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School Climate

A History of the Concept and Approaches to Defining and Measuring it on PISA Questionnaires

School climate is one of the significant factors determining educational achievement. However, the lack of instruments to measure it has complicated the study of this concept in Russia. We review the history of the study of the concept of "school climate," and we discuss approaches to how it can be defined. We describe the most widely used questionnaires for studying school climate and analyze the set of components that have been included in them. To conduct the empirical study, we chose the student questionnaire that is used in the PISA international study, which provides a theoretical basis for measuring a number of dimensions of school climate. We conducted a psychometric analysis using methods from confirmatory factor analysis and modern test theory. It turned out that the structure of the indices that are used to measure school climate is not what the

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framers of the questionnaire assumed it would be. It is unclear whether the questions reflect the school climate indicators that are specifically proposed in the questionnaires. Some of the judgments in the questionnaire have been worded in such a way as to elicit most students' agreement or disagreement with them without revealing any differences in how students perceive the subject of the question. The answer categories are unbalanced for most of the judgments. Respondents tended to fill them out in a one-sided fashion. We propose steps for how the instrument can be further improved.

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Introduction

The factors determining student success at school are one of the key topics in studies of education. These constitute a very diverse set of factors, including student characteristics, the parameters of the educational process, and the specific features of the school and its environment. Early studies in this area emphasized the characteristics of the student, the student's family, and the neighborhood in which the school is located. Later, the focus shifted to the qualities of teachers and the learning process. In recent decades, researchers have been increasingly analyzing the daily events that take place in school. Thus, they not only record the objective indicators of learning activities, but they also capture social and psychological characteristics.

One of these characteristics is school climate, an invisible element of school life that is felt by all participants. It has been empirically established that there is a link between school climate and the educational activity of students, the degree of student involvement in the learning process, student achievement (MacNeil, Prater, and Busch 2009; Sherblom, Marshall, and

Sherblom 2006), the school dropout rate of students, the likelihood that they will stay in school through the upper grades (Coleman 2001), and other academic outcomes. The school climate is seen as a predictor of not only academic achievements, but also of a different kind of learning outcome in school: the development of social skills, the level of students' self-esteem, and their emotional and psychological state (Shochet et al. 2006; Way, Reddy, and Rhodes 2007; Kasatkina and Aksenova 2013).

Interest in school climate goes beyond purely research or administrative concerns. It is also an important factor that parents of students consider when choosing a school for their child, for example. Centers for the study of school climate have been established in European countries and the United States. There are more than a hundred instruments that are used to measure it at the different stages of education (primary, secondary, and post-secondary) and how it affects various participants in the educational process (teachers, principals, students, and their parents). The results of studies using these instruments have found a very wide range of applications.[1]

The concept of "school climate" is multifaceted. It covers an extremely diverse range of aspects of school life, from the objective size and physical condition of the school building to the subjective perceptions of interpersonal relations within the school. Accordingly, the instruments that are used to measure this property of school life are equally diverse. They differ in both their measurement objectives and in the set of indicators of school climate that they choose to measure.

Systematic studies of school climate are an offshoot of studies of organizational climates. The results of these studies influenced how the concept of the "organizational climate" was applied to the context of the study of schools. The definitions and instruments that were used in the initial studies of school climate were borrowed from organizational studies. Studies of school performance also informed how studies of school climate were performed. The former analyzed factors that distinguish more successful schools from less successful ones. Developing in parallel, these two research traditions

have influenced the theory, methodology, and tools that are used for measuring school climate.

In Russia, the measurement of school climate can be divided into two trends. The first group limits itself to intraschool studies, in which school psychologists or guidance counselors provide assessments of the school climate of their schools (Bogdanova 2008). The Russian-language methodologies of measuring school climate that have been created for this purpose are designed to diagnose problems. They are not designed to measure indicators in a way that is suitable for academic research purposes and that enables schools to be compared with each other. The second approach to assessing school climate often uses data from such large-scale international studies as, for example, the Trends in Mathematics and Science Study (TIMSS)[2] comparative monitoring study or the Program for International Student Assessment (PISA).[3] However, neither those nor other instruments have been studied from the point of view of the quality of measurement. First of all, no one has yet questioned the structure of the identified factors of school climate. Can the questions in the questionnaire really be grouped into the proposed indices? Secondly, Russian-language studies have failed to address the psychometric aspects of the questions that have been included in the questionnaires. Do these questions really allow us to obtain a quantitative assessment and to differentiate schools on the basis of the degree of manifestation of certain school climate characteristics?

