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Challenging the knowledge-transfer orthodoxy: Knowledge co-construction in technology-enhanced learning for children with autism

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Experimental intervention studies constitute the current dominant research designs in the autism education field. Such designs are based on a 'knowledge-transfer' model of evidence-based practice in which research is conducted by researchers, and is then 'transferred' to practitioners to enable them to implement evidence-based interventions. While these research designs contribute important knowledge, they lead to a gap between what the research evidence may prescribe and what happens in practice, with a concomitant disparity between the priorities of researchers and practitioners. This paper discusses findings from the ESRC-funded 'SHAPE' project, which adopted a different model of evidence-based practice, focusing on knowledge co-construction. Pupils (N = 8), teachers (N = 10), a speech and language therapist and a parent in three different school communities investigated creative ways in which children's social communication skills could be enhanced through technology use. Through a participatory methodology, digital stories were used as a method to enable engagement with the practical realities of the classroom and empower practitioners to construct and share their own authentic narratives. Participants articulated precise knowledge about the learning opportunities afforded to them and their pupils through quality interactions that were mediated by the technologies, as evidenced through digital stories. The SHAPE project shows that it is feasible to develop methodologies that enable genuine knowledge co-construction with school practitioners, parents and pupils. Such co-construction could offer realistic opportunities for pedagogical emancipation and innovation in evidence-based practice as an alternative to the currently dominant and narrow model of knowledge transfer.

Keywords: technology-enhanced learning; participatory research; autism intervention; knowledge co-construction; knowledge exchange; knowledge elicitation; knowledge transfer

Introduction

Children on the autism spectrum represent the fastest growing group of children with special educational needs (SEN) in the UK (Parsons *et al.*, 2011b) and internationally (Cimera & Cowan, 2009). Presently, there are approximately 700,000 people with autism living in the UK, with an overall prevalence of around 1% (Baird *et al.*,

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2006). For education, these numbers create significant challenges: children with autism are the largest group of children in England with higher levels of support needs, as indicated by a statement of SEN or Education, Health and Care plan (Department for Education, 2015). Approximately 72% of these children attend mainstream schools (Department for Education, 2015) and yet many teachers feel they lack sufficient skills, knowledge and training to meet the needs of these children effectively (Jones *et al.*, 2008; Guldberg *et al.*, 2011). Technology-enhanced learning (TEL) has been proposed as one of the ways in which educational provision could be developed, improved and applied in more effective ways (e.g. Wass & Porayska-Pomsta, 2014). Consequently, understanding the evidence base as well as determining feasible mechanisms for TEL in autism practice in everyday educational contexts is a high priority and a mainstream educational issue.

However, in line with broader autism educational intervention research, the TEL field clearly prioritises a narrow range of methodologies for generating evidence of best practice (Fletcher-Watson, 2014). For example, the US National Research Council (NRC; 2001) stipulated that only randomised, quasi-experimental or single-subject designs can be considered to represent sufficiently robust foundations for demonstrating evidence-based practices (EBP). Crucially, with respect to their impacting the field of practice, these research designs are based on a 'knowledge-transfer' model, whereby the assumption is that research is conducted by academic or clinical researchers, which then needs to be 'transferred' or 'translated' to practitioners to enable them to implement evidence-based interventions. The US-based National Professional Development Center's focus on creating practitioner-friendly summaries that foreground the translation of scientific results into intervention practices, and creating manuals for EBPs (Wong *et al.*, 2014), are good examples of knowledge-transfer models.

Despite these translational aspirations, there remains a substantial gap between research and practice in autism education (Dingfelder & Mandell, 2011; Parsons *et al.*, 2013). This is problematic because there is a growing need for practical real-world solutions for education and life skills (Pellicano *et al.*, 2014), motivated by the fact that long-term educational, social and work-related outcomes for individuals with autism remain poor (e.g. Magiati *et al.*, 2012). This disparity between research and practice is further highlighted by the growing recognition that teachers tend to be less concerned about EBP per se and more interested in the fit of the given solutions with the needs of individual children (Stahmer *et al.*, 2011). Thus, the difference between researchers' and teachers' priorities can be characterised as a disparity between what the research evidence may prescribe and what happens, or can feasibly happen, in practice (Reichow *et al.*, 2008).

Although the experimental research designs that dominate the field perform an important confirmatory role, they often address fundamental, but nevertheless narrow, research questions that lack the flexibility to reflect the pragmatics of learning–teaching interactions and their complexity. Such experimental designs often deliberately strip away the contexts of unpredictable elements to remove any potential biases. This undermines the ability to capture and understand what happens naturally in practice, or to arrive at practical real-world solutions (Guldberg *et al.*, 2013). By contrast, participatory research methodologies (e.g. Leibowitz *et al.*, 2014), including

those incorporating multimedia tools (e.g. Hewitt *et al.*, 2003; Lin *et al.*, 2005), aim to draw on the situated knowledge of practitioners and on their adaptive responses to the nuances of the individual situational contexts. This aim is crucial, because such approaches foreground the fundamental importance of practitioner knowledge, gained through first-hand experience (Hammersley, 2005; Nind, 2006) rather than the observations and reports of clinical researchers. Furthermore, such approaches highlight that without the knowledge, understanding and experience of practitioners, research is unlikely to be fully meaningful, or have any real impact on practice (Nastasi *et al.*, 2000).

