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Research Article

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Age-related adaptation features of teachers of educational institutions

Modern educational reforms require teachers to be highly qualified and to adapt quickly to new working methods, including the use of digital technologies. The problem of teachers' professional adaptation remains relevant despite a large number of studies in this field. Aim: to determine the factors influencing the professional adaptation of teachers in educational institutions, as well as to analyze the age characteristics of adaptation and the psychophysiological characteristics of teachers. The study involved 137 teachers from the city of Karaganda, who were divided into three age groups: under 30 years, 30–45 years and over 45 years. The Spielberger–Khanin test was used to assess anxiety, the WAM test was applied for subjective assessment of well-being, activity and mood, the Anfimov's correction tables were used to study mental performance, as well as physiological methods (blood pressure measurement, analysis of heart rate variability). The level of reactive anxiety among teachers did not show significant differences between the groups. However, the analysis of well-being, activity, and mood showed that well-being decreased with age, activity levels showed slight fluctuations, and mood was higher in the first group. Mental performance also decreased with age, which was confirmed by the decrease in the number of viewed and found signs. In addition, an increase in blood pressure, heart rate, and the stress index of regulatory systems was observed. Higher activity of the sympathetic nervous system and pronounced functional tension of regulatory systems were also identified in the older groups. The results of the study confirm the need to support teachers at different stages of their professional activities. Measures aimed at reducing stress load and increasing teachers' level of adaptation in the context of the digital transformation of education are particularly important.

Keywords: teachers of educational institutions, age dynamics, adaptation, psychophysiological state, working capacity.

Introduction

Improving of pedagogical methods, including the development of inclusive education, as well as the new work tools integration such as electronic journals and diaries, modern information technologies, etc., requires teachers to be highly qualified and capable of rapid adaptation [1-2]. In such conditions, the problem of professional adaptation of teachers becomes particularly relevant, since the problem of securing and retaining of teachers in educational institutions is not being solved, despite a sufficient number of studies [3].

The activity of a teacher in the process of professional development involves overcoming certain crisis states and adaptation [4-5]. The works emphasize the need to create a favorable educational environment that supports and stimulates the professional growth of teachers.

The neuropsychiatric load of teachers, which has increased as a result of the reform of the education system, is associated with the risk of somatic and mental disorders [6-7]. At the same time, psychosocial factors of production, especially those related to work organization, have a greater impact on mental health than on physical [8–10].

Professional health risk factors for teachers include such specific factors characteristic of educational activities as high responsibility, irregular working hours, including out-of-hours action, significant requirements for the assimilation, preservation and reproduction of information, heavy loads on the vocal apparatus and additional loads (checking students' written papers and preparing for lessons, etc.) [11-12, etc.]. It is necessary to single out particularly specific factors, namely intense psychoemotional loads, which are also characteristic of this professional category, the presence of which largely determines deviations in the health status of teachers [13-14].

According to the data [15-16], work intensity is the leading unfavorable factor in the work process of teachers. According to the respondents, work exhausts teachers not only physically (about 80 %), but also

morally (almost 90 %). The professional activity of teachers is characterized by high emotional workload. With professional experience increasing, most teachers begin to feel the "pedagogical crisis", "exhaustion", and "burnout", which significantly affects their mental and physical health [17]. Therefore, the study of these mechanisms is of great importance for optimizing the functioning of teachers in changing conditions, which makes it possible to increase the effectiveness of their activities and ensure a better quality of life [18]. However, the research does not fully reveal the specifics of the age-related adaptation of teachers to the conditions of professional activity, the psychological characteristics that ensure the success of the adaptation process, and most importantly, the effectiveness of professional adaptation. In this regard, the study of the problem of teachers' adaptation to professional activity in the age aspect is still relevant.

Experimental

The article presents the results of the study conducted among 137 teachers of secondary schools in Karaganda city. The teachers were distributed by age in the following groups: group I — 18 persons under the age of 30 (average age 25.7±0.52), group II — 65 persons at the age of 30–45 (average age 37.6±0.55), group III — 54 persons over the age of 45 (average age 52.7±0.7).

