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Vidal-Hall, Charlotte, Flewitt, Rosie  and Wyse, Dominic (2020) Early childhood practitioner beliefs about digital media: integrating technology into a child-centred classroom environment. *European Early Childhood Education Research Journal*, 28 (2). pp. 167-181. ISSN 1350-293X

**DOI:** <https://doi.org/10.1080/1350293x.2020.1735727>

**Publisher:** Taylor & Francis (Routledge)

**Version:** Accepted Version

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## **Early childhood practitioner beliefs about digital media: integrating technology into a child-centred classroom environment**

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### **ABSTRACT**

*The effective integration of educational technologies into early childhood education remains a significant challenge. An important element of this challenge is how practitioner beliefs about pedagogy relate to how digital technologies are used in the early years classroom. Focussing on early childhood practitioner beliefs in relation to pedagogy and digital technologies, this paper reports on a doctoral study where Educational Design Research (EDR) methodology was used to investigate how a technology-focussed intervention might lead to changes in one teacher's approach to integrating digital media into her child-centred pedagogy. The data included reflective discussions over a period of 18 months, video observations of digital media use, and scrutiny of relevant documents. The intervention resulted in a change from the teacher being sceptical about the relevance of digital media for early childhood education to her developing effective strategies to integrate digital media into her child-centred pedagogy. This shift in pedagogic approach was made possible by the teacher changing her beliefs about the value of digital technologies in early education. Findings suggest professional learning should address practitioner beliefs about digital media and early years pedagogy, including providing time and space for teacher reflection.*

### **KEYWORDS**

Early childhood education; child-centred pedagogy; technology integration; teacher beliefs; play

### **Introduction**

Young children's engagement with popular culture and communication through digital technologies is an everyday reality (Plowman et al. 2012). However, the integration of digital technologies into early childhood classrooms remains a challenge, with one in four practitioners in the UK feeling that digital media do not have a place in early childhood settings (Billington 2016). Although empirical research has demonstrated digital technologies have much to offer early childhood classrooms (Fleer 2018; Flewitt, Messer, and Kucirkova 2014; Gillen et al. 2018; Lynch and Redpath 2014) multiple concerns remain around the suitability of digital technologies for young children (Dubicka, Martin, and Firth 2019). Technology has been found to be used inappropriately in early childhood settings when it is not integrated into a coherent overarching pedagogic approach (NAEYC 2012). Despite growing evidence of children's engagement with diverse digital devices and platforms in their out-of-school lives, digital media are often not regarded as having pedagogical value for early learning (Johnston, Highfield, and Hadley 2018). However, it is important to consider how children use digital media and what they do with them, rather than condemning screen use in schools (Holloway, Green, and Livingstone 2013). Whilst some argue that children need to be protected from the potential harms of digital media, others point to the 'immense' advantages digital media can offer (Dubicka, Martin, and Firth 2019, 204). Putting technology in schools is no guarantee of its positive impact on learning outcomes, as 'how digital technologies are used is as important as whether they are used' (McFarlane 2019, 3). Early childhood pedagogy is often seen as incompatible with digital media use and with what practitioners value as part of young children's learning (Marsh et al. 2017). Many

practitioners question the value of digital technologies in early childhood education, struggle to integrate them into their practice (Hernwall 2016), and have not developed effective pedagogy to support their integration into the early childhood classroom (Prestridge 2017). Practitioners tend not to associate technology use with free play (Nikolopoulou and Gialamas 2015) and do not see its use by children as an activity that can be supported by adult interaction (Thorpe et al. 2015). Furthermore, there is little evidence of digital technologies being embedded in the curriculum in ways that support the development of new and creative practices around technology. Although practitioners may be open to change, they remain unconvinced about the use of technology in play (Hatzigianni and Kalaizidis 2018) and do not use their pedagogical skills to support child-initiated learning with technology (Morgan 2010; Vangsnes and Økland 2015). Although research into the use of digital technologies in early childhood education is in its infancy, it has identified that there are many unresolved issues in the effective integration of technology into child-centred learning environments (Kewalramani and Havu-Nuutinen 2019).