Ultimately, what is needed is the recognition that evidence of pertinence to education occurs in diverse forms and thus, that it can be gathered through diverse means. This can be via objective measures obtained from controlled trials, as well as through subjective perspectives, grounded in professional understanding, experiences and interpretations of teachers. The question here is not whether these different forms of evidence are compatible, but rather how they can be mindful of each other and combined to offer a more balanced insight into best educational practices. Thus, calls for a need for educational sciences to be rooted at the practical level (Thomas, 2012) should not be read as speaking against the controlled experimental approaches (as both contribute to knowledge in important, but different, ways), but rather as recognising the need to broaden the concept of EBP beyond the knowledge-transfer model.

The SHAPE project's methodology

This paper presents the findings from the Economic and Social Research Council (ESRC)-funded project entitled 'Shaping the Future of Technology Use in the Classroom' (hereafter referred to as the 'SHAPE' project) that illustrates an innovative approach to utilising digital technologies to achieve the broader approach to developing the EBP that we advocate above. Specifically, we sought to enable practitioners to become co-constructors of knowledge through joint generation of ideas by investigating, analysing and reflecting on knowledge and practices through collaborative conversation and action. Whilst participatory approaches often converge on an action research paradigm, the key distinction between the two is that participatory research emphasises collaborative research, whilst action research has an additional emphasis on action and change (Bergold & Thomas, 2012). In participatory research, new understandings are intended as an outcome of a mutual refinement of perspectives through a dialogic exchange between participants. In SHAPE, the emphasis of the project was on collective enquiry, with the key aim being to ensure that practitioners' experiences, knowledge and ability could play the main role in the research process that was initiated and supported, but not dictated, by the researchers. Whilst this process also contributed towards improved outcomes for learners and new insights and perspectives for teachers, SHAPE's emphasis was on eliciting reflection rather than on effectuating action and change. To achieve this involved actively investigating how to specify, implement and create EBPs for pupils with autism through the use of digital stories as a tool for capturing the craft and tacit knowledge of practitioners (Thomas & Pring, 2004).

The SHAPE project investigated ways in which different technologies could become embedded in existing classroom practice by drawing upon four prior, and quite different, multidisciplinary TEL projects for autistic pupils—COSPATIAL (Parsons *et al.*, 2011a; Parsons & Cobb, 2014; Parsons, 2015); ECHOES (Porayska-Pomsta *et al.*, 2012); ReacTickles Magic (Keay-Bright, 2013); and Somantics (Keay-Bright, 2013)—and utilised the software developed during those projects as its basis for exploring innovative practices. Autistic pupils have differences in how they develop communication and language, and these are important developmental areas to focus on (Guldberg *et al.*, 2011; Parsons *et al.*, 2011), so the above technologies were selected because they all supported the development of children's social communication skills and language.

The method used was digital stories, a method originating in the arts field (Lambert, 2013), in which stories are told using still or photographic imagery combined with the narrative voice of the storyteller. The storyteller is usually narrating an event or experience through their own 'powerful voice'. In the case of SHAPE, school staff took on the role of the storyteller, drawing on personal experience to illustrate the relevance of technology for each unique user. The assimilation of visual material, plus narrative insight, also functioned to leverage the affordance of digital technology to capture a permanent record of the events about which the stories were told. The reason for choosing digital stories as a method was to give the school staff the opportunity to reflect upon their own experiences and give voice to them, leading to a tangible artefact that can be viewed by others, hence also creating the opportunity for meaning-making by sharing diverse perspectives and experiences (Black-Hawkins & Amrhein, 2014). The digital story creation thus deliberately aimed to bring professional knowledge and the situated experiences of teachers to the fore, to give agency to the schools and the teachers and to draw on the practical and often tacit knowledge of practitioners. More details about the methodology of digital stories in the SHAPE project can be found in Parsons (2015).