The sample was made up of teachers from general education institutions, including secondary schools and gymnasiums. The study involved teachers of primary, basic, and secondary general education who teach humanities, natural sciences, and mathematics. Since participation in the survey was voluntary and guaranteed complete anonymity, no separate written consent was requested. By returning the completed questionnaire, the participant confirmed his informed consent to participate in the study and gave permission to process the provided data. The study was approved by the Local Bioethics Commission of Karaganda Medical University (Protocol No. 17 dated 10/22/2024) and the Department of Education of the city of Karaganda in accordance with all the norms of the Helsinki Declaration (2013).

To determine the level of reactive anxiety, the Spielberger test in the modification of Khanin was used in the form of the questionnaire [19]. The results were evaluated on the following scale: up to 30 points — low anxiety, from 31 to 44 points — average, 45 points and above — high anxiety.

The subjective state of teachers was assessed by the results of the WAM test proposed by V.A. Doskin and his colleagues in 1973 [20]. This test covered three main characteristics: well-being, activity, and mood (WAM). With the WAM test, it is possible to identify specific aspects of the teachers' activities and condition, including their mood, concentration, stress level and efficiency. The questionnaire consisted of 30 pairs of characteristics that had opposite values. The analysis results were grouped according to the predefined key within three categories, and then the mean scores for each of them were calculated.

Blood pressure and heart rate (pulse) were used to assess the state of the cardiovascular system. Systolic and diastolic blood pressure was measured using the Korotkov–Yanovsky method while the subject was in the sitting position. The pulse was calculated by palpation in 60 seconds in the same position of subject.

To determine the level and dynamics of mental performance, proofreading tests for one minute were conducted using letter tables developed by V. Ya. Anfimov [21]. At the end of the test, the number of viewed and found letters was calculated, as well as the number of errors made during the task (these could be missing or incorrectly marked letters). We also calculated the attention intensity (AI) as the percentage of the number of viewed letters (VL) to the total number of letters (TL = 1600). The formula for AI calculating is as follows: **AI = VL / TL * 100**. Thus, when analyzing the test results, it was possible to get the understanding of the degree of concentration and efficiency of the subjects.

The analysis of heart rate variability (HRV) was performed by 5-minute cardiointervalography using the Varikard-2.4 software package [22]. The following statistical parameters of the heart rhythm were analyzed: the mean RR interval (mathematical expectation—Mean), the stress index (stress index—SI) of regulatory systems, characterizing the degree of centralization of heart rhythm control. The relative activity of the subcortical sympathetic nerve center was assessed by the ratio of the mean values of the low-frequency and high-frequency HRV components (LF/HF). The activity of the heart rate regulatory systems was assessed by the centralization index (CI = TP/HF), the level of activation of subcortical nerve centers was assessed by the calculated value characterizing the activity of regulatory systems (indicator of the activity of the regulatory systems—IRSA) [23].

The statistical analysis of the study results was carried out using the standard MS Microsoft Excel 2019 and STASTICA 10.0 software packages and included the calculation of the mean value of the variable (M)

and its standard error (±m). Intergroup differences between age categories were analyzed using the Student's criterion (t), which revealed statistically significant trends and patterns. The differences between the age groups were considered significant at $p<0.05$.

Results and Discussion

As the results of the study showed, the level of reactive anxiety among teachers of secondary schools was on average: in group I — 42±1.92 units, in group II — 42.5±1.24 units, in group III — 42.7±1.25 units (Fig. 1). No significant differences were found between the groups.

The analysis of the percentage of well-being, activity, and mood levels revealed the following dynamics. The well-being index in group I was 5.06±0.174 units, in group II — 4.62±0.147 units, in group III — 4.42±0.152 units ($p<0.05$). There were no significant differences in the activity index: in group I — 3.96±0.251 units, in group II — 3.67±0.141 units, in group III — 3.78±0.147 units. The dynamics of the mood index was studied, and it showed the following values: in group I — 5.9±0.317 units, in group II — 4.84±0.156 units, in group III — 4.93±0.145 units, however, there were no statistically significant differences.