The goal of our study is to provide a theoretical and empirical analysis of the concept of "school climate." As part of our theoretical analysis we offer a literature review of studies into this phenomenon. We provide an overview of the ways in which this concept has been defined and the types of components that have been proposed and chosen under these concepts. We also describe the most popular methods that have been used to measure the concept. We undertake an empirical analysis to assess the possibilities for measuring school climate that are offered by the PISA questionnaires: we establish which dimensions of school climate that we identified in the literature review are addressed in the PISA questionnaires. We

analyze the factor structure of the indices as well as the psychometric characteristics of the questions.

1. Theoretical analysis of the concept of "school climate"

1.1. A history of the study of the concept

Arthur C. Perry's *The Management of a City School*, which was published in 1908, is considered to be the first work that was dedicated to the study of school climate. As the principal of a school in Brooklyn, he wrote about the importance of establishing a favorable climate in the school to foster a sense of camaraderie among its members as well as to increase the general productivity and successful functioning of the school (Freiberg 1999).

Around the same time, at the beginning of the twentieth century, organizational researchers discovered the relationship between the climate or atmosphere at an organization and employee motivation, productivity, and job satisfaction. Thus, in the late 1920s a famous experiment was conducted at the Hawthorne Works of the Western Electric Company. The study showed that workers modified their behavior in response to interactions with colleagues and managers: when managers paid attention to their subordinates and praised them, the latter increased their productivity. These discoveries attracted the attention of educational researchers and, in particular, school researchers. After all, they reasoned, the school can be regarded as a special kind of organization.

Later, in the 1940s, studies of organizational climate and, as a result, of schools began to consider not only the links between the behavior of people and the external environment in which they find themselves, but also the links between the style of management and the behavior of the group. Kurt Lewin has observed that management policy determines the social climate of the staff, which in turn affects how employees work (Lewin, Lippitt, and White 1939).

The 1950s–1960s were marked by the active study of organizational behavior (McGregor 1960; Tagiuri 1968; Argyris 1958). Chris Argyris was one of the first to systematically link

organizational climate with efficiency, employee satisfaction, productivity, and employee turnover.

The first studies of school climate appeared during the second half of the twentieth century. The school was viewed as a particular kind of organization. The instruments that had been used to study organizations were adapted to the study of schools (Halpin and Croft 1963). Researchers were interested in the administrative structure and its related processes at the school. They studied the administrative practices of school principals as well as the social relations between teachers.

James Coleman's work exerted great influence on the study of school climate. He paid great attention to the role that school factors played in the educational achievements of students (Coleman et al. 1966). Coleman showed that any given school factor had a smaller influence on student educational outcomes than student family characteristics. Further studies largely refocused themselves on the family and individual characteristics of students, pushing school factors, including climate, into the background.

This approach remained current right up until the 1980s. The results of a new study by Coleman provided one of the weightiest arguments in favor of reevaluating the role that school factors play in student achievement. He concluded that students at private educational institutions had higher levels of academic achievement than students at public schools due to the better school climate at private schools. This climate is characterized by a trusting relationship between both parents and teachers and teachers and students (Coleman, Hoffer, and Kilgore 1982). During this period, researchers began to more frequently consider school climate in conjunction with the academic achievements of students (Kreft 1993). During the 1990s, school climate was analyzed at the level of particular classes and teachers (Zullig et al. 2010). Thanks to the studies of recent decades school climate has been recognized as an important determining factor of the effectiveness of educational institutions as well as student academic achievement, motivation, socialization, and behavior.

1.2. Approaches to defining the concept of "school climate"

Despite the fact that the concept of "school climate" has been studied for a long period of time, like many other concepts in the social sciences researchers have failed to agree on a common definition of it. Some researchers have cited its objective characteristics, whereas others have focused on its subjectively perceived ones. A third group combines aspects of both categories. As a result, proposed definitions often do not agree with each other.

