Received: 15 February 2021 | Accepted: 25 May 2021

DOI: 10.1111/bjet.13142

ORIGINAL MANUSCRIPT

British Journal of Educational Technology BERA

Exploring digital transformation through pretend play in kindergarten

Franziska Vogt | **Lena Hollenstein**

Centre for Early Childhood Education, St. Gallen University of Teacher Education, St. Gallen, Switzerland

Correspondence
Franziska Vogt, Centre of Early Childhood Education, St. Gallen University of Teacher Education, 9000 St. Gallen, Switzerland.
Email: franziska.vogt@phsg.ch

Funding information
Swiss Academies of Arts and Science, Grant/Award Number: National Programme on STEM Education

Abstract

Digitalisation and the accompanying transformation processes, involving data, technology and people, are part of children's life and will shape their future. Competences, such as digital skills, as well as creativity, communication, collaboration, critical thinking and problem solving are crucial to these transformation processes. In early childhood, these competences are essentially acquired through play, especially pretend play. The project 'we play the future' draws on the potential of pretend play to enable young children to be actively engaged in imagining themselves shaping digital transformation in the roles of inventors, developers and users. Drawing on an analysis of fields currently undergoing digital transformation, eight inputs for pretend play were developed to areas of digital transformation (eg, robotics, autonomous vehicles and Internet of things). Fifteen kindergarten teachers implemented the pretend play on digital transformation in their kindergarten after taking a half-day introductory professional development course. The children's play was filmed and analysed using qualitative multimodal interaction analysis in order to examine the ways in which the pretend play encourages the exploration of digital transformation amongst the children. The results

reveal the potential of pretend play for children to explore digital transformation and to acquire the digital competences needed in the future.

KEYWORDS
digital competences, digital transformation, early years education, play, qualitative research, role play, video

Practitioner notes

What is already known about this topic?
- Children integrate imaginative digital technology in their play.
- Guided pretend play is important for children's learning in kindergarten.

What this paper adds
- Ideas for pretend play in kindergarten to enable children developing an understanding of digital transformation in a playful way
- The paper presents findings from video analysis which indicate that children are using competences needed for the digital future during pretend play

Implications for practice
- Digital education should not just be focused on using and programming digital devices but include pretend play to explore digital transformation; through the inputs for pretend play suggested in the project, the kindergarten teachers support the children developing an understanding of digital technology.
- The inputs for pretend play enable children to develop competences such as technical and digital skills, as well as creativity, communication, collaboration, critical thinking and problem solving.

INTRODUCTION

Digitalisation and the accompanying transforming processes create new opportunities leading to rapid and fundamental changes in the lives and work of people (Appelfeller & Feldmann, 2018; Turja et al., 2009). Digital transformation refers to the changes in structuring processes made possible through digitalisation and technology; it explores the potential in bringing people, data and technology together in new ways (Schallmo, 2016; World Economic Forum & Accenture, 2017). Young children not only observe how adults around them use digital technology in their everyday lives but also have access to a range of technologies (Johnston et al., 2018; Nikolopoulou & Gialamas, 2015). In order to awaken children's interest in professions and activities linked to digital technology, digital technology can already be part of play in kindergarten, as has been demonstrated with robots (Arnott et al., 2020), smartphones (Bird, 2020) and tablets (Gilbert & Yelland, 2017). Referring to digital transformation as a digital revolution, Craft (2011, p. 33) describes four key characteristics of a changing childhood: '(a) *plurality of identities* (people, places, activities and literacies), (b) *possibility-awareness* (of what might be invented, of access options, of learning by doing and of active engagement), (c) *playfulness of engagement* (the exploratory drive) and (d) *participation* (all welcome through democratic, dialogic voice)'.

Pretend play, according to Craft (2011), is ideal for meeting all these key characteristics. Pretend play centres on children taking on a plurality of identities (a), to invent what could be possible (b), to explore and have fun (c) and to enable participation and have their own voice (d). In early childhood, play is at the centre of children's learning (O'Sullivan & Ring, 2018; Sundqvist & Nilsson, 2018; Turja et al., 2009; Vygotsky, 1967). For early childhood education, it was shown that *guided* pretend play leads to high-quality pretend play and offers the children learning opportunities in different areas (Kalkusch et al., 2020; Weisberg et al., 2013). Pretend play encourages an active, creative and critical handling of digital technology, contrasting significantly to the often passive use of digital technology (Brookfield, 2009; Wang & Wegerif, 2019). The potential of guided pretend play for enabling children to explore digital transformation processes and to acquire competences required for future digital transformation processes has not yet been explored.

This paper presents the project 'we play the future' in which inputs for pretend play have been created for kindergarten settings to enable children to acquire understanding of processes of digital transformation as well as to acquire competences needed for digital transformation (Vogt et al., 2020). The pretend play provides young children, aged between 4 and 6 years old, with the possibility to become actively engaged in imagining themselves as shaping digital transformation and at the same time develop competences required for future digital transformation.

