

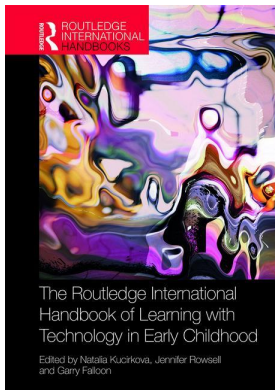
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## **The Routledge International Handbook of Learning with Technology in Early Childhood**

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### **Introduction**

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# 1

## INTRODUCTION

*Natalia Kucirkova, Jennifer Rowsell and Garry Falloon*

Rapid growth of digital technologies during the 21st century have paved the way for an upsurge in young children's digital play and learning, multimedia communication and new, multimodal literacies. Coupled with global inequalities in access to high-quality education, the socio-cultural impact of immigration and multicultural neighbourhoods on children's daily experiences, digital technologies and media are reshaping childhood and young children's lives. Technologies and media prompt us to consider what being literate means and implies for the children growing up today. Making meaning of these rapidly changing and complex relationships requires a multidisciplinary, open-minded approach with a range of rigorous, innovative and context-appropriate research methods.

When planning this Handbook, we set out to compile a collection of chapters that would discuss and exemplify how digital technologies affect learning and play, and the ways in which researchers study this impact on young children's lives in the 21st century. We aimed to provide a thoroughly researched and comprehensive overview of current multidisciplinary scholarship concerning children's media and technology. More specifically, we had three main objectives:

First, we aimed to complement current efforts to coordinate diverse perspectives and facilitate dialogue among groups of researchers who typically collect and share evidence in segregated communities. This objective was pursued with a strategic approach to the choice of authors and areas of research they represent. We approached researchers who are well-known in their respective fields and who can collectively offer expert insights into diverse, mixed and cross-disciplinary approaches to technology/media research with children aged between two to eight years.

Second, with our instructions to the authors, we aimed to collate chapters which would provide insights into the methods undertaken by the scholars in their respective fields. We envisaged that such an approach might empower other researchers to audit, reflect on and substantiate the value of their own methodologies and research approaches.

Third, we aimed to trouble the currently dominant monodisciplinary view among many Western policy-makers who favour quantitative and large-scale trials in making decisions about allocation of school resources and accountability measures for teachers. To avoid disciplinary-oriented, one-dimensional understanding of children's technology use, we aimed to emphasise the need for a 'toolkit' of diverse methodological and theoretical

perspectives to inform the policy and public discourse on a topic known to be controversial and prone to emotional and reactive responses. This objective meant that we commissioned chapters from researchers who provide additional support for existing policy-makers, as well as researchers who interrupt existing discourses by co-designing educational resources through co-inquiry with teacher and parent communities.

Underlying the Handbook is a wider objective to add to the efforts of some to move beyond a publication system that considers research disciplines in silos and sometimes pits one method against one other. This ambitious goal was partly a reflection of significant intellectual divisions in 2017 and 2018 and partly a reflection of our own multidisciplinary work.

### **Providing space for multidisciplinary**

The editorial task of assembling works from a range of research traditions and contexts was an incredibly rich and challenging experience. As editors we wanted to be inclusive and receptive towards a wide range of disciplines, which often act in contention and have not been brought together in one collection before. We approached the leaders in their fields and were delighted that they accepted our invitation. The contributing authors have shared with us their current research interests, their understanding of contemporary childhood issues, research approaches and reflections on digital media/technology and key insights from their work. We deliberately and specifically aimed to have authors whose work cuts across diverse fields and historically contested fields of research, bringing together research which is typically reported in books, journals and conference presentations. As a result, the volume includes a rich repertoire of studies from educational psychology, posthumanist literacy, narrative approaches, developmental approaches, arts-based and child's geographies fields, applied linguistics, language and phenomenology, developmental psychology and educational technology.

### ***The challenge of multidisciplinary***

Complexity brings to the fore multidimensionality as well as contradictions and conflicts. Many parents and educators acknowledge, but are also confused with, the complexity of considerations related to children's technology use. We admit that we too grappled with a cogent and coherent way of representing the complexity portrayed in the chapters. As editors, we discussed at length the merit of individual approaches, their rigour, terminology and how they advance knowledge in the field. We disagreed and discussed, often via emails and videoconference calls, our feedback to authors.

We endeavoured to maintain a pluralistic view on the importance of diverse voices. Accordingly, when providing feedback to authors, we aimed to enter in conversation with them and encourage them to produce the best chapter they can by pointing out contrasting evidence, as well as celebrating their expertise in a specific area. We were keen to profile the different theoretical lenses and methods employed by researchers from different disciplines, but this meant we needed to be open to different writing styles, and at times, epistemological perspectives. In a field that still needs to construct a definition of its key terms, it was often not easy to find a common language.