Many definitions of school climate are borrowed from studies devoted to organizational climate. They take into account such aspects of organizational behavior as job satisfaction, motivation, productivity, and social relationships. Argyris emphasizes the complexity of this phenomenon, and he describes climate as consisting of the complex, multifaceted interactions between the members of an organization G.A. Forehand and B. Gilmer define the climate as a set of properties of an organization that is relatively stable over time, distinguishes one organization from another, and influences the behavior of its members (Forehand and Gilmer 1964). According to B. Schneider, climate consists of the perception of events, activities, and methods of interaction, which are expected, regulated, and supported in the organization (Schneider 1972). W. Warner Burke and George H. Litwin have proposed that climate consists of methods of perception, expectations, and feelings that are shared by all members of the organization (Burke and Litwin 1992). Richard Kopelman and his coauthors define climate as an environment of work that is mediated by individual interpretations.

Renato Tagiuri provided the following general definition of organizational climate: it consists of a relatively permanent set of characteristics that describe the organization's internal environment. These characteristics 1) are perceived by its members; 2) affect their behavior; 3) reflect the properties of the organization; and 4) can be quantified (Tagiuri 1968).

As far as the school environment in particular is concerned, in his book Perry called it an esprit de corps that all participants in school life (teachers, parents, students, and principals) play a part

in shaping (Freiberg 1999). A.W. Halpin and D.B. Croft define the school climate as an elusive mixture of the perceptions that each individual has of his work, the roles that he plays in interpersonal relations, and his interpretation of the roles of other individuals (Halpin and Croft 1963). H. Jerome Freiberg believes that the school climate is the soul and foundation of the school that makes teachers, students, and school participants feel that they are a part of this institution (Freiberg 1999). Wayne N. Welsh believes that school climate consists of norms, values, and mindsets that define the relations between school agents. It consists of the individual perception of each member of the student body at school and the processes that take place in it (Welsh 2000). Jonathan Cohen and his coauthors define school climate as the norms, values, interpersonal relations, and practices of teaching and learning as they are subjectively filtered by perceptions of individuals at school. They emphasize that all participants in school life in one way or another influence, shape, and change the school climate (Cohen et al. 2009).

In summarizing the above definitions, we can distinguish three key features of organizational climate that many researchers have noticed. First of all, climate is viewed as a psychophysical phenomenon, i.e., it is the subjective perception by agents of the processes that take place at the organization (Schneider 1972; Burke and Litwin 1992; Kopelman, Brief, and Guzzo 1990; Halpin and Croft 1963; Cohen et al. 2009). Secondly, and this thesis follows from the first one, climate is a latent construct whose indicators can be the answers of members of organizations to questions about norms, practices, and other phenomena that are relevant to a particular organization. Third of all, the climate is a phenomenon that is constant across time (Forehand and Gilmer 1964; Tagiuri 1968). In other words, climate cannot change from year to year simply as a result of the hiring of new employees by the organization or the matriculation of new students in the school. Significant reforms and a change in behavioral practices must be made for noticeable changes to take place in organizational climate.

1.3. Components of school climate

During the 1960s, the view that school climate was a complex concept took hold, and approaches to how this concept could be operationalized and measurement instruments could be created began to be developed. One of the first instruments that was used to evaluate school climate was created by Halpin and Croft: the Organizational Climate Description Questionnaire (OCDQ; Halpin and Croft 1963). In their opinion, the school administration, and in particular the principal, is responsible for determining what the school climate will be. Therefore, in their questionnaire for school personnel, questions were asked about the activities and characteristics of the principals and teachers. It was proposed that eight factors are responsible for climate indicators:

—The level of unity among teachers
—Relations with the school principal
—The level of teacher job satisfaction
—Relations with colleagues
—The level of alienation of the principal
—The level of control exercised by the principal
—The exchange of ideas with the principal
—The principal's respectful attitude towards students

In the 1970s, the American psychologist R.H. Moos developed his own concept of school climate (Moos 1979). He considered climate as only one of six indicators of the school's social environment along with location, behavioral practices, organizational structure, the average socio-demographic characteristics of individuals in the organization, as well as the established rules. He distinguished three aspects of the school climate: social (interpersonal relations between agents at the school), affective (conceptions of the school and feelings towards the school), and organizational (rules and structure).