DIGITAL TRANSFORMATION AND ITS RELEVANCE FOR CHILDREN'S FUTURE LIVES

Digital technologies like mobile and connected devices, cloud computing, social media, Internet of things, big data, artificial intelligence or robotics open up new opportunities to bring processes, people and data together (Appelfeller & Feldmann, 2018; Schallmo, 2016). Digital transformation refers to the potential of changing such processes. As a result, new business models, work processes and job profiles are emerging. Digital transformation is constantly changing, and new fields of digital transformation are evolving. Currently, the following seven technological trends have been identified as driving digital transformation today (World Economic Form & Accenture, 2017): (a) artificial intelligence, (b) autonomous vehicles, (c) big data analytics and cloud, (d) custom manufacturing and 3D printing, (e) Internet of things, (f) robots and drones and (g) social media and platforms.

In the future, new technological trends and new areas of digital transformation will undoubtedly emerge. The digital transformation processes by which digital technology will define new processes as to how people, data and technology work together will become important in the children's future, in everyday life and in the field of work. It is therefore essential that children are given the chance to obtain the necessary competences to envisage themselves as actively shaping digital transformation in all areas of life. From an early age, children need to explore digital skills such as installing, programming, developing, debugging, connecting and forming an understanding of data exchanges between two devices or microchips. This 'broad and somewhat debated range of analytic and problem-solving skills, dispositions, habits, and approaches used in computer science' has also been coined with the term *computational thinking* (Bers et al., 2014, p. 146). On the basis of a systematic literature review of digital skills and so-called *21st century skills*, seven 'core 21st century digital skills' were identified: 'technical, information management, communication, collaboration, creativity, critical thinking and problem solving' (Van Laar et al., 2017, p. 583).

DIGITAL TRANSFORMATION AND PRETEND PLAY IN KINDERGARTEN

In early childhood, the above-mentioned core skills are used to engage in pretend play: the children interact with each other, communicate and cooperate in pretend play, and they try out processes and ideas, exploring opportunities in fantasy (Arnott, 2017). If digital transformation is made salient as a content of pretend play, technical skills and information management (Van Laar et al., 2017) can also be acquired. Children can explore themselves as active technological agents, ie, as the children imagine acting in the role of a computer scientist or technician and use pretend-play digital devices (Bird, 2020; Turja et al., 2009). The pretend-play devices are non-functioning objects, such as old smartphones and tablets, or objects created by the children made out of cardboard (Bird, 2020). Turja et al. (2009, p. 359) describe activities for children to experience themselves as active technological agents involving the following roles: '(a) producer (designer, inventor, constructor/manufacturer); (b) maintainer, repair person; and (c) user (consumer: selecting and using technology in everyday life, professional user)'. Pretend play encourages children to imagine themselves in different (future) roles in work and everyday life and thus to experience themselves as actively using digital technology and shaping digital transformation processes. By pretending to be computer scientists and IT technicians, as well as pretending to live in a smart home, children can experience themselves as techno-savvy (Craft, 2012). Arnott et al. (2020) found that children spontaneously incorporate digital aspects in their pretend play, particularly when resources simulating everyday digital artefacts (like phones, computers and keyboards) are made available to them. Bird (2020) explored how children use imaginative technologies, pretend typing on a keyboard or posting a picture on social media. For this, they not only use digital artefacts but also use other things to pretend that these things would be digital devices, ie, using a building block as a phone.

The quality of pretend play is promoted by providing pretend play material and through guiding pretend play (Kalkusch et al., 2020; Perren et al., 2019). The approach of using play to introduce curricular topics through providing materials and guiding pretend play is also called *guided play* (Weisberg et al., 2013). Guiding pretend play on digital transformation involves teachers providing play areas with materials simulating digital artefacts, but also joining in pretend play, model understanding of digital processes and encourage children's ideas. Although children observe the use of digital technology in everyday life, the processes of digital transformation are not salient: digital transformation is based on communicating about the potential of digital technology and developing new processes for tackling everyday problems. Through guided play, these processes can become topics of pretend play.

On the basis of the literature discussed, we propose that guided pretend play provides a promising approach for young children to foster the exploration of digital transformation for young children. Digital transformation defines the process by which digital technology transforms—indeed redefines—work, domestic and leisure processes. We regard it as essential that children receive inputs from their teachers to activate and broaden their thoughts as to the future potential of digital technology. Guided play supports the children to go beyond the uses of digital technology they experience in their daily life, to envisage themselves to be users, developers and producers of future digital technologies. Children also contribute to the exploration of digital transformation, as children's imagination in pretend play extends beyond understanding 'what it means and how it feels' (Parry & Scott, 2019, p. 443). The project presented here seeks to use the potential of guided pretend play to foster competences required for digital transformation such as the 21st-century digital skills (Van Laar et al., 2017). Specifically, the paper focuses on the following research question: in what ways do the inputs for pretend play encourage the children to explore the potential of digital transformation and to acquire competences required for digital transformation?

METHOD

In order to explore the potential of pretend play for children acquiring competences required for digital transformation, an explorative intervention study was chosen. The intervention consisted of a professional training and the implementation of the inputs for pretend play on digital transformation. Due to the explorative nature of the research question, a qualitative design based on video analysis was foreseen, whereby the implementation of guided play in kindergarten was central.