### ***Multidisciplinary and diverse writing styles***

Research is reported differently in different disciplines. We wanted to reflect this reality and as a result, the Handbook is written using various styles and formats. Some chapters are written in

a subjective and narrative voice, some in an objective and persuasive voice. Some co-authored chapters explicitly reveal the authorship of individual sections by presenting them as a dialogue or attributing specific sections to different authors, while others are written in one neutral voice. Some chapters make an explicit reference to technology as a specific material resource that can be studied in its own right, while others conceive of technology as an integral part of children's socio-material being in the world. Some authors highlight how prior research could contribute to understanding of children's digitised lives, while others point out its inadequacy for a dynamically changing environment, defined by novelty.

Coming to the field with our own subjectivities and methodological biases, we needed to reconcile the authenticity of diverse research. Our editorial principle was not to judge but to showcase research practice that is firmly grounded in theoretical perspectives and empirical data. We did not homogenise researchers' approaches by providing them with templates or requests for more 'evidence'. Instead, we aimed to ensure they are honest and transparent about their methods and approaches, so that readers can truly see the multiple layers of children's technology research.

### ***Multidisciplinarity and diverse methods***

We consider diversity as a source of celebration, not a road to reduction. We wanted to respect and celebrate the expanding methodologies in all disciplines. Consequently, some chapters draw on multiple-team studies that they evaluated through randomised controlled trials, while others describe an intervention they developed, implemented and evaluated themselves. Some authors provide an original synthesis of theories, while others position their work in a strong empirical base of cumulative evidence in a specific area. Some chapters are descriptive and discursive, some are explanatory and some are normative. All chapters are richly theorised, and they follow a systematic approach to generating original evidence.

This does not mean that we could escape questions around hierarchy of evidence. However, we felt that assigning prominence to one method, discipline or research team would be a partisan strategy. We decided to leave it to the readers to draw their own conclusion of how sound the individual researchers' justifications are, and what their value is in the field of digital technologies. Had we favoured one type of evidence over another we would be complicit in an elitism that deems only a certain calibre of research worthy of informing policy and practice.

### ***Multidisciplinarity and one-sided policy***

Technology brings into sharp relief the need for conversations with researchers across communities. The educational research is at an important and exciting juncture in history, where a divided culture in methods and epistemologies (or to use more radical terms, positivist and humanist approaches) fuel partisan arguments and hamper progress in practice. We firmly believe there is a real danger in monodisciplinary approaches that eschew some research approaches as lower status if they do not follow a quantitative or large-scale evaluation. Through the attention to interdisciplinary evidence and diverse ways of approaching children's engagement with digital technologies/media, we hoped to address the uncomfortable reality that policy, and in many cases educational practice, are behind scholarly understanding of children's use of technology.

However, it would be naïve to assume that the individual chapters in the Handbook carry equal weight in their impact on policy and attracting research funding. Despite the richness and diversity represented in this Handbook, the national and international educational policies are remarkably one-sided and uneven. We can significantly bridge the divide if everyone

participates in the conversation, and perhaps even if the Handbook sparks more and nuanced conversations. It is in this awareness that Natalia shares her own reflections on the value of multidisciplinary in making an impact on educational practice.

### Multidisciplinarity and reality

I have been studying children's engagement with personalised books from a developmental psychological perspective in an experimental paradigm (Kucirkova et al., 2014), as well as from a qualitative educational perspective using a multimodal discourse analysis (Kucirkova et al., 2013). I have also co-designed ed apps, and my work has been published in either psychology or education or human-computer interaction journals. The methods and theoretical frameworks that I have been following over the years were aligned with the rules and norms of their disciplinary orientations. This approach has meant that I could produce messages that are valid and recognised in the individual research groups and their publication outlets.

Together with my colleagues, we documented how digital, personalised books support positive parent-child interactions at home and motivate children to read and learn new concepts. Based on the research findings, I took several steps to support teachers' integration of personalised books into pre-K education: I wrote articles for practitioner magazines (e.g., *Exchange*, *The Reading Teacher*, *Teach Primary*, *English 4-11*) as well as blogs in newspapers with significant circulation (e.g., *Newsweek*, *The Huffington Post*, *The Guardian*). I have also regularly presented my work at several large-scale professional organisations, including the annual conference of the International Literacy Association, United Kingdom Literacy Association and British Council.

These efforts were not completely without success, but they were certainly not a game-changer. This is not because teachers did not like the idea of creating or co-creating books with their children. Many found the idea and the research behind it interesting. However, in most cases this was not enough to sustain the practice long-term. In some cases, the teachers could not even imagine how to initiate book-making in their busy classrooms, as they were focused on preparing children for tests and exams. I realised that my approach required a larger structural change, but also that my focus on scalable outcomes assumed a top-down model of science.

I thought that a way of addressing it was to adopt the opposite approach: bottom-up and work with teachers directly to initiate the educational change. This happened organically during my postdoctoral studies, when I was approached by a pre-school (kindergarten) teacher. Amy (pseudonym) read about my work on iPad apps in the local press and was keen to try the Our Story app (a tablet app for making digital books that we developed at the Open University) in her classroom. We exchanged several emails and began a conversation about what might work in her classroom. The teacher introduced me to her colleagues, who worked incredibly hard to support children from low-income families in the English Midlands. They were keen on using Our Story to support the children's language and early literacy skills. I conceived the study as a formative experiment that would elucidate how digital personalised books could be implemented in a pre-school environment and meet established pedagogical goals. The goals were set by the teachers, and as per the typical educational design research, we planned and adjusted the data collection according to what was happening in the classroom.

