European Journal of Special Needs Education

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/rejs20

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To cite this article: Marja Syrjämäki, Jyrki Reunamo, Henri Pesonen, Raija Pirttimaa & Elina Kontu (2023): The involvement of autistic children in early childhood education, European Journal of Special Needs Education, DOI: 10.1080/08856257.2023.2179310

To link to this article: https://doi.org/10.1080/08856257.2023.2179310

Published online: 17 Feb 2023.

EUROPEAN JOURNAL OF SPECIAL NEEDS EDUCATION
https://doi.org/10.1080/08856257.2023.2179310

The involvement of autistic children in early childhood education

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ABSTRACT

Research on the involvement of autistic children in daily activities in inclusive early childhood education is scarce. In Finland, all children, including autistic children, under the age of seven (before basic education) are entitled to participate in early childhood education and care. Children also attend compulsory, free-of-charge pre-primary education during the year before their basic education begins. Furthermore, attending early childhood education and care is not dependent whether a child requires day care because of their parents' work. Autistic children attend early childhood education in inclusive day care centres. Thus, in this study, we examined the involvement of autistic children by focusing on the objects of their attention during daily activities in inclusive day care centres in Finland. The data were collected between 2017 and 2020, during the research and development project Progressive Feedback, in which children were observed using systematic sampling. The study material consisted of observations of seven autistic children as part of a larger sample of children. The data were analysed using statistical methods. The results indicated that, during their deepest involvement, autistic children expressed positive emotions regarding participation and collaborated with and directed their focus towards other children. Moreover, autistic children demonstrated the most intensive involvement during adult-supported play.

ARTICLE HISTORY
Received 16 November 2022
Accepted 6 February 2023

KEYWORDS
Early childhood education; autism; involvement; social orientations; emotional well-being; play

Introduction

In this article, we look at everyday life in Finnish day care centres focusing on autistic[1] children and their involvement in daily activities. The national core curriculum for early childhood education and care (EDUFI Finnish National Agency for Education 2022) promotes inclusive values and underlines participation, equality and equity as key principles guiding the implementation of early childhood education and care (ECEC).

The educational culture highlights interaction and play as key elements in improving development, learning and well-being for every child. The curriculum (EDUFI 2022) also

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defines the support to be provided for the children's development and learning, as required by the individual child's needs, which is primarily provided as a local service in the child's own ECEC group. In Finland, autistic children with ASC attend ECEC in inclusive day care settings.

Zeidan and colleagues (2022) report the prevalence of autistic children to be 1 per 100. In ECEC, however, young children may not be diagnosed at an early age. In Finnish ECEC, this is something we can only estimate, because diagnostic-based statistics for special education were abandoned in 2011 (Lintuvuori 2015). Likewise, in ECEC, no accurate statistics concerning autistic or any other children with special educational needs (SEN) are available (Suhonen et al. 2017). Most often, autistic children require support in social communication, interaction and processing everyday sensory information (World Health Organization 2019). These support needs make participation and daily life in a group of children challenging.

In our study, the key concept is involvement, which is equated with social orientations, daily activities and observed orientations. Involvement, especially that of autistic children in the context of ECEC, is under-researched. To explore involvement, we therefore analysed observations of everyday situations in Finnish day care centres with a particular focus on child involvement. Our research materials part of a larger research project Progressive Feedback consisting of observations of seven autistic children.

Sense of belonging as a basis of involvement, social orientation and emotional well-being

Children's involvement can be seen as one crucial criterion of quality in early ECEC (Laevers 1994, 2005b). Involvement means an individual's ability and tendency to orient and focus on something with concentration and perseverance. The person involved is deeply motivated and feels satisfaction and positive energy (Laevers 2005a). The basis of involvement can be considered the sense of belonging (see e.g. Pesonen et al. 2017), which refers to the extent to which an individual feels they are accepted, respected and a supported member of a group or community (Baumeister, Leary, and Steinberg 1995), which is one of the most important basic human needs (Maslow 1968). In an ECEC context, the concept refers to the extent to which children feel accepted and supported by other children and adults as well as wanting to be socially connected to their peers (Emilsson and Eek-Karlsson 2021). This fundamental element of feeling a sense of belonging is closely linked to well-being.

