Preschool education quality in Russia: Trends and relations

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Abstract

The results of a Russian national study of the quality of preschool education (2016–2017, $N_{kindergartens}$ = 1,301) are discussed with a focus on possible predictors of quality dynamics on the relations between Early Childhood Environment Rating Scale–Revised scores and group size, number of teachers in a group, child/adult ratio, teachers' qualifications and working experience, and enrollment of teachers into in-service training. The child/adult ratio was found to be a stronger predictor of process quality than the group size and the number of teachers. No connection was revealed between process quality and teachers' age and working experience. The impact of in-service training depends on the evidence-based orientation.

Keywords

preschool education; quality evaluation; structure quality; process quality; group size; number of teachers; child/adult ratio; qualification; in-service training; working experience; age

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Introduction and the focus of the study

The quality of preschool education[1] is one of the key factors of successful child development (Barker, 2015; Melhuish et al., 2008; Schweinhart et al., 2005; Sheridan & Pramling Samuelsson, 2013; Sylva et al., 2013). A study of preschool education quality in 2016 revealed both strong and deficient aspects of Russian preschools (Remorenko et al., 2017). In this regard, the question about the factors that can affect the improvement of preschool education quality is our current interest.

From this perspective, one of the research focuses is the analysis of the connection between "structure quality" and "process quality" in preschool education. Structure quality is the conditions that are created for children and teachers at different levels: at the level of the country's education system (e.g., national regulations), at the institutional level (e.g., organizational culture, administration of the program, management style, provision for professional growth of teachers, budgeting), at the level of a classroom (e.g., group size, child/adult ratio, floor area in the classroom), and at the staff level (e.g., qualifications, working experience, professional skills; Early et al., 2005; Slot, 2018). Process quality is the quality of adult–child interaction and the accessibility of various materials and equipment for children.

The focus of the present study is the connection between structure quality and process quality. It is important to discover what factors determine process quality in preschool education.

Relationship between structure quality and process quality in preschool education, according to current research data

Several recent cross-cultural studies show common trends in the development of the idea of preschool education quality in different countries (Sheridan, Williams, & Pramling Samuelsson., 2014; Slot, Lerkkanen, & Leseman, 2015). Consequently, research data for the connection between structure and process qualities from different countries can be used for a better understanding of common mechanisms of preschool education quality development (Cassidy et al., 2005).

Structure and process qualities represent the variables whose relations are vital for improving preschool education quality. Currently, there are many studies of the relationship between these parameters, which are an important context for our research.

Structure quality and children's outcomes

A number of studies underscore the relationship between structure quality (characteristics such as child/adult ratio, the vocational training background of the teacher, etc.) and children's performance (Bauchmüller, Gørtz, & Rasmussen, 2014; Belolutskaya & Veraksa, 2018; Gavrilova, Veraksa, & Bukhalenkova, 2018; Pramling Samuelsson, Williams, & Sheridan, 2015; Skalická, Belsky, Stenseng, & Wichstrøm, 2015). A famous British longitudinal study presented a significant correlation between teachers' qualifications and children's performance. This connection was even more obvious when the qualifications of the preschool administrator was in focus (Sylva, Melhuish, Sammons, Siraj-Blatchford & Taggart., 2004). A study in the U.S. (of 2,439 children from 671 kindergartens in 11 states) revealed that professional training and curriculum quality

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contribute to better school readiness (Mashburn, 2008). A Danish study (Bauchmüller et al., 2014) showed that having a higher proportion of male teachers has a positive effect on the results of the final test in Danish primary schools.

Nevertheless, researchers point out that, often, direct links between structure quality and child development are not statistically significant (Bowne, Magnuson, Schindler, Duncan, & Yoshikawa, 2017; Organisation for Economic Co-operation and Development [OECD], 2011; Sabol, Soliday, Pianta, & Burchinal, 2013; Slot, Bleses, Justice, Markussen-Brown, & Højen, 2018). The data from one of the studies, by Sabol et al. (2013), seems important for us in this context—that is, in the analysis of the relation between kindergarten ratings (such as the Quality Rating and Improvement System [QRIS], which currently exists in a number of US states) and children's literacy outcomes. The study found a lack of such links in almost all areas, which allowed the authors to conclude that there is a need for a serious analysis of the parameters included in such ratings (Sabol et al., 2013).

Bowne et al. (2017) conducted a meta-analysis of studies that revealed the relationship between the two most widely used parameters of structural quality (the number of children in the group and the child/adult ratio) and children's outcomes in US elementary schools from 1960 to 2007. The results of the meta-analysis do not allow us to say that the group size or child/adult ratio predict children's school success. If such connections exist, they are nonlinear. At the same time, the authors of the meta-analysis noted that, in a 1979 study, it was found that 18 children per group is the limit after which there is a negative effect on quality (even at an optimal child/adult ratio of 9:1). The most common conclusion is that the relationship between structural quality and child development is mediated by the quality of the process—in particular, the quality of educational curricula and the competence of the teachers (Lipsey & Farran, 2016; National Institute of Child Health and Human Development Early Child Care Research Network, 2002). In particular, the British longitudinal Effective Pre-School, Primary and Secondary Education (EPPSE) project showed a steady interrelation between the amount of time a child attended kindergarten and their achievements at school. At the same time, an American study also discovered a connection between those two factors—though it was found to be unsteady (i.e., differences disappeared at Grade 3). All this suggests that what matters is not only the period in which a child is enrolled a preschool program but also the quality of that program (Lipsey & Farran, 2016; Sylva et al., 2004).

Process quality and children's outcomes

The links between the quality of the educational process and children's outcomes are more obvious in some recent studies. Most consistently, this relationship was traced in the EPPSE project (about 3,000 children). The quality of the process was measured using the Early Childhood Environment Rating Scale–Revised (ECERS-R) and Early Childhood Environment Rating Scale Curricular Extension (ECERS-E). Children's outcomes were assessed using the British Ability Scales II (block building, picture similarities, verbal comprehension, and naming vocabulary); on this basis, each child received a general cognitive ability score, and then—using standardized tests—got scores in reading and mathematics (Melhuish et al., 2008; Sylva et al., 2013). Also, we note that these studies allowed us to establish the fact that high-quality preschool education is a particularly significant developmental factor for children within the risk zone (i.e., children with disabilities or for whom English is not their mother tongue). A

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kindergarten with a high-quality educational process partially compensates for developmental disorders and reduces the risk of misbehavior (Melhuish, 2004; Sylva et al., 2004). Similar data were obtained in a German study (547 children from 97 kindergartens), in which it was also found that, in kindergartens with higher ECERS-R and ECERS-E scores, children demonstrated better readiness for school (based on such parameters as oral speech, readiness for writing, pre-reading, and communicative development; Lehrla & Smidt, 2018). Significant relations between process quality and child outcomes were also found in a Greek study (Petrogannis, 2002) and in another German study (Smidt & Rossbach 2016).