In this participatory research context, we were interested in working with schools and teachers in a democratic way, through emphasising the importance of interdisciplinary and interprofessional co-construction and sharing of knowledge between the research community (i.e. us) and stakeholders (i.e. teachers, but also by extension—children and parents). In other words, we made it clear to the participating schools that it was *their* stories that were encouraged (and knowledge and practices *they* wanted to show), rather than stories that were led or dominated by our perspectives as researchers (i.e. knowledge we wanted or might have expected to see). The intention was for the stories to be very much 'owned' by the schools, to enable contextualisation of both the gathering and interpretation of evidence through recording activities, comments, actions and reactions that were deemed interesting, valuable and noteworthy by the participants. Co-construction in this context therefore meant that teachers decided on the content of the stories, rather than the researchers. Although a researcher assembled the footage in one of the schools, in all other cases the school practitioners contributed the stories and directed what was told by providing the footage, reviewing the rough cut produced by the researchers and then informing the final editing, thus co-constructing. The intended outcome of the project was to provide both school staff and researchers with an environment in which

knowledge could be shared in an *actively generative* manner through the creation of digital stories, as opposed to a *reactive* one in which the researchers prescribe the activities that should take place and the teachers respond accordingly. Our focus was on how teachers embedded emerging TEL tools within classroom contexts and curricula over a period of four months and *independently* of the researchers.

The methodology was implemented by first conducting a series of workshops in the respective schools. These workshops focused on giving information to the teachers about narrative concepts and the technical issues related to the creation of the digital stories. The workshops were interactive, and involved all the participating school staff in moving towards a shared vision, joint expectations and clear parameters. This included discussion about which technologies school staff would use, and which children could benefit most from involvement. The school staff then decided on the learning outcomes they wished to focus on with different children (see Table 1 for an outline of the learning outcomes considered for the autistic pupils in the three schools discussed in this paper).

After the initial workshops, the researchers worked with the schools, assessing their needs accordingly and visiting the schools at least three times in the four-month period in which staff were working with the technologies and creating the digital stories. In this period, the research team supported the teachers to: embed their chosen technologies in the school setting; help them with technological challenges; support them with the digital cameras and technologies they needed to make digital stories; and empower school staff to define the stories they wished to tell through the digital story creation. Researchers were available to support schools both with the story creation and with the technical aspects of creating the stories. In some cases, researchers were needed to help with editing, and in other cases, schools were happy to undertake this themselves.

We followed the BERA-RSA (2014) ethical guidelines and the robust ethical procedures in place at the lead institution. All those involved were fully informed of the purpose and uses of the project. Where possible, children were supported through an assent process prior to and during any involvement. Parents, teachers and children all viewed the video footage—and the resulting digital stories—prior to their use on the portal and could withdraw up until the penultimate version of the digital stories. Our commitment throughout the research was to developing relationships based on mutual respect, encouraging inclusion of participant voices and acting with integrity, honesty and transparency.

Twenty-nine digital stories were created across six schools, 21 of which received permission to upload to the project website. In order to do justice to the detail of the findings, this paper focuses on the findings from three of the six schools, representing a cross-section of autism-specific, generic special and mainstream provision (Radlett Lodge, Trinity Fields School and Minworth Primary School, respectively). The digital stories were edited video clips ranging from 0.58 to 6.22 minutes long showing teachers and children engaging with, talking about and reflecting on their experiences with the technologies used in the project. These videos also became resources that disseminated 'good practice' to other schools in an accessible and situated way, via the project website. Space precludes description of all 21 stories, but they are available via open access at bit.ly/2cdmImn.

This paper draws on analysis of 12 digital stories created in three of the schools (see Tables 2, 3 and 4 later, which give an outline of each story), coupled with the field notes from our work with the schools, and notes from our workshops and reflective team meetings in which we discussed how the knowledge co-construction process emerged differently in the different schools. As outlined above, our participatory methodology placed emphasis on working with practitioners in a democratic way, enabling practitioners to take control of gathering and creating their own evidence. Although the method of digital stories was one that was chosen to authentically represent the voice of the practitioners, the focus of the paper is not on the digital stories as a method per se, but on the *knowledge co-creation process* itself. Three themes of 'context for engagement', 'empowerment and ownership' and 'voices and perspectives' emerged through undertaking a meta-analysis of the digital stories in conjunction with examining data from field notes and commentary written by team members on the process of creating the digital stories in the school, and discussion. These themes focused on three main aspects of the knowledge co-creation process.

(i) *Context for engagement.* Local features and relationships that may have contributed to the relative success of the digital story generation in different schools.
(ii) *Empowerment and ownership.* The extent to which the digital story knowledge-creation process enabled schools to tell their own stories.
(iii) *Voices and perspectives.* An examination of whose stories and views are represented through the stories.

The analysis also captures the learning of staff and pupils, as reported by the digital stories. Table 1 provides overview information about the participants, the learning objectives for the different pupils and a short summary of the *context for engagement*, *empowerment and ownership* and *voices and perspectives* in those respective schools.

Radlett Lodge

Context for engagement

Radlett Lodge is a National Autistic Society school located in Hertfordshire that accepts children between the ages of 4 and 19 years old who have a diagnosis of autism. The research team and the school staff had good support from the Head Teacher and Senior Management Team, who released resources and facilitated changes to the timetable, so the staff were free to undertake this work. Rachael Lee, the school's Speech and Language Therapist (SALT), was our main point of contact. Rachael was an experienced SALT, with seven years of experience of working closely with autistic pupils. She had undertaken study for an autism-specific qualification, so she had in-depth knowledge of autism and a specialism in social communication.

