

VII International Forum on Teacher Education

Key Factors of Teacher's Professional Success in the Digital Educational Environment

Pavel N. Ustin (a), Elvira G. Sabirova* (b), Timirkhan B. Alishev (c), Fail M. Gafarov (d)

(a), (b), (c), (d) Kazan Federal University, 420008, Kazan (Russia), 18 Kremlyovskaya street,
sabirovaelli@yandex.ru

Abstract

Based on the studies of the daily work of teachers in educational institutions, it was noticed that the teacher in the learning process makes decisions on average every minute. The primary school teacher interacts even more actively with their students. Although most of such interactions are not planned. The teacher is constantly looking for new ideas, they improvise, use innovations. And they always reflect on what they are doing. Many solutions are the product of teachers' personal pedagogical experience and their intuition. These solutions are often not included in the research results. The purpose of the study is to identify the main patterns of influence of the educational environment components on the effectiveness of teachers' professional activities. The problem of teachers' professional development is gaining significance in scientific research. However, the educational environment itself contains a number of factors that contribute to the professional success of a teacher. Factors can help, stimulate the teacher to the most effective and efficient forms of work with students, or they can create obstacles, difficulties that lead to the teacher's failure to succeed. The empirical study revealed a number of features of the educational environment that impact the success of the teacher's professional activity based on the analysis of big data accumulated in the system "Electronic Education in the Republic of Tatarstan" and statistical reports. Further, it is planned to use the identified features in the management (possibly modification) of the professional development trajectory of the teacher.

Keywords: big data, digital educational environment, data-based decision-making, teacher professional success, factors.

© 2021 Pavel N. Ustin, Elvira G. Sabirova, Timirkhan B. Alishev, Fail M. Gafarov

This is an open access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Published by Kazan federal university and peer-reviewed under responsibility of IFTE-2021 (VII International Forum on Teacher Education)

* Corresponding author. E-mail: sabirovaelli@yandex.ru

Introduction

Thanks to a large amount of data, organizations have additional opportunities to grow and improve the quality of their services, including educational ones. However, the critical question is how to manage, analyze, and extract value from raw data.

According to the studies of the everyday practice at educational organizations, the average teacher makes 0.7 decisions per minute during interactive learning (Borko et al., 1990), and the primary school teacher carries out from 1,200 to 1,500 interactions with students during the day, most of which are not planned and require on-the-spot decisions (Johnson & Jackson, 2019). Therefore, it is possible to assume that most of the decisions made by teachers and administrators of educational organizations are based on intuition and personal experience, that is, they cannot be justified by research results or reliable analytics (Coldwell et al., 2017).

Purpose and objectives of the study

The purpose of this study is to identify the main patterns of influence of the educational environment components (socio-economic and infrastructural characteristics, characteristics of the educational organization, indicators of the educational process, socio-demographic and qualification characteristics of teachers) on the effectiveness of the professional activities of teachers (primary school teachers and subject teachers in general education organizations).

Literature review

At the present stage, the analysis of pedagogical theory and practice on the problem of the effectiveness and efficiency of teachers' professional activity shows that it is necessary to move from the assessment of individual pedagogical skills to a comprehensive assessment of the impact of various educational environment components. Therefore, the professionalism of a teacher is a complex integral indicator that includes the reflection of a whole set of factors.

The main factors of success are the personal qualities of the teacher, which, on the one hand, is obvious, and on the other, is confirmed by a number of studies (e.g. Zhemukhova, 2009). For example, the effectiveness of teachers' professional activities is influenced by the level of development of the value-semantic sphere of the teacher's personality. Zorina and Dyshlyuk (2014) describe three groups of teachers at different stages of career growth, highlight the specificity of value-semantic characteristics of teachers, which affects the professional activities of teachers.

Students, describing a modern teacher, give such characteristics as openness, friendliness and understanding of the individual characteristics of students. They see the teacher as being creative, the one who has a wide range of interests and hobbies, who knows the subject deeply with a relaxed manner of teaching.

Another factor in the success of a teacher's professional activity is the perception of them by students, which depends on various characteristics. For example, Irving (2004) noted a high correlation between the perception of mathematics teachers and the following characteristics: interesting tasks that are set for students; systematic assessment and reflection; motivation to study mathematics, teaching mathematical terminology.