By the 1980s, hundreds of studies devoted to the topic of school climate and using various instruments to measure it had appeared. A meta-analysis was conducted to systematize the results of these studies (Anderson 1982). The author classified

the indicators of school climate that were used in these studies in accordance with the four dimensions of this concept that had been identified by Tagiuri (1968).

1. The physical and material characteristics of the school (ecology), including the characteristics of the school building, how well equipped the classrooms are, the size of the school, and the number of classrooms.
2. The individual dimension (milieu), including for teachers (work experience, career satisfaction, and evaluation of one's own effectiveness), students (attitude towards school, classes, and involvement in the learning process), administration (level of alienation from the academic process and the nature of the reports that teachers are required to submit).
3. The social dimension (social system), including relations between teachers, students, parents, administrators, etc.
4. The cultural dimension (culture), including the expectations for student achievement that teachers, administrators, parents and the students themselves have; the system of norms and rules that regulate relations between the participants in the educational process and the specific features of the evaluation system.

A meta-analysis of studies dedicated to school climate that was conducted at a later date (Cohen et al. 2009) also identified four of the most frequently listed aspects of climate:

1. Safety (physical and emotional, including norms and rules)
2. Teaching and learning (professional characteristics of teachers, academic development)
3. Relationships (between students, teachers, principals, and parents)
4. Physical environment (school size; the presence of resources, materials, and elective courses; etc.)

The social and physical components of the climate have been identified in both meta-analyses and are substantially consistent with each other. The dimension of "teaching and learning" proposed in the study by Cohen et al. and the individual dimension of the school climate described in the analysis of Carolyn Anderson are closely related constructs, which include the

personal characteristics of teachers and students. However, Anderson relies on the theoretical framework of Tagiuri. That means that he was influenced by traditions that have arisen around the study of organizations. The fact that his meta-analysis singles out the cultural aspect of climate, which consists of expectations and the level of camaraderie between school actors, seems quite natural. The second meta-analysis was based on empirical data. It did not identify the cultural dimension of organizational climate. Anderson's classification fails to include the level of safety that is felt to exist in a school, which is among the four most frequently listed elements of school climate.

A survey conducted by K. Zullig and his coauthors (Zullig et al. 2010) used statistical methods for the first time to verify the results of a theoretical analysis of how the concept of school climate has been operationalized historically. During the first, theoretical stage of the study, the authors identified the following five aspects of school climate that are the most frequently found in the literature:

1. Level of camaraderie among members of the student body
2. Level of safety
3. Academic outcomes
4. Physical conditions
5. Social relations

Later, the authors carried out a secondary analysis of the data that were obtained from various studies of school climate by means of confirmatory factor analysis, and they identified eight latent constructs:

1. Sense of community
2. Observance of order and discipline
3. Academic support of students
4. Physical conditions of the school
5. Level of satisfaction that students express about their studies
6. Discrimination/showing preference for certain students over others
7. Relations between students
8. Relations between students and teachers

Thus, the authors showed that the five-factor model does not match the empirical data. There are three separate constructs that make up the social dimension of the school climate: relations between students and teachers, discrimination/showing preference for certain students over others, and relations between students. As a result, a total of eight factors were identified.

Thus, for almost the past one hundred years school climate has either been given the limelight or it has been deemphasized in favor of other factors that determine the effectiveness of school education. Over the course of this period of time, the very concept of "school climate" has come into being, and various approaches to operationalizing this concept have been developed. Scholars most frequently propose the following as subcomponents of the "school climate" concept:

1. Relations between agents at the school
2. Physical environment (characteristics of the school and its classrooms)
3. Individual factors (a feeling of belonging to the school, discipline)
4. Organizational culture (expectations, rules, and norms)

2. An analysis of the PISA questionnaire

In the empirical part of the study, we will turn our attention to the PISA study questionnaires, and we will identify which of the school climate factors that were identified during the literature review are used in these questionnaires. Then we will conduct a psychometric analysis of these factors using methods from confirmatory factor analysis and modern test theory.