In Australia, the Classroom Assessment Scoring System was used to assess the quality of the educational environment in a 5-year longitudinal study, in which more than 2,500 children participated (Tayler, 2016). An interrelation was found between structural support and verbal ability.

An analysis of the effectiveness of the Head Start program showed that there are the interrelations between the quality of the educational environment and the vocabulary of children, as well as between the quality of adult–child interaction and mathematical outcomes (Malone et al, 2017).

In another American study (Gordon, Fujimoto, Kaestner, Korenman, & Abner, 2012), a relationship between the results of learning environment assessment using the ECERS-R and the children's outcomes in language and mathematics was detected, and the authors of the study assumed that this could be due to the psychometric features of the assessment tools. At the same time, the authors of a review of a wide range of studies on this subject indicated that the relations between educational process quality and child outcomes are most likely not linear. They emphasized that the quality of the process starts to affect children's outcomes after overcoming certain crucial means: quality was more strongly associated with mathematics and reading outcomes when quality was high (good or stronger; Zaslow et al., 2010).

Structure quality and process quality

Since process quality, according to research data, mediates the influence of structure quality on children's development, it is especially important to understand exactly how the different structure quality parameters can affect the quality of the educational process in which a child is enrolled so as to enable adequate decision-making in educational policy.

Among the indicators of structure quality, researchers often mention the group size and the child/adult ratio. However, an empirical test showed that the relation between these characteristics and process quality is not so obvious. Significant correlations were found in some studies (e.g., Bigras et al., 2010; Gordon et al., 2012; Hartman, Warash, Curtis, & Hirst, 2016) but not in others (e.g., Pianta et al., 2005; Slot, Cadima, Salminen, Pastori, & Lerkkanen, 2016; Slot, Leseman, Verhagen, & Mulder, 2015). A meta-analysis of 72 studies from 23 countries in five geographical regions showed that the data are inconsistent: positive correlations are found in some cases, but negative correlations are found in others (Vermeer, van IJzendoorn, Cárcamo, & Harrison, 2016). The same meta-analysis indicated that, in 10 studies, there were weak but still significant interrelations between the child/adult ratio and the educational process quality. A 2018 OECD review

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(Slot, 2018) indicated that having fewer children both in a group and per a staff member were associated with a higher process quality, although in some studies, this relationship has not been so obvious.

Positive relations between process quality and the combination of younger age and higher salary of teachers were found in one empirical study (Pessanha, Aguiar, & Bairrão 2007). Similarly, other studies have found that having a large number of children from families with low socioeconomic status (Pianta et al., 2005), as well as children from migrant families (Slot, 2018; Slot et al., 2018), affects process quality negatively.

The relations between process quality and parameters such as the experience of teachers is also uncertain. A study by Phillipsen, Burchinal, Howes, and Cryer (1997) indicated that teachers having medium experience (i.e., neither extended nor beginner) is optimal for process quality. A 2018 meta-analysis (Slot, 2018) also pointed out that the data on this parameter are inconsistent, and it is assumed that there is some optimum work experience that has a positive effect on process quality. However, there is a group of parameters of structure quality, whose relationship with the process quality is fixed quite consistently.

First, a teacher's qualification—a bachelor's degree and especially a bachelor's degree in preschool education—positively correlates with process quality (Hartman et al., 2016; Phillipsen et al., 1997; Pianta et al., 2005; Slot, 2018; Slot et al., 2018; Sylva et al., 2004). Moreover, the importance of a kindergarten principal's qualifications has been especially noted for its effect on the quality of interaction between teachers and children. Similar results were found in Manning, Garvis, Fleming, & Wong's (2017) meta-analysis, which analyzed 48 studies. Overall, they found that higher teacher qualifications are significantly correlated with a higher quality of education and care in early childhood settings.

Second, professional development opportunities for teachers, such as various kinds of in-service training programs, play a great role: a positive correlation was found with staff in-service training (or professional development) and process quality (Mashburn, 2008; Slot, 2018; Slot et al., 2015, 2018). Also, dealing with the scales for the evaluation of learning environment, as a tool for self-assessment, has also been noted as a way to improve the quality of the educational process (Hui et al., 2017).

Third, the role of organizational climate of a kindergarten, management style, and team-building should not be underestimated (Slot, 2018; Slot et al., 2018; Slot, Lerkkanen, & Leseman, 2015). Descriptions of the interaction styles in a team that enhances educational process quality includes parameters such as collegiality, opportunity for professional growth, support in a supervision format, a fair reward system, ability to participate in decision-making, the goals of the organization, orientation on tasks, quality of spatial environment (which allows staff to feel comfortable in the kindergarten), and support of creativity and innovations, all of which are important. It is emphasized that institutional-level parameters are currently insufficiently studied.

Finally, a factor of another level—the level of the regional or national education system—has also turned out to be significant: namely, the development of kindergarten rating systems (e.g., the QRIS). Data obtained in the U.S., China, and Australia suggests the idea that participation in such rating systems and the publication of research on quality have a positive effect on educational process quality (Zaslow et al., 2010).

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Mediators

The ambiguity of the data obtained in different studies regarding the significance of different structural quality parameters may be explained by the fact that relations are more complex and mediated. In 2015, Slot, Lerkkanen, and Leseman conducted a meta-analysis of available data regarding factors that affect process quality in five countries: the UK, Finland, Germany, the Netherlands, and Portugal. In the UK, teachers with lower qualifications who were enrolled in a kindergarten with a good educational curriculum showed better process quality than their colleagues in primarily care-oriented kindergartens. Thus, the type of kindergarten curriculum was more powerful than the teacher's level of qualification. In Germany, it was found that the number of migrant children in a group reduced the quality of the learning process, but research has shown that a higher level of experience of the teacher can significantly diminish this effect. In daycare centers in the Netherlands, where there was a less appropriate child/adult ratio but conditions for the professional growth of teachers, a higher process quality was found (specifically, a more comfortable atmosphere in the group). In Finland, a smaller group size was positively related to process quality in a daycare center but negatively related in school: here, the type of educational organization was the mediator. A similar situation was discovered in Portugal, where the staff working in the public sector showed the best process quality, even with an inappropriate child/adult ratio.