### **Practitioner beliefs and digital media**

There is a close relationship between early childhood practitioners' beliefs and attitudes towards digital media and how they are conceptualised and used in early childhood settings as part of children's play (Edwards 2016; Yelland 2011). Teachers' 'ways of thinking' are vital components in their practice (Nespor 1987) and influence their conceptualisation of tools and resources to support learning, such as how digital media are used, or not, with children (Ertmer, Ottenbreit-Leftwich, and Tondeur 2015). The nature of early childhood education and its emphasis on first-hand experiential child-initiated learning is frequently a barrier to the integration of digital media (Mertala 2017; Palaiologou 2016). Anxieties exist about children's physical inactivity, passivity and lack of verbal and social development when using digital media (Flewitt, Messer, and Kucirkova 2014). These anxieties are compounded by beliefs about the developmental appropriateness of technology-based virtual learning experiences versus traditional hands-on, non-digital activities (Bird and Edwards 2014; Lindahl and Folkesson 2012). Given the centrality of learning through play in early childhood, practitioners' pedagogic beliefs and what they deem to be relevant to play will influence the ways they draw on digital media to support the educational goals of the classroom (Nuttall et al. 2013). There may be different pedagogical practices in settings depending on practitioner beliefs, and approaches to using technology (or not) reflect these beliefs (Ljung-Djärf, Åberg-Bengtsson, and Ottosson 2005). The pedagogical decisions practitioners make about the integration of digital technology into classroom rules and routines influence how and what children learn with technology (Arnott 2016). Further insights are therefore needed into the factors that shape practitioner beliefs and practices, with a view to identifying strategies to facilitate change and shifts in thinking in relation to the appropriateness and potential of digital technology in play-based curricula for young children (Johnston, Highfield, and Hadley 2018). Significantly, the research reported in this paper used Educational Design Research (EDR) (McKenney and Reeves 2012) to understand practitioner beliefs about technology and pedagogy, and then to use this understanding to develop a naturalistic intervention designed to support the effective integration of digital media into an early childhood classroom.

This paper demonstrates how one practitioner reflected on the tension between her beliefs about technology and about the importance of play-based pedagogy to integrate digital media throughout the day and in all curriculum areas by following children's lead and their interests. The research sheds light on how early childhood education practitioners can develop effective pedagogical strategies to integrate digital media into a

play-based classroom in ways that stimulate and support young children's learning. The two research questions guiding the study were:

- (1) What beliefs influence the integration of digital media into early childhood pedagogy?
- (2) What pedagogical approaches integrate digital media effectively into early childhood settings?

### **Pedagogy shaping learning with digital media**

The research reported in this paper drew on sociocultural views of learning as located in social and cultural contexts (Vygotsky 1978), where a complex matrix of factors shapes children's classroom experiences with technology (Arnott 2016), and where learning is mediated by practitioners' explicit and implicit actions (Wertsch 2007) that in turn shape the sociocultural contexts in which children learn. These actions include the pedagogical decisions practitioners make around the rules and routines that direct children's use of technology (Arnott 2016). The research conceptualised classrooms as dynamic learning environments and used the notion of a classroom learning ecology (Cobb et al. 2003) to describe how practitioner beliefs, their distal and face-to-face interactions, and the resources, activities and physical environment they organise shape the integration of technology in early childhood classrooms. Using the concept of classroom learning ecology enabled an examination of how individual elements may change with the introduction of new practices, which in turn points to what might make the integration of these practices possible in other contexts.

### **Methods**

EDR was used to develop a naturalistic classroom-based intervention to address practitioner beliefs and investigate pedagogy to integrate digital media into an early childhood classroom. The research design aimed to identify and address factors hindering digital media uptake, such as practitioners' reluctance to intervene in children's digital play, and their beliefs that may constrain the integration of digital technologies into teaching and learning. Design research is a distinctive approach that develops a solution to a problem in the form of an intervention. It allows the researcher to identify which particular features of an intervention are more effective and why (Reeves 2011). EDR uses 'design principles' (Plomp and Nieveen 2013; Reeves 2006) to describe the different elements of a solution. Table 1 summarises how the design principles used in the intervention related to education theory, and how the intervention led to new practices and changed practitioner roles.