A further factor in the success of a teacher is the level of their qualifications. Research examining the influence of teachers on their students shows that teacher qualifications are reflected in student academic performance. Depending on the effectiveness of teaching, the spread of academic performance can range from 7 to 21 %. The results of teaching mathematics showed a greater impact, on average 11%, less in reading - 7%. In schools with low socio-economic status, the teacher's influence on the student is higher. It is noted that the degree of teacher influence on students practically does not depend on the teacher's educational background and work experience (Nye et al., 2004). However, a meta-analysis by Druva and Anderson (1983) revealed a relationship between the length of teaching experience and the effectiveness of teaching. Based on 50% of studies, it was noted that the good academic skills of a teacher have a positive effect on the academic performance of schoolchildren (Greenwald et al., 1996).

In a study by Sanders (2000), it was found that the average performance of students who were taught by teachers with low efficiency increased by only 14% per year. For students who studied with teachers with high effectiveness, the average performance increased by 52%. It is noticed that the counter-balance of negative influence occurs weakly if the class earlier was taught by a teacher with zero efficiency, with subsequent correction by effective teachers. Thus, the academic success of students also directly depends on the relative effectiveness of the teacher.

A significant problem at present is the lack of empirical evidence to identify effective methods used for teacher training (Walsh, 2006). Research on teacher training (Qu & Becker, 2003) shows that four-year undergraduate studies and an alternative educational route through teacher education have little or no impact on graduate teacher performance. Based on the analysis of a wide range of studies, it was shown that teacher education only slightly affects the academic success of students.

In studies aimed at analyzing the impact of teachers' academic program track taken in higher educational institutions on the effectiveness of their professional activities (Sparks, 2004), it is noted that teachers who are trained in their subject at a higher educational institution are more effective teachers than those who have not completed this study.

It is believed that an important indicator of the successful professional activity of a teacher is a deep knowledge of the content of the taught subject (Shulman, 1987). However, a meta-analysis performed by Ahn and Choi (2004) showed that subject knowledge in mathematics among elementary and high school teachers does not significantly affect the academic success of students. Another study by Darling-Hammond (2006) notes that a certain level of subject competence is important for the teacher, which affects the quality of teaching.

Another study (Glazerman et al., 2006) on a randomized sample of teachers with field-specific (56 respondents) and without field-specific (44 respondents) education did not reveal a difference between teachers in literature and showed the correlations for mathematics teachers. It is also shown that practical experience influences the successful professional performance of a teacher (Metcalf, 1995). Such experience is gained by future teachers in the learning process and acting teachers in their professional activities.

On the other hand, studies of the impact of teacher certification procedures on the effectiveness of their teaching revealed a number of contradictions. A study (Goldhaber & Anthony, 2004), based on a sample of 600,000 North Carolina schoolchildren, showed that there is no relationship between teacher certification and the academic success of students in the disciplines of reading and mathematics. But another study (Lustick & Sykes, 2006) showed that the presence of certification leads to the effective professional activity of teachers. Also, some research (e.g. Sanders et al., 2005) showed that the academic success of students increases if those teachers have passed the certification. High-quality training of certified teachers involves the use of effective psychological and pedagogical methods and technologies, such teachers aim at forming deep knowledge of the subject. But this does not always affect the results of students' work (Hattie & Clinton, 2008).

The importance of professional self-education of a teacher, their individual results are determined by their demand for updating the educational system (Alieva, 2019). The problem of professional development of a teacher is reduced to self-development, determining the appropriate ways to increase the level of pedagogical competence and personality formation (Pereslavl'tseva, 2017). There is a need to identify criteria and indicators of professional growth of a teacher taking into account modern realities.

The influence of professional development on the effectiveness of teaching was shown in a meta-analysis of seventy-two studies (Timperley et al., 2007). A positive correlation was observed in the disciplines of natural science, writing, mathematics and literature.

Based on the analysis of the current state of research to identify significant factors that influence the academic success of students as an indicator of the professional success of a teacher, the most effective approach is proposed by Hattie (2008). The meta-analysis was based on a sample of more than 86 million students, the results of more than 50,000 world studies were carried out. Hattie identified such factors as the quality of education and the length of the teaching experience; indicators of teacher certification; teacher training; the level of qualification of teachers based on the academic success of their students.