When observing individuals, the indicators of emotional well-being are level of concentration, energy, persistence and precision, as well as posture, facial expressions and reactions (Laevers 2005a). Ekman (1992) proposed seven emotions that are universal, arise instinctively and appear in other primates, namely anger, fear, surprise, sadness, disgust, contempt and happiness. The human emotional system responds to environmental threats and opportunities by producing different behaviours, and the facial expressions connected to these reactions signal one's emotional state (Nummenmaa 2017). The basic emotions have remained unchanged during the evolution of the human species; however, one's social environment and emotional experiences shape one's emotional expression (Ekman and Cordaro 2011). Moreover, autistic people's display of emotions may differ from the expressions neurotypical people are used to and can thus become a challenge in

social interaction (Brewer et al. 2015). However, issues related to social situations should be also considered from the perspective of the 'double empathy problem', as this concept suggests that both autistic and neurotypical people have challenges in understanding one another (Milton 2012, 2020). For example, neurotypical people might not know how to read facial expressions during interactions with autistic people (e.g. Milton 2020).

In ECEC, play is important in creating a sense of belonging and thus involvement (see e.g. Pesonen et al. 2017). The involvement generated in play is a basis of development and learning for preschool-aged children (Bodrova and Leong 2015; In play, a child's satisfaction and thus involvement are highly visible (Laevers 2005a). Autistic children are more likely to engage in play that provides pleasurable sensations past the age when this is usually common (e.g. Bodison 2015; Erickson Tomaino, Miltenberger, and Charlop 2014). The most universally documented unique characteristic in autistic children concerns the less apparent forms of symbolic play. They are often object-focused during play and less engaged with other children and adults (Adamson et al. 2009; Kasari, Freeman, and Paparella 2006; Lifter, Mason, and Barton 2011). Pierucci and colleagues (2015) found that no single clear instrument exists to measure the play of autistic children instead, the children's developmental and interaction skills should be considered. Interventions concerning play seem to focus more often on behavioural matters than on interaction and friendship among autistic children and their peers (Chang, Shih, and Kasari 2016). Moreover, it seems that many studies highlight the instrumental value of play for them. The intrinsic value and importance of play in enabling a sense of belonging may often be overlooked (see e.g. Pierucci et al. 2015).

For instance, in a previous study Howard and McInnes (2012) measured involvement and emotional well-being using the Leuvens Involvement Scale (Laevers 1994). They separated 'like play' situations from 'non play' ones based on whether an adult was proximal, observing or present. The placement of children on the floor or around a table also played a role, as did the children's participation level and whether the participation was voluntary or compulsory. The study demonstrated that both involvement and emotional well-being were associated with 'free like play' activities (Howard and McInnes 2012). Likewise, a Norwegian study revealed that children's well-being and involvement have a positive relationship with free play activities and, in contrast, the levels of well-being and involvement were low in less voluntary play situations (Storli and Hansen Sandseter 2019).

The Leuvens Involvement Scale (Laevers 1994) of emotional well-being and involvement is widely used, but Powell and colleagues (2008) offer another way to analyse children's involvement in preschool practices. An eco-behavioural approach combines environmental aspects (e.g. physical arrangements of the classroom and the teacher's pedagogical practices) and children's actions (Powell et al. 2008). Based on observations in 12 early childhood classrooms, both active engagement with focused attention and task-related movement and attentive behaviour characterised by action-oriented observation were identified as involvement. The authors connected active involvement with children's routine activities or play, alone or in peer groups, and with a teacher either monitoring or being distant. Attentive involvement occurred in transitions and activities with the whole group but also in one-on-one situations with a teacher directing or questioning (Powell et al. 2008).

In determining what is important for children, some studies overlooked an important aspect: interaction and peer group interaction in the experience of well-being. Minkkinen (2015) studied child well-being in elementary schools in Finland and Norway and formed a structural model that combines the individual and social elements of well-being. She proposed that the social elements of the school environment impact through subjective experiences, but that collective experiences are also important for individual well-being. Research has revealed that positive social relationships are related to sense of belonging, which can lead to improved well-being (e.g. Pesonen, Kontu, and Pirttimaa 2015).

Objective and research issues

Existing research on autistic children in ECEC has highlighted important perspectives about interventions promoting social skills and communication, play and behavioural matters (e.g. Martinez et al. 2021; Dynia et al. 2020; Rende Berman 2018; Hart Barnett 2018). Another area of research, both internationally and in the Finnish context, has focused on promoting the inclusion and interaction of autistic children (e.g. Kangas, Uusiautti, and Määttä 2011; Olsen et al. 2019). However, research on the involvement of them in daily ECEC activities is scarce. To fill this research gap, the aim of the present study is to explore involvement and its role in ECEC activities, especially concerning autistic children. To conduct the current study, we posed the following questions:

(1) To what extent is children's involvement related to their emotions and social orientations?
(2) How is children's involvement related to their targets of attention and different ECEC activities?