Inputs for pretend play and professional development

Within the project 'we play the future', inputs for pretend play in eight different areas of digital transformation were created (Vogt et al., 2020). The development of the inputs for pretend play was based on scientific knowledge regarding digital transformation, play and gender as well as drawing on a consultation with experts from the field of information technology. The project extends existing corners of pretend play in an imaginative way to incorporate the theme of digital transformation (the traditional home corner found in kindergartens becomes a *smart* home corner) and completely new play corners. The eight areas selected for creating inputs for pretend play were based on current digital transformation initiatives (World Economic Forum & Accenture, 2017) and possible future developments as well as including core digital processes required for digital transformation such as data switching via sensors and microchips. Furthermore, the project sought to ensure that the themes closely relate to the everyday experiences of young children. The inputs for pretend play on digital transformation comprised the following eight areas: (a) IT Centre, (b) robotics, (c) 3D printer, (d) autonomous vehicles, (e) Internet of things, (f) police and tracking, (g) online shop and (h) food laboratory (Vogt et al., 2020). This range could be widened; additional areas for inputs could be envisaged, such as health care and space exploration. The inputs for pretend play chosen deliberately exclude ethically problematic issues of digital transformation, such as surveillance, cyber risks and manipulative information (Helbing, 2019).

The project provided the participating kindergartens with a selection of materials to stimulate pretend play (ie, old laptops and wooden tablets with exchangeable laminated cardboard surfaces) but no functioning technology. These non-functioning devices allow for the teacher and the children to focus on the unfolding of the pretend play without having to handle the digital technology. Many kindergarten teachers are reluctant to include digital technology in kindergarten because they do not feel sufficiently competent in its use (Nikolopoulou & Gialamas, 2015).

All participating kindergarten teachers were introduced to the fundamentals of the project in a half-day professional development course before going on to implement the pretend play on digital transformation in their kindergarten. Introducing each of the eight pretend play inputs, the training particularly addressed the following questions: which aspects represent processes of digital transformation, which aspects of the particular area are current and new developments of digital transformation, and which are not (yet) real? How could the kindergarten teachers guide the play in such ways that the digital transformation as developing new processes to solve everyday and work problems with the help of digital technology is at the heart of the play?

Sample

Fifteen kindergarten teachers participated in the study and implemented the pretend play in their kindergarten. Kindergarten is part of the compulsory education system for 4- to 6-year-olds in Switzerland. Kindergarten education follows a competence-based curriculum, in which information technology and media is regarded as a cross-sectional area (Bildungsdepartement Kanton St. Gallen, 2017).

In the study, the kindergarten teachers attended a professional development course and then implemented at least three of the pretend play inputs in their kindergarten. They introduced the areas through guided pretend play, without teacher-directed circle time. They were asked to both let children play on their own and then participate again to guide and enrich the play to further explore digital transformation. This set-up corresponds with the pedagogical approach in kindergarten in Switzerland, in which a phase of free play is to be available to the children on a daily basis.

Data collection and analysis

Video observations of children's play was carried out twice in the course of 3.5 months, capturing the children's play and the teacher's guidance using two video cameras on stands directed towards the play area and following the movements, as well as two to three additional small microphones placed in the play area. Children's parents and guardians as well as the teachers gave written consent to being videoed. On the day of the filming, the children were free to decide for themselves whether they wanted to take part in the play on digital transformation, based on their parents' written consent for participation in the videos, or whether they wished to be in another play areas or involved in different activities. In total, 45 h of recorded video material was gathered.

The video data were analysed qualitatively using multimodal interaction analysis (Goodwin, 2018; Mondada, 2014). First, the coding provided an overview of the video data. Relevant situations were identified according to ethnographic sampling (Knoblauch & Tuma, 2011); 941 sequences of pretend play interactions were identified overall. The content of each sequence was summarised and categorised as to whether digital transformation was highly relevant (128 sequences), partly relevant (457) or not at all (356). ‘Highly relevant’ included sequences where digital transformation was the main theme of the play activity, ie, programming a robot and installing microchips; ‘partly relevant’ was coded for sequences with aspects of digital transformation, which were not explicitly in focus, ie, payment with the mobile and IT specialists checking whether the smart home is working. Out of the 128 sequences, 10 were selected for a fine-grained multimodal interaction analysis. These 10 sequences represent play sequences, which were observed in similar ways several times; they encompass the different areas included in the inputs for pretend play and represent sequences of children playing with the teacher as well as amongst themselves. Several researchers were engaged in data sessions interpreting precise transcripts of these sequences, which include utterances, actions, gestures and viewing direction (Knoblauch & Tuma, 2011). These precise transcripts were interpreted turn by turn. Researchers rotated different roles in the data sessions. While one researcher prepared the transcript as described above, the other two to three researchers were shown the transcript turn after turn and formulated observations, interpretations and hypotheses as to what was observed, what the meaning of a particular utterance, action or gesture could be and what might happen next. An example is provided in Table 1.

The findings of the data sessions were compiled in interpretations. Where required, the video was consulted again.