At the same time, a comprehensive analysis of the components of the educational environment that affect the effectiveness of teachers' professional activities in a general education organization causes difficulties. These difficulties are associated with a large number of components of the educational environment, the complexity of their structuring and simultaneous empirical verification, as well as the significance of these components. There are also issues associated with the inclusion of a large number of educational institutions in the study to reflect the full picture of the influence of the components of the educational environment on the professional success of a teacher. It is also difficult to take into account the interrelationships between the components themselves, based on an understanding of the entire education system.

The solution to these difficulties is possible if a digital educational environment is used. Educational organizations actively use modern digital platforms for storing and processing data necessary for the implementation of the educational process. It is possible to provide high-quality analytics using data sets regarding the components of the educational environment that affect the effectiveness of teachers' professional activities in a general education organization. Earlier, the authors conducted a study (Alishev, Ustin, & Sabirova, 2020) which proposed a theoretical model. This model describes the main structural components of the educational environment that affect the effectiveness of teachers' professional activities (primary school teachers and subject teachers in a general education organization). These are socio-economic and infrastructural characteristics, characteristics of the activity of an educational organization, indicators of the educational process, socio-demographic and qualification characteristics of teachers.

The research presented in this article reflects one of the results of the empirical verification of the provisions proposed in the theoretical model.

Methodology

The research was carried out on the basis of big data structuring methods. The research of the available array of educational information on all students and all teachers of organizations of general education of the Republic of Tatarstan for the period from 2009 to 2020, collected in the information system "Electronic Education in the Republic of Tatarstan", was carried out by specialists-humanitarians (in pedagogy, psychology, sociology) and specialists in the field of information technologies. The results were based on the analysis of big data (more than 1,000,000,000 digital traces, more than 120,000 teachers).

The following methods were used for statistical information processing: correlation analysis, variance analysis, factor analysis, regression analysis, frequency analysis, and cluster analysis. The studied features of the components of the educational environment were clustered into different groups, followed by the allocation of common features.

A large-scale empirical study of the features of the educational environment parameters influence on the success of the teacher's professional activity was conducted based on the analysis of big data accumulated in the system "Electronic Education in the Republic of Tatarstan" and in the forms of statistical reporting since 2009. The system records depersonalized data on 121,902 teachers, information on 90,741,876 lessons conducted, and 1,034,312,802 marks given. BigData technologies were used to perform high-performance computing related to the intellectual and analytical processing of this data. As a result, algorithms for working with big data in the digital educational environment have been developed and proposed.

Results

Based on the obtained empirical results and their theoretical understanding, the influence of various factors of the educational environment on the success of the teacher's professional activity is shown (on the example of the educational environment of the Republic of Tatarstan). The professional success of primary school teachers (grades 1-4) and secondary and high school teachers (subject teachers) was studied.

As an indicator of the professional success of teachers, the features of the academic performance of the students they teach were used.

The article shows the partial influence of the educational and methodological support of the educational process on the success of the professional activity of a teacher of a secondary educational organization (on the example of the Republic of Tatarstan). In primary school, it was revealed that students who study according to certain textbooks (subjects: Russian, The world around us) give stable high statistically reliable ($p\text{-value} < 0.05$) results in academic performance. A study on the middle and senior level showed that textbooks of several authors are used in a number of disciplines.

The analysis of textbooks of such disciplines as Social studies, Physics, Biology, Chemistry in schools of the Republic of Tatarstan did not reveal a direct impact of educational and methodological support on academic performance, showing mixed results. At the same time, as in the primary level, textbooks (Mathematics, Russian) are distinguished between the ones where the results of students' academic performance are higher.

Data from the electronic journal and electronic diary were also studied, which helped to classify thematic lesson planning and homework texts based on the agglomeration clustering method. To compare texts, we considered methods based on the Levenshtein distance and cosine similarity. For each cluster, the proposed educational and methodological complex was selected. The most productive were three clusters of educational and methodological complexes, one of which is in the Tatar language. Thus, a partial influence of the educational and methodological support of the educational process on the success of students' educational activities is shown.

The influence of the experience of teachers' pedagogical activity on the success of students' education in the Republic of Tatarstan is shown. To solve the problem, we considered data groups: teaching experience, experience in the current position, general experience, and the teacher's qualifications category. Data on primary school teachers (grades 1-4) and subject teachers (grades 5-11) were considered separately. The use of mathematical statistics methods, i.e. Pearson, Spearman, and Kendall correlation coefficients (Kobzar, 2012) showed that primary school teachers (grades 1-4) there is a positive correlation in terms of teaching experience, experience in the current position, general experience, and qualifications category - the longer the experience of teaching primary school teachers in the Republic of Tatarstan, the higher the quality of students' education.