Empowerment and ownership

Prior to engaging with the technology, Rachael identified that she needed to work on communication skills with three particular autistic boys and that the COSPATIAL and ECHOES technologies aligned with that aim. Subsequently, Rachael quickly took

Table 1. Summary of 'context of engagement', 'empowerment and ownership' and 'voices and perspectives'

	Radlett Lodge	Trinity Fields	Minworth
Participants	SALT, five teachers, LSA and three pupils	Four pupils and three teachers	One autistic pupil and a peer, the mother of the pupil, two teachers and the school technician
Learning and development	Conversation skills, collaboration, motor skills and turn-taking	Choice, engagement and movement, development of attention and motivation	Enabling peer relationships, home–school liaison, making technology accessible
Context for engagement	*Specialist autism school*	*Special school*	*Mainstream infant and junior school*
Empowerment and ownership	*Shared and reciprocal* The SALT and other school staff identified priorities and focused on the development of conversation skills and joint attention	*Independence* Teachers undertook a meta-review of their work through conversations about video clips, with a focus on engagement, attention, motivation and observation of qualitative changes in the pupils	*Researcher control* The knowledge construction remained under the control of the researcher who focused on identifying how the technologies could enable inclusion and support home–school liaison for a particular pupil
Voices and perspectives	Pupil voices and staff perceptions were foregrounded. Stories present engagement with technology as an artefact that can be tailored to the immediate needs of the pupils	The stories were unscripted conversations between teachers, drawing attention to emergent interaction and contextualising pupils' experiences	The researcher's analysis of how the school could use technology to enable inclusion is highlighted though the stories of one particular child and her use of the technology

control of the process and took the initiative for the activities that provided content for the stories. She was very much the lead practitioner in facilitating and timetabling sessions for the children, and staff, using the technologies, and in filming those sessions, as well as eliciting related reflections from staff and pupils. She also participated in this herself, providing her own point of view on camera in relation to the strengths of the technologies, as well as how they could be improved (see Table 2 for a summary of the digital stories from Radlett Lodge, including the learning outcomes for the pupils as well as the evidence provided by practitioners about their own learning).

At Radlett Lodge, the digital story-creation process involved a shared and reciprocal relationship with the research team. School staff were very clear about when they needed scaffolding from the researchers and when they were ready to move forward with, or even bypass, the technical challenges of using the technologies with the pupils, and to address the challenges of creating digital stories about their work. Significantly, Rachael participated in co-authoring a paper on the development of digital stories as a method for enabling knowledge co-production (Parsons, 2015), which is

Table 2. Summary of the digital stories at Radlett Lodge specialist school for children with autism

Story title	People	Voices and perspectives	Themes
Collaboration by stealth	Rachael (SALT) involved three young teenagers with autism, who are verbal. They feature in the clip, as well as the LSA and the teacher	A set of commentaries from the teacher, LSA and SALT. Teachers' comments are interwoven with clips of the boys working with the software to illustrate the points the staff make about what they learnt	The focus is on how the software enabled staff to teach the pupils to maintain and exit conversations
Outside the box	Rachael involved three young men with autism who feature prominently in the clip. The clip shows them working with the technology. There are commentaries from the teacher and LSA	The focus is on the staff and what they learnt in relation to *assessing* the children	Rachael talks to camera about what she learnt from the process and she highlights how she was able to identify the boys' difficulty in switching topics in conversations. The LSA talks about what she learnt regarding how children enhanced their ability to collaborate with others
Working party	Rachael and three boys, running a working party to see what they think about the technology. The boys watch some of the video clips of their work with the technology and they give feedback of their opinions	Rachael engages the pupils in reflection and feedback on the process of working with the technologies	Key messages relate to the problems with generalisation from technology to the classroom; the lure of the virtual world and the power of the technology
Playing with ECHOES	Five members of staff give feedback about the sessions they ran with the ECHOES software, interspersed with clips of the children engaging with the software	Voice of the teachers with clips of the pupils working with the software	Staff talk about how they used the technology with children who were non-verbal and who at first were not interested

also why she is named explicitly here. The researchers mainly scaffolded and supported the staff to express their stories, and advised and supported them with respect to the use of the individual technologies.

Voices and perspectives

The digital stories (see Table 2) focused on what the pupils and teachers learnt from the process. There are clear narratives foregrounding teachers' voices about how the

technology supported the staff in their teaching. For example, in the 'Outside the box' clip, Rachael talks about how the software enabled her to teach certain conversation skills in a way she would not have been able to do before. Other staff talked about how the software motivated the pupils, and how it revealed new things about how pupils collaborated with one another.