TABLE 1 Example of the transcript and interpretations (selection) for one turn

Turn	Time	Girl (IT Centre)	Boy (IT Centre)	Girl (customer)
5	09:44–09:45	Watches	'Good' gets up and fetches the robot from the corner behind	The girl continues to stand next to the desk and watches
Interpretations—what can be observed: • The IT specialists accept the request to hire a robot. • One of the children—the boy—gets up and takes action. • The customer does not move or take action.				
Interpretations—what could happen next: • The customer asks about the costs. • The customer does not say anything but awaits the IT specialists' explanations about the functioning of the robot, ie, whether it is required to log in to control the robot. • The customer expects that the boy is installing something either entering commands at the robot directly or remotely with the tablet. • The girl from the IT Centre enters the conversation, eg, activates an account or asks the customer for her name or asks for how long she needs the robot.				

RESULTS

Multimodal interaction analysis of 10 sequences revealed the various ways in which the pretend play encourage children's exploration of digital transformation. Three sequences are presented here to illustrate the analysis focusing on children's understanding of digital transformation and the digital competences obtained.

How to transmit data

The pretend play 'online shop' includes digital transformation in such a way that a jumpsuit with sensors is delivered by the online shop and put on by customers in their homes to take body measurements. The data from the jumpsuit are integrated in the online shopping process in such a way that on the tablet, the app only brings up clothes in the correct size for the customer to choose from. The order is processed in the online shop, and a parcel with the clothes is delivered.

> Child 1 sits at the table with the keyboard and a mouse; child 2 holds the tablet; child 3 holds a box and child 4 sits on the floor putting on the jumpsuit with sensors. Child 2 holds the tablet and says "no, no, no and I, I—" [tentative, questioning voice] (02:28). Child 3 takes the tablet out of child 2's hands and says, "You can do him like this" (02:30). Child 3 directs the tablet towards child 4, stretches out her arms and moves the tablet from her shoulder height down and says "mmm". Child 4: "no, not now" (02:33). Child 3 gives the tablet back to child 2. Child 2 takes the tablet but then puts it away on a shelf. Child 4 is still putting the jumpsuit on. Child 2 and child 3 both handle the boxes, child 2 then says, "I want this" to which child 3 says, "We can both do this" (02:42). Child 4 says "oh" and moves towards the children 2 and 3. Child 3: "Then I take—, I am the tablet" and repeats louder "I am the tablet" (02:45). Child 3 takes the tablet from the shelf and taps on the tablet surface while child 4 takes the jumpsuits off and puts it on again. Later child 3 scans child 4 wearing the jumpsuit (03:33), taps onto the tablet and asks, "What would you like?" (03:37). Child 4 approaches child 3, looks at the tablet and says, "I want blue clothes" (03:45), child 3 says "okay" and taps on the tablet.

In the analysis of the interactions, the unfinished question of child 2 (02:28) can be interpreted as either an uncertainty as to the way the pretend play roles were shared out or an uncertainty on what to do with the tablet. Child 3 interprets it as an uncertainty about what to do with the tablet and proceeds to demonstrate the scanning to child 2. Child 3 directs the tablet towards child 4 with the jumpsuit and makes a sound to represent the data transfer between jumpsuit sensors and tablet app. Child 4 protests that he is not yet ready, also indicating an understanding of how data are transferred between the jumpsuit and the tablet. Precise sequencing is important for designing algorithms within computer science (Bers et al., 2014). To imagine the processes as sequential steps of bringing data, technology and people together is crucial for digital transformation. Children 3 and 4 also expect that the app allows choosing clothes on the tablet, indicating that they have formed an understanding of data collection and computing, as well as of the role of the Internet in digitalisation. They pretend to use information management competences, one of the seven core competences (Van Laar et al., 2017). The play sequence shows the children in the roles of users (Turja et al., 2009), using the tablet and the jumpsuit as digital devices as part of the everyday activity of shopping. During the pretend play, the children collaborate, for example, when finding a way of sharing the roles (02:42). They

communicate in different ways, ie, discussing the choice of clothes (03:37) and providing an explanation on how to use the tablet (02:30). The analysis of this pretend play sequence shows that digital competences, including technological and information management (data transfer, the connecting of devices, sensors and scans and the Internet) as well as communication and collaboration, are fostered (Arnott, 2017; Van Laar et al., 2017).

Programming the robot

In this kindergarten, the IT Centre includes robotics. Robots were made using boxes, a metre tall, with antennas and a face drawn. The pretend play centres on the idea that the IT Centre is a company producing, programming and lending robots for customers needing a robot.

> Child 1 and child 2 sit behind a counter of the IT Centre, child 3 approaches. Child 3: "May I please have the robot? To rent?" (09:38). Child 2 nods, child 1 asks: "For monitoring?" (09:43). Child 3: "Yes." Child 1 gets up, pulls the robot towards the counter, and asks: "What should it be capable of?" (09:50). Child 1 sits down again, picks the tablet up and says, looking at the tablet: "It is already capable of jumping, walking and running" (09:55). Child 3 hesitates: "Running." Child 1: "It is already capable of this" (10:00). Child 3 mentions walking, child 1 repeats that the robot is capable of that already. Child 3: "Everything it already is capable of" (10:05). Child 1 shakes his head: "Mmmh, not everything", then looks up from the tablet and grins: "For example—boxing" (10:13). Child 3 repeats "boxing"; child 1 taps on the tablet, nudges the robot and addresses the robot: "Boxing at once!" (10:17). Child 1 grins and looks at child 3: "Is capable of boxing" (10:20). Child 3: "And then it also has to—it also has to cake—cake—" (10:26). Child 2: "Baking." Child 3: "What?" Child 2: "Baking cake." Child 3: "yes," then addressing child 1: "Baking cake" (10:33). Child 1 taps on the tablet, says "good," gets up and pushes the robot towards child 3: "Good, come on, now you can take it with you" (10:37). Child 3 takes the robot and leaves.