Subject teachers, on the contrary, showed negative correlations of the average grade with an increase in teaching experience and the total work experience of the teacher. The indicator of experience in this position found a weak positive and weak negative correlation depending on the subject being taught. The indicator of the qualifications category revealed positive correlations with academic performance.

The influence of demographic differences among school teachers (primary classes and subject teachers) on the success of school students' education has been revealed. Primary school teachers (grades 1-4) showed a weak positive correlation in Physical education and Literature reading. Female teachers in these disciplines have a higher success rate of students' learning activities compared to male teachers. Subject teachers (grades 5-11) showed a weak negative correlation in Mathematics, Physical education, Biology, Geography, Social studies, Physics, English, Chemistry, Computer science and information and Communication technologies, Technology and Health and wellness.

Male teachers in these academic disciplines have higher learning success than female teachers. Based on a comparative analysis of the average grades given by male and female teachers (using the Student's t-test), it is shown that in primary school, male Physical education teachers have a lower success rate than female teachers. In the case of subject teachers, men are more successful than women.

The influence of the age characteristics of school teachers (primary classes and subject teachers) on the success of their professional activities has been shown. Russian primary school teachers were found to have weak positive correlations in Mathematics, Russian language, and English, and weak negative correlations in Technology and Music. Therefore, in Mathematics, Russian language, and English, the scores were higher for older teachers, and in Music and Technology for younger teachers – based on the methods of correlation analysis comparative analysis (Student's t-test), and the k-means method (age was divided into 5 clusters). Primary school teachers showed weak positive correlations in Mathematics, Russian language, and English, and weak negative correlations in Technology and Music-that is, in Mathematics, Russian language, and English, the scores were higher for older teachers, and in Music and Technology for younger teachers. For subject teachers weak negative correlations were found in Mathematics, Physical education, Geography, History, Social studies, Physics, Computer science and information and Communication technologies, Health and wellness, Technology, and Fine arts. Therefore, younger subject teachers have higher average scores compared to their older counterparts.

Based on comparative analysis, it was revealed that in primary school, teachers under 50 years of age have lower grades in English and higher grades in Physical education, Technology, and Music than older teachers. Subject teachers under the age of 50 have higher grades in subjects than teachers over the age of 50. The exception is English. In English, young teachers have a lower level of student grades than older teachers.

Correlation analysis (Spearman) after dividing the age into 5 clusters showed that in primary school, older teachers in Mathematics, Russian and English have higher success rates. Younger subject teachers are more successful than older teachers in Mathematics, Physical education, Geography, History, Social studies, Physics, Computer science and information and Communication technologies, Health and wellness and Fine arts.

The influence of the peculiarities of teachers' education on their professional success has been shown. Previously, based on the collected data in the personal accounts of teachers, a "Unified directory of universities" was developed.

Based on the heterogeneity of teachers' references to their universities and, accordingly, the heterogeneity of the source data, the Levenshtein distance method was used, which allowed us to correlate the names by similarity and develop a single reference book for universities in the Republic of Tatarstan. Next, a two-stage analysis of the impact of education on the professional success of the teacher was carried out. At the first stage, the analysis was carried out using comparative analysis (Student's t-test). For the analysis, we took three universities in each discipline with the largest number of teachers who studied at these universities. The results showed the following:

For primary school teachers, education does not affect their success in such subjects as Physical Education, Technology, Art and English. At the same time, qualifications significantly affect the professional success of a teacher in such subjects as Mathematics, Literary reading, Music, the World around us, and the Russian language.

For secondary and high school teachers, qualifications do not affect their success in such subjects as English, Fine arts, Computer science, Music, Health and wellness, Physical Education, Music, Technology, Biology and Geography. At the same time, qualifications significantly affect the professional success of a teacher in language disciplines (Native language, Native literature, Literature, Russian).

In the second stage, the impact results were specified through data clustering and analysis using the Pearson consensus test (the analysis was conducted separately for each academic year). Based on the k-means clustering method, the average grades of teachers in different disciplines were divided into 5 clusters. Next, a conjugacy matrix was constructed that characterizes the number of hits of the average grade in a certain cluster for each university. Based on the conjugacy matrix, the Pearson agreement criterion was calculated, which showed that with an increase in the number of universities involved in the analysis, the group of subjects for which the teacher's qualifications is a significant factor increases. As a result, groups of subjects are identified according to the peculiarities of the influence of the teacher's qualifications on their professional success.