The 'Playing with ECHOES' clip captured work being undertaken with non-verbal pupils. Here the focus was on capturing teachers' perceptions of using the technology, and on the enjoyment and motivation of the pupils to interact with the software as well as with the teachers present. 'Playing with ECHOES' presents teachers' focus group discussion about the affordances of the technology. This discussion is interweaved with concrete examples illustrating exactly how the teachers used the technology with the individual pupils. Given that not all teachers were present in all of the TEL sessions with children, the use of video allowed all teachers to share their approaches with one another, and facilitated situated recall for those teachers who recounted their use of the technologies and the children's reactions to them.

Overall, the Radlett Lodge clips tell stories of exploration and learning, as well as of engagement with technology as an artefact that can be tailored to the immediate needs of the pupils. The specific needs of the autistic pupils are foregrounded, with a focus on how the technology supported the development of the conversation skills of the autistic pupils, their engagement in learning and their ability to collaborate with one another. From the stories, clear evidence emerged about how the technologies impacted teachers' knowledge and their understanding of the balance between the affordances of the technologies used and their own role as facilitators of best uses of those technologies, given their intimate knowledge of the individual pupils' specific learning needs. The teachers shared their situated interpretations of children's successes and needs, and made overt their decision-making processes and strategies for engaging the children in meaningful activities given the tools available. This in turn not only offered to the researchers situated access to nuanced exemplars of how the different technologies were appropriated by teachers and children, but also provided a concrete basis for researchers and teachers to co-create a set of recommendations for further improvements of the technology.

Trinity Fields School

Context for engagement

Trinity Fields School and Resource Centre in South Wales offers specialist education and resources for pupils with a range of learning disabilities, who are aged 3–19. Teachers at Trinity Fields have pioneered the use of interactive technologies to support both physical and cognitive development, and in 2014 the school was awarded the Naace 3rd Millennium Learning Award for their use of gesture-based technologies with the most hard-to-reach pupils. One teacher, in particular, took an interest in the SHAPE project. He was Head of ICT and undertaking a Postgraduate Diploma in Professional Development in Severe Learning Disabilities/Profound and Multiple Learning Disabilities.

Empowerment and ownership

The process of creating the stories (see Table 3) emerged from conversations between this teacher and other members of staff who were not responsible for ICT development per se. The school has invested heavily in IT and all the staff and children have access to the most innovative of technology resources. This teacher had used the Somantics software for his postgraduate study and had then observed significant improvements in social behaviour and a reduction in anxiety. His enthusiasm for qualitative changes for one autistic pupil had provided the motivation to support his colleagues in setting up gesture-based technologies, and in documenting sessions using video as an additional 'pair of eyes' for observing individual and group activities. Consequently, this member of staff collated many video examples and was able to facilitate conversations with little input from the SHAPE team. These conversations were also videotaped and the idea for a story

Table 3. Summary of stories from Trinity Fields special school

Story title	People	Voices and perspectives	Themes
Ben's story—Trinity Fields	Teacher commenting on video clip of child interacting with the software and telling her interpretation of Ben's (the child's) story through commentary of what he is doing	The teacher is studying a video clip of the pupils engaging with the software and is commenting on the behaviour, stating that the goal was to overcome the child's avoidance of and apparent disinterest in certain school activities	The clip describes the pupil's issues—e.g. getting him to move more, his behavioural difficulties and how the technology is used to address that. The teacher refers to the use of an engagement scale to measure the pupil's development
Callum's story—Trinity Fields	Teacher tells story of a child by commenting on what is happening in the video clip of interaction with software. Gives the viewer broader information about the child first	Teacher as observer and commentator	Teacher comments on how pupil is vocalising and moving. He enjoys the stimulation but is not interested in what is happening around him
Charys's story—Trinity Fields	Teacher commenting on video clips	Teacher as observer and commentator	This pupil is verbal and loves Somantics but does not like some of the patterns
Jordan's story—Trinity Fields	Teacher, with clips of child in background.	Teacher commentary of what the child is doing and using that as a general way of telling the story of the child	Somantics has been used in class for a whole school year. The only thing that keeps him focused is this. He likes 1:1, and pulls the teacher in to participate in it

formed through a process of meta-review, whereby the SHAPE researcher invited members of staff involved on the project to watch the videos of their conversations and to develop a narrative that was meaningful to them and that reflected their point of view of the pupils' interactions.

Voices and perspectives

The conversations between teachers provided a personal point of view, drawing attention to the emergent interaction between the pupils and the technology. The nature of Somantics is very open-ended, such that the goal may not be apparent at the outset, and so success relies greatly on the contingency of the interaction. The pupil must initiate the interaction through movement for Somantics to respond, the effects of the movement are immediately mirrored on screen and thus a dialogue emerges between the pupil and the projected image they have created. The unscripted nature of this dialogue provides the opportunity for the teacher to create a narrative in order to contextualise the pupil experience. For this reason, the storytelling process flowed naturally when the teachers reviewed the video footage. Although most of the autistic pupils were non-verbal, the videos revealed very clear intentions and choices—made by the pupils—that could not have been understood without the video reflection. The stories drew attention to the nuanced changes in the pupils' interactions to explain how the software enabled more positive outcomes. In short, these clips address the impact of the technology on engagement and attention, and how the software supports pupils who are hard to reach and engage in other ways.