The study is based on data from the "Education and Career Trajectories" project,[4] which was conducted by the Institute of Education of the National Research University Higher School of Economics. We used data from the so-called "strategic panel," which was released in 2011 when Russian eighth-graders participated in TIMSS (4,893 students from 210 schools).[5] During 2012, the same students participated in PISA (4,399 students from 208 schools).[6]

The TIMSS sample, which was used to launch a longitudinal study, was populated from various classes: all of the students were surveyed in one class that was selected at random at each school participating in the study. The PISA study has a different design: 15-year-old students were randomly selected at a school, so it excludes the ability to study the social processes occurring in a particular class or the ability to analyze the results at either the individual level or at the class level. The use of longitudinal study data in particular makes it possible to assess how well school climate is being measured using PISA questionnaires on a sample that is constructed at the class level.

2.1. Description of the variables

We identified six sets of questions that relate to school climate in the PISA student questionnaires in accordance with our literature review. Each set is then classified into one of the following indices:

1. Mathematics Teacher Support
2. Classroom Management
3. Teacher-Student Relations
4. Sense of Belonging to the School
5. Attitude towards School: Learning Outcomes
6. Attitude towards School: Learning Activities

Each question presents a judgment about school life. Students are asked to indicate how strongly they agree with the statement on a 4-point scale. Table 1 presents these judgments as well as the name of the index to which they belong.

In theoretical terms the first three indices belong to the social dimension of school climate. The construct "Sense of Belonging to the School" describes the school's culture, and the factors "Attitude towards School: Learning Outcomes" and "Attitude towards School: Learning Activities" are factors that describe the individual dimension of the climate.

Table 1.

	Dispersion [%]					
	within the class	between classes	Factor loads according to the CFA results	INFIT MNSQ	OUTFIT MNSQ	Difficulty
Teacher Support						
My teacher tells us that we must study hard.	0.342 [91]	0.035 [9]	1.000	1.22	1.23	-0.88
My teacher provides additional assistance to students who need it.	0.401 [86]	0.063 [14]	1.343	0.78	0.72	-0.03
My teacher helps students to learn mathematics.	0.370 [86]	0.058 [14]	1.315	0.73	0.67	-0.33
My teacher gives students the opportunity to express their opinion.	0.533 [86]	0.085 [14]	1.208	1.18	1.28	1.25
Classroom Management						
The teacher is able to get students to listen to him.	0.437 [94]	0.026 [6]	1.000	1.07	1.08	-0.36
The teacher maintains order in the classroom.	0.381 [77]	0.113 [23]	1.391	0.66	0.64	-0.29
The teacher starts class on time.	0.424 [85]	0.075 [15]	1.315	0.80	0.77	-0.45
The teacher has to wait a while for the students to calm down.	0.686 [85]	0.123 [15]	0.633	1.44	1.55	1.10
Relations with Teachers						
Students get along with most of the teachers.	0.381 [93]	0.028 [7]	1.000	0.96	0.93	-0.93
Most of the teachers are interested in the lives of their students.	0.519 [93]	0.037 [7]	1.123	1.01	1.02	0.79
Most of my teachers really listen to what I have to say.	0.467 [96]	0.020 [4]	1.227	0.84	0.80	0.07

(*Continued*)

Table 1.

(*Continued*)

	Dispersion [%]					
	within the class	between classes	Factor loads according to the CFA results	INFIT MNSQ	OUTFIT MNSQ	Difficulty
If I need additional help, I will receive it from my teachers.	0.466 [93]	0.033 [7]	1.232	0.89	0.87	-0.16
Most of my teachers treat me fairly.	0.517 [92]	0.042 [8]	1.105	1.25	1.31	0.22
Sense of Belonging to the School						
I feel isolated from my classmates.	0.512 [96]	0.023 [4]	-0.654	1.06	1.11	-0.37
I easily make friends at school.	0.434 [98]	0.010 [2]	1.000	0.90	0.88	-0.52
I feel that I am a part of the school.	0.485 [99]	0.007 [1]	1.169	0.87	0.86	-0.13
I feel uncomfortable and out of place at school.	0.890 [99]	0.013 [1]	-0.622	1.20	1.28	-0.02
It seems to me that my classmates like me.	0.421 [98]	0.008 [2]	0.897	0.99	1.00	0.17
I feel lonely at school.	0.544 [97]	0.018 [3]	-0.701	1.00	1.05	-0.45
I feel happy at school.	0.551 [95]	0.028 [5]	1.251	0.87	0.86	0.38
Everything at my school is perfect.	0.693 [92]	0.064 [8]	1.200	1.12	1.14	0.93
I am satisfied with my school.	0.517 [92]	0.042 [8]	1.234	1.00	1.00	0.00
Attitude Towards School: Learning Outcomes						

(*Continued*)

Table 1.