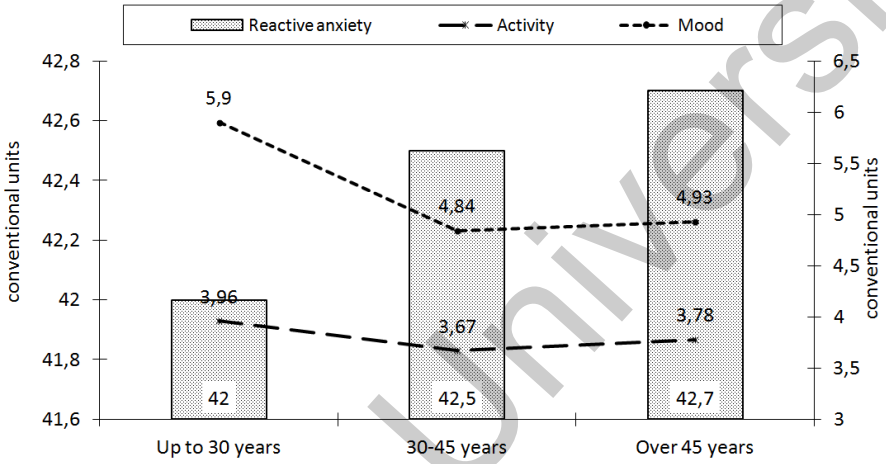

Figure 1. Age-related dynamics of reactive anxiety and WAM indicators

When evaluating the proofreading tests according to the table of V. Ya. Anfimov, significant differences in mental performance were revealed (Fig. 2). The average number of viewed letters in group I was 435.7±25.86, in group II — 415.4±20.72, in group III — 373.7±18.45 ($p<0.05$). The number of found letters in group I was 51.5±3.15, in group II — 49.9±2.24, in group III — 43.8±2.12 ($p<0.05$). The dynamics of the attention index showed the highest values in group I — 27.2±1.62, in group II it was 25.9±1.29, in group III — 23.3±1.15 ($p<0.05$). The number of errors had no significant differences and amounted to 0.7±0.23 in group I, 1±0.19 — in group II, and 0.6±0.19 characters — in group III.

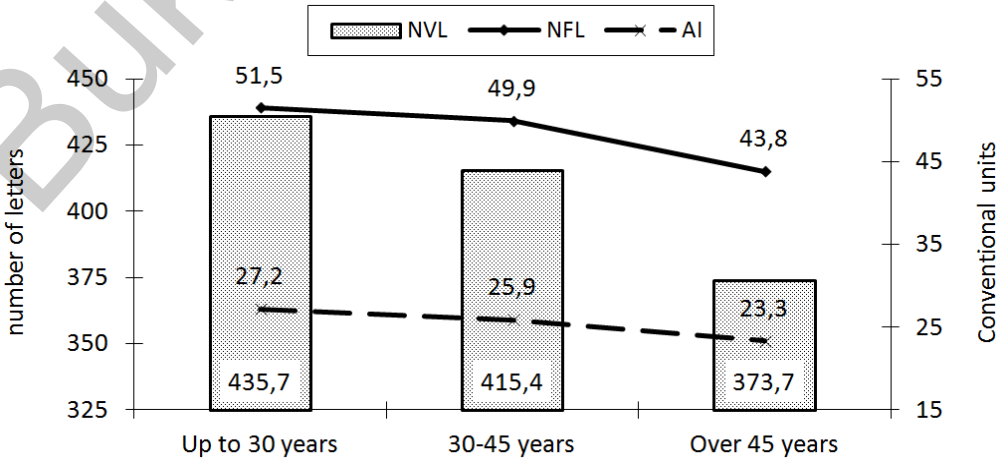

Figure 2. Age-related dynamics of indicators of correction tests according to the table of V. Ya. Anfimov

The analysis of blood pressure indicators revealed their significant increase in age dynamics (Fig. 3). The mean value of diastolic pressure in group I was 73±3.21 mmHg, in group II — 82.3±1.92 mmHg ($p<0.05$), in group III — 93.7±2.45 mmHg. ($p<0.05$). The mean value of systolic blood pressure in group I was 106.6±3.35 mmHg, in group II — 117.7±2 mmHg ($p<0.05$), in group III — 127.4±2.04 mmHg ($p<0.05$). The heart rate also showed the significant increase: in group I — 74.1±1.18 beats/min, in group II — 78.6±0.83 beats/min ($p<0.05$), in group III — 80.3±1 beats/min ($p<0.05$).