The methods of data collection were chosen to support an in-depth understanding of the factors hindering and facilitating digital media uptake, with a view to finding ways to integrate digital media into teaching and learning across the curriculum. A key feature of EDR is how it can help practitioners recognise and confront their beliefs (Bradley 2013), which can lead to meaningful change in teaching and learning environments (McPake and Stephen 2016). The contribution of EDR to knowledge is twofold: it aims to produce usable knowledge in the form of a solution to a problem along with theoretical understanding of a problem that can be applied in other contexts. EDR was therefore considered an appropriate methodological approach for this study because it can enable solutions to classroom-based problems that have been tested and developed in situ with practitioners.

The study site was chosen purposively to represent features of digital media use in play-based early childhood settings, as identified in research literature. The class teacher, Vicky<sup>1</sup>, was an experienced practitioner with strong child-centred pedagogical beliefs, whose practice was

founded on principles of play-based learning. The school was located in a city centre in the southeast of England, and the nursery class where the study was conducted offered 24 part-time places for children aged 3–4 years. Digital media available to the children in this classroom at the start of the research (see [Figure 1](#)) consisted of one internet-connected desktop personal computer (PC) and an interactive whiteboard (IWB) connected to a second PC for practitioners' use. During fieldwork, the school bought a set of 15 LearnPad touch screen tablets for the nursery which Vicky introduced into the classroom.

*Table 1: Summary of design principles used to drive the intervention*

<b>Design principle</b>	<b>Related theory or literature</b>	<b>Practitioner role</b>
<b>1. Practitioners interact with children using digital media during free-flow play</b>	Sociocultural theory: mediation of cultural tools	Interaction in play
<b>2. Practitioners should follow children's interests</b>	Sociocultural theory: meaningful contexts for teaching and learning	Interaction in play
<b>3. Practitioners plan to use digital media with children</b>	Extension of existing classroom practice	Planning
<b>4. Planning should take into account what digital media can add to learning</b>	Literature showing a lack of pedagogy around use of technology to support learning	Planning
<b>5. Researcher to provide time and space for reflection on beliefs and practice</b>	Literature around teacher beliefs	Reflection

Vicky had a leadership role in that she was responsible for planning and leading children's learning in the nursery, and guided two full-time early years qualified support staff. The organisation of teaching and learning throughout the day reflected Vicky's child-centred pedagogical beliefs and her knowledge and understanding of children's developing needs and interests. Each three-hour morning and afternoon nursery session followed the same routine and was split into two 15-minute whole class practitioner-led sessions, interspersed with free-flow play during which children had free access to indoor and outdoor classroom resources.

The research followed the British Educational Research Association (2018) ethical guidelines, and approval for the study was gained from the UCL Institute of Education ethics review process. Formal written consent was received from all adults involved in the research, as well as school gatekeepers and children's parents. Adult participant consent forms included a letter describing the purpose of the research and how participation might impact on adults and children. All child and adult participants were informed they could withdraw from the research at any time and that pseudonyms would be used in research write-ups. Practitioners were also informed that anything they said or did would be kept strictly



confidential to minimise the risk of any adverse effect on their self-esteem or position within the school. Consent from parents for their children's participation was considered 'proxy consent' (Mayne, Howitt, and Rennie 2016), and children's verbal assent was gained before each classroom observation by asking them if they wanted to talk to a researcher or be video recorded. Children were informed about the research through the use of a digital picture book written by the lead author for this purpose.

The research took place over one academic year. Data included 25 video-recorded observations of Vicky using the IWB, PC and LearnPads with children in different activities and areas of the classroom as well as children using digital media independently. Field notes were supplemented with a reflective research diary and 26 weekly classroom planning documents. Weekly audio-recorded interviews conducted after practitioner observations of digital media use by children, and activities where practitioners used digital media with children consisted of 13 practitioner-initiated unstructured discussions and 7 researcher-led semi-structured interviews. These discussions and interviews provided time and space for reflection on how and what children learned and Vicky's role in their learning. Interviews frequently developed into a 'conversational partnership' (Flewitt 2011) that created space for Vicky to be a co-participant in developing and implementing the intervention. This approach helped address the possible power imbalance between Vicky and the researcher, and helped to maintain an equitable relationship between practitioner and researcher. In EDR, the researcher may hold the balance of power in relation to theory but practitioners are equally powerful in evaluating the success of an intervention and its impact on children's learning and their own practice.