Child 3 demonstrates knowledge of the script to rent something in a shop (09:38) but seemingly does not expect to have to specify the functions required of the robot. By contrast, child 1 has a concept that robots need to be programmed for specific functions. Child 1 also understands that the robot comes with some basic functions already installed, that this information is visible via the app on the tablet and that checking and programming the robot is not performed directly on the robot but rather remotely with the tablet. Child 1 is adhering to the need to distinguish between the functions, which are already installed, and the customised functions, which need to first be programmed. Child 1 takes the lead in the play in demanding that the customer, child 3, has to specify the desired functions before taking the robot. Child 1 moves the play forward in giving an example. Grinning (10:20) indicates that child 1 enjoys the thought of the robot boxing; it might also be slightly provocative, as it could be assumed that fighting is not an acceptable behaviour in kindergarten. Child 1 taps on the tablet as soon as child 3 repeats the idea and checks the robot. This action shows an understanding that the robot is customised on the app with the tablet and that programming needs to be followed by a test of functionality. In nudging the robot and uttering the command (10:17), child 1 probably verbalised the programming and testing action. By providing the example of boxing, child 1 has modelled digital transformation as discerning a function, programming it first, testing the function and then using the robot. This now enables child 3 to make a specific request, baking a cake, which child 1 programmes with the tablet.

Throughout the sequence, the children remain true to their roles within the pretend play. Child 1 gives hints and models the process, thus scaffolding the digital competences relating to technological aspects (basic functions, new functions, remote programming and testing functionality), as well as problem solving. In this sequence, digital transformation is imagined as the children think of new functions a robot could fulfil, changing processes of everyday life. The children use elaborate competences of communication and collaboration as well as creativity (Van Laar et al., 2017). Critical thinking (Van Laar et al., 2017) is touched upon, as a robot can be programmed to do things, which are potentially harmful. However, this is not elaborated upon but rather included in a playful way: boxing and baking are considered as the type of functions, for which a robot can be useful. Following Turja et al. (2009), the children are playing being producers, who construct and manufacture digital devices, as well as being the end-users and consumers of said robots.

Programming an app to solve a problem, teacher initiating the idea as customer

The following sequence involves two pretend play corners in the kindergarten, combining the IT Centre with an ice-cream shop—the idea is based on the input of pretend play in the area of a food laboratory.

> Child 1 in the role of the computer scientist comes to the ice cream shop and asks the teacher, in the role of the shop owner: "Do you have a problem?" (12:33). Teacher, holding the tablet: "Yes, look, I always have to get up so early in the morning to come in and make ice cream. I do not like always having to get up so early (12:47). Therefore, I have a question: could you programme this and connect it—" (12:52). Child 1 reaches out to take the tablet. Teacher: "Wait a second to connect, so, that while I am at home, I can select which ice cream I want to make on the tablet and then it would make it automatically" (13:03). Child 1 nods: "Yes, of course," takes the tablet from the teacher and goes to the IT Centre. [Short conversation between teacher and another child]. Child 1 addresses the teacher: "Yes but excuse me" (13:20), pointing to an app on the screen: "What did you do here? Have you done something here?" Teacher: "Yes, that you could programme anew" (13:22). Child 1 cleans the laminated surface of the tablet with water, thus deleting what was drawn on it (13:47), and draws carefully an app on the laminated surface (14:49). [Teacher waits and comments, how useful the app will be]. Child 1: "You should press this at 10 o'clock. At 10, and then you do not need to get up. At 10, you can sleep a bit more and then you get up to work" (15:54). Child 1 carries on drawing the app: "If you press something wrong, everything will break down" (17.25). Teacher: "Could you programme a safety button?" Child 1 nods, taps on the tablet and hands it over (17:38).

The question "Do you have a problem?" was taken to be an opening line for a new play action. The computer scientist of the IT Centre seeks to start a new episode of the pretend play. The teacher seizes the moment and guides the play in the direction of the IT Centre solving a problem through digital transformation. She poses a problem (having to get up early) and introduces the pathway to the solution in modelling actions using the terms 'to programme' and 'connect' (12:52). Child 1 appears to already have a concept of programming in wanting to take the tablet right away. Child 1 has a procedure in mind, drawing the new programme as an app onto the tablet surface. Child 1 has a concept of deinstalling apps demonstrated in the action of cleaning the tablet surface and of the need to check first whether deinstalling is the wish of

the customer (13:20). The pretend play actions symbolising deinstalling (cleaning) and installing (drawing) show how artefacts symbolising digital devices support pretend play (Arnott, 2017). The explanation of the use of the app shows that child 1 understands that there can be a remote control being installed to monitor and direct the ice-cream machine via the Internet from the tablet, a crucial technological understanding. Critical thinking (Van Laar et al., 2017) is expressed as the child takes into account that digital processes can also go wrong (17:25). Very clearly, the child plays the role of producer (Turja et al., 2009), inventing, designing, programming and installing an app. This process takes time and deliberation, visible in the care taken to draw the app. Also in this pretend play sequence, the child communicates with the teacher as customer, collaborates in responding to the customer's needs and acts as creator of the app. Very much at the centre of this sequence is digital transformation as problem solving (Van Laar et al., 2017). Child 1 initiates the sequence by asking whether there is a problem, thus positioning the work of computer scientists about solving problems, and referring to the problem of the customer throughout the sequence.