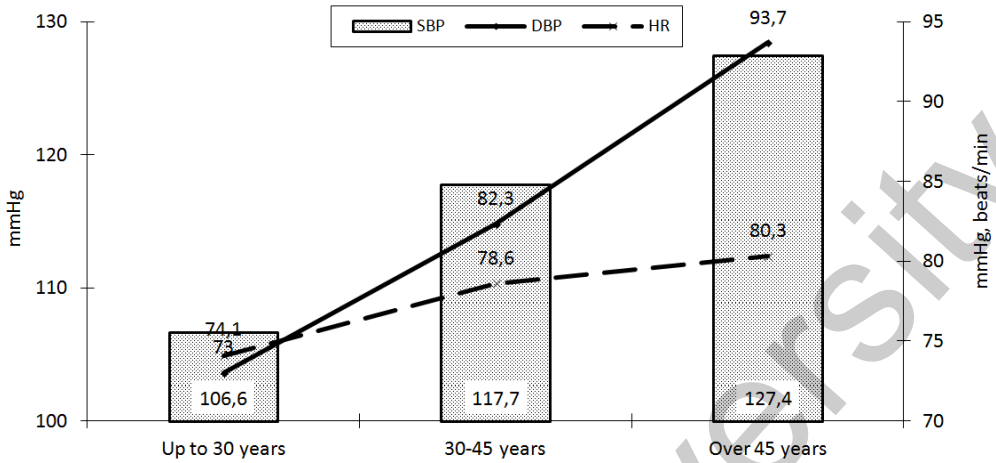

Figure 3. Age-related dynamics of indicators of the cardiovascular system functioning

The mean value of the stress index (SI) of regulatory systems in dynamics was 352.4±100.83 and 352.5±85.72 units in groups I and II, respectively, in group III the indicator increased to 401.2±62.53 units (Fig. 4). The ratio of the mean values of the low-frequency and high-frequency components of HRV (LF/HF) was 1.3±0.27 units in group I, 3±0.62 units — in group II ($p<0.05$), and 3.8±0.81 units — in group III ($p<0.05$), indicating increased activity of the subcortical sympathetic nerve center. The heart rate control centralization index (CI) in group I was 2.4±0.52 units, in group II — 5.2±0.98 units ($p<0.05$), in group III — 6.4±1.21 units ($p<0.05$). Analysis of the dynamics of the indicator of regulatory systems activity (IRSA) showed that in group I it corresponded to the "expressed functional stress" level (4.2±0.34 units), in groups II and III it increased to the "strongly expressed functional stress" level and amounted to 5.1±0.3 and 5.2±0.41 units, respectively.

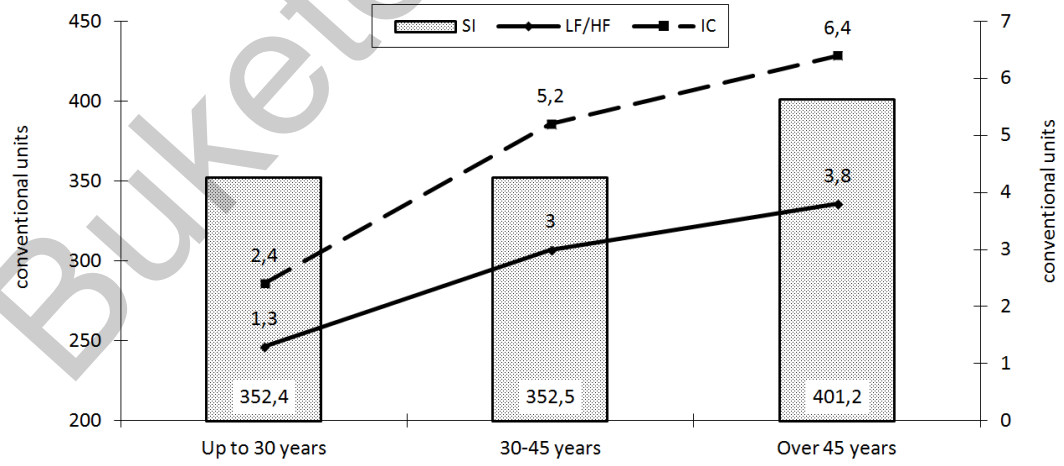

Figure 4. Age-related dynamics of heart rate variability indicators

The intensity of the teacher's work is determined by several factors reflecting mental stress: creative approach to tasks, analysis, assessment and observation of the learning process, activities with limited time, emotional involvement and responsibility for the result of work, the occurrence of controversial situations related to the profession, sensory overload and lack of physical activity [24].

