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Development and psychometric properties of nomination scales for high academic potential in early childhood education and care

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ABSTRACT

This paper describes the development of two nomination scales designed to measure parents' and teachers' perceptions of high academic potential among young children, and how the scores correlate with assessed high potential. Parents and teachers of 243 children (49% girls) taking part in the research project 'Skoleklar' responded to written surveys, and children were evaluated with specially designed assessments on tablet computers. Principal component analyses and confirmatory factor analyses revealed a seven-item solution for the teachers' nomination scale and a four-item solution for the parents' nominations scale that fitted the data well, and that correlated in the expected direction with assessed potential. The teacher scale had stronger correlations with assessed potential than the parent scale. Implications for practice and future research are discussed.

KEYWORDS

Perceived potential; assessed potential; Early Childhood Education and Care (ECEC); nomination scales; scale validation

Introduction

Children with high academic potential in preschool have a much faster rate of cognitive development than their peers (Clark 2007; Porter 2005), and ignoring early identification and support for these children can lead to social, emotional and academic problems (Kuo et al. 2010; Pfeiffer and Stocking 2000; Sankar-DeLeeuw 1999). This paper describes the development of two nomination scales designed to measure parents' and teachers' perceptions of high academic potential among young children, evaluates the correlations of these scale scores with assessed high potential, and presents the resulting scales as a support for the process of identifying and understanding individual cognitive differences among children in early childhood education.

Scales and screening assessments are parts of a complex assessment process. Best practices for assessment of high academic potential in young children recommend the use of developmentally appropriate assessment instruments as screeners before further

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assessment is implemented (Davis, Rimm, and Siegle 2013; Morrison 2014; Pfeiffer 2002). An effective universal screening phase has practical advantages. It can reduce the costs and time devoted to assessment, as well as result in fewer missed students compared to traditional identification approaches (Card and Giuliano 2016; McBee, Peters, and Miller 2016; Qaseem et al. 2012). Parent and teacher nomination scales have been the most commonly used mechanisms for the screening of academic potential (Callahan, Moon, and Oh 2013; McBee 2006; Peters and Gentry 2013). However, despite many examples of such instruments in the literature, descriptions of well designed, psychometrically sound identification instruments for the identification of high academic potential among the youngest children remain scarce (Hertzog 2013; Morrison 2014). This is especially true in the Norwegian Early Childhood Education and Care (ECEC) context. Within this system of universal ECEC, recent educational policies are only just beginning to recognize the special needs of children with exceptional academic potential, and to recommend that early childhood educators support their development (Jøsendal 2016; Norwegian Ministry of Education 2020).

Therefore, our study aims to present some fundamental aspects for the development and validation of an early childhood high potential screening instrument based on parent and teacher nominations. These screening instruments are intended to be cautiously used as a first step in a more complex identification strategy in early childhood education and care centres, when required.

Early identification of high potential

Even though early identification of high potential is considered important (Dowdall and Colangelo 1982; Hertzog 2013; Kuo et al. 2010) and has been shown to reduce the risk of developing social, emotional and educational problems (Kuo et al. 2010; Pfeiffer and Stocking 2000), it is not without its concerns (Lakin and Lohman 2011; Lee and Olszewski-Kubilius 2006; Lohman 2005). Questions around what to identify, how to identify, and at what stage of the child's development such identification is most appropriate, are examples of the questions that continue to trouble the field (Erwin and Worrell 2012; McClain and Pfeiffer 2012; McKenzie 1986). Such questions are important, have consequences for how we choose to identify young children with high academic potential, and ultimately for the type of support we provide for identified children.

Various terms are used in the literature for labelling children with high potential, including but not limited to 'gifted', 'precocious', 'bright' and 'talented'. These terms are not necessarily synonymous, since they possess differing connotations and relate to different theoretical conceptions. In the present study, we have chosen to use the term 'high academic potential', indicating that children can show a high potential in intellectual abilities, but that only through identification and stimulation from the environment can this high potential develop. This is aligned with Gagné's (2005) theoretical model which suggests that high potential exists along a continuum, but can only lead to high performance and achievement when it is identified and provided with optimal conditions for development. Children with high potential are those whose potential exceeds that of children of the same age. These children should be identified and stimulated with learning opportunities beyond the typical level of their age peers (Idsøe 2019; Subotnik,

Olszewski-Kubilius, and Worrell 2011). Current practices for the identification of high academic potential indicate that effective identification systems should employ multiple criteria and non-traditional measures such as teacher and parent nominations, peer nominations, assessments of creativity and nonverbal assessments (Davis, Rimm, and Siegle 2013; Lohman and Foley Nicpon 2012; Pfeiffer and Blei 2008).