DISCUSSION

It is the aim of the study to examine the ways in which the inputs for pretend play encourage the exploration of the concept of digital transformation in early childhood education and support children obtaining crucial digital competences. The discussion begins with children's understanding of digital transformation and then addresses competences fostered through the pretend play and concludes with an analysis of the strengths and limitations of the intervention study.

Children's exploration of digital transformation

The results of the multimodal interaction analysis indicate that the pretend play did indeed enable children to explore fundamental aspects of digital transformation. These included transmitting data between devices, deinstalling and installing, programming and developing—processes crucial for using, producing and repairing digital technology. The children clearly demonstrated that they imagine using and creating digital technology, a finding similar to that in Bird et al. (2020). The multimodal interaction analysis enables effective discernment on how children develop an understanding of digital transformation, by sometimes verbalising digital transformation processes or demonstrating their understanding in their pretend play actions.

All eight inputs for pretend play could be implemented by the participating teachers. Findings discussed in the literature (ie, Arnott, 2017; Bird et al., 2020; Turja et al., 2009) lead to the conclusion that children come to the topic with an awareness of digitalisation, as digital transformation is already a part of their daily life. While the sequences selected for this contribution included an online shop, robotics and IT Centre, the analysis of all videos reveals that also the other inputs for pretend play enable learning about digital transformation.

The three sequences discussed demonstrate a variety of ways in which learning is initiated and supported. In the three sequences, all aspects of the technological dimension of the digital 21st-century skills (Van Laar et al., 2017) were explored, though to lesser extent the dimension of information management.

In the first two sequences presented above, the children play independently. The sequences occurred after the teachers had introduced the pretend play input through playing with them. Teachers were asked to engage actively in pretend play to provide input as well as withdrawing and letting the children play independently. This is in line with common practice in Swiss kindergarten pedagogy. In both sequences, children share their digital

competences by playing together. The child demonstrating the connection between the tablet and the jumpsuit to the other child models the digital processes. The child playing the computer scientist with knowledge about robots models this understanding of digital transformation to the child playing the role of the customer. By suggesting boxing, the child scaffolds the other child's understanding. The sequence involving the programming of an app to solve the problem of the ice-cream shop owner highlights the potential of teachers participating in the play and initiating problem solving and learning. The teachers remain in the pretend play but model their thinking about how to solve the problem through a digital transformation process while drawing on the children's ideas.

With the help of the multimodal interaction analysis, it becomes clear that children explore the concept of digital transformation while they pretend to use digital technology or pretend to be a computer scientist or IT technician. In pretend play, they explore the three roles identified by Turja et al. (2009): they pretend to be producers, maintainers and users. These approaches to digital technology could also be fostered in other activities, as described by Turja et al., such as using digital apps to draw or programme a toy robot. Observing all these roles being played in pretend play, guided by the teachers participating in the play, and the provision of thematically varied pretend play corners and artefacts make us confident to suggest that pretend play should be recognised as an effective approach to learning about digital transformation.

Crucial competences for the digital transformation in the future

Children develop digital understanding, as well as other competences equally crucial for the digital future (Arnott, 2017; van Laar et al., 2017). The analysis presented above revealed that communication and collaboration were found in all pretend play sequences, probably by default. Similarly, creativity plays an essential role, as children imagine what robots could perform and what apps might be needed. Problem solving is explored in the pretend play, by way of asking which tasks the robot should perform or the teacher initiating the idea for a new app. Critical thinking is also noted as seen in the functionalities of the robot or the need for a safety button to prevent wrong use.

The pretend play sequences analysed above contain the four keys (Craft, 2011, p. 33), which have been identified as important for early childhood to appropriate the changes associated with digital transformation. The children took on a *plurality* of identities, as pretend play requires the assumption of a new role. As was demonstrated in the multimodal interaction analysis, the children and the teachers used their play identity to explore digital transformation, remaining in the pretend play situation throughout. Awareness of the *possibilities* is noted in all sequences, as is *playfulness* of engagement: excitement and laughter was noticeable particularly when boundaries of reality were pushed and ideas of the realm of imaginary possibilities were explored. Teachers and children very much stayed in dialogue, *participation* was ensured.

Strength and limitations

With the help of pretend play, children could explore many key aspects of digital transformation—this is a strength of the explorative intervention study. They explored the theme of digital transformation and showed crucial competences, which are needed for digital transformation (Van Laar et al., 2017). The inputs for pretend play have the potential to stimulate interest and foster identification with professions and activities in the field of digital transformation in kindergarten, noticeable as the children sustained intense and long pretend play sessions. Nevertheless, some limitations exist.