*Figure 1: Location of digital media in the classroom*



There were opportunities during and after fieldwork for open dialogue between Vicky and the researcher during which Vicky spoke freely about the impact of the intervention. These 'professional conversations' gave Vicky a voice in the research and allowed the

researcher to respond to her concerns and observations about the intervention. An abductive orientation to analysis (Timmermans and Tavory 2012) was used, combining inductive and deductive procedures (Mintz 2012). This allowed a priori theoretical ideas related to the intervention design to be combined with categories emerging from the data. The interpretive framework and analysis were facilitated by HyperRESEARCH qualitative data analysis software, which helped to ensure a systematic scrutiny of all evidence generated throughout the relatively lengthy period of data collection.

## **Findings**

The main finding of the research was that Vicky's integration of digital media was supported by reoriented beliefs about digital media and their value as pedagogical tools. This finding had 3 key aspects: 1. changes to the practitioner's planning, and as a result her use of digital media; 2. reflection on the practitioner's role supporting children's digital media use, and 3. congruence between beliefs and practice.

### ***Planning interaction with digital media***

Before the intervention, the observations and interviews showed digital media were not part of Vicky's pedagogical decision-making. A key change introduced through the intervention was Vicky adding to her written practitioner-led planning, for the first time, the use of the digital media to support teaching and learning. Using the IWB with children meant Vicky overcame her strongly expressed negative views about digital media as 'something that sucked the life force'. Her perception of the way children engaged with digital media as 'solitary and passive... offering little opportunity for children's input into their learning... and hindering children's language and communication' was a barrier to her fully integrating digital technology into classroom routines and activities. Vicky's comments suggested she attached little value to digital media as resources to support learning through play or children's co-construction of their own learning. This perception of digital media meant they were not included in practitioner-directed teaching, and neither Vicky nor the support staff supported children's learning and exploration with digital technologies.

None of the practitioners intervened in or supported children's digital game-play or explored the use of digital media alongside children during free play sessions. Infrequent interactions with children when they used the PC tended to focus on technical aspects of learning such as mouse control. The digital media devices in the classroom were not effectively integrated across the curriculum, and they were not included in the different routines and approaches to teaching and learning observed in this classroom. The following comment is typical of Vicky's attitude towards children's use of digital media during the early observational phase of this study:

I started off feeling that as it was children had too much screen time at home...didn't really see the value and was worried that it was stopping them from talking and being creative.

Vicky planned interactions with children using games on the IWB and LearnPads during free play and whole class directed teaching activities. Integrating digital technology into the way she planned teaching activities encouraged Vicky to consider digital technology as a pedagogical tool, and to develop her role in supporting and extending children's learning. During the first few weeks of the intervention, Vicky found a computer programme on the Times Educational Supplement iBoard (TES iBoard [n.d.](#)) website of resources for teachers. Vicky explained to the researcher she liked the way children could use this programme to talk and write about familiar daily events that included getting dressed, having breakfast; coming

to school, going home, and brushing their teeth before bed. This kind of oral sequencing activity was already part of her pedagogical repertoire to support children's language development.

Vicky introduced the activity during a whole class guided teaching session and modelled how children could put their words into written script to add to the pictures using the keyboard on the PC, which was attached to the IWB. Once the whole class session was finished, rather than leaving the IWB, Vicky worked alongside children who wanted to use the TES iBoard programme. This was the first time Vicky had planned a whole class IWB activity and then supported children who wanted to use the IWB during free play. With each child, Vicky used the programme in a way that was led by the child's individual interest in, and understanding of, the connection between letters and sounds as well as their ability to navigate around the screen using the mouse or pen tool. Reflecting with the researcher on this session afterwards, Vicky commented on her own learning:

It was a revelation to me because every child got something different out of it. For Danny it was about the silly sounds the letters made and navigating around the screen. For Maryam it was about using her knowledge of phonics to write words and with Niamh it was about putting her words on the screen.