Nominations from parents and teachers are important and supplement each other. Parents observe early patterns in speech development, literacy, and numeracy, and parent nominations can, therefore, be a powerful and valid predictor of academic ability (Louis and Lewis 1992; Worthington 2001). However, teachers' input is also very important in the process of discovering high potential (Pfeiffer 2015; Pfeiffer and Blei 2008) as their contact with groups of children allows them to identify potential that stands out as exceptional. Parents and teachers also tend to observe different developmental stages, with parents observing the earliest years and ECEC teachers observing the comparative development as children approach school age. In the present study, parents evaluated the child's development during the first 3 years, and teachers evaluated the child's comparative development in kindergarten.

The Norwegian Early Childhood Education and Care (ECEC) system

In Norway, all children aged 1–5 are offered a place in publicly regulated and subsidized ECEC centres. ECEC attendance is high, with an enrolment rate of 97% among children aged 5 years. The Norwegian Framework Plan for Kindergartens (Norwegian Directorate for Education and Training 2017) regulates the pedagogical content of ECEC, which focuses on holistic development through care, play, and learning. Norwegian ECEC centres are characterized by a social pedagogical tradition, and not the school readiness approach that is seen in other countries (Bennett and Tayler 2006). However, the Scandinavian social pedagogical tradition may be moving towards integration with a social investment view of ECEC, where perspectives on children's future possibilities and interests, and the intrinsic value of childhood, can be combined (Tuastad, Bjørnestad, and Alvestad 2019). Free play and outdoor activities are highly prioritized in Norwegian ECEC, and the share of such activities during a typical day is very high (Karlsen and Lekhal 2019; Moser and Martinsen 2010). Less time is therefore given to intentional pedagogical activities. Within this tradition, the assessment of children's early potential is very uncommon.

In conclusion, although different identification strategies have been used and promoted in the literature, there has been ongoing disagreement about whether teachers, parents, IQ tests, or some combination of the three, is the most reliable and valid approach (Ciha et al. 1974; Cornish 1968; Gear 1976; Gottfried, Gottfried, and Guerin 2009; Hodge and Kemp 2006; Silverman, Chitwood, and Waters 1986). These instruments have, however, rarely been used, or their use evaluated, with pre-primary-aged children. Furthermore, no such instruments have been applied or evaluated in the Norwegian context. As early identification and educational support is important for the engagement and later educational success of students with high academic abilities, there is an urgent need to evaluate the reliability and validity of different, cost effective, and non-intrusive mechanisms for the screening and early identification of high academic potential.

Aim of this paper

This paper aims to discuss the development and psychometric properties of two nomination scales based on parents' and teachers' perceptions of high academic potential in pre-schoolers within the Norwegian context. In addition, we investigate the relationship between parents' and teachers' perceptions of high potential and directly assessed potential (early vocabulary and math skills) among the young children in this study.

Method

Sample and procedure

Data for this study came from the research project 'Skoleklar' ('School readiness'). All children in the last year of ECEC from one municipality ($N = 287$) were invited to participate in the study. The parental consent process resulted in a final sample of 243 children (49% girls, mean age 5.8 years). The sample is relatively representative of the Norwegian population and is more fully described elsewhere (Lenes et al. 2020; Størksen et al. 2015). Parents and teachers responded to written surveys, and the assessments of the children were administered on tablet computers by assistants who received 2 days training in the application of the assessments with young children. The training focused on technical issues and procedures to ensure reliability, as well as effective child-friendly assessment. The study was approved by the Norwegian Centre for Research Data.

Instruments

Development procedures of nomination scales

There are many definitions and perspectives on giftedness as a multidimensional concept (Subotnik, Olszewski-Kubilius, and Worrell 2012). For our study, we choose to focus on high cognitive or academic potential in early childhood. We believe other areas of childhood potential, such as creativity or artistic potential, are also important, but fall outside the scope of this study. Our intention is not for these scales to be used to select children for a special advanced program, but rather to learn more about these children and their pedagogical needs, to create a learning environment that maximizes their growth opportunities.