For junior level (grades 1-4): subjects that depend on the teacher's qualifications: Mathematics, Russian language, Literary reading, the World around us, Fine arts, Technology. They do not depend on the teacher's qualifications: Physical Education, Music, English.

For senior level (grades 5-11): subjects that depend on the teacher's qualifications: Russian language, Literature, History, Social studies, Geography. The following subjects do not depend on the teacher's qualifications: Mathematics, Physical Education, Biology, Physics, English, Chemistry, Computer science, Tatar language, Technology, Health and wellness, Tatar literature, Fine arts, Music, Art.

The heterogeneous nature of the impact of advanced training courses is shown (data containing information about the name of the course, the number of hours, the subject of the course and the institution where these courses were held are used). The analysis showed that the average score can change both upward and downward, but these changes are insignificant. The results obtained show the insufficiency of using traditional methods of statistical processing in processing large volumes of high-quality data. It is assumed that the changes will be highlighted at the second stage of the project when the methods of neural network analysis of big data shall be connected.

The mechanisms and regularities of the influence of the educational load on the success of the teacher's professional activity have been shown. The number of lessons conducted by the teacher during the school year was taken as a value that characterizes the load. Based on the Pearson correlation and regression analysis, the following results were obtained. In primary school, a weak negative correlation was found in all disciplines – if the teacher's workload is high, then this negatively affects the success of students. The strongest negative correlations were found in Mathematics, Russian, and Literary reading. The weakest correlations are in Physical education, Technology, Music, and English.

In secondary and high school, weak negative correlations were also found in all subjects. The strongest negative correlations were found in Mathematics, Geography, Physics, Chemistry, and Music. The weakest correlations were found in Physical education, English, Technology, and Health and wellness.

The regularities and mechanisms of the influence of the features of the content of classes on the professional success of the teacher have been revealed. A more complete solution to this problem is assumed during the implementation of the second stage of the study. As part of the first stage, a pilot analysis was carried out - based on the texts of lesson planning in Mathematics. In the texts of lesson planning, an automatic search for keywords describing the topic of classes was carried out. In the course of the study, the use of project activities in the classroom was studied. The analysis of the impact of the content of classes (project activities included/not included) on the Mathematics lessons in primary school (grades 1-4) showed unexpected results. The average score of students who had classes with the use of project activities was lower than that of students who did not have project activities. Perhaps this is due to the specifics of the discipline "Mathematics" or to the fact that project activities are mainly used by young teachers, whose professional success is lower compared to more experienced ones (according to the results of the study).

Features of formation of probable vectors of development of educational activity of students on the basis of their previous educational activity are shown.

In general, students who did not continue their studies in the 10th grade, in the primary and secondary levels, showed a lower level of academic performance by 10-15% than their peers who moved on to high school.

The academic performance of students in grades 7 to 9 in Mathematics, Russian, Physics and Social studies is 6-10% lower than that in grades 10-11. There was also a significant decrease in academic performance in the 9th grade by 6-12% – this is a common indicator, typical for both students who finished school after the 9th grade, and for those who moved to the 10th grade.

The first explanation for the results is due to the fact that after the 9th grade, the least academically successful students leave school, which leads to an average increase in academic performance. The second explanation is that teachers underestimate grades in grade 9 and further overestimate them by grade 11, which is indirectly confirmed by a visible increase in the average grade from grade 10 to grade 11, as well as a drop in the average score of grades 9 relative to the average score for grades 7-8 in almost all subjects.

The features of the influence of the characteristics of educational institutions on the average grade of students are shown. Based on a comparative analysis, significant differences in the professional success of a high school teacher and ordinary school teacher are identified. It is shown that primary, secondary and high school teachers are more successful in all subjects in high schools compared to regular schools. The exceptions are such subjects as Physical education, Technology, Art.

Significant differences in the professional success of teachers in urban and rural schools have been highlighted. It is shown that primary, secondary and high school teachers in urban schools are more successful than in rural schools. The most significant differences among primary school teachers were found in such subjects as Literary reading, the world around us and Music. The most significant differences among secondary and high school teachers were found in Mathematics, Physical Education, Russian, Literature, Physics, Chemistry, Computer science and Technology. At the same time, no differences were found in Health and wellness and Social studies.