By examining the involvement of autistic children in ECEC, the current study will increase our understanding of an under-studied topic and thus has the potential to improve inclusion practices in ECEC.

Methods

The data are derived from a Finnish ECEC research and development project called Progressive Feedback, in which children were observed by using systematic sampling (see below) between 2017 and 2020. The sampling procedure is explained in detail in the Observation chapter. The total data were collected from 951 ECEC units and considered 3,958 children, including 268 children with SEN and seven with a diagnosis of autism. In the randomly selected sample, children's SEN were reported by the staff (but not to the observer). Each autistic child was found to be observed in a different ECEC unit, and each observed child happened to have a different observer. For the observers, there were no instructions or focus on autistic children, and the selection and observation process was entirely random. The dataset for this study resulted in 141 random observations via which we can study everyday learning processes.

Context of Finnish ECEC

According to the most recent statistics and reports, the percentage of children with SEN varies between 6.6 and 8% (e.g. Pihlaja and Neitola 2017; National Institute of Health and Welfare 2013) Based on the 2022 Law Reform in ECEC, support for learning, development and wellbeing is implemented in the form of general, intensified and special support, following the three-tiered model of basic education (2018, 1998). The fundamental idea is to provide the needed support as soon any need arises and strengthen its intensity, duration and systematisation, while general support moves towards intensified or specific support (EDUFI 2022). In mainstream ECEC groups, the support and special education of autistic children is mostly carried out during part-time co-teaching by the ECEC teacher and an early childhood special education teacher (ECSET) or in consultation with ECSET and ECEC professionals. If the child's best interests so require, they can attend ECEC in integrated special groups, with these being small groups in which children with and without SEN play together and interact every day. A full-time ECSET is employed for these groups (Syrjämäki, Pihlaja, and Sajaniemi 2018).

Participants

In total, there were seven children with a diagnosis of autism in the data. The children's age varied between 59 and 85 months ($M = 70$ months, SD = 7 months). Of the children, five were male, one was female and one child was reported as 'other'; four had an immigrant background. In those classrooms where autistic children were present, the number of children varied from 10 to 27 ($M = 15$ children, SD = 4 children). The children's months of attendance in the ECEC unit varied between nine and 55 months ($M = 18$ months, SD = 6 months). The dataset for this study resulted in 141 random observations via which we can study the everyday learning processes of autistic children. On average, there were 20 random observations for each child.

The data were drawn from 3,958 children, including 268 with SEN and seven with a diagnosis of autism. In the total sample, the children's ages varied between 10 and 87 months ($M = 54$ months, SD = 19 months). The sample was 52.2% male, 47.4% female and 0.4% 'other'. Moreover, 16% of children had an immigrant background, and the number of children in the classrooms varied from eight to 37 ($M = 17$ children, SD = 5 children).

Observation

The observation method has been used in several studies (Nikkola et al., 2022; Reunamo and Alijoki 2014). There were more than 200 observers, who were volunteer teachers recruited by the municipalities. The observers undertook a one-day training course, practised observation in their own group and then spent another day checking the reliability of observations and practical issues arising from them. The actual observing was carried out in different day care centres from those in which the observers knew either the staff or the children; neither did the observers have any information about the children or their background. The observation covers the period from September 2017 to February 2021.

Using systematic sampling, the observers picked five random children from the observed group for observation and made a list of these children. Then, at four-minute intervals, the five children were observed, following the order of the list. After 16 minutes, the cycle began again, with the first child on the list. The four-minute observation cycle consisted of two minutes of preliminary observation, one minute or 30 seconds of actual observation and one minute for coding. The codes were uploaded to an online server. If a child was absent, the next child on the list was observed. One observation session lasted four hours, either 8:00–12:00 or 12:00–16:00. The observation occurred during all activities, including breakfast, learning sessions, play, care, transitions and outdoors. Rest and sleep sessions were omitted from the analysis. Play was, by far, the most frequent activity, including material play with toys, physical play, roleplay and rule play. The children were not aware that they were being observed. The observer did not interfere with the group or individual activities in any way. The staff was not informed of the exact days of observation. The time sampling method was applied to the observation implemented (APA Dictionary of Psychology 2022; Zakszeski, Hojnoski, and Wood 2017).