In summary, the process of reviewing and selecting stories from the many video clips prompted teachers to describe particular developmental trajectories in the autistic pupils towards independence. For example, they would notice the pupil pause, reflect and choose when to stop or continue the interaction, or when the technology became the conduit to a desired real-world behaviour, such as emotional self-regulation. Seeing both the pupil *and* the technology through the same filter (i.e. the screen) provided the means for gathering such 'in the moment' evidence, and sharing it with other teachers who might otherwise not have understood the significance of these small changes.

Minworth Primary School

Context for engagement

Minworth is a mainstream infant and junior school in the West Midlands. The Head Teacher expressed strong support for the project and attended two meetings with the principal investigator before the project started. She selected the children whom she thought would benefit most, as well as two teachers whom she thought would be interested in being involved with the project. She also organised for supply cover during the digital stories workshop and released staff so that they could attend for a whole afternoon. The teachers who attended the workshop participated actively, preparing short stories and providing commentaries to camera. The teachers

involved in the project did not have experience of working with pupils with autism, nor had they attended any autism-specific training at that stage. They were both newly qualified. As the project progressed, the teachers became more disengaged, and articulated their wish for the researcher to take control of the process. The school was conducting formal assessments and they indicated that they needed to focus on literacy and numeracy activities. There was pressure on staff time, with the researcher finding it difficult to negotiate with the school about setting aside time to work on the technologies. The teachers were also reluctant to generate the stories independently from the researcher, and the researcher had difficulty engaging them in this process. The teachers expressed a lack of confidence about the digital story-creation process and wanted the researcher to undertake the filming, construction of stories and editing.

Empowerment and ownership

The school dynamics, as described above, gradually resulted in disengagement of the teachers from actual work with the technologies, and thus also with the digital story-creation process itself, with the researcher taking control of the whole process. Therefore, the project evolved in a very different way from Radlett Lodge and Trinity Fields, with the researcher de facto 'running the project', identifying how the technologies could be used in the school, interpreting the potential of the technologies and advising the staff about how to use the technologies (see Table 4).

The role of the researcher became one of taking a lead in organising, interpreting and disseminating the use of that technology in the school and taking on a role akin to an advisory teacher who implemented the work with the children and engaged them in using the technologies. In addition to conducting the work with the children, the researcher collated the digital stories with the staff, with a child and a parent becoming involved through being interviewed (e.g. as in 'Welcome to Sophie's world'). In this context, the digital stories became more of a way of gathering data about how the technology was used in this particular school, and with this particular child, rather than giving voice to the teachers to tell their story.

Voices and perspectives

The content of these stories focuses on how the use of Somantics enabled one child to gain better relationships with her peers, focusing on e-inclusion practices through situating the pupil at the centre of the story, and representing her voice, while also focusing on the researchers' interpretation of how the technology had enabled the inclusion of this pupil. Although the IT technician takes centre stage in the 'Making technology accessible' story, and teachers comment on how they use technology more broadly in the school (see 'Teachers experiences of using types of technologies'), the clips largely represent the researcher's voice and interpretation, and the teachers' views are mostly absent. A pupil's perspective is foregrounded via the efforts and perspective of the researcher, and there is limited interaction in the stories between the different 'actors' at the school. As such, in the context of this school, there was limited

Table 4. Summary of the stories at Minworth mainstream primary school

Story title	People	Voice	Themes
A story of e-inclusion	The clip shows Sophie, a pupil, interacting with the technology, commenting on why she likes the technology and in dialogue with a peer	The child comments directly on her experience, and this is interspersed with clips of her engaging with the technology. There is an interpretative overlay of the researcher who put the material together in the form of a short written commentary	Sophie is able to use her work with the technology to communicate with another pupil; the work enables her inclusion with her peers
Welcome to Sophie's world	The clip features the mother of a pupil interspersed with clips of the pupil. The researcher is in the background, having asked the mother questions, with the mother directing her answers to the researcher	This clip starts with the voice of the child saying 'welcome to my world'. After this, the clip focuses on the researcher talking to the mother about the child and what goals to work on	Sophie is sharing with Mum what she is doing in school. Some clear objectives were set for Sophie through the work with the technology and these were shared with the mother
Making technology accessible	The IT support technician talks about the Raspberry Pi	The focus of this clip is on the IT support technician providing suggestions to the research team about how Somantics software could become more accessible if written on Linux software through Raspberry Pi	The IT support technician gives advice on how the technologies in this project could become more accessible to the school community
Teachers' experiences of using types of technology	Researcher asks questions and teachers and LSAs answer	This provides a commentary from teachers about how they generally use technologies in school	Two members of staff from the different mainstream schools talk about how they use technologies

evidence of the collaborative and reciprocal relationships between the research team and the teachers that we experienced in other settings.