Multiple steps were taken to develop the nomination scales presented in this study. There are three phases recommended for creating a rigorous scale – item development, scale development and scale evaluation (Boateng et al. 2018; Hinkin 1995). We first reviewed the literature in the field and examined the existing rating scales for high ability in preschool children, such as the gifted rating scales GRS-P and SIGS (Pfeiffer, Petscher, and Jarosewich 2007; Ryser and McConnell 2004). These home and preschool rating scales assess children's abilities in seven different domains, each of these assessed with a 12–18 items scale. We modified these scales into local screening instruments for parents and teachers, because the Norwegian ECEC system does not include cognitive tasks that could reveal high intellectual abilities among these children. We also opted for a shorter version compared to the existing instruments, as this investigation was part of a larger research project and had limited time designated for this identification process.

The second step consisted in selecting and adapting and/or creating an initial pool of items that would indicate advanced cognitive development in the nomination scales. These items were developed after examining the characteristics identified by professionals in the field (Clark 2007; Frasier 1995; Pfeiffer, Petscher, and Jarosewich 2007; Piirto 1999; Ryser and McConnell 2004; Terman 1925). We selected teacher items that reported current information on the child's observed abilities in everyday ECEC context, and parent items that focused on parents' unique knowledge of their child's early development (0–3 years). This resulted in an initial set of 40 items.

To attain preliminary feedback on the initial set of 40 items, we conducted a series of qualitative interviews with 2 specialists in child development, 2 caregivers and 3 parents leading the Norwegian association for parents of gifted children 'Lykkelige barn' ('Happy children'). There were no other Norwegian 'specialists' in the gifted field at the time we made the scales. We removed the items that did not fit with the Norwegian ECEC context and with the overall purpose of the project.

Based on this feedback from child specialists, caregivers and parents, the teacher questionnaire was reduced to 10 questions on the teacher's perception of the child's academic potential that were answered with a Likert scale from 1 (incorrect) to 4 (correct). These 10 questions are reproduced in Appendix A. The parent questionnaire was reduced to 6 questions on the parent's perceptions of their child's early development that were answered with a Likert scale from 1 (strongly disagree) to 5 (strongly agree). These six questions are reproduced in Appendix B. These two scales are investigated for their psychometric properties in the following sections.

Early use of advanced vocabulary and early mathematical skills are among the most common characteristics of gifted pre-schoolers (Clark 2007; Porter 2005; Smutny 1998). Intelligence tests developed for this age include vocabulary, mathematics and other cognitive tasks (see, e.g. Lohman [2011] and Wechsler [2014]). Based on these examples, we used a vocabulary test and a mathematical skills test as the criteria for validation of our nomination scales.

Vocabulary test

We used the Norwegian Vocabulary Test (NVT) (Størksen et al. 2013) to measure vocabulary ability. In this test, children were shown 45 different pictures on a tablet screen and instructed to give the names of each as they appeared (Cronbach's Alpha = .842).

Mathematical skills test

We assessed kindergarten mathematical skills with the Ani Banani Math Test (ABMT) (ten Braak and Størksen 2021). This test consisted of 18 items targeting numeracy, geometry and problem solving. The tasks are playfully based on children helping a little monkey with activities such as counting toys and identifying geometrical objects on a computer tablet (Cronbach's Alpha = .740).

Analyses

We applied a model validation technique by partitioning our data into two random subsets, consisting of approximately 50% of the total sample in each. In the first sample (sub-sample 1), we conducted principal components analyses (PCA) with extraction based on

eigenvalues >1 and oblique rotation (Varimax resulted in the same conclusions). In our second sample (sub-sample 2), we used confirmatory factor analyses (CFA) to evaluate how well the factor models developed with sub-sample 1 generalized to an independent dataset. In addition to these analyses of factorial validity, we investigated concurrent validity by calculating the correlations between the observed total scores of the parent and teacher nomination scales and the observed scores of the ABMT and NVT at the same time point. Descriptive analyses, PCA and correlational analyses were carried out in SPSS (IBM 2019). CFA was conducted in Mplus (Muthén and Muthén 2014), and the models were fit to the data with a robust maximum likelihood procedure (MLR). The goodness of fit was evaluated with the Tucker–Lewis Index (TLI), the Confirmatory Fit Index (CFI) (≥.95), RMSEA (≤.06) and SRMR (≤.08) (Hu and Bentler 1999). Residual covariances were allowed between items if they had similar wording and/or content and revealed problems if constrained (modification index >10.0). We used the full-information MLR estimator in Mplus to account for missing data (Enders 2010; Graham 2009).