The observed items included ECEC activities, children's activities, children's main object of attention, involvement, emotions and social orientations (see Reunamo 2007). The reliability of the observation was estimated throughout the observation with paired comparison. Nineteen pairs of observers were randomly selected to carry out the same observations without knowing each other's classifications, totalling 736 observations.

The classification of involvement was based on the Leuven Involvement Scale (Laevers 1994), in which the degree of children's sustaining, creative and energetic processing of their activity is measured on a Likert scale from one to five. A high level of involvement is an indicator of deep processing of the activity and the zone of proximal development (Vygotsky 1978). All table means are based on the Leuven Involvement Scale (Laevers 1994). The reliability of the paired observation (intraclass correlation coefficient, one-way random) for involvement was .756 (CI 719, 789, $p < .0005$).

Social orientation observation categories were based on Reunamo's (2007) categories of accommodative, participative, dominant, non-social and not defined social roles. The Kappa for the social orientation was 40.5% (CI 35.7%, 45.3%, $p < .0005$). Social orientation was defined by openness/closedness and impact/no impact in the context.

The emotion categories were originally based on Ekman's (1992) categories of observable emotions (anger, fear, surprise, sadness, disgust, contempt and happiness) but were later adapted based on the 2015 round of research (e.g. Veijalainen, Reunamo, and Heikkilä 2019). The negative emotions were anger, irritation, frustration, fear, anxiety, sadness and depression. According to the observation instructions, when no emotion could be observed, the emotion was coded as neutral. The positive emotions were joyfulness, happiness, contentment, surprise, alertness, curiousness and enthusiasm. The reliability of the paired observation (Kappa) for emotions was 51.4% (CI .39.1%, 57.6%, $p < .0005$).

Analysis

The differences in the mean values of involvement were tested with variance analysis (univariate general linear model). The reliability of involvement was estimated with

intraclass correlations. The reliability of emotions, ECEC activities and social roles was estimated by Cohen's Kappa. The level of statistical significance was .05, cross-tabulations were used to check the differences in involvement between autistic children and those without autism and the statistical significances of column proportions were tested with adjusted p-values (the Bonferroni method).

Ethics

The Ethical Review Board in the Humanities and Social and Behavioural Sciences at the University of Helsinki reviewed the original research. According to their statement (45/2018), the study met the requirements of the board. Based on the material submitted to it, the board concluded that the planned study followed the guidelines issued by the Research Ethics Advisory Board and was ethically acceptable. The participating municipalities agreed to allow the data to be collected for the research. The educators and directors conducted their evaluation as part of the municipal early education evaluation. The names, groups and units were not collected; nor were the names, birthdays, social security numbers or identifiable guardians of the children. Parents' consent was sought for each observed child. The observation was conducted as part of everyday activities. The research procedures did not affect the children's everyday activities. The observers' training emphasised respecting the children's own feelings and rights.

Results

To help the reader understand the statistics, an example observation is first described. For example, the child is observed outdoors, playing with sand. The ECEC activity category is thus outdoor activity. The child happens not to show any emotion during observation (emotion category is no emotion). The child in the example observation has no contact with other children during the observation (social orientation category is withdrawn). The child focuses on the sand (target of attention category is non-social). The sand activity is routine and repetitive, with no sign of interest (involvement category is low involvement).

Involvement related to emotions and social orientations in ECEC

First, we explored the emotions experienced during the day in ECEC and the relationships between a child's involvement and social aspects in ECEC activities. The observed emotions can be examined as indicators of well-being and involvement. A person also has multiple orientations in different social situations. In Table 1, the mean value of involvement (1–5) is compared between positive, neutral and negative emotions observed in the children. The number of autistic children was seven, and the number of observed

Table 1. The mean involvement in positive, neutral and negative emotions of autistic children (N = 7).

	Mean	Std. Deviation	N
Positive emotion	3.34	1.14	65
Neutral or no observed emotion	2.49	0.99	53
Negative emotion	2.27	1.03	15

Table 2. The mean involvement in different social orientations.

	Mean	Std. Deviation	N
Participates	3.25	1.02	53
Adapts	2.71	1.07	31
Withdraws	2.69	1.24	39
Plays other role	2.50	1.38	6
Dominates	2.25	1.14	12

Table 3. The mean involvement with different targets of attention.