The qualitative multimodal analysis of the play interactions reveals some of the processes by which understanding is constructed through play. It is, however, a limitation of the study that the learning processes of the children could not be observed for a longer time. Further research would benefit from knowing how the play develops over time. Being an explorative intervention study, the research clearly demonstrates that pretend play instigates processes of learning and constructing meaning about digital transformation, but no comparison to other methods can be drawn out of this study, such as a picture book, coding a robot or programming on a computer. This was not the intention of the study. Other approaches to the theme of digital transformation in kindergarten might also contribute to children's learning. Not having used digital technology but focusing on pretend play with non-functioning digital artefacts probably brings with it specific advantages. As research has found that many kindergarten teachers have little confidence in using digital technology in kindergarten (Nikolopoulou & Gialamas, 2015), the approach of the study to deploy wood tablets, old laptops and pretend mobile phones for the pretend play might help to lower the barriers for kindergarten teachers to integrate digital education in kindergarten. The inputs for pretend play were providing them with an accessible way into integrating the topic of digital transformation in their kindergarten classroom and curriculum. As pretend play clearly sparks creativity, communication and collaboration between the children, the role of guiding children's play about the future opportunities of digital transformation might also kindle teachers' playfulness and creativity in relation to the topic of digital transformation.

CONCLUSION

The study seeks to kindle children's interest in and learning about digital technology by way of encouraging the children to play, to pretend and to enact being computer scientists and IT technicians and explore the concept and possibilities of digital transformation. It is clear that the children are already acquainted with digital transformation in their daily life. By giving the children the opportunity to negotiate ideas and meanings and to actively invent new solutions acquaints them with the future that awaits them. Furthermore, using guided pretend play, teachers were able to initiate children's thoughts about the current and future potential of digital technology, to focus processes between people, data and technology, and to be creative in problem solving.

The arrangement of guided play and the inputs for pretend play clearly sparked the children's imagination and interest. The high potential of pretend play for supporting competences required for the future of digital transformation leads to the conclusion that pretend play is an important approach to digital education, as the children are able to envisage themselves in an active and creative role, shaping digital transformation in various ways. The potential of pretend play is in line with the potential of digital transformation—playing the future in the here and now, developing crucial competences such as communication, collaboration, creativity, critical thinking and problem solving.

ACKNOWLEDGEMENTS

The project was supported by a grant from the Swiss Academies of Arts and Science as part of the National Programme on STEM education with the focus on digital transformation. We wish to thank the kindergarten teachers and children for their participation in the project. Open Access Funding provided by Padagogische Hochschule St Gallen.

CONFLICT OF INTEREST

We have no known conflict of interest to disclose.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ETHICS STATEMENT

Ethical guidelines for research were followed throughout; in particular, participants gave written informed consent and were made aware that they are free to withdraw anytime during data collection.

ORCID

Franziska Vogt https://orcid.org/0000-0002-2023-0431
Lena Hollenstein https://orcid.org/0000-0002-9441-8146

REFERENCES

Appelfeller, W., & Feldmann, C. (2018). *Die digitale Transformation des Unternehmens* [The company's digital transformation]. Springer. https://doi.org/10.1007/978-3-662-54061-9

Arnott, L. (Ed.). (2017). *Digital technologies and learning in the early years*. Sage. https://doi.org/10.4135/9781526414502

Arnott, L., Kewalramani, S., Gray, C., & Dardanou, M. (2020). Role-play and technologies in early childhood. In Z. Kingdone (Ed.), *A Vygotskian analysis of children's play behaviours: Beyond the home corner* (pp. 76–93). Routledge. https://doi.org/10.4324/9780429027369-9

Bers, M. U., Flannery, L., Kazakoff, E. R., & Sullivan, A. (2014). Computational thinking and tinkering: Exploration of an early childhood robotics curriculum. *Computers & Education*, *72*, 145–157. https://doi.org/10.1016/j.compedu.2013.10.020

Bildungsdepartement Kanton St.Gallen. (2017). *Kanton St.Gallen Lehrplan Volksschule - Medien und Informatik: Einleitendes Kapitel* [Canton St.Gallen Elementary School Curriculum - Media and Information Technology: Introductory Chapter].

Bird, J. (2020). "You need a phone and camera in your bag before you go out!": Children's play with imaginative technologies. *British Journal of Educational Technology*, *51*(1), 166–176. https://doi.org/10.1111/bjet.12791

Brookfield, S. D. (2009). Self-directed learning. In R. Maclean & D. Wilson (Eds.), *International handbook of education for the changing world of work* (pp. 2615–2627). Springer. https://doi.org/10.1007/978-1-4020-5281-1_172

Craft, A. (2011). *Creativity and education futures: Learning in a digital age*. Trentham Book.

Craft, A. (2012). Childhood in a digital age: Creative challenges for educational futures. *London Review of Education*, *10*(2), 173–190. https://doi.org/10.1080/14748460.2012.691282

Gilbert, C., & Yelland, N. (2017). Re-imagining play with new technologies. In L. Arnott (Ed.), *Digital technologies and learning in the early years* (pp. 34–51). Sage.