Unlike carefully controlled approaches that focus on demonstrable outcomes of effectiveness, formative experiments recognise and actively address the complexity of classroom environments. These design-based models of teacher professional development directly focus on knowledge co-creation, teacher-researcher collaboration and teachers' empowerment. The teachers enjoyed using the app, and through their enthusiasm, developed a suite of engaging activities

for the children which they continued long beyond my involvement. There was no doubt that the teachers and children enjoyed making their own personalised books. Their self-evaluation report and children's smiling faces showed a lot of enjoyment in the process of making and sharing stories. However, if we were to measure the impact of this approach on children's learning it would be of a negligible effect size. The teacher-led approach towards the books' design and content was not maximised for the children's academic skills.

How might we interpret the educational 'impact' of these examples? Researchers who follow the medical model of evidence would argue that my approach would need refined models of delivery and higher accountability or incentive measures for teachers who do not follow the implementation protocol. Researchers who follow a humanist approach towards evidence would argue that a top-down approach of disseminating research to the teachers is both misguided and generalised, and that teachers need to be co-creators of the materials they are supposed to teach from. In other words, data should be co-produced together with individual participants and the wider community they are part of. I believe that we need both approaches towards evaluating impact (in addition to more substantial and repeated studies in my specific case) *and* we need to integrate them with the notion of multiple realities that characterises multidisciplinary.

The more I engage in the 'politics of research', the more I learn that one type of evidence (or one type of research approach towards evidence) cannot make a lasting and/or significant impact on practice. Teachers are diverse groups of people and they have their own epistemologies, ontologies and practices that inform what they do. We can accommodate this diversity only if we support multiple narratives that partake in jointly securing equal status and legitimacy to the two-fold nature of teachers' agency: competence and empowerment. Research evidence on what works needs to make sense and be of value to the teachers. They need to be willing to make changes to their practice through intrinsic motivation and contribution. At the same time, teachers need to feel competent in their teaching and have sensible and theorised materials to inform their pedagogies. Researchers from either side of the disciplinary spectrum of educational evidence can contribute invaluable insights into the factors that influence what teachers know, what they need to know and what they would like to know.

As a community of academics and scholars, we have a long but very exciting road ahead of us to achieve this goal. The chapters in this book showcase the possible contributions of individual approaches to foster teachers' competence and empowerment in facilitating young children's learning and play with digital technologies and media. It is our hope that the chapters will stimulate interest in multidisciplinary research collaborations and programs with teachers, parents and other major stakeholders. To help readers navigate the methodological and theoretical diversity available in the Handbook, we next look at the book's structure.

### **The Handbook's structure**

The empirical work of our editorial team reflects the different approaches in the field, and we found it inspiring to closely engage with researchers from different disciplinary orientations. The challenge arose when we attempted to find a common thread in the diverse writings. Our initial organisation of the book, which was focused on topics in early childhood such as influence of learning environments (home or school) or material aspects of specific media, would not do justice to the cross-cutting themes addressed by our authors. Even though the contributors apply different theoretical lenses and methods, they overlap in their focus on early childhood phenomena. All chapters offer usable knowledge on the enduring early childhood topics, albeit with different application possibilities. After some reflection, we decided to structure the Handbook according to three enduring dimensions of empirical research. These three dimensions

distinguish the unique contribution of individual research approaches: their attention to ontology, epistemology and practice of children's use of technology.

### ***Part II: studies answering ontological questions***

The chapters in this section theorise how children take on original identities in *becoming* literate with technologies. The contributors use innovative as well as more established ways to document how children explore, experience and interact with technologies. The studies are significant in advancing the theories of children's technology use and building a profound understanding of the time and space (or geographies and realities) of children's experiences with technology. The researchers ask where and how children use technologies and aim to establish the ways in which children participate and share their way of being with technologies.

### ***Part III: studies answering epistemological questions***

Epistemological chapters focus on how children's knowledge and learning are (co)constructed with a diverse range of technologies. These chapters are rooted in specific disciplines that reflect the researchers' understandings of what it means to learn and to know. The researchers' key contributions lie in elucidating how children develop their own cognitive and emotional understandings of technologies. Our contributors ask how children think through their use of technologies, and which psychological processes and social influences are at play as children construct their knowledge. They aim to study children's engagement in conjunction with, and not separate from, their interests and histories, and they actively engage with their subjectivities during the study design and evaluation.

### ***Part IV: studies answering practice-related questions***

Chapters that fall into this group can be further divided into two sub-categories of pedagogical and conceptual approaches to children's technology. Both sub-groups study the resources and conditions that create the most powerful learning opportunities for children. Pedagogical studies focus on the teaching strategies related to children's technology use in a variety of environments, including formal and informal learning settings. Researchers whose work falls into this category investigate the features and materials of effective pedagogies and the schooling culture shaping their use. The learning-sub-group researchers focus on children's gains in skills and knowledge, and the context and content supporting these gains. The researchers ask how different types and kinds of technologies influence children's learning. They frame their inquiries around children's learning, which can be conceptualised both in terms of academic achievement as well as socio-emotional capabilities. The researchers in this group examine the ways in which children participate in learning situations, and how adults and technologies scaffold this participation. Adults are the mediators, mentors and ambassadors of children's technology use, and researchers in this group aim to provide guidance on the most effective adult mediation models.