	Mean	Std. Deviation	N
Several children	3.45	1.13	11
Another child	3.18	0.75	11
Non-social	3.07	1.30	44
Adult	2.71	1.17	48
Whole situation	2.41	0.80	27

emotions was 133. Table 2 presents the children's mean involvement in different social orientations.

Positive emotions had the highest mean value of involvement. Children's involvement in various emotions differed statistically significantly from each other, F (2, 130) = 11,949, $p = < .001$. The effect size (η2) was large (.155). In a post hoc test (Tukey), the involvement during positive emotions was statistically significantly higher than that during neutral emotions, $p = < .001$, 95% CI (.3786, 1.3172), and negative emotions, $p = .002$, 95% CI (.3454, 1.7982).

Children's involvement in different social orientations differed statistically significantly, F (4, 141) = 2.977), $p = .022$.The effect size (η2) was intermediate (.081). In the post hoc test (Tukey) the only statistically significant difference between groups was the higher mean involvement of participation in comparison to dominance, $p = .048$, 95% CI (.0064, 1.9842).

Attention, ECEC activities and involvement

The second research question was aimed at the children's target of attention during the activities, routines and pedagogical practices of a day in ECEC as well as their involvement related to those activities. In Table 3, children's mean involvement with different targets of attention varies.

The highest mean in involvement occurred when the autistic children were focusing on a group of children. The second highest mean in involvement was observed when they were focused on another child. The mean differences between groups were statistically significant, F (4, 136) = 2.689, $p < .034$, and the effect size (η2) was intermediate (.073). However, in the post hoc test (Tukey) no statistically significant differences could be detected. The higher mean in the attention to several children is marginally statistically significant in comparison to the whole situation, $p = .075$, CI 95% (−0.0637, 2.1580). In Table 4, we can see how children's mean involvement varies between ECEC activities.

The activity which generated the most involvement was, by far, supported play indoors. This type of play is a mostly child-initiated activity in which the teacher is observing or participating in children's play processes and ready to facilitate children's

Table 4. The mean involvement in different ECEC activities.

	Mean	Std. Deviation	N
Supported play indoors	4.00	0.67	10
Outdoor activity	3.17	1.22	35
Teaching	3.00	1.14	27
Care	2.56	0.92	18
Eating	2.46	0.93	24
Free play indoors	2.44	1.15	27

own processes when support is needed. The differences between the involvement means in different activities were statistically significant, F (5, 135) = 4.634, $p < .001$.The effect size (η2) was large (.146). Based on post hoc test (Tukey), the statistical significance was highest in comparison to free play indoors, $p = .002$, CI 95% (.3976, 2.7190). Supported play elicited higher involvement than eating situations ($p = .003$, CI 95% .3643, 2.7190) and care situations ($p = .012$, CI 95% .2107, 2.6782). The other group differences were not statistically significant. Another finding demonstrated in Table 4 is that although supported play is valuable in terms of well-being and learning, it was the least frequent ECEC activity within our data.

Key findings

As an overview of the results, we highlight the following aspects. First, involvement is related to positive emotions, and the autistic children demonstrated the deepest involvement when participating and collaborating. Second, among the activities in ECEC, the most intensive involvement was observed during adult-supported play. The result indicates that children need teachers' scaffolding in making play processes meaningful. Further, the children were involved at the highest level when their focus was directed to other children or an individual child. This result shows that peer relations may be the most important relations for the well-being and learning of autistic children.

Discussion

In this study, we examined autistic children and their involvement in ECEC in Finland, with involvement defined as sustained intense activity with concentration, creativity, energy, and persistence (Laevers 2005a). We were interested in children's observed emotions and social orientations, daily activities and routines and object of attention, which were studied in relation to their involvement. According to Laevers (2005a), involved children demonstrate their potential and operate at the limits of their capabilities. Those relationships, introduced as the findings of our study, also described the well-being of the children in our study and the depth of their learning processes (see Laevers 1994).