The 2018 OECD review, based on an analysis of videos, indicated that many things depend on the competence of teachers—in particular, whether teachers with large groups of children can organize work in small groups. Thus, the competence of teachers, as organizers of both the educational process and the interaction of children in groups, can compensate for having a large number of children in a group. This was also indicated by the results of a study by Swedish colleagues (Sheridan et al., 2014).

These studies indicate that, if we are looking for the structural factors related to process quality, it is important to take into account variables that may be associated with key parameters. Additionally, Zaslow et al. (2010) concluded that studies will become more accurate if we use more specific quality parameters (i.e., not only mean general scores) to establish more subtle interrelations.

Research design

In 2016 and 2017, at the initiative of the Federal Service for Supervision in Education and Science of the Russian Federation, a national study of the quality of preschool education was conducted. For the first time in Russia standardized observation was used as the main method in a study of this kind. The ECERS-R (Harms, Clifford, & Cryer, 2005), which was approbated in Russia (O. A. Shiyan & Vorobyeva, 2015; I. B. Shiyan, Zadadev, Le-van, & Shiyan, 2016) and officially published in Russian in 2016, was chosen as the tool for measuring preschool quality. The research model was tested in the Moscow region in 2016 (Remorenko et al., 2017).

The ECERS-R has 43 items (aspects of quality focused on learning environment, process and care), which are grouped in seven subscales. Each item is assessed through approximately 10–15 indicators (observed situations and other evidence), systemized on four levels of quality. Each indicator is scored "yes"/"no" (or, additionally, "not available," if appropriate). The items are then scored according to the level of indicators

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that have all or the most "yes" scores for positive levels and "no" scores for the "inadequate" level. The subscales and the general quality scores have the following levels: "inadequate" is equal to mean scores 1.00–2.99; minimal, 3.00–4.99; good, 5.00–6.99; and excellent, 7.00.

In the 2016–2017 national study, the interrelation between structure quality (group size, child/adult ratio, teachers' qualifications, work experience, participation in advanced training programs), process quality (the interaction between staff and children; e.g., parameters like encouraging children to communicate, using language to develop reasoning skills, supervision of children, discipline), and the availability of materials for children to choose from (e.g., the possibility of using books, illustrations, art materials, mathematics, blocks, exploring nature, experimentation, role play) were investigated. The evaluation of learning environment quality was conducted with the ECERS-R in accordance with required procedure. The staff of the Laboratory of a Child Development at Moscow City University (who were Environment Rating Scales Institute–certified trainers) trained 155 assessors to conduct the study.

In addition to the ECERS-R, some specific tools were developed specially for:

- the case-study, in which the assessors traced the engagement of teachers and other staff in certain types of learning activities (e.g., during whole-group time, indoor and outdoor free play)
- investigation of the parameters of structure quality. The teachers of the observed groups completed a questionnaire about their qualifications, age, participation in in-service training, and so on.

It is important to underline that the actual engagement of adults in the educational process was the focus of the study instead of the formal child/adult ratio. According to official statistics of Russia (Federal State Statistics Service, 2017), there was one teacher per 11.3 children on average (this data was obtained as division of the general population of children—from 2 months to 7 years of age and who were enrolled into early childhood education and care programs—by the total number of teaching staff members of those services). However, in fact, teachers most often work in shifts, and assistant teachers who work throughout the day deal primarily with care and cleaning. To investigate the child/adult ratio, assessors registered both the nominal list of children and the number of children present during observation.

In 2016, the sample included 423 kindergartens from 40 regions of the Russian Federation; in 2017, there were 1,301 kindergartens from 74 regions (2.6% of all kindergartens in Russia; 87% of all regions). The sample was verified and unreliable data were removed (the observers' results were compared with the results of an anchor expert group; the 30% range of means below and above the borders of their standard deviations were the marker for removing observer's data). The study was conducted by regional research teams according to the protocols and included two cohorts: the 'Best' and 'Random' cohorts. Kindergartens in the Best cohort were the leaders of municipal ratings. Such ratings are usually based on the merits of children and teachers in competitions, the structural characteristics of quality, and any special status as a training center. These ratings did not have evidence-based criteria and were not national. Therefore, we decided to assess how well the established systems of distinction between the best and ordinary kindergartens coincided with the quality criteria of the ECERS-R.

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The Best cohort was a third of the sample. The remaining two-thirds of the sample, the Random cohort, was represented by kindergartens with no specified merits, selected randomly. On the day of observation, the assessor randomly chose one group from the kindergarten (the age of children was 3–5 years) where the observation was being conducted.

In 2017, the sample had 367 kindergartens take part in the study for a second time. Observation was carried out in the same preschool groups as in 2016. After the 2016 study, some of them received feedback about their results and discussed their strengths and deficiencies with experts. We recommended this to all experts participating in the study, but it was beyond the project protocol.

In this paper, we use the data of the 2017 study while presenting and discussing structural parameters. This is because the 2017 sample included the greatest range of kindergartens from the 2016 sample, and the parameters structure quality could not have changed significantly since that time. The verified sample included 288 preschool groups in 2016 (96 of them were in the Best cohort; 192, in the Random cohort), 1,087 preschool groups in 2017 (266 in the Best cohort; 823, Random cohort). Among those that participated for a second time, there were 287 preschool groups with successfully verified data.

We used Pearson's test for correlation analysis; matching confidence intervals and Welsh's *t* test for significant differences; cluster regression analysis; and the R programming language. To reject the null hypothesis, we use an alpha of .01 (or .05 where otherwise indicated in the text).

This research was carried out in accordance with the Code of Ethics of the Russian Psychological Society.

Results and discussion

2016–2017 preschool education environment quality dynamics

Comparing the 2016 and 2017 results, we divided the 2017 sample for each cohort (Best and Random clusters) into two groups: first-time participants ("newcomers") and repeat participants ("second-time participants"). We needed to check the assumption that participation in the study influenced the development of the quality of the system as a whole and that the groups therefore differed significantly from each other.