Results

Principal component analyses

Ten questions were developed to assess teachers' perceptions of the child's academic potential (Appendix A). The scoring format was a four-point Likert scale ranging from 1 (incorrect) to 4 (correct). We conducted exploratory analyses on sub-sample 1 (a random sample consisting of approximately 50% of the full sample). Principal component analysis with Varimax rotation revealed a three-factor solution (eigenvalues > 1). Seven of the items had loadings on one factor, and inspection of the item content indicated a solution where the other three redundant items were dropped. The seven-item solution resulted in a one-factor solution with loadings ranging from .66 to .83. These items are displayed in Table 1.

Six questions were administered to the parents to measure their perceptions of their child's early development (Appendix B). The scoring format was a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Principal component analysis based on sub-sample 1 revealed a two-factor solution where four of the items loaded on a single factor. Inspection of item content indicated the retention of the four items that loaded on the same factor, and this resulted in a one-factor solution with loadings ranging from .60 to .81. These items are displayed in Table 1.

Confirmatory factor analyses

To evaluate whether the solutions obtained from the principal component analyses on sub-sample 1 could be replicated in sub-sample 2, confirmatory factor analyses were conducted. The goodness of fit for seven-item solution for teacher nominations was fair according to some criteria, CFI = .94; TLI = .91; SRMR = .048, but was inadequate according to the RMSEA = .092, 90% CI (.041, .014). However, the inspection of the modification index suggested freely estimating the residual covariation between two items that shared common substantive meaning ('The child can already write and read' and 'The child can solve a puzzle meant for older children'). By estimating this parameter, the model resulted in a close fit to the data, RMSEA = .057, 90% CI (.000, .011); CFI = .98; TLI = .97; SRMR = .037.

Table 1. Item content and descriptive statistics for the observed scores on the teacher nomination and parent nomination scales.

Item	M	SD	SK	KT
Teacher Nomination Scale (scored from 1 to 4)				
The child can already write and read	2.01	0.84	0.49	2.59
The child shows early interest in geography, the universe, and nature or other topics	2.64	1.00	−0.17	1.98
The child can create interesting and unusual shapes with different materials	2.90	1.00	−0.40	2.00
The child can solve a puzzle meant for older children	2.86	1.04	−0.48	2.03
The child understands abstract concepts like the meaning of 'death' or the meaning of 'time'	3.00	0.88	−0.51	2.46
The child learns new skills without much training and repetition	3.19	0.88	−0.72	2.48
The child asks many questions and gives many comments to adults	3.08	0.98	−0.68	2.30
Parent Nomination Scale (scored from 1 to 5)				
The child learnt to speak early (e.g. first words around 6 months, first sentence around 12 months, and simple conversations around 18 months)	3.40	1.24	−0.31	2.01
The child had many questions about concepts before the age of three	3.58	1.08	−0.45	2.63
The child has a high level of concentration (e.g. the child spent much time playing alone with a toy or looking in a picture book before 2 years old)	3.48	1.13	−0.35	2.33
The child learned to read and write quite early (around the age of three)	1.80	0.90	1.25	4.50

Note: M = Mean, SD = Standard Deviation, SK = Skewness, KT = Kurtosis.
The Teacher Nomination Scale was scored from 1 (incorrect) to 4 (correct). The Parent Nomination Scale was scored from 1 (strongly disagree) to 5 (strongly agree).

The four-item solution for parent nominations was a good fit for the data as it was fully saturated. Finally, we tested a two-factor solution for the teacher and parent scales together. This model resulted in a very good fit to the data, RMSEA = .025, 90% CI (.000, .068); CFI = .99; TLI = .99; SRMR = .048; see Figure 1. The correlation between the two factors was moderate and significant ($r = .33$, $p < .05$).

Concurrent validity

The zero-order correlations between the teacher nomination scale and parent nomination scale scores and the two hypothesized concurrent covariates (vocabulary and mathematics) are presented in Table 2. As can be observed, teachers' perceptions of academic achievement have a higher correlation with the two criteria variables (vocabulary: $r = .44$; mathematics: $r = .46$) than parents' perceptions of early development (vocabulary: $r = .31$; mathematics: $r = .22$).

Discussion

In this study, we investigated the psychometric properties of teacher and parent nomination scales for high academic potential among children in Early Childhood Education

Table 2. Zero-order correlations and descriptive statistics, teacher, and parent nomination scales, vocabulary and mathematics.