Collectively, the chapters in the three sections offer a comprehensive survey of methods and approaches in the field of children's technologies. The three structural lenses of ontology, epistemology and practice are not method-specific; indeed, diverse research methods and traditions are included within the individual groups, comprising mediated discourse analysis, multimodality, community-based research, ethnographic case studies of family literacy, eye-tracking, cognitive and educational neuroscience, design-based research and many others.

As mentioned, we approached this Handbook as an ambitious and radical project. We take account of the fact that it is rare to position language-based methods alongside visual and arts-based methods in one volume. This is the first fully interdisciplinary Handbook on the topic of children's technology use. We do not rule out the possibility that our efforts to showcase and contribute to multidisciplinary have failed. It is possible that some readers, especially readers who have been instructed in monodisciplinary approaches, will find it challenging to contemplate developmental research alongside a posthuman perspective. It is also possible that some researchers will argue that multidisciplinary is happening and there is no need for its substantiation in shared volumes. To these readers we offer the following reflection: at the time of writing this introduction, extreme wealth inequalities keep growing within individual nations as well as across nations. While Western billionaires contemplate the type of car they want to send to Mars, millions of people are in desperate need of humanitarian aid and may face famine and diseases such as cholera. Globalisation, economic distress and mass immigration have fuelled a wave of nationalism in countries across the globe. International ethics are characterised by socio-cultural insecurities, extreme liberalisation and extreme protectionism. Set against this backdrop of profound moral crisis and human suffering, the danger of failing to understand multiple realities could not be greater. Addressing the scale and depth of these challenges requires radical changes to the status quo. To move the needle, researchers need to be actively engaged with multiple perspectives to promote understandings of multidimensionality and complexity. Researchers need to enter into dialogues in shared spaces, including written publications, to create a level playing field for everyone.

This premise states indirectly that researchers need to make informed and educated choices about the methods they use in their enquiries. We asked all contributors to provide a theorised rationale for their methodological choices and include examples of data and interpretation of results. In this way, we envisaged to weave together a coherent perspective on the field and to facilitate collaboration across disciplinary boundaries. Aware of the legacy of failed interventions that had assumed universality and generalisability, we wanted to highlight the potentialities of multidisciplinary work to chart future collaborative projects.

### **Multidisciplinary projects**

If we approach the rich area of children's technology use as a community of multidisciplinary researchers, we need to come to grips with multidisciplinary definitions of evidence. Most researchers would know that the link between policy and research is not linear and stable over time. Many colleagues have also experienced the highs and lows of working with policy-makers, and learnt that by the time a research idea cascades down to actual practice, it might lose its theoretical basis or empirical validity. Even though many academics work in close partnership with policy-makers, their messages are often reduced to an oversimplified framework of 'what works' rather than 'how might it work'. Nevertheless, the rapid and uncoordinated accessibility and availability of digital technologies among young children, the fast-advancing industry of children's digital media and the characteristics of global societies create a perfect storm for simplistic interpretations of what works and what doesn't. We therefore offer a few reflections on the methodological approaches we are particularly inspired by.

For researchers with a quantitative orientation, the current lack of cumulative evidence on specific types of new media could be addressed with a focus on enduring features of technologies (e.g., interactivity or multimedia effects), which are available in older and newer forms of media. Cross-sectional and multi-level analyses are essential to understand the multiple influences on children's technology interactions, and some ground-breaking and innovative work



is currently underway in several research laboratories profiled in this book. The generation of sound conclusions requires that researchers use observation as well as elicitation methods, documentation and interventionist work.

A particularly fruitful method of educational research and technology-related research with young children in particular, is that of co-research, where participants act as co-creators of knowledge. In sharp contrast to technology-driven initiatives, our contributors advocate for increased professional development and authentic conversations with teachers and wider communities involved in mediating children's technology use. Their research is often collaborative with teachers and educators, who can participate in the data collection and data interpretation through action or design-based research approaches. Research needs to be collaborative with the children too, as children can explain and provide insights into their experiences and productions with technologies. Co-research with designers is also possible, and desirable, as it paves the way for a much tighter connection between research and production of digital products for young children. Visual methods, such as video, photography and drawings, are a useful and promising way of capturing and archiving such research collaborations.

In sum, we maintain that it is only through informed understanding of the different methods, theories and policy approaches that we can generate a narrative shift in the field of children's technology use. This is why the book's structure does not make a sharp distinction between traditional research binaries (e.g., qualitative and quantitative approaches or realist and positivist views). Instead, the methods and theoretical perspectives intersect and collapse these boundaries, concordant with our epistemic conviction that it is time to start to couple separate research modes of inquiry into frameworks that contemplate their synergistic potentialities. Without a real understanding of difference within our research circles, we are all poorer: conclusions based on one discipline or one method of evidence can only provide a partial view of reality.