This activity demonstrated to Vicky she could plan and initiate an activity at the PC or IWB, but also be guided by children's individual interests and developing capabilities as she introduced them to both technological skills and different aspects of early literacy. The TES iBoard activity was pivotal in Vicky's conceptualisation of digital media as tools to support learning and Vicky later described this session as 'a real transition moment for me'. Rather than focusing on assisting children's use of the technology itself as in guided interaction (Plowman and Stephen 2005), Vicky observed how she could be part of children's digital play and follow their interests.

### ***Pedagogical interventions in play***

The TES iBoard activity demonstrated to Vicky the difference her interactions could make and that 'just having the whiteboard on is not enough. I need to be there too'. As Vicky spent more time with children using digital media, her intentional interactions with children were supported by evidence of the impact of these interactions as this comment shows:

The other big thing that has changed for me is understanding that my intervention is really, really important because first of all I saw this great social stuff happening and I thought OK but I don't really see my role in this social stuff happening.... but then reflecting again, when I was seeing this happening I understood that by moving in I could really, really extend what was happening and it was differentiated by virtue of these children leading and then I could extend.

Vicky looked for opportunities to intervene in children's digital play while at the same time making instructional decisions that extended their learning. Vicky used her pedagogical skill to recognise and take advantage of teaching moments in the same way she did when she supported children's non-digital activities during free play. Her interventions supported the ways children used digital media rather than directed or diverted the direction of child-led activity. Vicky did not direct children's activity but she remained in the background and was guided by the children themselves and her knowledge of their developing capabilities and interests. The following extract from a video-recorded observation is typical of her



interactions with child-initiated digital game-play, where the children often taught her what to do, and she explored games playfully with children:

Vicky: Click on it. So if you click on it (pause) use the mouse it will water, it will rain  
Over the plants. How do you get him to use the watering can?

Danny: You just press on the flowers.

Vicky: What do I need to do now? So you're pressing on the cloud to make it bigger.  
We need the bird to come don't we to eat that caterpillar. Is there anything we can do  
to make the bird come?

Danny: No it just (pause) ahhh (the bird appears and drops a seed)

Vicky: So do we have to grow them before the caterpillar can eat them?

Vicky began to engage in dialogue with children about their game play, on the children's terms and in tune with the nature of their play. Vicky's interventions frequently supported children's successful completion of games and activities that they had chosen, such as drawing a picture of a favourite film character, or her asking more knowledgeable children to explain to others how to play a digital game. When Vicky explored new games and forms of digital media with children or asked children to explain to her how to play games she asked questions such as: 'So what happens if we,' or 'So do we have to grow them,' and 'We need the bird to come down, don't we'. Using the pronoun 'we' emphasised the joint nature of the activity and her active presence as part of the game.

When children first used the LearnPads in the classroom, Vicky was present to provide support and asked children how they wanted to use them and what games they wanted to play. She sat with a group of children on the floor in the reading area, waited for children to approach her and then responded to their requests and questions, taking her lead from the child and the game medium. [Figure 2](#) shows how Vicky sat alongside children, both supporting and learning about their use of the new LearnPads. Vicky described using her interventions to encourage children to teach her in the same way she observed children teach each other. She referred to this way of supporting children's digital media use on several occasions and commented, 'I am doing more with the kids on the computer and learning how to use it with them,' explaining how, 'I don't have the time to work out how to learn everything so if I see a child do something new I get them to explain to me what they did'. When Vicky asked children to teach her she invited herself into children's use of digital media but on their terms, positioning the children as experts and herself as the less knowledgeable participant in activities initiated by children. This was a role reversal from her pre-intervention approach of using interactions to teach operational skills such as mouse control.

Vicky's supportive interactions included her awareness of children using diverse digital media around the classroom and she used her pedagogical skill to be alert to children's initiatives, responding to them by joining children using the IWB, PC or LearnPads. Vicky maintained a presence near the IWB or positioned herself near areas where children chose to use the LearnPads and directed other practitioners to do the same. In this way, children using digital media were within practitioners' peripheral vision, and their observations of children during these times informed their decision-making and planning. These occasions were sometimes detailed in Vicky's written plans and indicated her constant awareness and response to children's needs and interests, as she made on-going observations during free play. Post-intervention, digital media were part of a process of being aware of children's engagement with digital media around the room and responding in ways that resembled Vicky's engagement with children in other areas of their learning.