Variable	1	2	3	4	M	SD	SK	KT
1. Teacher nomination	–				2.81	.68	−.53	2.57
2. Parent nomination	.26**	–			3.06	.79	−.10	2.70
3. NVT	.44**	.31**	–		26.35	5.70	−.42	2.86
4. ABMT	.46**	.22**	.46**	–	10.62	3.13	−.32	2.83

Note: M = Mean, SD = Standard Deviation, SK = Skewness, KT = Kurtosis, ABMT = Ani Banani Math Test. NVT = Norwegian Vocabulary Test, ** $p < .05$.

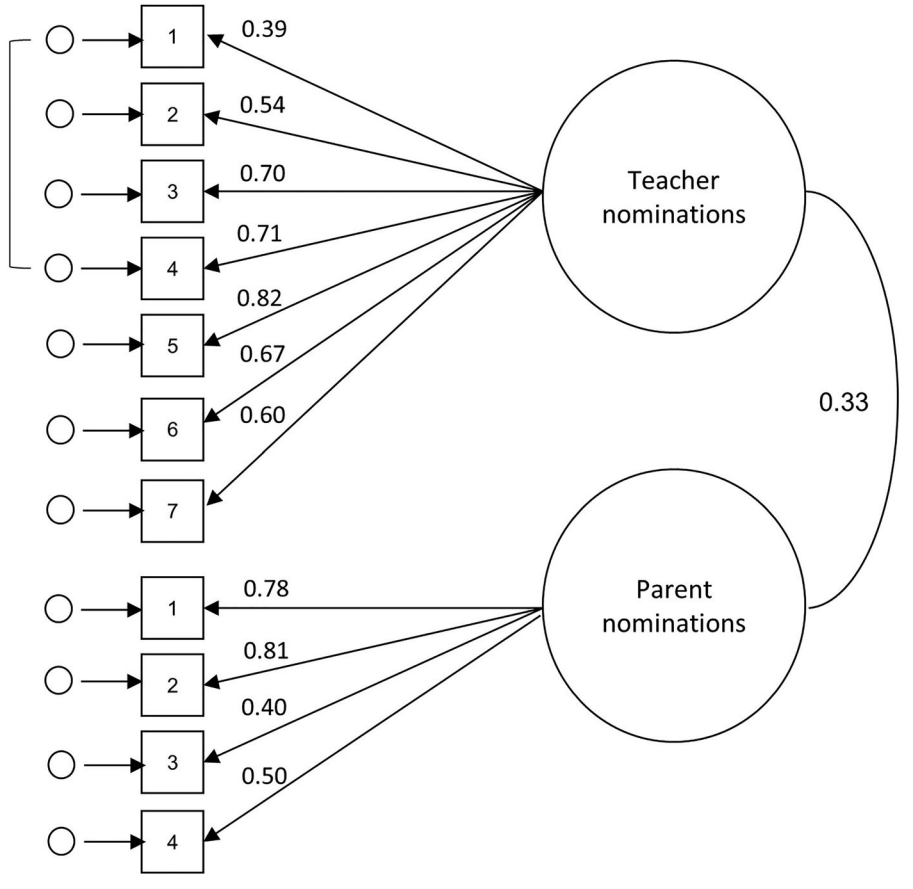

Figure 1. Confirmatory factor analysis for teachers' perceptions of the child's academic potential and parents' perceptions of early development.

Note. Goodness of fit: RMSEA = .025, 90% CI (.000, .068); CFI = .99; TLI = .99; SRMR = .048.

and Care in Norway. Principal component analyses and confirmatory factor analyses revealed a seven-item solution for teachers and a four-item solution for parents that were a good fit for the data. The two scales for perceived high academic potential correlated in the expected direction with assessed potential in mathematics and vocabulary, with the teacher scale showing stronger correlations. This may indicate that the teacher scale is better for screening purposes. However, it is important to note that the parent items related to children's early development (0–3 years) whereas the teacher items related to children's current development (in their final year of ECEC, and at the same time as their potential in mathematics and vocabulary were assessed). Future research may reveal how well the two nomination scales predict future development for the children, and whether they identify different aspects of childhood potential that may emerge over time.