We conclude this introduction with an imaginary case study, which illustrates how multidisciplinary teams could mutually enrich each other's approach to the empirical study of children's use of technologies. We describe the methods and approaches characterised by ontological, epistemological and practice-related research questions that amalgamate multiple methods and perspectives.

### ***Multidisciplinary empirical research***

Let us imagine that we set out to investigate children's understanding of Stephen Hawking's legacy, with a focus on their reading and meaning-making with a specific technology: a book written by Stephen Hawking for children. The children are eight years old; they come from diverse backgrounds and live in the UK, Canada and Australia.

We select the title *George and the Blue Moon*, which was written by Stephen Hawking and his daughter Lucy and was illustrated by Garry Parsons. The book is volume five in a popular 'The George series' for readers aged eight and above. The story plot recounts the story of two best friends, George and Annie, who have been selected for an astronaut programme to prepare children for a manned mission to Mars in 2025. The story is replete with mysterious space missions and scientific concepts that the children and their friends need to grapple with. In terms of format, the book contains black and white photographs of the cosmos taken by real astronauts and is offered in four formats: eBook, audiobook, paperback and hardback.

In a comprehensive inquiry, we would want to ask ontological, epistemological and practice-related questions that elucidate the relationship between children's technology use and their meaning-making, learning and interactions with others. In researching children's contemporary reading experiences, our key ontological questions might be: How would the children perceive

their roles in the space mission? How would they respond to the wider political themes of the book (e.g., the book directly criticises the Mars One project, which aims to send people to Mars by 2025)? How do children become actively aware of their role on planet Earth, in exploring artefacts such as this book? Which insights do material theories offer into children's social, technical and ecological understanding of self?

Our epistemological questions would be framed around children's ways of thinking through the ontological dilemmas. Which scripts and schemas do children use to construct their knowledge of the cosmos, and how does the book support this process? Do the children identify with the characters and their adventures?

In terms of practice, we would ask what impact the book makes on children's learning and development, and which conditions explain the impact? We would study children's engagement with the book in a specific time and place and try to evidence, for example, children's learning of the book's scientific concepts, such as the periodic table or the notion of terraforming. In terms of explaining the impact, we would look closely at the features of the book's content and format, children's age and role of adults (teachers and parents) in different learning situations. Ideally, we would want to consider the two-fold nature of learning where gains in one domain might represent losses in another domain and acknowledge this duality. For instance, we would want to look at children's attention span with specific features and how motivation might change over time and impact long-term gains. When explaining our data, we would want to check how children's learning types, ability levels, prior knowledge and age might inform future work.

We could examine these questions in a controlled experimental design, but we could also examine the relationships qualitatively and discuss, for example, how different background factors influence children's learning (e.g., children's interest in science and possible previous exposure to scientific topics, including the previous books in the George series).

In answering all three types of questions we would want to get as much insight as possible into children's actual engagement with the book. We would not be able to run multidisciplinary approaches simultaneously, but we could conduct different studies in different phases, gradually feeding into each other. The key in quantitative approaches will be to ensure that we go beyond simple counting and use rigorous and theorised quantitative approaches. The key to qualitative observations will be that they are participatory and allow us to think about children in ways that extend our theories and expand conventional practices.

For example, we could explore the design of the reading space and children's engagement with the individual pages through eye-tracking. We could conduct repeated and longitudinal interviews with the children to get an insight into their own perceptions of the reading experience. When studying children's reading of the digital version of the book, we would want to capture children's interactions with a screen capture as well as their interactions around the screen, with multiple cameras that are both wearable and static in the room. In crafting our own methodological and theoretical contribution to this area, we would want to build on existing research and capture both children's subjectivities and relationality to others around them. Such an approach would generate detailed and thick descriptions of children's experiences, and illustrate not only the individual facets, but also the connections among them.

The chapters in this Handbook offer methods, tools and resources to answer some of the questions we would be asking in our imaginary case study. The variety of topics, methods and theories adopted by our contributors represent a comprehensive breadth of intellectual capital represented in current scholarship. Today's researchers need to be fully aware of the unique role their specific approach plays in the diverse landscape, and tightly link their chosen method and perspective to the purpose of their research. To generate sharable theories and applicable recommendations for practice, researchers need to use sensitive, relevant, up-to-date and innovative

research methods in all fields, but particularly so with new phenomena such as children's use of technologies.

Through a joint editorship of one volume, the editors engaged in conversations and contemplations we would not be able to have in our individual disciplines. We offer the following chapters to our readers in the spirit of dialogue and self-reflection and encourage them to ponder the value of multiplicity and the underlying power of different methodologies.

