Salloum, et al., 2015). The assembling and disassembling of cultural products re-positions the teacher and student as co-directors and co-editors of their social world (McWilliam, 2010). Through the use of digital media this enables changing the pedagogical focus from the teacher to the learner. Hall & Higgins (2005) quote ‘Sousa (2001) and Walker-Tileston (2004) [who] point out that children of the 21st century have been part of a multi-media world from birth and as a result they are comfortable with such technologies and this experience can be exploited in the learning environment.’ *Pop Up Play* therefore advocates for a shift away from traditional roles in the classroom and is a landmark contribution to education futures.

ACKNOWLEDGMENT

Thanks are due to De Montfort University; The Spark Arts for Children including Adel Al-Salloum, Harriet Roy, Jayne Williams, Dawn Bowden, Laura Evans, Gemma Kiddy, Rachael Mabe, and Keith Turner; Ben Waller, Rachel Bunce and Luke Woodbury, Asha Blatherwick for Dotlib Ltd. Our collaborators at Mellor Community Primary School, Leicester, Karen Hammond, Lynn Pallatt; Three Ways Special School, Bath, Lucy Heaton, Ben Edwards; New Walk Museum and Art Gallery, Leicester, Hugo Worthy; Embrace Arts, Leicester, Marianne Pape; Braunstone Library at the BRITE Centre, Leicester and Dovelands Primary School, Leicester: staff, children, parents and carers. Our Think Tank members: De Montfort University, Dr Gerard Moran and Will Buckingham; Leicester City Council, Adrian Wills; Three Ways Special School, Ben Edwards and Mellor Community Primary School, Karen Hammond.

REFERENCES

Ahn, J. G., Kim, G. J., Yeon, H., Hyun, E., and Choi, K. (2013). Supporting augmented reality based children's play with pro-cam robot: three user perspectives. In *Proceedings of the 12th ACM SIGGRAPH International Conference on Virtual-Reality Continuum and Its Applications in Industry* (pp. 17-24). ACM.

Al-Salloum, A., Woodbury, L., Vear, C., and McConnon, L. (2015). *The Spark Arts for Children: Pop Up Play*. Research and Development Report. Nesta.

Anthamatten, P., Wee, B. S. C., and Korris, E. (2013). Exploring children's perceptions of play using visual methodologies. *Health Education Journal*, 72(3), 309-318.

Auslander, P. (2008). *Liveness: Performance in a Mediatized Culture*. Routledge.

Bennett, N., Wood, E., and Rogers, S. (1997). *Teaching through play: Reception teachers' theories and practice*. Buckingham: Open University Press.

BERA - British Educational Research Association. (2011). *Ethical Guidelines for Educational Research*. London: BERA. Available @ <http://www.bera.ac.uk/publications/guidelines/2011>

Bodrova, E., and Leong, D. J. (2003). Chopsticks and counting chips: Do play and foundational skills need to compete for the teacher's attention in an early childhood classroom? *Young Children*, 58, 10-17.

Bredenkamp, S., and Copple, C. (2009). *Developmentally appropriate practice in early childhood programs* (Rev. ed.). Washington, DC: National Association for the Education of Young Children.

Brown, E., and Cairns, P. (2004). A grounded investigation of game immersion. In CHI'04 extended abstracts on Human factors in computing systems (pp. 1297-1300). ACM.

Calleja, G. (2011). *In Game – from Immersion to Incorporation*. MIT Press.

Craft, A. (2011). *Creativity and Education Futures: Learning in a digital age*. London: Trentham Books.

Dewey, J. (1933). *How We Think*. Boston: D.C. Heath and Company.

Dourish, P. (2001). *Where the action is: The foundations of embodied interaction*. Cambridge: The MIT Press.

Farrow, R. and Iacovides, I. (2014). “Games and the Limits of Digital Embodiment”. *Philosophy & Technology*. June 2014, Volume 27, Issue 2, pp 221-233.

Feldon, D. F., and Kafai, Y. B. (2008). Mixed methods for mixed reality: understanding users' avatar activities in virtual worlds. *Educational Technology Research and Development*, 56(5-6), 575-593.

Gallagher, S. (2004). *How the Body Shapes the Mind*. Oxford: Oxford University Press.