As shown in Table 1, the confidence intervals of second-time participants do not overlap with the 2016 results for both clusters, indicating that their mean total quality scores differed significantly . As for newcomers, a significant difference from the 2016 sample was found for the Random cluster but not for the Best cluster. The method of overlapping confidence intervals, which gives evidence for statistical significance, was used to demonstrate how accurately the means within the groups were determined. It was verified with Welch's *t* test for mean total quality scores: both newcomers and second-time participants showed significant differences with the 2016 results in the Random cluster ($p < .001$ for both). However, in the Best cluster, only the second-time participants had significant differences ($p = .001$); newcomers had none ($p = .759$).

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It is noteworthy that second-time participants of the Random cluster in 2017 had the same mean total quality score as the Best cluster in 2016 ($p = .969$). Besides this, the comparison of the mean values of newcomers and second-time participants within each cluster revealed higher means in the latter (0.41 more in the Best cluster, and 0.19 more in the Random cluster) and a significant difference between the groups of newcomers and second-time participants (Random, $p = .005$; Best, $p < .001$).

Table 1
Comparison of mean general quality scores: Best and Random clusters, 2016 and 2017

Cluster		2016	2017	
			Newcomers	Second-time participants
Best	*n*	96	183	83
	M	3.88	3.92	4.33
	99% CI	3.81–3.96	3.87–3.97	4.25–4.41
Random	*n*	197	619	204
	M	3.37	3.69	3.88
	99% CI	3.32–3.42	3.67–3.72	3.83–3.93

All this justifies the assumption that improvement in process quality, regardless of whether a kindergarten was in the Best or Random clusters, was most likely associated with participation in the study (the procedure and criteria were known to participants, they had the results of the first-year evaluation, etc.). As for the Best cluster newcomers, we can assume that they considered their process quality condition to be rather high and did not check the criteria for expertise very carefully before observation.

At the same time, the mean score of newcomers in the 2017 Random cluster was higher than for the kindergartens in the 2016 Random cluster. This is presumably connected with the attention of the professional community on the study, the results of which were discussed and published within a year following the first stage. The complexity of this factor's influence (e.g., similar changes were not found for the Best cluster) requires additional study.

The differences between the Best and the Random clusters in 2017

In regard to significant differences between the 2017 Best and Random clusters, looking at them more closely, they differed significantly in all seven subscales (see Table 2).

Even a deeper analysis (in specific aspects) showed significant differences in 24 of 43 items. This included items such as interest center arrangement and indoor space design; support of speech and reasoning development; space and equipment for gross motor activities; interaction style and discipline provision; organization of group classes; and engagement of children with health limitations in the educational process. There were also differences in the provision for meeting the professional needs of the staff, the opportunities for professional growth, and in the interaction and collaboration of the teams (i.e., in the organizational climate). The following parameters did not significantly differ between clusters:

- five items linked to the health-care routine and safety (e.g., "Nap/rest," "Toileting/diapering")

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- six items linked to the accessibility of certain materials and opportunities—"Books and pictures"; "Blocks"; "Nature/science"; "Sand/water"; "Space for privacy"; and "Promoting acceptance of diversity". Each item requires a certain range of materials in free access for the sufficient time period during the day, a variety and appropriate number of them according to group size, and developmental interaction of a teacher with children while using these materials
- all types of supervision (two items)—time for free play and schedule
- two items in the "Parents and staff" subscale ("Provisions for personal needs of staff" and "Supervision and evaluation of staff").

Table 2
Means of the Best and the Random clusters in 2017 in regard to seven subscales

Subscale	Cluster		*p*
	Random (*n* = 823)	Best (*n* = 266)	
1. Space and Furnishings	3.51	3.83	< .001
2. Personal Care Routines	3.81	4.01	.0171[a]
3. Language/Reasoning	3.79	4.10	< .001
4. Activities	3.14	3.45	< .001
5. Interaction	4.59	4.87	.001
6. Program Structure	3.89	4.22	< .001
7. Parents and Staff	4.12	4.53	< .001

[a] Significant when $\alpha = .05$.

This allows us to conclude that ECERS criteria, in general, correspond with the ideas of preschool education quality as established in the Russian educational system. Since the Best cluster comprised top kindergartens according to regional rankings, significantly higher ECERS-R scores for this cluster (compared to the Random cluster) would also entail that the ECERS-R is rating some of the same qualities as in the regional rankings.

The lack of significant differences between the two clusters in some parameters could be explained by some normative regulations (e.g., *Sanitary and Epidemiological Requirements for the Structure, Content and Organization of the Mode of Operation of Preschool Educational Organizations*, 2013) and by manuals for teachers, which had been elaborated in previous decades before the Federal State Educational Standard for Preschool Education (2013) was introduced and did not meet their requirements.

Relations between process quality and teacher qualifications, working experience, and teachers' participation in in-service training programs

As shown in Figure 1, 97.15% of teachers had vocational pedagogical training (qualified as a specialist; had a bachelor's or master's degree in teaching; or a PhD in Pedagogy or Psychology). Within this figure, 42.35% graduated from vocational college, 53.47% had a bachelor's degree, and 1.33% had a completed or incomplete postgraduate education in pedagogy. Furthermore, 1.87% of teachers were, at the time of the study, either in the process of professional teaching training or had not completed it for some other reason, and 0.89% obtained professional training in some other area. Only 0.09% had no professional training at all.

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When it came to working experience, teachers were more or less equally distributed in two-thirds of the samples between those with 3–10 years of practice (31.32%) and 11–25 years of practice (30.96%). Approximately a quarter of the sample included teachers with over 25 years of experience (25.80%), and 11.92% more comprised teachers with fewer than 3 years of experience (considered by authorities to be "young specialists"; see Figure 2).

Figure 3 contains data for teachers who took in-service training within the preceding 3 years (2015–2017). Only 7.30% of teachers did not have any such training; the rest (92.70%) did. Of those who participated in in-service training, a majority were generally satisfied (96.61%), and a small share of them (3.39%) were not.

Cluster dispersion analysis did not reveal any consistent relations between process quality and any of abovementioned parameters of structure quality (teachers' qualifications, working experience, or participation in in-service training). We only observed some inconsistent correlations in regard to a few factors (when $.01 < p < .05$). Each cluster group was analyzed separately: "Best–newcomers," "Best–second-time participants," "Random–newcomers," and "Random–second-time participants." In the comparison of parameters with significant differences for each cluster group, no regularities were revealed either in the mean total quality score of learning environment or in individual factors (including those related to process quality: encouraging children to communicate, using language to develop reasoning skills, staff–child interaction, the general supervision of children, etc.).