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## Chapter summaries

The second chapter of the volume, co-authored by Pam Whitty and Jennifer Rowsell, is a reflective conversation by scholars in the fields of early childhood education and literacy studies. The authors engage in a reflective dialogue about the genesis of their projects, and the varied ways that projects have influenced their understandings of materiality, literacy and children's digital and non-digital lives. Reflections on vignettes and theories are interwoven with a future-gazing look at ways of framing children's literacies in deeper theoretical origins and non-deficit discourses in practice. In the chapter, there is a strong focus on methods that they have adopted for digital research alongside non-digital research across age groups. The authors' conversation culminates in a reflection on the ways in which the field of education studies can draw inspiration from contemporary philosophical discourses that aim to push the boundaries of and blur the dividing lines between the traditional domains of epistemology, ontology and ethics.

In Chapter 3, Garry Falloon summarises seven years of his work with 5- to 11-year-olds in seven separate studies that used mixed methods to investigate how selected iPad apps influenced student learning in mathematics, literacy, language development, science and computational processing/coding. Garry used a bespoke iPad embedded data system to record students' interactions with the apps and the StudioCode video analysis software to organise and analyse the data. This approach enabled him to make recommendations to teachers regarding app selection, device management and student groupings in the classroom.

In Chapter 4, Debra Harwood and Diane Collier provide insights into a two-year study of a pre-school forest school program in Canada. The chapter outlines how the researchers conceptualised their research methods, which acknowledge and richly theorise researchers' subjectivities and latest technologies. The participating children used GoPro cameras to document their experiences in the forest and Harwood and Collier analysed the 'child-matter', the socio-material and discursive encounters that ensued.

In Chapter 5, Rahat Zaidi explores the connection between 'transculturalism' and literacy with specific emphasis on diversifying approaches to reading within the context of early childhood programs in mainstream, ethnically diverse classrooms. The chapter builds a case for a dialogic reading approach using dual language books (DLBs) that correlates well with the demographic shifts occurring within early childhood programs today. The research outlines a method of literacy intervention building on the dialogic approach, incorporating technology and juxtaposing two languages. The author concludes by suggesting that the incorporation of DLBs is integral to the development of research methodologies that remain attentive to cultural

difference and language as a malleable object that can be productively manipulated by young learners over the course of their educational development.

In Chapter 6, Anne Haas Dyson focuses on the whys and hows of turning the usual research approach to ethnography upside-down. Rather than viewing children through the official lens of school, Dyson opts to view school, and the rich and diverse experiences therein, through the unofficial lens of children. The author seeks to problematise the adult-centric notion of ethnography, instead striving toward an ethnographic methodology that privileges children's perspectives. Importantly, the insights gained from this chapter cannot be universalised and applied to some broader population, but rather simply give us concrete material to think with, engendering new insights into the way children negotiate social life. The chapter offers productive interpretive frames with which to conceptualise abstractions such as the notion of belonging.

Kerryn Dixon and Hilary Janks in Chapter 7 present outcomes from a two-year ethnographic study of Leah, a 6-year-old South African girl, and her generation of texts combining both print and digital literacies in the creation of original learning artefacts. Using a unique methodology involving the researchers collecting multimodal data during collaborative play episodes, the authors weave a detailed account of the influence of the digital on Leah's development of transmedia texts, suggesting that while time-consuming, such methods are necessary to provide data sufficiently detailed to unpack these complex interactions.

In Chapter 8, Sumin Zhao reflects on how social media apps affect children 'on the move'. She uses a case study of a Chinese immigrant family to outline a young boy's heritage language and literacy learning with his dispersed family members. Analysis of the multimedia messages sent via the WeChat app shows the interconnected nature of multimedia practices by multiple family members. Through a critical evaluation, the author invites reflection on cross-cultural sensitivities involved in video-based research.

Candace R. Kuby, in Chapter 9, takes a post-qualitative inquiry stance, drawing on the work of St. Pierre and others in her beautifully articulated discussion of the need for multimodal and digital literacy research to reject Cartesian perspectives of separation of mind, body and environment, in favour of methods that view research-able interactions as *assemblages* or *entanglements*, as a way to better understand and analyse the complexity of the "relationships of humans, non-humans, and more-than-humans in how the world comes into being" (p. 133). She challenges readers to question prevailing ontological and epistemological views of how we 'come to know', calling for a reconceptualisation that views knowledge as created through a relational ontology that dismantles traditional hierarchical structures, moving us towards ethico-onto-epistemological approaches that acknowledge the complexity of relationships between subjects and objects in the generation of meaning.

In Chapter 10 by Cathy Burnett and Guy Merchant, the authors further explore children's play on- and off-screen in classrooms. The authors wrestle with the inadequate methods available to posthumanist researchers interested in capturing the fleeting and intertwined social, material and embodied aspects of children's play in the digital era. The chapter moves on to consider the method of 'stacking stories' as a viable alternative to consider the socio-material-embodied entanglements in children's play with tablets.

Jackie Marsh is the author of Chapter 11. Marsh draws on a larger research project concerned with children's play, with a focus on participatory research methods to capture the richness of children's use of tablet apps. Children's interaction with the apps was documented with wearable and 'point-of-view' cameras. In addition to observations and interviews, children's own perspectives and experiences informed the researchers' understanding of post-digital play. Children's interactions with apps are considered in terms of 'analogue and digital assemblages of play', which theoretically enrich and expand posthumanist analyses.