(*Continued*)

	Dispersion [%]					
	within the class	between classes	Factor loads according to the CFA results	INFIT MNSQ	OUTFIT MNSQ	Difficulty
My school did little to prepare me for adulthood after graduation.	0.567 [91]	0.054 [9]	1.000	1.01	1.14	1.05
The classes that I took at school were a waste of time.	0.449 [93]	0.034 [7]	0.971	0.94	0.82	-0.08
My school education taught me how to make decisions.	0.394 [97]	0.013 [3]	1.298	1.08	0.96	-0.31
School taught me skills that are relevant for getting a job.	0.430 [95]	0.022 [5]	1.398	0.93	0.85	-0.67
Attitude Towards School: Learning Activities						
Hard work in school will help me get a good job.	0.349 [96]	0.016 [4]	1.000	0.90	0.80	-0.14
Hard work in school will help me get into a good university (institute or college)	0.330 [96]	0.014 [4]	0.986	0.77	0.67	-0.57
I like to earn good grades.	0.318 [96]	0.014 [4]	0.768	1.15	1.04	-0.69
Hard work in school is very important for me.	0.498 [96]	0.022 [4]	0.998	1.05	1.23	1.40

2.2. Results

The indices were studied across several stages. First, we assessed the consistency of the students' responses by calculating the indicators for variance of judgments in indices at the class and individual levels. During the second stage we verified how much the judgments within a single index were consistent with each other by using a confirmatory factor analysis (CFA), and we also studied their factor structure. Because the indices were developed on the basis of an analysis of an international sample, it was necessary to verify whether their factor structure would be valid when used with Russian data. Finally, we investigated the functioning of judgments and response categories on the basis of the methods of modern test theory (item response theory [IRT]).

The amount of variance between judgments at the class level demonstrates how much indices reflect the existence of supra-individual factors: mindsets, opinions, and attitudes of an entire class about this or that phenomenon of school life. If such collective mindsets are strong, then the answers of students in a single class will be fairly similar, but the differences between schools will be significant. In this case the variance between classes will be high. If such mindsets are not very strong, then the judgments will only reflect students' individual perceptions of school life. In this case the answers of students in a single class will not resemble each other, and they will differ from each other to the same degree as the answers of students from different schools. Then the variance within a class will have higher indicators.

Table 1 (columns 3 and 4) presents judgment variance values and the percentage of variance that they indicate within classes and between classes.

It is proposed that the differences between classes are significant if the amount of variance between classes explains more than 10 percent of the data variation (Hox 2002). In our case, this criterion is satisfied by judgments falling under the "Mathematics Teacher Support" and "Classroom Management" indices. Consequently, the answers of students from various schools differ significantly from each other for these dimensions of school climate. The wording of the judgments

about school climate seeks to capture how students perceive the state of affairs at their school, and to a lesser extent they reflect the personal mindsets or attitudes of students. The remaining judgments are characterized by low degrees of variance between classes and a relatively large degree of variance within the class. The indices of "Relations with Teachers," "Sense of Belonging to the School," "Attitudes towards School: Learning Activities," and "Attitudes towards School: Learning Outcomes" capture differences at the individual level and precisely reflect the subjective dimensions of school climate.

Next, we verified the qualities of the latent variables that reflect the constructs that are recorded in the names of the indices. First, we conducted an exploratory factor analysis. Its results showed that on the whole the six-factor model that is used in PISA questionnaires is suitable for the available data. However, the exploratory analysis is only the initial stage of verifying the index structure, because it is based on the assumption of all possible relationships between statements and indices. But the quality criterion is the ability to explain as much of the percentage of variance as possible. Our goal is to test a particular model where the factors are the PISA indices that we consider, and the judgments that form part of the indices (the factor loads for each of the judgments are given in Table 1, Column 5) are the factor indicators. In other words, we are seeking to confirm that each factor is associated with only one judgment, and the set of judgments is grouped into only one factor and is not linked to the other factors.