Hall, I., and Higgins, S. (2005). Primary school students' perceptions of interactive whiteboards. *Journal of Computer Assisted Learning*, 21(2), 102-117.

Heidegger, M. (1962). *Being and Time*. Harper Collins: NY.

Ihde, D. (2007). *Listening and Voice – Phenomenologies of Sound, 2nd Edition*. State University of New York Press: Albany.

Jones, A. (1998). *Body Art/Performing the Subject*. University of Minnesota Press.

Jung, E., and Jin, B. (2014). Future professionals' perceptions of play in early childhood classrooms. *Journal of Research in Childhood Education*, 28(3), 358-376.

Kettlewell, K., Southcott, C., Stevens, E., and McCrone, T. (2012). *Engaging the disengaged*. NFER. Available @ http://www.nfer.ac.uk/publications/ETDE01/ETDE01_home.cfm

King, R. (1978). *All Things Bright and Beautiful? A Sociological Study of Infants Classrooms*. Chichester: John Wiley & Sons.

Larsen McClarty, K., Orr, A., Frey, P.M., Dolan, R.P., Vassileva, V., and McVay, A. (2012). *A Literature Review of Gaming in Education*. Pearson. Available @ http://researchnetwork.pearson.com/wp-content/uploads/lit_review_of_gaming_in_education.pdf

Lavender, A., Bay-Cheng, S., Kattenbelt, C., and Nelson, R. (2011). *Mapping Intermediality in Performance*. Amsterdam University Press.

Lieberman, J. N. (1977). *Playfulness. It's Relationship to Imagination and Creativity*. New York: Academic Press Inc.

McInnes, K., Howard, J., Crowley, K., and Miles, G. (2013). The nature of adult-child interaction in the early years classroom: Implications for children's perceptions of play and subsequent learning behaviour. *European Early Childhood Education Research Journal*, 21(2), 268-282.

McGonigal, J. (2010). *Gaming can make a better world*. TED 2010 available @ http://www.ted.com/talks/jane_mcgonigal_gaming_can_make_a_better_world#t-662073

McGonigal, J. (2011). *Reality Is Broken: Why Games Make Us Better and How They Can Change the World*. London: Jonathan Cape.

McGonigal, J. (2005). "All Game Play is Performance/Game Play is All Performance. A manifesto in anticipation of delivering the keynote address for Playful: The State of the Art Game. May 2005" available @ http://www.avantgame.com/McGonigal_preview%20manifesto_The%20State%20of%20the%20Art%20Game_May%202005.pdf

McWilliam, E. (2010). Learning culture, teaching economy. *Pedagogies: An International Journal*, 5(4), 286-297.

Merleau-Ponty, M. (1962). *Phenomenology of Perception*. New York: Routledge.

Morie, J. (2007). Performing in (virtual spaces): Embodiment and being in virtual environments. *International Journal of Performance Arts and Digital Media*, 3(2-3), pp 123-138.

Prensky, M. (2001). Digital Natives, Digital Immigrants Part 1, *On the Horizon*, Vol. 9 Issue: 5, pp.1 – 6.

Rogers, Y., Scaife, M., Gabrielli, S., Smith, H., and Harris, E. (2002). A conceptual framework for mixed reality environments: designing novel learning activities for young children. *Presence: Teleoperators and Virtual Environments*, 11(6), 677-686.

Sousa D.A. (2001). *How the Brain Learns*. Corwin Press, Thousand Oaks, CA.

Sternberg, R. J. and Preiss, D. D. (Eds.). (2013). *Intelligence and technology: The impact of tools on the nature and development of human abilities*. Routledge.

Vear, C., and McConnon, L. (2015, forthcoming). *Pop Up Play: A Digital Creative Play Space*.

Walker-Tileston D. (2004). *What Every teacher Should Know About Media and Technology*. Corwin Press, Thousand Oaks, CA.

AUTHORS

First Author – Dr. Linda McConnon Ph.D, De Montfort University, linda.mcconnon@btinternet.com

Second Author – Dr. Craig Vear PhD, De Montfort University, cvear@dmu.ac.uk

Correspondence Author – Dr. Linda McConnon Ph.D, De Montfort University, linda.mcconnon@btinternet.com