The data allow us to conclude that teachers with a bachelor's degree did not demonstrate better process quality than those with vocational college training (even though this qualification level is considered, in the Russian context, to be lower). Teachers with more working experience did not provide higher process quality either.

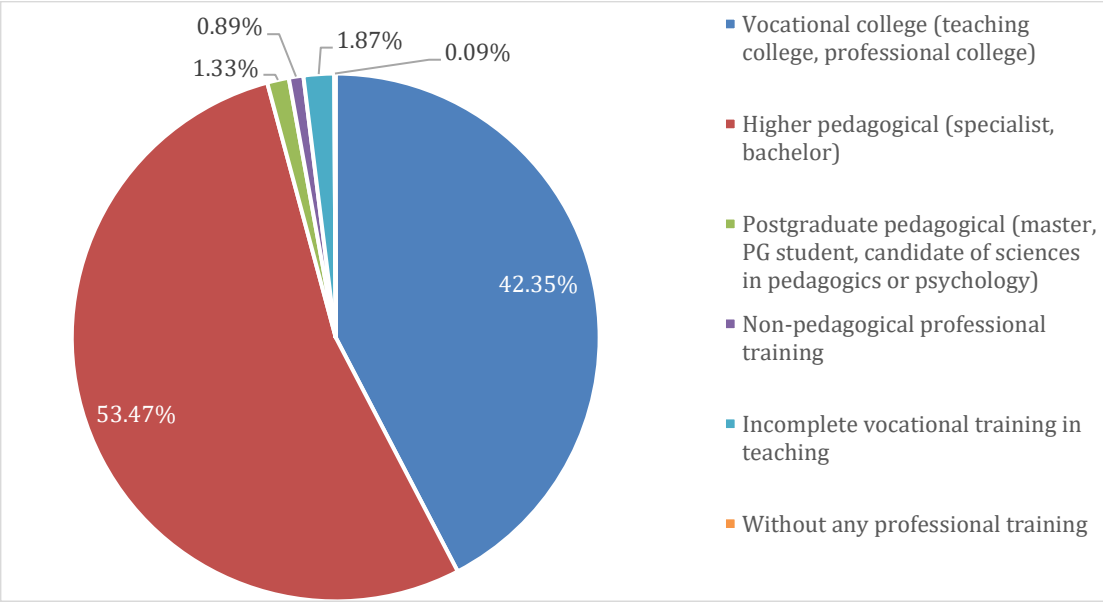

Figure 1. Distribution of teachers according to their qualifications (n = 1,124).

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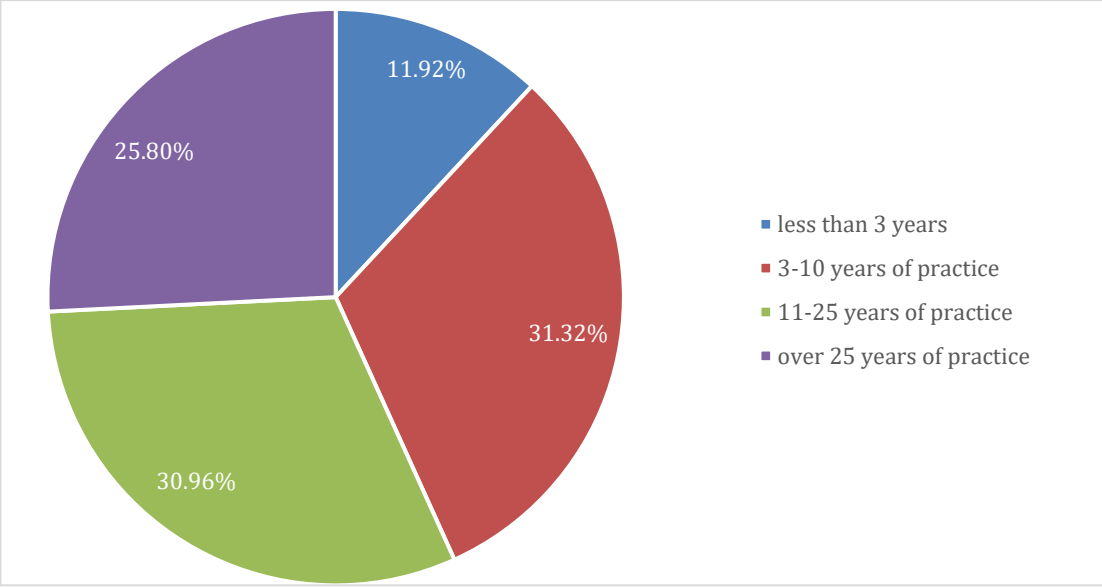

Figure 2. Distribution of teachers according to their working experience (*n* = 1,124).

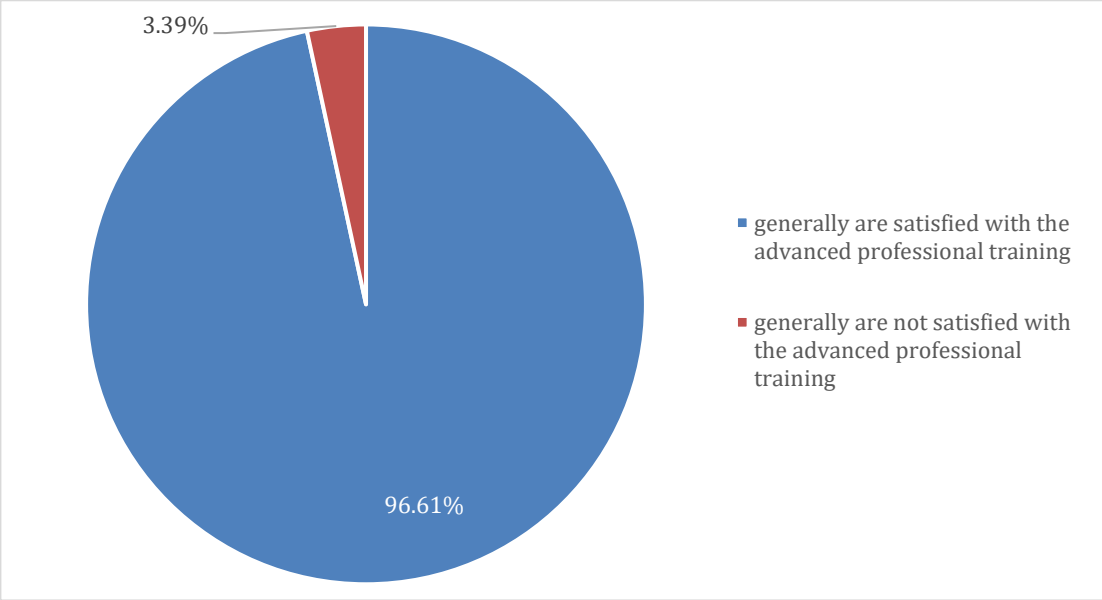

Figure 3. Teachers' attitudes to in-service training (so called advanced professional courses) they had attended (*n* = 1042: teachers who had undertaken in-service training in the preceding 3 years).