Pedagogical activity requires the teacher to constantly interact with students, colleagues, and the administration, and it creates increased demands on the adaptive capabilities of the body. Studies show that teachers have the increased level of psychoemotional stress, which eventually leads to the depletion of adaptive mechanisms [25].

It was noted [26] that age-related crises among teachers aged 40–45 years are accompanied by the job satisfaction decrease in and the anxiety increase, which can manifest in the deterioration of well-being and cognitive functions. This corresponds to the data of our study, which revealed the decrease in the indicators of well-being and activity among teachers of older age groups.

According to the study of the European Occupational Safety and Health Agency (EU-OSHA, 2021), teachers are at the increased risk of occupational stress developing, which leads to the development of psychosomatic diseases [27-28].

The number of studies [29-30] demonstrate that teachers have increased levels of cortisol, a stress hormone, which confirms the influence of professional activity on the endocrine system. The results of our study also indicate the increase in sympathetic activity (LF/HF increase) with age, which indicates the increasing effect of stress.

Psychophysiological stress leads to functional changes in the body, such as the deterioration in well-being and subjective assessment of the condition (according to our data, this is the decrease in well-being, activity and mood), the cognitive functions decrease (decrease in the number of viewed and found letters, the attention index), high blood pressure and heart rate (our study revealed the increase in systolic and diastolic blood pressure and heart rate with age).

Prolonged exposure to stress without adequate compensatory mechanisms leads to the development of professional burnout syndrome [31-32]. Chronic stress among teachers leads to increased fatigue and decreased performance, sleep disorders, depressive states and, as a result, the development of cardiovascular diseases [33-34].

These data are confirmed by the results of our study, which revealed the dynamics of deterioration in the indicators of regulatory systems, which indicates a gradual depletion of adaptive resources.

Studies of the psychophysiological state of teachers indicate the high workload associated with their professional activities. The work of a teacher requires not only high cognitive activity, but also significant emotional and communicative costs, which leads to the formation of chronic stress and tension of adaptive processes [35-36]. In general, the results of the study emphasize the need to develop comprehensive programs aimed at maintaining the psychophysiological health of teachers of various age groups, taking into account specific changes related to age and professional activity.

Conclusion

1. Stress caused by professional activity has the expressed effect on cognitive functions, which is manifested by the mental performance and attention decrease. With the years, teachers experience the decrease in the amount of the processed information and the decrease in the attention index, which may affect the quality of teaching and require the development of support programs and trainings to maintain cognitive functions.

2. The adaptive mechanisms of teachers have significant stress, which is expressed in the physiological stress markers increase (increased blood pressure, stress index of regulatory systems and activity of the sympathetic nervous system). Long-term exposure to stress can lead to serious health consequences, namely the development of hypertension, cardiovascular diseases, emotional burnout and mental disorders.

3. In order to minimize the effects of professional stress on teachers, it is necessary to monitor the psychophysiological state of teachers and develop adaptation strategies, increase the stress tolerance of this category of specialists through special trainings and self-regulation programs.

Conflict of interest

The authors declare no conflict of interest.

Author Contributions

The manuscript was written through contributions of all authors. All authors have given approval to the final version of the manuscript. CRediT: **Smagulov N.K. —** Conception and design of study, methodology, Analysis and/or interpretation of data, supervision, writing draft, editing. **Arystanbay A.A. —** data curation, formal analysis, investigation, Drafting the manuscript. **Tykezhanova G.M. —** data curation, formal analysis, investigation. **Svetlik M.V. —** methodology, Analysis and/or interpretation of data, writing draft, editing.