Goodwin, C. (2018). *Co-operative action*. Cambridge University Press. https://doi.org/10.1017/9781139016735

Helbing, D. (2019). Societal, economic, ethical and legal challenges of the digital revolution: From big data to deep learning, artificial intelligence, and manipulative technologies. In D. Helbing (Ed.), *Towards digital enlightenment* (pp. 47–72). Springer. https://doi.org/10.1007/978-3-319-90869-4_6

Johnston, K., Highfield, K., & Hadley, F. (2018). Supporting young children as digital citizens: The importance of shared understandings of technology to support integration in play-based learning. *British Journal of Educational Technology*, *49*(5), 896–910. https://doi.org/10.1111/bjet.12664

Kalkusch, I., Jaggy, A.-K., Burkhardt Bossi, C., Weiss, B., Sticca, F., & Perren, S. (2020). Promoting social pretend play in preschool age: Is providing roleplay material enough? *Early Education and Development*, 1–17. https://doi.org/10.1080/10409289.2020.1830248

Knoblauch, H., & Tuma, R. (2011). Videography: An interpretative approach to video-recorded micro-social interaction. In E. Margolis & L. Pauwels (Eds.), *The Sage handbook of visual research methods* (pp. 414–430). Sage. https://doi.org/10.4135/9781446268278.n22

Mondada, L. (2014). The local constitution of multimodal resources for social interaction. *Journal of Pragmatics*, *65*, 137–156. https://doi.org/10.1016/j.pragma.2014.04.004

Nikolopoulou, K., & Gialamas, V. (2015). ICT and play in preschool: Early childhood teachers' beliefs and confidence. *International Journal of Early Years Education*, *23*(4), 409–425. https://doi.org/10.1080/09669760.2015.1078727

O'Sullivan, L., & Ring, E. (2018). Play as learning: Implications for educators and parents from findings of a national evaluation of school readiness in Ireland. *International Journal of Play*, *7*(3), 266–289. https://doi.org/10.1080/21594937.2018.1532720

Parry, B., & Scott, F. (2019). Researching children's play and identity in the digital age: A holistic approach. In O. Erstad, R. Flewitt, B. Kümmerling-Meibauer, & I. S. P. Pereira (Eds.), *The Routledge handbook of digital literacies in early childhood* (pp. 442). Routledge. https://doi.org/10.4324/9780203730638-33

Perren, S., Sticca, F., Weiss-Hanselmann, B., & Bossi, C. B. (2019). Let us play together! Can play tutoring stimulate children's social pretend play level? *Journal of Early Childhood Research*, *17*(3), 205–219. https://doi.org/10.1177/1476718X19849248

Schallmo, D. R. A. (2016). *Jetzt digital transformieren* [Now digitally transform]. Springer. https://doi.org/10.1007/978-3-658-14569-9

Sundqvist, P., & Nilsson, T. (2018). Technology education in preschool: Providing opportunities for children to use artifacts and to create. *International Journal of Technology and Design Education*, *28*(1), 29–51. https://doi.org/10.1007/s10798-016-9375-y

Turja, L., Endepohls-Ulpe, M., & Chatoney, M. (2009). A conceptual framework for developing the curriculum and delivery of technology education in early childhood. *International Journal of Technology and Design Education*, *19*(4), 353–365. https://doi.org/10.1007/s10798-009-9093-9

Van Laar, E., Van Deursen, A. J., Van Dijk, J. A., & De Haan, J. (2017). The relation between 21st-century skills and digital skills: A systematic literature review. *Computers in Human Behavior*, *72*, 577–588. https://doi.org/10.1016/j.chb.2017.03.010

Vogt, F., Hollenstein, L., & Mueller, K. (2020). *Wir spielen die Zukunft: Gendersensible Freispielimpulse für den Kindergarten zur digitalen Transformation - Beschreibung der Freispielimpulse* [We play the future: Gender sensitive pretend play impulses on digital transformation for kindergarten. Description of pretend play impulses]. : Pädagogische Hochschule St.Gallen. www.weplaythefuture.ch

Vygotsky, L. S. (1967). Play and its role in the mental development of the child. *Journal of Russian and East European Psychology*, *5*(3), 6–18. https://doi.org/10.2753/RPO1061-040505036

Wang, M., & Wegerif, R. (2019). From active-in-behaviour to active-in-thinking in learning with technology. *British Journal of Educational Technology*, *50*(5), 2178–2179. https://doi.org/10.1111/bjet.12874

Weisberg, D. S., Hirsh-Pasek, K., & Golinkoff, R. M. (2013). Guided play: Where curricular goals meet a playful pedagogy. *Mind, Brain, and Education*, *7*(2), 104–112. https://doi.org/10.1111/mbe.12015

World Economic Forum & Accenture. (2017). *Digital transformation initiative. Unlocking $100 trillion for business and society from digital transformation*. https://reports.weforum.org/digital-transformation/wp-content/blogs.dir/94/mp/files/pages/files/dti-executive-summary-website-version.pdf

How to cite this article: Vogt, F., & Hollenstein, L. (2021). Exploring digital transformation through pretend play in kindergarten. *British Journal of Educational Technology*, 52, 2130–2144. https://doi.org/10.1111/bjet.13142