In Chapter 12, using examples of early childhood play from independent research studies, Karen E. Wohlwend and Jaye Johnson Thiel take a closer look to ask: What did they miss? In initial multimodal analysis of these events, how did an implicit human-centred insistence on semiotic affordances and strategic design tame the mobile jumble of children's play and making? In this chapter, the authors apply a materialist theoretical lens to early childhood play to traverse the interconnected terrains of multimodality, materiality and technology. They blur the line separating the material from the digital by demonstrating that there are multiple salient points of connection between crafting toys out of paper and scribbles on an iPad. In the authors' view, both activities constitute a form of technology learning – an insight that aligns nicely with their materialist view of learning as an agentic act of becoming.

In Chapter 13, Linda Laidlaw, Joanne O'Mara and Suzanna So-Har Wong address events and research experiences that have taken them into a deeper appreciation of the value of auto-biographical, participatory and ethnographic methods for researching digital experiences of young children's learning and playing at home, in their communities and beyond. The authors start with the home and also extend to the ways in which their research has travelled across and into the communities they inhabit and include considerations of the varied ways that children's experiences may be shaped further, by policies that impact school and home and by the media. The authors have found common ground among their diverse backgrounds; their methodological approach draws from a range of methods and approaches including autobiographies, a range of ethnographies and the occasional incorporation of feminist perspectives.

In Chapter 14, Joanne Orlando challenges frequently articulated views on the negative effects of technology on young children's learning and creativity by arguing the need to more fully understand how technology can open new and different opportunities for learning, and how this can be best supported by adults and others involved in facilitating children's interactions with digital devices. She explores the methods she used in her recent study on children's use of technology in the home, arguing that they provided a safe and non-judgemental framework yielding high-quality data revealing participants' true perspectives on technology use with and by their children.

Donell Holloway, Leslie Haddon, Lelia Green and Kylie J. Stevenson's Chapter 15 takes a posthumanist view exploring very young children's interaction with literacy apps on touch-screen devices within the context of the family environment. Drawing on data from an Australian Research Council Discovery Project, the authors provide a rich case study account analysing the nature of the interactions between a parent, their toddler and an iPad literacy app. This chapter reveals interesting insights into how the *instructional assemblage* created during such interactions provides unique opportunities for scaffolded learning.

Through the combined strength of two ethnographic research studies, Rachel Heydon and Xiaoxiao Du (Chapter 16) provide rich descriptions of intergenerational literacy practices in multilingual learning contexts. The chapter offers readers a window into careful ethnographic observations of families enacting literacy as a part of their everyday lives and specifically how culture and linguistic systems circulate within these familial moments. A unique feature of Heydon and Du's chapter are the ways in which they integrate an analysis of linguistic systems, multimodal meaning-making, and the various materialities that play a role in family routines and understandings about communication. Technologies play a role in this sea of activities in a natural and tacit way offering readers a more grounded sense about how imbricated digital worlds are in terms of literacy specifically and everyday habits more broadly.

Chapter 17 by Anne Mangan, Trude Hoel and Thomas Moser describes ways in which researchers might investigate young children's experiences when reading books using touch-screen devices – specifically introducing methods useful for studies investigating the multisensory,

embodied and interactional experiences of these children when engaged in shared reading with adults. The authors suggest adopting a *full embodiment* approach to such research to support the development of in-depth and interdisciplinary understandings of what comprises quality and effective early reading processes using digital devices.

Chapter 18 by Aspa Baroutsis and Annette Woods considers literacies and learning within current times and frames of thinking, and they then present data from one study of how children learn to write and produce texts in their early school years. The authors apply a design-based experimental methodology, which supports an underlying social justice imperative of their work, namely, the achievement of quality literacy pedagogy for poor children. The empirical research outlined in the chapter stands as an example of design-based research in which the researchers used a technological intervention in an attempt to improve the writing of 6- to 7-year-old children in one classroom setting.

In Chapter 19, Melissa L. Allen and Shu Yau argue for the need for reconceptualising how children with Autism Spectrum Disorder (ASD) are assessed and evaluated, highlighting the importance of moving beyond traditional approaches based on the use of standardised instruments. They suggest that the use of these instruments fails to recognise the heterogenous nature of children with ASD, contending that more individualised approaches to diagnosis or a wider range of analytical measures is required. Their chapter explores options combining passive neuropsychological and neuroscientific methods that run alongside more conventional approaches to provide data that will support the development of more individualised profiles that better meet children's specific needs.

In Chapter 20, Jim Anderson, Ann Anderson, Ji Eun Kim and Marianne McTavish make the case for the need to use mixed methods in educational research to accommodate complex research questions, serve multiple purposes of research recipients who live in diverse communities and contribute to knowledge in diverse contexts. The eclecticism and pragmatism theoretical frameworks are used to explain how mixed methods correspond not only to specific research questions but also to the decision, audience, ethics and impact. The authors draw on their own work in Canadian multilingual communities to showcase the use and value of observations, interviews, focus groups, artefacts and standardised tests.