Autistic children demonstrated deeper involvement in their activities when they were observed to have positive emotions. It has been found that when an activity is meaningful to a child and they progress well, the child uses their full potential, and the process generates meaningful learning experiences and well-being (Laevers 2005a). The social context is also important. Based on the findings of this study, autistic children indicated a higher level of involvement during participative roles than in dominant roles, in particular. In such participative roles, participation can mean being heard, receiving

support and feeling a sense of belonging. Perhaps this type of participation can also be seen as offering various ways of interacting with others. For example, interacting with other children does not necessarily have to include direct social contact. Previous research has suggested that autistic individuals enjoy and benefit from activities that do not require direct social interaction but can lead to an improved sense of belonging and well-being (e.g. Pesonen, Kontu, and Pirttimaa 2015; Pesonen et al. 2021; Pesonen and Nieminen 2021). Instead, children feel that they belong when they are surrounded by their peers and perform activities (e.g. play) that allow them to be in social interactions that may not be considered direct in nature (see also Pesonen, Kontu, and Pirttimaa 2015).

In our study, we also discovered that peer relationships seem to play a key role in promoting involvement and, thus, well-being and learning. Our findings demonstrated that autistic children were most involved in their activities when they were oriented towards several children or just one child at a time; indeed, they were even more involved in such activities than those in relation to adults, non-social objectives or the situation overall. This is an interesting finding, as previous studies have shown that autistic children (Chang, Shih, and Kasari 2016), as well as those with SEN generally (Broomhead 2019), have fewer experiences of social interaction with neurotypical peers. Thus, this finding suggests, in alignment with earlier studies, that ECEC professionals must provide systematic support for the interaction and social skills of the individual child and the group as a whole (Broomhead 2019; Chang, Shih, and Kasari 2016).

Furthermore, our findings indicate that autistic children were the most involved in adult-supported play situations. In such play, the teacher is not merely playing with the child but, rather, is ready to enrich children's processes and scaffold the interaction within the play (Reunamo et al. 2013; see also Syrjämäki, Pihlaja, and Sajaniemi 2018). In play, a sensitive teacher identifies the children's intentions, both in the group and at the individual level, and the responses to them and connects their processes with learning and participation (Acar, Hong, and ChaoRong 2017; Syrjämäki, Pihlaja, and Sajaniemi 2019). For example, the characteristics of autism are unique for each child and may manifest in multiple ways in terms of their everyday life in ECEC (see also Kalliala 2014). Thus, sensitivity is a key concept when examining the ECEC professional's ability to support an individual's play as part of a group of children (Kalliala 2011). A professional adult is sensitive when observing children to identify their emotional needs and interaction initiatives and able to steer a single child towards peers and peer interaction (Syrjämäki, Pihlaja, and Sajaniemi 2018). Such a professional moves flexibly between pedagogical guidance methods, observing the play from the outside and sometimes actively participating in it (Syrjämäki, Pihlaja, and Sajaniemi 2018; see also Fleer 2015). The sensitive teacher also takes note of the abovementioned unique ways to play and interact. Overall, the described sensitivity can also be seen in the context of the double empathy problem, as the sensitive adult is bridging the gap between autistic and neurotypical individuals, who may have challenges in understanding each other (see Milton 2012; Milton, 2020). Furthermore, our findings strongly support the idea that the play activities of autistic children require support from ECEC professionals, which is unquestionably important in early education.

Limitations and future directions

Although our study contributes to the literature, a few limitations should be considered. First, the study included only a small number of autistic children in the dataset. Therefore, we are not seeking generalisations; rather, we intend to highlight new aspects related to the involvement of autistic children in the ECEC context. Second, our paper used a wide range of data that were not collected specifically for the purposes of this study, suggesting the need for further studies. Future research should consider whether a deeper and longer-term observation of autistic children utilising qualitative data and methods would provide broader information about children's involvement, interaction and play in an ECEC setting. A more detailed study of pedagogy that could strengthen the commitment and interaction of ECEC professionals is also an important research topic.

Based on our findings, adult-supported play is the least frequent activity among autistic children. Therefore, we strongly recommend that ECEC professionals be aware of the importance of interactive, supported play. We suggest that children can deepen their zone of proximal development (Vygotsky 1978) by integrating the views and ideas of others in their own interaction in a way that does not necessarily require direct social interaction. For all children, but for autistic in particular, finding and enabling diverse ways of social interaction and participation is crucial (see Chang and Shire 2019). During supported play, children and teachers meet in the process of creating new play worlds and, moreover, find diverse ways to strengthen peer interaction in an ECEC child group. This shared creation may be the most important skill an autistic child – or any child – needs.

Note

1. In this article, we use identity-first language, as is preferred by many autistic people. (Kenny et al. 2016; National Autistic Society 2023).

Disclosure statement

No potential conflict of interest was reported by the authors.

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