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Жалпы білім беру мекемелері мұғалімдерінің бейімделуінің жас ерекшеліктері

Заманауи білім беру реформалары мұғалімдерден жоғары біліктілікті және жаңа жұмыс әдістеріне, соның ішінде цифрлық технологияларға тез бейімделуді талап етеді. Осы саладағы көптеген зерттеулерге қарамастан, мұғалімдердің кәсіби бейімделу мәселесі өзекті болып қала береді. Зерттеудің мақсаты: Жалпы білім беретін мектеп мұғалімдерінің кәсіби бейімделуіне әсер ететін факторларды анықтау, сондай-ақ педагогтардың бейімделуінің жас ерекшеліктерін және психофизиологиялық сипаттамаларын талдау. Зерттеуге Қарағандыдан жас ерекшеліктеріне қарай үш топқа бөлінген 137 мұғалім қатысты: 30 жасқа дейін, 30-45 жас және 45 жастан асқан. Мазасыздықты бағалау үшін Спилбергер-Ханин сынағы, әл-ауқатты, белсенділік пен көңіл-күйді субъективті бағалау үшін САН сынағы, психикалық өнімділікті зерттеу үшін Анфимовтың түзету кестелері, сондай-ақ физиологиялық әдістер (қан қысымын өлшеу, жүрек соғу жиілігінің өзгергіштігін талдау) қолданылды. Зерттеу барысында жалпы білім беретін мектеп мұғалімдері арасындағы реактивті мазасыздық деңгейі топтар арасында айтарлықтай айырмашылықтар болмағаны анықталды. Алайда әл-ауқатты, белсенділікті және көңіл-күйді талдауда жасына қарай әл-ауқаттың нашарлағанын, белсенділіктің шамалы ауытқулары болғанын және бірінші топта көңіл-күйдің жоғары екенін көрсетті. Ақыл-ой өнімділігі жасына қарай төмендеді, бұл қаралған және табылған белгілер санының азаюымен расталды. Сондай-ақ қан қысымының, жүрек соғу жиілігінің және реттеуші жүйелердің кернеу индексінің жоғарылауы байқалды. Симпатикалық жүйке орталығының белсенділігінің артуы және үлкен топтардағы реттеуші жүйелердің айқын функционалдық кернеуі байқалды. Зерттеу нәтижелері кәсіби қызметтің әртүрлі кезеңдерінде мұғалімдерді қолдау қажеттілігін растайды. Білім берудің цифрлық трансформациясы жағдайында стрестік жүктемені азайту және мұғалімдердің бейімделу деңгейін арттыру шаралары ерекше маңызды.

Кілт сөздер: жалпы білім беру мекемелерінің мұғалімдері, жас динамикасы, бейімделу, психофизиологиялық жағдайы, жұмысқа қабілеттілігі

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Возрастные особенности адаптации учителей общеобразовательных учреждений

Современные образовательные реформы требуют от учителей высокой квалификации и быстрой адаптации к новым методам работы, включая цифровые технологии. Несмотря на большое количество исследований в данной области, проблема профессиональной адаптации педагогов остается актуаль-

ной. Цель исследования: определение факторов, влияющих на профессиональную адаптацию учителей общеобразовательных школ, а также анализ возрастных особенностей адаптации и психофизиологических характеристик педагогов. В исследовании приняли участие 137 учителей из Караганды, разделенные на три возрастные группы: до 30 лет, 30–45 лет и более 45 лет. Использовались тест Спилбергера-Ханина для оценки тревожности, тест САН для субъективной оценки самочувствия, активности и настроения, корректурные таблицы Анфимова для изучения умственной работоспособности, а также физиологические методы (измерение артериального давления, анализ вариабельности сердечного ритма). В ходе исследования выявлено, что уровень реактивной тревожности среди учителей общеобразовательных школ не имел значительных различий между группами. Однако анализ самочувствия, активности и настроения показал, что самочувствие ухудшалось с возрастом, активность имела незначительные колебания, а настроение было выше в первой группе. Умственная работоспособность снижалась с возрастом, что подтверждалось уменьшением количества просмотренных и найденных знаков. Также наблюдался рост артериального давления, частоты сердечных сокращений и индекса напряжения регуляторных систем. Отмечено увеличение активности симпатического нервного центра и выраженное функциональное напряжение регуляторных систем в старших группах. Результаты исследования подтверждают необходимость поддержки педагогов на разных этапах профессиональной деятельности. Особенно важны меры по снижению стрессовой нагрузки и повышению уровня адаптации учителей в условиях цифровой трансформации образования.

Ключевые слова: учителя общеобразовательных учреждений, возрастная динамика, адаптации, психофизиологическое состояние, работоспособность

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