*Figure 2. Learning together on the LearnPad during free-play.*



### ***Congruence between beliefs and practice***

Different approaches to interactions as part of free play and directed teaching gave Vicky direct experience of how her intentional interventions in digital play could extend the learning she observed when children used digital media. Her experience of using digital media with children as part of the intervention enabled her to change her view: 'I now see the computer very much as a tool, whereas I didn't see that before'. Given Vicky's initial description of her response to the presence of digital media in the classroom as 'reactionary' rather than 'reflective' it seemed unlikely Vicky would have changed her approach to using digital media without a shift in the way she conceptualised them as tools to support early learning.

As Vicky's beliefs changed with regard to digital media, so did the nature of her interactions in support of children's digital media use. When Vicky chose to intervene in children's play with digital media it was because she had observed the value of these interactions and how they could support specific learning outcomes, in line with her beliefs about early learning theory and practice. She linked children's use of the IWB and LearnPads to her own goals for learning and was able to find ways to support and extend learning through her own intentional actions. Congruence between Vicky's core pedagogical beliefs and her concept of digital media as pedagogical tools was key in enabling changes to the use of digital media in the classroom. Vicky expressed the importance of making digital media 'fit' with her beliefs about pedagogy in the following interview extract:

- |             |   |
|-------------|---|
| Researcher: | As soon as you could find a way that computers fitted in with your existing beliefs around early years practice, then that was key.   |
| Vicky:      | Yes, yes, yes because if it didn't fit in with what I consider good early years practice then I wouldn't use it. Because there's lots of things I would like, but actually they don't fit in with practice, so I'm reluctant to use them. |

Vicky needed a rationale for using digital media that was compatible with her strong belief in children learning through self-directed play and the role of practitioners in supporting learning.

During the study, Vicky shifted her mindset by observing and talking about how digital media could support the kind of child-led learning environment that was already embedded in her pedagogical beliefs. This pedagogical congruence between Vicky's beliefs about digital media and those shaping her practice required a significant shift in her beliefs and attitudes so that she could approach using digital media in the same way as she did other classroom resources. The digital technologies themselves were not the instruments of change as they did not in and of themselves prompt changes to Vicky's practice. Rather, it was Vicky's beliefs that changed through observation, reflection, changes to practice and more reflection, so her new practices helped to shift her beliefs, which in turn further changed the ways she interacted with children when using technology in the classroom. With evidence of how children's learning and development was enhanced by her actions to support the use of digital media, Vicky was able to further extend her use of digital technology.

## **Discussion**

Previously published research identified a lack of knowledge about effective pedagogical approaches to support technology integration into early learning (Fenty and Anderson 2014) particularly for early childhood practitioners whose core belief is in the value of learning through play (Bourbour and Masoumi 2017). The research reported in this paper showed how the integration of digital media was not constrained by a lack of knowledge per se, but by how pedagogical beliefs and practices interacted with beliefs about digital media and their place in early childhood classrooms. The integration of digital media into classroom routines and practice required changes to teacher beliefs and interactions around digital media. In this study, shifts in beliefs prompted by reflection on changing practice around digital media supported the effective integration of digital technologies. Without a shift in beliefs and understanding of how children used digital media there would have been no imperative for sustained change.

The research extends existing literature demonstrating a close relationship between beliefs and practice (Bourbour and Masoumi 2017) and how technology is integrated in accordance with pedagogical beliefs (Ertmer et al. 2012). The findings showed that attempts to make one teacher's pedagogy more effective needed to take into account their pedagogical beliefs and practice. Beliefs about young children's learning and development place teachers within a discourse of early years pedagogy that reflects their ideologies and value systems. Being part of a particular discourse means accepting a set of assumptions and acting in accordance with them (Ljung-Djårf, Åberg-Bengtsson, and Ottosson 2005). This research suggests how teachers might consider how digital media can be integrated into their existing pedagogical beliefs, and develop an approach based on congruence between beliefs and practice.