The influence of the number of school shifts on the professional success of a teacher has been highlighted. For primary classes, higher teacher success was found in schools with two shifts in all subjects. In the secondary and high school classes, a statistically significant decrease in the professional success of teachers in schools with two shifts in the following subjects was found: Mathematics, Russian, Physics, Chemistry.

The influence of the school age on the average grades (with the date of foundation before 1980 and after 1980) is analyzed. It is shown that the professional success of teachers in new schools is significantly higher than in older schools in all subjects.

The influence of the number of students studying at the school on the professional success of the teacher has been shown. It is pointed out that in primary school, the number of students directly affects the professional success of teachers in all subjects. In secondary and high school, an increase in the number of students leads to a decrease in academic performance in such subjects as Mathematics, Physical education, Physics, Chemistry and Technology.

Discussions

Based on the conducted research, a pilot version of the theoretical and empirical model is proposed, which reflects a number of mechanisms and patterns of influence of the educational environment components on the success of the teacher's professional activity. This version of the model is preliminary and will be refined and specified at the second stage of the project when testing the methods of neural network analysis of big data accumulated and structured in the created database.

The empirical and theoretical foundations of constructing a digital model of an individual trajectory of a teacher's professional development using neural networks are proposed. Based on the results of theoretical and empirical research, the mechanisms and patterns of influence of the educational environment factors have been identified, which partially allows us to predict the features of the teacher's professional trajectory. At the same time, the use of various traditional methods of mathematical statistics (correlations, comparative analysis, regression analysis, clustering) and the construction of a linear model of multiple regression showed an insufficient level of forecasting the professional success of the teacher and the need to use nonlinear models with the inclusion of neural network analysis methods to increase predictive accuracy.

Conclusion

The implementation of the first stage allowed us to establish the mechanisms and patterns of influence of certain factors on the professional success of primary school teachers and subject teachers. The discovered mechanisms and patterns will serve as the basis for the second stage of the project when teaching the neural network module to analyze, interpret and predict the trajectory of the teacher's professional success. At the same time, it was found that when working with big data, when huge arrays of digital traces are involved, the use of traditional methods of statistical processing of big data (correlations, comparative analysis, factor analysis, regression analysis, etc.) allows us to identify the main trends. A more accurate calibration of the influence of various factors and their synergy on the professional success of the teacher will be carried out with the inclusion of neural network methods in the study.

Acknowledgements

The reported study (all theoretical and empirical tasks of the research presented in this paper) was funded by Russian Foundation for Basic Research (RFBR) according to the research project “Digital model of formation of an individual trajectory of teacher’s professional development based on big data and neural networks (on the example of the Republic of Tatarstan)” № 19-29-14082.

References

- Ahn, S., & Choi, J. (2004, April). Teacher’s subject matter knowledge as a teacher qualification: A synthesis of the quantitative literature on students’ mathematics achievement. *Paper presented at the American Educational research Association, San Diego, CA.*
- Alieva, L. V (2019). Professional self-education as a resource for the formation of the creative personality of a teacher-educator. *Pedagogical art, 1*. URL: <https://cyberleninka.ru/article/n/professionalnoe-samoobrazovanie-resurs-stanovleniya-tvorcheskoy-lichnosti-pedagoga-vospitatelya> (date of access: 09/06/2021).
- Alishev, T. B., Ustin, P. N., & Sabirova, E. G. (2020). Opportunities for Improving the Professional Success of Teachers in the Modern Educational Environment. *ARPHA Proceedings, 3*, 89-100.
- Borko, H., Livingston, C., & Shavelson, R. J. (1990). Teachers' thinking about instruction. *Remedial and Special Education, 11*(6), 40-49.
- Coldwell, M., Greany, T., Higgins, S., Brown, C., Maxwell, B., Stiell, B., Stoll, L., Willis, B., & Burns, H. (2017). *Evidence-informed teaching: an evaluation of progress in England. Research Report*. Department for Education.
- Darling-Hammond, L. (2006). *Powerful teacher education: Lessons from exemplary programs*. San Francisco, CA: Jossey-Bass.
- Druva, C. A., & Anderson, R. D. (1983). Science teacher characteristics by teacher behavior and by student outcome: A meta-analysis of research. *Journal of Research in Science Teaching, 20*(5), 467-479.
- Glazerman, S., Mayer, D., & Decker, P. (2006). Alternative routes to teaching: the impacts of Teach for America on student achievement and other outcomes. *Journal o Policy Analysis and Management, 25*(1), 75-96.