In Chapter 21, Narelle Lemon outlines a unique and progressive research methodology for use in early childhood educational contexts in the hopes of recasting students as active participants rather than passive subjects, before tracing the genesis of children's visual narratives in the context of a specific classroom-based study. Lemon explicitly seeks to challenge traditional classroom power dynamics by encouraging the development of reflective skills and ensuring a more egalitarian approach to early childhood education in which all the voices of the classroom are heard. The methodology that the author presents, and for which she advocates, engenders research practices that validate students' own perspectives and amplify their voices within and beyond the classroom. Additionally, her uniquely equitable and collaborative method of generating visual narratives opens up avenues for mutually beneficial dialogic engagements between students, educators and researchers, allowing children to take active roles in shaping their learning experiences.

In Chapter 22, Linda Knight explores the use of Arts-based methods for researching how young children use and learn from digital media. She suggests Arts-based approaches enable researchers to gather more detailed data in multidimensional research projects involving the use of digital technologies, through its accommodation of multiple forms and interpretations of data. Linda presents her argument by clearly differentiating between arts-focused and arts-based research through reference to two fictional project examples. Her chapter concludes by offering a series of useful recommendations for researchers considering using Arts-based methods.

In Chapter 23, Fiona Jelley, Kathy Sylva and Valeria Ortiz Villalobos revisit the role of technologies in supporting parents in supporting their children's learning and reading. The authors provide a useful overview of the importance of effective home learning environments and the pedagogical resources and methods that have been traditionally used to train parents. Examples of two recently developed apps illustrate the ways in which guides and videos can reach parents and provide targeted support.

In Chapter 24, Lena Lee draws on Bourdieuan and Critical Race Theory in an analysis of her study involving Latino pre-schoolers that infused technology in a science curriculum aimed to motivate and improve the children's learning and engagement through exposure to 'real-life', technology-supported science experiences. The chapter introduces and describes her study, which is followed by an analysis of how her investigation challenged traditional views of the effects of a socio-economically aligned digital divide on the technology-supported learning opportunities of racial minority students. She argues that the rich experiences of the children in this study were not only beneficial educationally, but also were illustrative of how learning designs of this nature can support equity and social justice goals.

In another co-authored chapter, Chapter 25, Rebecca A. Dore, Jennifer M. Zosh, Brenna Hassinger-Das, Roberta Michnick Golinkoff and Kathy Hirsh-Pasek bring together research concerned with e-books that is electronic/digital books available for computers, consoles and tablets. The researchers extract five key lessons from a decade of research on e-books: (1) It is vital for research to keep up with rapidly changing technology; (2) balancing the wide variety of e-book features and creating generalisable findings is a challenge; (3) context and previous experience matter; (4) there is a need for innovative methods for quantifying language, behavioural/emotional engagement, and caregiver-child interaction and (5) using multiple measures helps capture multiple facets of learning. These lessons neatly capture the key opportunities and challenges for existing and future research and design of e-books.

Similarly to Harwood and Collier, Lucy Caton and Abigail Hackett explore the methodological extensions that can be achieved when children's own perspectives can be conveyed with GoPro cameras. Chapter 26 approaches video-based research in terms of 'visual ontologies' and discusses the choices that permeate and become visible when children, camera and space interact. The authors illustrate how Deleuze and Guattari's concepts apply to the contemporary practice of video-based research and how the notions of embodiment and form can be constructed to challenge reductionist interpretations of children's experience of space.

In Chapter 27, Peggy Albers, Vivian Maria Vasquez and Jerome C. Harste demonstrate how they have used critical literacy and visual discourse analysis for 15-plus years to study images in print-based and in digital spaces, a methodology they call critical visual discourse analysis (CVDA), with particular attention given to early childhood and teacher education work with images. The authors' research investigates how images work and how they are constructed, interpreted, internalised and reproduced. They also attempt to understand the extent to which visual information contributes to identities that viewers/readers may or may not wish to take on. The authors argue that this work brings to the fore the significance of creating opportunities for teachers and children to be critically and consciously literate in the digital era of the 21st century.

In the concluding chapter (Chapter 28), Sibylla Leon Guerrero, Ola Ozernov-Palchik, Michelle Gonzalez, Jennifer Zuk and Nadine Gaab provide an insight into how cognitive neuroscience can leverage mobile apps to screen children for dyslexia. The app is currently in development and includes activities that tap into seven pre-reading predictors of children's reading outcomes: phonological awareness, phonological memory, rapid automatized naming, letter-sound knowledge, vocabulary, oral language comprehension and family history of reading difficulty (dyslexia). The team describes the app development process, including its significant

clinical and educational implications for identifying children at risk for reading difficulties. The chapter includes a comprehensive summary of existing literacy screening instruments and will be of interest to researchers who have developed or plan to advance empirically-based mobile applications.

We encourage the readers to read the chapters carefully and critically, in relation to their own epistemologies, ontologies and practice. We believe the value of multiple methods and perspectives lies not only in the individual studies making up the mosaic but also the connections between the individual research pieces. This Handbook can be thus viewed as our attempt to assemble some core pieces for a mosaic that we all need to complete.