This research also showed there is a nuanced relationship between pedagogical beliefs and beliefs about digital media use in early childhood settings, and this relationship shapes the decisions teachers make about integrating digital technologies into young children's learning. The initially ambivalent and subsequently congruent relationship between beliefs and practice mediated how the teacher in this study chose to support, or not, children's digital media use in the classroom. Her reluctance to support children's digital media play as she did with other child-led aspects of play was not related to a lack of pedagogical skill or to

an inherent dislike of technology. Rather, she did not conceive of digital media as tools that could support valuable learning across the curriculum in an early childhood context.

In this study, the teacher's beliefs about digital technologies conflicted with her pedagogic principles of child-initiated play. These core beliefs had prevented her from seeing beyond her preconceptions, and had rendered her unable to include digital media in her pedagogical planning and decision-making. Furthermore, she had not taken the time to stand back and observe the ways children integrated digital media into their play and had no evidence on which to base new practice and beliefs. In this classroom, change was mediated during the EDR intervention by a combination of shifts in practice and reflection on the impact of changes in relation to the teacher's beliefs about the importance of play-based early learning and their use of digital media. Planning the inclusion of digital media in directed teaching, along with pedagogical interactions with children using digital media as part of their play provided evidence of how practitioner interventions could support and extend learning without compromising strong pedagogical beliefs. This evidence supported the reorientation of beliefs about digital media and enabled congruence between beliefs and practice.

Through a combination of reflection, observation of children at play and the adoption of new practices for digital technologies, the beliefs that had hindered technology use were replaced with 'new' beliefs that supported the use of digital media across the curriculum. This allowed for 'new' pedagogy for digital media that was in-keeping with her core beliefs and pedagogical decision-making. The integration of digital media was supported by pedagogical decision-making that were evident in other areas of the curriculum but had not previously been applied to digital media. The IWB, PC and LearnPads were no longer 'outside' the instructional decisions made for young children, but were incorporated into written planning, integrated into whole class teaching sessions and supported playfully by the teacher during the children's free play activities. The teacher used digital media as pedagogical tools during child-led digital play, with instructional decisions for their presence that supported children's learning with and about technology. The research therefore questions the findings of previous research that practitioners lack pedagogical strategies to integrate digital media, and suggests they may have the strategies but that they are yet to realise how these may be applied to digital media.

For children to learn with and about technology and develop digital literacies beyond operational skills, practitioners need to be present for some, although not all the time, to play alongside children when they are using digital media during free play and during teacher-directed activities. The implications of this research for classroom practice point to the need to address practitioner beliefs through a combination of teacher reflection, observation and changes to practice. Professional learning is needed that will provide practitioners with the time and space to reflect on the use, or lack of use, of digital media and their potentially beneficial impact on learning. Practitioners need to see and experience first-hand evidence of how they can use technology to support child-led learning, and to develop their own professional role in extending that learning. Further research is needed to determine whether the relationship between pedagogical beliefs and beliefs about technology investigated in this research pertains to other teachers and their settings. Given the limitations of research conducted in one classroom, further research in more settings would help to establish whether similar interventions and pedagogical strategies could be effective in diverse early childhood settings. The aim of such research would be to develop a professional learning model for the effective integration of digital technology in classroom-based early learning that has been designed and tested in real classrooms with practitioners.

Rather than suggesting there is one ‘ideal’ pedagogical approach to achieve the integration of diverse technologies into early learning, this study has found that a core dimension of successful practice is the creation of a reflective and discursive space for teachers to reflect on how digital media can be incorporated into existing approaches to teaching and learning. This pedagogical approach is summed up by Vicky in the following reflective comment:

Perhaps it’s also about doing direct teaching to introduce skills but once they’ve got those skills looking at how they’re using things to think about how we can develop them. Because it’s what we do isn’t it... we say this child’s really interested in this... they’re doing it in this way... how can we extend it ... what can we do?

**Note 1.** Pseudonyms are used throughout.

**Disclosure statement:** No potential conflict of interest was reported by the author(s).

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