Discussion

Context of engagement

The way the technologies were used differed substantially between the schools, as did the extent to which school practitioners worked independently of researchers. In principle, all schools were keen to participate in the project, but in practice not all of them were equally able to dedicate the resources to it. These differences reflected the

necessity for the commitment of teachers' and schools' management to the reality not only of participating in such a project, but also engaging in the exploration and invention of new ways of teaching and learning as facilitated by the use of TEL and its capture via digital story creation.

For the teachers and researchers, the active negotiation of meaning through the digital story-creation process was central to their participation in the project (Parsons, 2015), and all the participants in the project came to this domain with different experiences, understandings, competencies and expertise. Many of the staff members were innovative, expansive and willing to take risks by trying new things, while a minority were more conservative in their approach and less directly involved, necessitating the research team to take the lead. This lack of engagement came as a surprise, as we had believed that by creating more democratic and respectful conditions for knowledge creation this project would seem more acceptable to all teachers.

The reduced involvement from some teachers revealed an important lesson, because it became clear that not all schools are ready to engage with knowledge co-construction through collaboration with researchers. Instead, knowledge transfer was important and meaningful to them and, therefore, also a useful way for us to negotiate our relationship with them. Consequently, the fact that schools 'handed over' greater power to the research team at different stages of their involvement is perhaps reflective of a necessary continuum of participation along which schools may either start, stick or move depending on their attitudes, experiences and available resources (Seale *et al.*, 2014; Parsons, 2015). Some teachers may have the confidence and commitment to take risks and relish greater power sharing with researchers in such a project whilst, for others, it was enough to contribute and to have researchers take more of a lead in terms of how technologies were used to support individual children. The research revealed a difference between the specialist and special school, and the mainstream school, which could be due in part to the confidence and experience of the staff involved in the project. The lead practitioners at Radlett Lodge and Trinity Fields had undertaken additional qualifications in special educational needs; they were experienced practitioners who were open to experimentation, and they had high levels of support from the management of their schools, in terms of autism practice, technology use and trying out new ways of supporting their pupils. In the mainstream school, the teachers were less experienced, were far less open to experimentation and had other pressures on their time, such as SATs testing and large classes.

Therefore, two important issues emerged. Firstly, the extent to which practitioners felt able to experiment with learning–teaching situations and their ability to engage in generating evidence of their practices differed between schools and practitioners. This highlights a possible cultural issue of entrenchment of many practitioners and institutions in the same established modes of supporting learners (see e.g. Hewitt *et al.*, 2003). Where the digital stories were most effective, their creation enabled practitioners to observe how pupils interacted with technology and provided an excellent mechanism for enabling reflection and observation, both of which are crucial skills for teachers (Guldberg *et al.*, 2013). Such mechanisms align well with the transactional model in autism, which sees the difficulties of individuals with autism as emerging from an interaction between an individual and the environment (Prizant, 2015). Secondly, there is an apparent lack of availability of tools for expression and knowledge

representation, through which teachers can share their knowledge with a range of stakeholders in a way that is meaningful to all. This points to a methodological gap, insofar as there is a notable lack of common means of expression available through which a teacher may be able to communicate their experiences to others (other practitioners as well as researchers), without having to make a heroic effort to learn a means of expression that is entirely foreign to them (e.g. Lin *et al.*, 2005; Porayska-Pomsta, 2016). Thus, a willingness to participate, along with the democratic approach to evidence generation and sharing, may be hindered by a lack of confidence in exploring new ideas, coupled with a lack of common tools for capturing, expressing and interpreting knowledge.

Empowerment and ownership

The discussion thus far highlights that construction of knowledge and the process of knowledge co-creation cannot be separated from the people or the processes that produce new knowledge (Wenger, 1998). Crucially, the schools that were the most supportive were the ones with which we already had working relationships, or that had contacted us because they were interested in what we were doing. This highlights the importance of creating good relationships with school communities, working to build trust and social capital, and develop a shared language, over time (Guldberg & Pilkington, 2006). To take risks in this kind of partnership requires trust within staff teams as well as between schools and researchers, and these trusting relationships are important for sharing what you do know as well as recognising what you do not know.

This emergent knowledge creation can be uncomfortable for both practitioners and researchers, as it involves moving outside the 'comfort zone' of one's own practices. Nevertheless, this direct and active encounter with other practices can be conducive to learning and reflection, because they can enable us to see our practices from the point of view of others (Wenger *et al.*, 2014), thus yielding both better knowledge of other practices and better understanding of one's own practices. However, the individual practitioners in the respective schools had varying statuses as 'social actors', and their position within the school therefore mattered with regard to their readiness for learning and reflection.