The formally registered participation of teachers in in-service training (a certificate of participation without the analysis of the training program quality) was not linked to higher process quality either. This conclusion follows an analysis of the process quality of second-time participants (i.e., sampled in both 2016 and 2017) that demonstrated either positive quality dynamics or not. Correlation analysis of the changes in the quality of second-time participants showed that positive dynamics (i.e., an increase of more than 0.18 points in the mean total quality score) were not significant when the alpha was .01 but were significant when the alpha was .05. This was more often in cases when teachers had received feedback about their 2016 research results and discussed them with experts,

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compared to cases in which teachers had not announced their results or enrolled into any discussion with experts (significant connections to the subscales: Space and Furnishings, $r = .227$, $p = .004$; Activities, $r = .315$, $p < .001$; and Parents and Staff, $r = .223$, $p = .004$). The Language/Reasoning subscale had nonsignificant correlations when $\alpha = .01$, but significant when $\alpha = 0.05$ ($r = .189$, $p = .015$).

To conclude the findings concerning teachers' qualifications, working experience, and enrollment into in-service training programs, none of these parameters are likely associated with higher quality scores with the exception of specific in-service issues: the fact that teachers discussed the results of the 2016 study seemed to be important for enhancing process quality. It can be concluded that in-service training is likely to affect process quality if the training activities include feedback based on assessment results and discussion of them.

Relations between process quality and the group size

According to the data, the nominal list for groups in the Best cluster consisted of 28.1 children (the maximum registered nominal list number was 55); the Random cluster, 26.6 (maximum 51). The share of preschool groups with more than nine children at the moment of observation was 94.70%; with more than 18, 40.01%. At the moment of observation, approximately 65% of the nominal list was present: on average, 18.2 children in the Best cluster (maximum 45) and 16.9 children in the Random cluster maximum 42).

Correlation analysis of interconnections between learning environment parameters (mean total quality score and certain item scores) and the number of children (nominally listed and present at the moment of observation) was conducted separately for the Best and Random clusters. Weak or medium significant correlations ($p < .001$) were observed (the Best maximum rank, $r = -.55$; the Random maximum rank, $r = .25$).

In the Best cluster, significant negative correlations were discovered between the nominal list of children and 26 items (including "Space for privacy," "Informal use of language," "Meal/snacks," "Art," "Sand/water," "Discipline," "Staff–child interactions," "Interactions among children," "Free time," "Group time"), and between the number of children present and 15 items (including "Greeting/departing," "Meal/snacks," "Art," "Sand/water," "Supervision of gross motor activities," "Schedule," "Free play"). Most of them were very weak, but one for the nominal number of children in the list was medium ("Schedule," $r = -.55$, $p < .001$), and two were weak but steady ("Greeting/departing," $r = -.48$, $p < .001$; and "Supervision of gross motor activities," $r = -.41$, $p < .001$). We also registered a significant positive correlation between the number of children present and the "Math/number" item; this requires additional investigation because it seems to be illogical (more children in a class appears to be connected with higher availability and variety of materials and the teachers' greater development of interaction with children while they use these materials).

In the Random cluster, significant negative correlations were discovered between the nominal list of children and six items ("Indoor space," "Meals/snacks," "Sand/water," "Provisions for children with disabilities," "Supervision and evaluation of staff," and "Opportunities for professional growth"), and between the number of children present and five parameters ("Indoor space," "Sand/water," "Use of TV, video, and/or

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computers," "Provisions for children with disabilities," and "Opportunities for professional growth"). Positive significant relations were observed for eight items and the nominal list of children, and for 11 items with the number of children present. All of them were very weak. Furthermore, positive correlations appear inconsistent and illogical, as explained above.

To sum up the relations between process quality and the group size, in the kindergartens of the Random cluster, correlations were mostly weak and inconsistent. However, in the Best cluster, having fewer children in the class significantly correlated with better quality. This fact is important because it can be related to a mediation effect: there are probably some additional factors (e.g., teachers' qualifications) that mediate process quality and group size, but this needs further investigation and discussion.

Relations between process quality and the number of adults engaged in the educational process

All cases of educational activity within the observation period were analyzed with respect to the number of adults actually engaged in learning interactions with children. In the Best and the Random clusters, cases in which there was only one teacher with the whole group were considered separately to cases in which there were two or more teachers with the children. In the Russian context, it is uncommon to have more than two teachers for one group (thus, clusters with three or four teachers were not determined separately, but included in the cluster with more than one teacher in one class).

The most frequent observation of two or more teachers engaged in some educational activity was when children were putting on clothes to go outside (87.26% in the Best cluster and 90.62% in the Random cluster). Undoubtedly, it is a very important moment of the day, but group classes and free play are much more extended for learning tasks. Therefore, it is crucial to analyze those activities.

Whole-group time (excluding music and physical education classes, which usually take place twice a week in special rooms and are held by specialists with relevant qualifications) engaged two or more teachers in only 36.90% of cases in the Best cluster and in 33.41% of cases in the Random cluster. When it came to indoor and outdoor free play, the proportion of two or more teachers participating was even smaller: 25.15% and 23.10% in the Best cluster, and 27.74% and 22.21% in the Random cluster, for indoor and outdoor, respectively. If we consider that, normally, 26–28 children were present in a class (see the data in the section "Relations between process quality and the group size"), difficulties in individualized learning interactions between teachers and children during group time and free play were unpreventable.

Correlation analysis did not demonstrate a consistent significant relationship between the proportion of time during observations when two or more adults were engaged in different activities and mean total quality score (Best, $r = .072$, $p = .262$; Random, $r = .052$, $p = .158$) or with the subscales (e.g., Language/Reasoning: Best, $r = .091$, $p = .155$; Interaction: Best, $r = .075$, $p = .244$; Random, $r = -.01$, $p = .853$). And in the Random cluster, the Language/Reasoning subscale had nonsignificant correlations when $\alpha = .01$, but significant (yet too weak) when $\alpha = .05$ ($r = .076$, $p = .039$).