- Goldhaber, D., & Anthony, E. (2004). *Can teacher quality be effectively assessed?* Seattle, WA. Center on Reinventing Public education and the Urban Institute.
- Greenwald, R., Hedges, L. V., & Laine, R. D. (1996). The effect of school resources on student achievement. *Review of Educational Research*, 66(3), 361-396.
- Hattie, J. (2008). *Visible Learning: A Synthesis of Over 800 Meta-Analyses Relating to Achievement*. New York: Routledge.
- Hattie, J., & Clinton, J. (2008). Identifying accomplished teachers: A validation study. In *Assessing teachers for professional certification: The first decade of the National Board for Professional Teaching Standards*. Emerald Group Publishing Limited.
- Irving, S. E. (2004). *The development and validation of a student evaluation instrument to identify highly accomplished mathematics teachers*. Unpublished PhD., The University of Auckland, Auckland, New Zealand.
- Johnson, R. C., & Jackson, C. K. (2019). Reducing inequality through dynamic complementarity: Evidence from Head Start and public school spending. *American Economic Journal: Economic Policy*, 11(4), 310-49.
- Kobzar, A. I. (2012). *Applied Mathematical Statistics. For engineers and scientists: a tutorial*. Moscow: FIZMATLIT.
- Lustick, D., & Sykes, G. (2006). National Board Certification as professional development. What are teachers learning? *Educational Policy Analysis Archives*, 14(5), 1-43.
- Metcalf, K. K. (1995, April). Laboratory experiences in teacher education: A meta-analytic review of research. *Paper presented at the Annual Meeting of the American Educational Research Association, San Francisco, CA*.
- Nye, B., Konstantopoulos, S., & Hedges, L. V. (2004). How large are teacher effects? *Educational Evaluation and Policy Analysis*, 26(3), 237-257.
- Pereslavtseva, E. V. (2017). Professional growth of a teacher: in search of criteria and indicators of effective activity. *Public education*, 6-7(1463). URL: <https://cyberleninka.ru/article/n/professionalnyy-rost-uchitelya-v-poiskah-kriteriev-i-pokazateley-effektivnoy-deyatelnosti> (date accessed: 09/06/2021)

- Qu, Y., & Becker, B. J. (2003, April). Does traditional teacher certification imply quality? A meta-analysis. *Paper presented at the Annual Meeting of the American Educational Research Association, Chicago, IL.*
- Sanders, W. L. (2000). Value-added assessment from student achievement data: opportunities and hurdles. *Journal of Personnel Evaluation in Education, 14*(4), 329-339.
- Sanders, W. L., Ashton, J. J., & Wright, S. P. (2005). *Comparison of the effects of NBTS certified teachers with other teachers on the rate of student academic progress. Final report.* Arlington, VA: National Board for Professional Teaching Standards.
- Shulman, L. S. (1987). Knowledge and teaching: foundations of the new reform. *Harvard Educational Review, 57*(1), 1-22.
- Sparks, D. (2004) The looming danger of a two-tiered professional development system. *Phi Delta Kappan, 86*(4), 304-306.
- Timperley, H., Wilson, A., Barrar, H., & Fung, I. Y. Y. (2007). *Teacher professional learning and development: Best evidence synthesis iteration [BES].* Wellington, New Zealand: Ministry of Education.
- Walsh, K. (2006). Teacher Education: Coming Up Empty. Fwd: Arresting Insights in Education. Volume 3, Number 1. *Thomas B. Fordham Foundation & Institute.*
- Zhemukhova, L. Z. (2009). The success of a teacher as a pedagogical problem. *Bulletin of the Russian State Pedagogical University named after A. I. Herzen, 109.* URL: <https://cyberleninka.ru/article/n/uspeshnost-uchitelya-kak-pedagogicheskaya-problema> (date accessed: 09/06/2021).
- Zorina, E. S., & Dyshlyuk, I. S. (2014). Development of the value-semantic sphere of the teacher as a factor of his professional success. *Bulletin of the Tomsk State University, 382.* URL: <https://cyberleninka.ru/article/n/razvitie-tsennostno-smyslovoy-sfery-uchitelya-kak-faktor-ego-professionalnoy-uspeshnosti> (date of access: 09/06/2021).