The results of the CFA speak to the low quality of the model (RMSEA = 0.064, CFI = 0.797, TLI = 0.772, SRMR = 0.069).[7] Consequently, the judgments are interrelated in a somewhat different way than is assumed in the questionnaires. The same judgment can be associated with different factors, i.e., it is not possible to measure just one of the six indices. Rather, you are forced to measure several at once. In addition, the model showed that some of the judgments may belong to other constructs that are not included within it. Consequently, the meaning of the presented statements can be interpreted in different ways, and this ambiguity leaves the door open to multiple interpretations of the measured indices. The results of the CFA allow us not only to

evaluate the quality of the model, but also to see what judgments are the most problematic. In our case, it would be possible to improve the model and to make it more suitable for the data that we obtained from the "Education and Career Trajectories" project by changing its initial specification to take into account the residual correlation between judgments, which are shown to be linked with each other even after accounting for factor loads.

First of all, these are judgments that are classified under the "Sense of Belonging to the School" index: "I feel isolated from my classmates," "I feel uncomfortable and out of place at school," and "I feel lonely at school." Insofar as these judgments express negative emotions, they stand out from the remaining judgments in this index and remain linked with each other in our model even after accounting for factor loads.

Secondly, these are judgments from the "Attitude towards School: Learning Outcomes" index: "My school did little to prepare me for adulthood after graduation" and "The classes that I took at school were a waste of time." Both judgments are negative, and besides measuring the student's general attitude towards school they measure the student's opinion about the benefit of studying at school as a particular aspect of their attitude, which explains their connection.

Finally, two more judgments in the "Attitudes towards School: Learning Activities" index carry a separate semantic load. We have in mind the judgments "Hard work in school will help me get a good job" and "Hard work in school will help me get into a good university." They are linked to the personal trajectories of students after graduation and describe the positive result of diligent work in school, which means that they are strongly correlated among themselves in addition to being correlated within the "Attitude towards School: Learning Activities" index.

After we added the three correlations between the above judgments and made the changes to the specification of the CFA model, we recalculated the quality indicators.[8] The modified model has satisfactory goodness-of-fit statistics: RMSEA = 0.043, CFI = 0.909, TLI = 0.900, SRMR = 0.054.

Next, we analyzed the psychometric properties of the questionnaire's questions using methods from modern test theory (IRT) to complement the study of the factor structure using the CFA and the evaluation of judgments and response categories from the point of view of their informativeness and utility for construct measurement.

To start with, we had to determine the exact model that we were going to apply. Theoretically speaking, values that are measured using the Likert scale can be analyzed within the framework of a model with fixed intermediate categories (rating scale model). This model proposes equal intervals between categories on the answer scale for all judgments. Another possible model has arbitrarily spaced intermediate categories (Partial Credit Model, PCM). It proposes uneven intervals between categories on the answer scale for all judgments. The choice of the appropriate model is based on the AIC and BIC information criteria. The smaller the value of the index, the more the model matches the available data. In our case, the model with arbitrary intermediate categories is better suited to the data. Thus, further analysis was performed within the framework of this model (Table 2).

We started by studying reliability. The Cronbach alpha coefficient, which characterizes the consistency of judgments in the factors under consideration, varies from 0.7 to 0.8. Given that these factors consist of a small number of judgments, such values can be considered acceptable.

We studied the functioning of the judgments themselves during the next stage. To do this we calculated the INTFIT MNSQ

Table 2.

AIC and BIC Information Criteria for Comparing Models.

	AIC	BIC
Model with fixed intermediate categories	143039.7	143509.3
Model with arbitrarily spaced intermediate categories	141729.6	142586.6

(Unweighted Mean-Square Statistic) and OUTFIT MNSQ (Weighted Mean-Square Statistics) goodness-of-fit statistics, which express the data's level of fit with the model. The model proposes the following: as the degree of fit with the statement increases, the respondent's score for the corresponding index also increases. If a particular feature was highly marked for respondents (they have a high score for an index), but they tended to disagree with the statement that is included in the index, or if, on the contrary, students with low overall scores for the index agree with the judgment, the goodness-of-fit statistics will indicate this. The recommended values for these indicators vary from 0.5 to 1.5.