The two nomination scales showed only a modest association with each other. This may be because our scales related to different developmental stages. They also only showed modest correlations with the two criteria variables. But maybe this is as high

as we could expect, as Norwegian children do not receive formal school readiness interventions, making it more difficult for the teachers to evaluate their academic potential. Regardless, we believe that our findings demonstrate that several sources of nomination information and scales should be used together for screening young children for high academic potential, and the characteristics of these scales support that belief.

Our findings suggest that the two scales can function as screening instruments when used together as part of a more comprehensive assessment procedure, contributing independent information to an identification strategy for high academic potential in ECEC. Children with high potential are a heterogeneous group that is not easily defined or assessed and will be best identified through diverse assessments. Research points to the importance of early identification and support to ensure optimal cognitive and emotional growth among these children (Kuo et al. 2010), and there is a call in the literature for technically sound, easy to use, and non-intrusive instruments for early academic identification (Hertzog 2013; McBee et al. 2016; Morrison 2014). Our study, therefore, contributes to the field by providing two valid nomination scales. This is especially important for the Norwegian context where recent educational policies have expressed the expectation that kindergartens will identify and support the needs of high potential children in preschool, but where no valid screening instruments have existed (Norwegian Ministry of Education 2020).

In our study, teachers' judgement seems to be more accurate than parents' in predicting children's high academic potential in preschool. The literature on these issues is mixed (Galindo and Sheldon 2012; Hodge and Kemp 2006; Silverman et al. 1986; Worthington 2001). Our findings contradict previous studies suggesting that teachers are not able to make valid judgments in this area (Fatouros 1986; Hadaway and Marek-Schroer 1992) and add to the empirical support of teachers as able nominators (Pfeiffer and Petscher 2008).

Both parents and teachers desire to develop children's potential and cultivate their capacity and passion for learning. Combining the information from both perspectives, together with information from other identification instruments, will be a first step towards understanding the needs of these children. Providing the opportunities for all children to develop according to their potential, and to demonstrate advanced learning behaviour where appropriate, should be the next step. Rich and responsive environments in early childhood education will support this cognitive and affective growth and will establish patterns of successful learning that continue throughout children's life (Kuo et al. 2010).

Limitations

These scales do not explore growth and development but are a measure of static information at an early age. As learning is dynamic and uneven for every child, assessment should be ongoing and flexible. The findings from this study indicate that these nomination scales should, therefore, be carefully used and only as an initial screening in a complex and ongoing identification process.

The sample in our study is Norwegian and moderately small, and at this preliminary stage, does not result in findings that are generalizable to any other than similar groups of children. However, as this study presents two short and easy to administer nomination

instruments, they can be easily replicated and validated with larger samples, including children of other cultures and demographic characteristics, in the future.

Implications for future research and practice

These scales can be cautiously used as an initial screening step in the early identification of academic talent in young children. They can also be combined, and complemented with other screening instruments, for even more reliable screening. Future research should explore the mechanisms for the combination of scales, and the validity of combined measures for more accurate screening and identification.

The present parent and teacher scales could be valuable for a variety of research purposes both nationally and internationally. The scales are short and simple to administer, and further research should validate them with larger samples. In addition, future longitudinal studies could explore how the scales predict the developmental trajectory of high potential. The results from this study enhance our understanding of children with high academic potential, and future research could explore mechanisms for the identification of students with unique talents in other areas, and with other needs that may require pedagogical adjustments. This in turn will support the urgent call for educational policies that facilitate the development of rich and supportive playful learning environments that promote the holistic development of all children in the Norwegian ECEC sector.

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Appendix

Appendix A: Pool of teacher items before factor analytic procedures

1. The child can already write and read
2. The child prefers younger or older peers
3. The child shows early interest in geography, the universe, and nature or other topics
4. The child can create interesting and unusual shapes with different materials
5. The child can solve a puzzle meant for older children
6. The child understands abstract concepts like the meaning of 'death' or the meaning of 'time'
7. The child learns new skills without much training and repetition
8. The child asks many questions and gives many comments to adults
9. The child is occupied with concepts such as justice
10. The child is sensitive and sympathetic with others

Appendix B: Pool of parent items before factor analytic procedures

1. The child learnt to speak early (e.g. first words around 6 months, first sentence around 12 months, and simple conversations around 18 months)
2. The child had many questions about concepts before the age of 3
3. The child has a high level of concentration (e.g. the child spent much time playing alone with a toy or looking in a picture book before 2 years old)
4. The child learned to read and write quite early (around the age of 3)
5. The child needs less sleep than others
6. The child displayed early motor skills