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Meanwhile, Welch's *t* test revealed some significant differences between the preschool groups of the Best and the Random clusters in which there were two or more adults interacting with children during 50% or more of the observation time ($p < .001$). The same effect was discovered between the clusters in groups in which there was only one adult engaged or in which two adults interacted less than 50% of time ($p < .001$). In 39 items, there were no significant differences in the groups between having two or more adults or having only one teacher engaged, according to most parameters in the Best cluster. There were no significant differences in 41 items in the Random cluster in regard to whole-group time. In indoor and outdoor free play, the number of nonsignificant items was the same or more: 40 and 39 for the Best and Random clusters, respectively, with respect to indoor free play, and 41 and 42 for the Best and Random clusters, respectively, with respect to outdoor free play.

Having mostly nonsignificant correlations within but significant differences of mean total quality scores between the Best and the Random clusters probably indicates that, on the trend level, the engagement of two and more adults cannot be significantly and directly connected with process quality or that process quality is mediated by teachers' competence (which is more likely to be different between clusters). Nonetheless, additional circumstances that clarify this connection should be examined.

Relations between process quality and the child/adult ratio

A cluster regression analysis was conducted, covering subscales and items in regard to periods of the day during which the assessor observed group activities and free play. The relations between the child/adult ratio and the Language/Reasoning subscale were revealed.

Preschool groups that participated in the case-study ($n = 520$) were divided into clusters with equal ranges in regard to the number of children per adult (each range was a multiple of nine because, in Bowne et al.'s [2019] meta-analysis, a 9:1 child/adult ratio was revealed as optimal; fractions were rounded off). Edge clusters were tested if they had enough data to compare with others; the last cluster (28–35:1) did not and was combined with the previous cluster (19–27:1), with the assumption that, after a certain group size (more than 18 children; Bowne et al., 2017) the effect on quality could negative. In the end, Clusters 1 (2.5–9:1), 2 (10–18:1), and 3 (19–35:1) contained 134, 257, and 129 preschool groups, respectively.

The mean quality scores on the Language/Reasoning subscale within each cluster were averaged. There was a linear reduction of the subscale mean score as the child/adult ratio increased (see Figure 4). The red spots on Figure 4 indicate the mean scores for each cluster. The boxes and whiskers have their traditional meaning: their lower and upper borders represent the first and third quartile, respectively, and the bold line inside indicates the median. The whiskers represent the range of observed mean scores that did not exceed the equilateral quartile range from the upper or lower box border. Dispersion was performed in quite a conditional way, with some smearing to the right and left of the scale to visually separate overlapping points.

We found significant differences in subscale mean scores between Clusters 1 and 2 ($p = .003$), Clusters 1 and 3 ($p = .006$), but not between Clusters 2 and 3 ($p = .827$). This

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mostly seems to indicate that a child/adult ratio above 10:1 negatively influences the quality of teacher–child interaction in communicative development and child thinking.

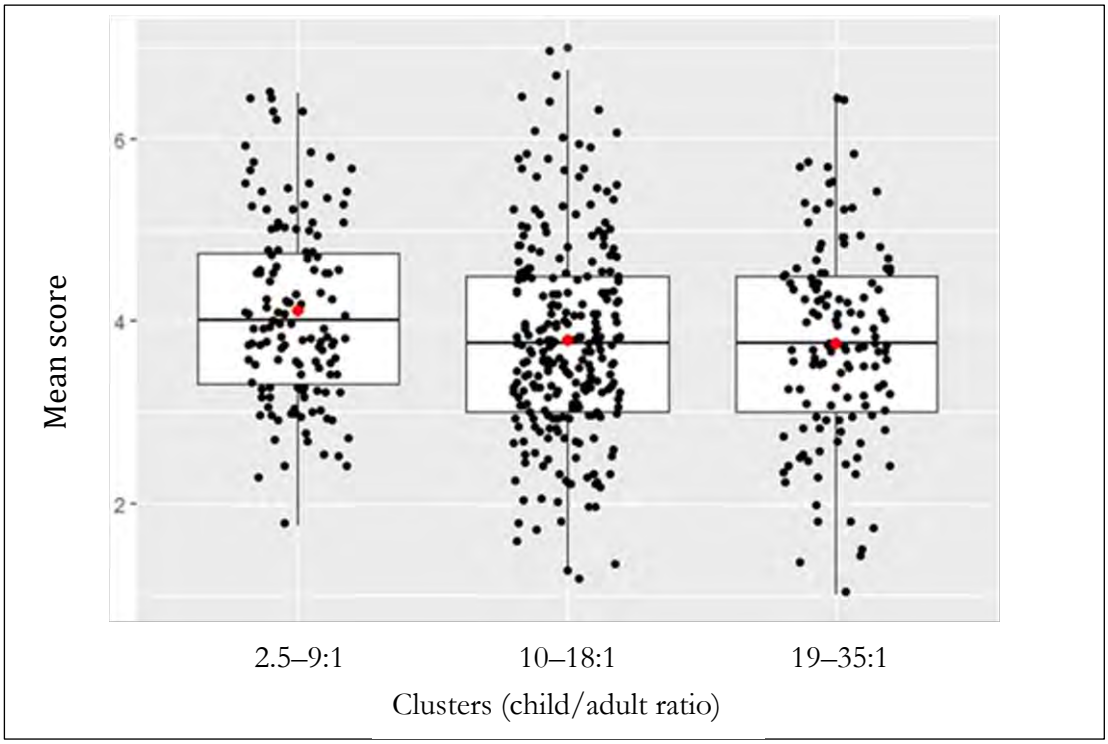

Figure 4. Dispersion graphs combined with boxes and whiskers, representing the mean scores of the Language/Reasoning subscale by child/adult ratio (Clusters 1 to 3, left to right: n = 134, 257, and 129, respectively).

To test the hypothesis that there is a linear reduction for subscale mean scores, which would suggest a linear decrease in process quality with increasing child/adult ratio, we divided the subscale mean scores of the sample into more clusters and performed a regression analysis of the mean scores on these clusters' centers. This allowed for the exclusion of random variations of subscale mean scores within each cluster.

When dividing the whole range of ratios into four equal clusters (approximately n = 130 in each cluster), we obtained a linear regression, adjusted R^2 = .9669, p = .011 (see Figure 5). Before performing linear regression, we averaged, within each cluster, the subscale mean scores of all preschool groups in that cluster to level out random parameters that did not affect this dependence that we want to uncover. Through these averages, we carried out a regression on the means.