It was apparent that teachers and professionals with considerable support from senior management, confidence in their own skills and agency with respect to driving new initiatives were those who were most willing and able to engage in knowledge co-construction. By contrast, staff members who did not necessarily have this level of social capital, or might already have felt marginalised within a professional community of practice, were those least willing to engage in the process. In these respects, the different stakeholders each came with their own experiences and levels of reliability and competence (Wenger *et al.*, 2014). These experiences were also reflected in the voices and perspectives that were shared through the stories, and it is to these that we turn next.

Voices and perspectives

The practitioners' ability to engage around the shared work allowed them to engage in various forms of learning through their individual craft and personal knowledge

being taken into account, providing them with a powerful tool for expression (Guldberg *et al.*, 2013). In this process, the digital technologies provided a way to capture and reflect on practices, and learning, that brought tacit or informal knowledge to the fore (Fisher *et al.*, 2006). This tacit knowledge refers to those context-based experiences that cannot easily be captured, or codified (Davenport, 2008). The work of the staff at Trinity Fields showed this in their commentaries of the pupils interacting with the technology, revealing their hitherto undeclared ability to detect important information about the nuanced interactions of the pupils. Through application of the technologies in their daily routines, these teachers were often able to articulate very precise knowledge about what the different technologies afforded the individual pupils and what design modifications might be necessary to make those technologies more flexible, usable and useful. Indeed, in most of the digital stories of the two specialist schools, it was the voices and perspectives of the teaching and related professional staff members that were prominent. This reflects, in part, how we constructed the project in the first place, but it also illustrates the value of the digital story approach for eliciting and showcasing teachers' perspectives in observable and shareable ways. Although our focus was specifically on TEL, such an approach could usefully be explored and applied for any aspect of teaching and learning.

Other voices and perspectives were showcased too, of course: children's experiences, as well as their learning with the technologies, were made observable for scrutiny and reflection through the creation of the stories. Findings from other research highlights that pupils with autism have a natural affinity for technology (Fletcher-Watson, 2014), and that technology can offer a safe and predictable environment for them (Battocchi *et al.*, 2008), whilst simplifying the complexities of social interaction (Bosseler & Massaro, 2003) and enhancing communication (Ploog *et al.*, 2013). The SHAPE digital stories show evidence of these points but, with their focus on use in situ, they also clearly outline an important point highlighted by Seale (2009), about how technologies can help to maximise empowerment and participation.

The pupils' own reflections and feedback on the technologies were presented in some cases (e.g. 'Working party' in Table 2 and 'Sophie's world' in Table 4). Therefore, the digital stories method was not privileged towards those who were wielding the camera or taking a meta-perspective on the stories; children's experiences were featured strongly within the narratives, alongside teaching staff and other professionals. Given that knowledge co-construction necessarily entails the contribution of multiple perspectives, it is vitally important to illustrate that children's voices were represented in the process also. This is especially timely and important in the context of the strengthened role of children's (and parents') voices in relation to educational provision within the new Special Educational Needs and Disability Code of Practice in England (Department for Education, 2015).

Conclusions

Knowledge transfer from researchers to the classroom has shown little impact on improving educational outcomes for children, to the extent that there have been much stronger calls for the closer involvement of educational professionals as 'active agents' rather than 'passive participants' in research (BERA-RSA, 2014, p. 8). We

have argued that there is a need to devise, implement and critically reflect on methods for enabling teachers to be active agents in research in the context of educational interventions for children with autism, where knowledge-transfer models of EBP are almost exclusively prized and promoted. One of the major challenges therefore relates to how teachers can be empowered to co-create knowledge in ways that allow them to capture, compare and develop more in-depth perspectives as a basis for innovation within their own educational practices. The SHAPE project shows that the methodological process and the practice of developing digital stories may enable the creation of new forms of situated evidence that is meaningful to researchers and practitioners, thus enabling better understanding of the interrelationships between people, pedagogy and technology (Abbott, 2007). As we have outlined in this paper, the process of creating digital stories enabled practitioners to observe nuanced interactions between pupils and the technology and to use an autistic pupils' affinity with technology to enable inclusion. Whilst enhancing practitioners' ability to reflect and observe, the digital stories also showed evidence of ways of using technology to support turn-taking in pupils, the development of conversation skills in adolescents and enhanced motivation, engagement and emotional regulation in pupils who were hard to reach. The digital stories also became a valuable way to share innovative practice. The evidence generated from them could provide an essential bridge between the different perspectives and roles of all the stakeholders in knowledge and practices aimed to serve the development and education of autistic pupils, in specialist as well as mainstream schools. While the research and methodology presented in this paper focus specifically on technology-enhanced practices for autism, many of the findings of the SHAPE project are of relevance to mainstream education and the challenges that cut across different forms of educational support and practice. Specifically, not all teachers and schools are ready or willing to be knowledge co-creators in the way that we envisaged. Researchers and schools needed to develop more sustained and sustainable, trusting and mutually reinforcing partnerships (Parsons *et al.*, 2013) in order to enable more opportunities for genuinely collaborative, insightful educational practices that both critically inform and are informed by the evidence base.

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