When dividing into five equal clusters (approximately n = 100 in each cluster), regression precision was still high, adjusted R^2 = .9678, p = .002. If we continue to further divide the range into more clusters, the sample volumes at each interval reduce, and statistical precision is lost, which results in a reduction in the coefficient of determination. For example, for nine clusters, the adjusted R^2 drops to .7896, which is still acceptable, though, for assuming linear regression.

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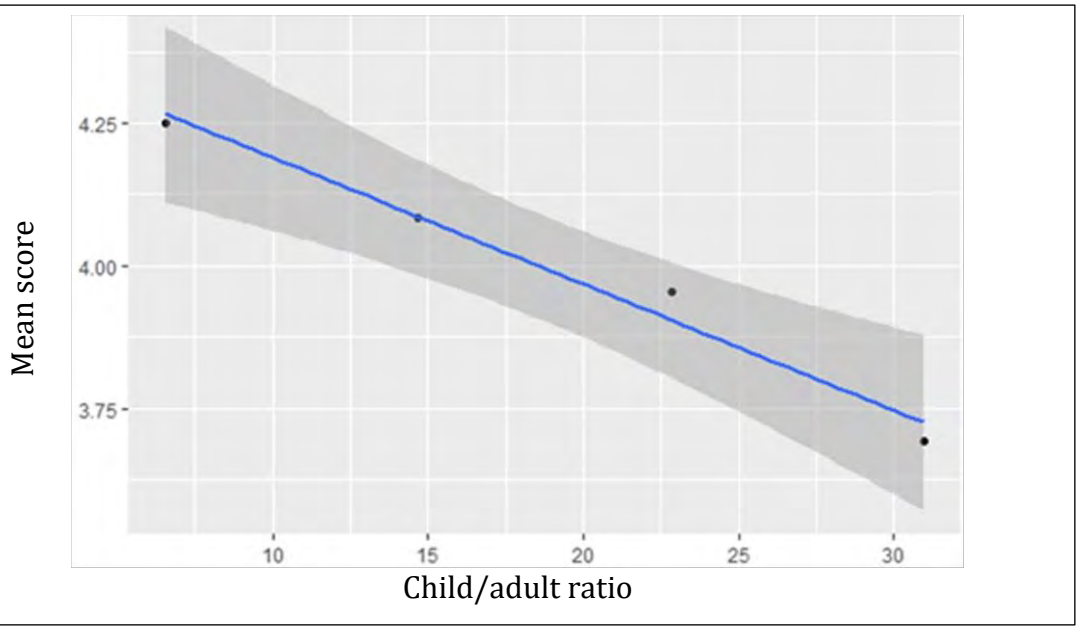

Figure 5. Regression analysis of the Language/Reasoning subscale mean score dependence on child/adult ratio for four clusters. The dark gray area and the blue line show the trend of the subscale quality score reduction in regard to the centers of the clusters.

Conclusion

The study examined process quality growth from 2016 to 2017. It is possible that growth is explained by the presentation of the objective criteria for preschool education quality to the professional community and by the second-time participating kindergartens' awareness of their 2016 results. However, the lack of uniformity in the growth of process quality required additional examination of the factors that affected it.

The differences between the Best and Random clusters confirms that the ideas of high-quality preschool education established in Russian regions coincide with the process quality criteria established in the ECERS-R or at least do not contradict them.

The uniformly low results for the Best and Random clusters for certain items can be explained by some normative regulations (e.g., "Sanitary and Epidemiological Requirements," 2013) and traditions that are established in some out-of-date teaching manuals (e.g., directive teaching methods).

The absence of interconnections between process quality and the level of teachers' qualifications confirms the assumption that the quality of teacher training in college versus in university is not so distinct.

It is important to note that these data contradict the results obtained in other studies, in which a connection between teachers' qualifications and process quality has been observed (e.g., Hartman et al., 2016; Manning et al., 2017; Phillipsen et al., 1997; Pianta et al., 2005; Slot, 2018; Slot et al., 2018; Sylva et al., 2004). One of the reasons may be that, according to specialists in the field of preschool education, the content of all kinds of vocational education does not correspond to modern ideas about the quality of

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preschool education and the requirements of the Federal State Educational Standard for Preschool Education. This hypothesis must be tested in further research.

No connection was revealed between process quality and teachers' age and working experience. This could be explained through the reproduction of out-of-date ideas through in-service training systems.

The inconsistency of connections between process quality and in-service training programs in which teachers had been enrolled, as discovered in our study, is also a finding that goes against data obtained in other studies, in which such connections were found (e.g., Mashburn, 2008; Slot, 2018; Slot et al., 2018; Slot, Lekkernan, & Leseman, 2015).

At the same time, the fact that obtaining feedback on the results of the research is significantly correlated with the positive dynamics of process quality allows us to conclude that in-service training programs can be effective when they are based on the quality evaluation results of the kindergarten and when they allow the staff to discuss them and reflect on their actions.

In the vast majority of cases in this study, the learning activity in the preschool group was conducted by a single teacher while the assistant teacher interacted with the children mostly for care routines or was not engaged in the learning process at all. No relation between the number of teachers and process quality requires further investigation and clarification of the reasons. It can be likely explained with a teacher-oriented approach when whole-group activity dominates during the day (Sheridan, Shiyan & Shiyan, 2018). As shown in previous studies (Remorenko et al., 2017; Sheridan et al., 2018), this approach is still very common in Russian kindergartens, and it invalidates the factor of the number of adults. Besides, we found that the high number of children per teacher in class negatively influenced the quality of teacher–child interactions in communicative development and child thinking. It corresponds to the findings of some other studies (e.g., Bowne et al., 2017).

The relations of group size (nominally and within the observation period) and process quality did not appear to be consistent. In the Best cluster, there were more correlations, and they were more logical than in the Random cluster. Still, in both, they were weak and inconsistent. One can observe a similar situation with the engagement of the second adult in the learning process: education quality was often noticeably higher with the engagement of one or two adults in the Best cluster than in the Random cluster. This suggests that there are some mediators that affect these relationships (e.g., the professional competence of teachers). This assumption requires further verification.

Regression analysis revealed a significant relationship between the child/adult ratio and the scores for the Language/Reasoning subscale. The child/adult ratio seems to be a stronger predictor of process quality than the group size and the number of teachers in the group are.

[1] The preschool education system in Russia includes children from 3 to 7 years of age.

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