The obtained statistical goodness-of-fit values (INFIT and OUTFIT MNSQ) are within the range of the recommended values. In other words, all of the judgments function correctly, and the indices do not contain any judgments whose answers contradict the answer profile as a whole. For example, students who noted that they receive a low level of support from teachers (they have a low initial score for the corresponding index), as we expected, tended not to agree with judgments belonging to this index.

The "difficulty" indicator makes it possible to assess how easy or hard it is for students to agree with the proposed judgments. The average value is 0. Positive values indicate that students find it very hard to say that they agree, that is, they are very unlikely to agree with the judgment. Negative values indicate the opposite: a large number of respondents agree with the judgment. In addition, the markedness of this feature is assessed for the respondent ("the difficulty that the respondent experiences when answering"). Both indicators are measured using logit functions. If the distributions of both indicators have intersecting values, this means that the questionnaire contains judgments that reflect an attitude about a construct that is characteristic for a particular respondent. If, on the other hand, the distributions of the two difficulty values do not intersect or intersect insufficiently, then it indicates a situation where the respondents do not have enough judgments to express their attitude about the construct that is being studied.

The level of difficulty in agreeing with judgments in the questionnaire that we studied varied from –0.93 to 1.4. Students had an

average level of difficulty agreeing with most of the judgments that were analyzed. However, the exceptions were the statements: "My teacher gives students the opportunity to express their opinions" (No. 4); "The teacher has to wait a long time for the students to calm down" (No. 8); "Everything at my school is perfect" (No. 21); "My school has done little to prepare me for adult life after graduation" (No. 23); "Hard work in school is very important for me" (No. 30). The enumerated judgments were characterized by a fairly high level of difficulty on the part of respondents. However, if we consider the level of feature markedness for respondents that is in the range of –1.41 and 6.89, then even these judgments are insufficient to provide an accurate description of the opinions of the test subjects. More than 40 percent of subjects demonstrate feature markedness of more than 1.4 logit functions. In other words, a significant share of students in the sample have an insufficient number of more difficult judgments that would correspond with the feature that is characteristic for them.

2.3. Study of answer categories

Next, we turned to the study of the functioning of answer categories. The respondents assessed judgments on a four-point scale, ranging from "completely disagree" to "completely agree." Theoretically speaking, the scale is considered balanced if all answer categories have been chosen more or less equally and if as the degree of markedness of a particular feature increases, respondents increase their agreement with the statements that correspond to that feature. If these conditions are violated, this, firstly, may indicate that the scale has no differentiating capacity and that it is not informative: respondents for whom a feature is equally marked choose differing answer categories (this happens, for example, when respondents fail to recognize a difference between two neighboring categories). Secondly, this may be an indication that the response scale does not function correctly: respondents are very likely to choose a category, but nevertheless they do not mark it, and conversely, respondents for whom the given feature indicated by the judgment is not marked

nevertheless express their agreement with it. In this case the INFIT MNSQ and OUTFIT MNSQ goodness-of-fit statistics that were calculated for this category will indicate this.

Our results have shown that for the statement "I feel uncomfortable and out of place at school" (No. 17) the level of markedness of the feature does not correspond to the answer category. Respondents who noted their complete disagreement or disagreement with this statement did not have the corresponding low level of feature markedness that would be expected for this category. Consequently, the categories are not able to differentiate between people. In other words, they do not convey useful information, and respondents perceive them as being indeterminate.

The goodness-of-fit statistics record a discrepancy between the data obtained from the "Education and Career Trajectories" project and the model for the "I completely disagree" answer category given in response to the following judgments: "The teacher is able to get students to listen to him" (No. 5), "The teacher has to wait a while for the students to calm down" (No. 8), "Most of my teachers treat me fairly" (No. 13), "I feel isolated from my classmates"(No. 14), "I feel uncomfortable and out of place at school" (No. 17), "I feel isolated from my classmates" (No. 19), "My school did little to prepare me for adulthood after graduation" (No. 23), "I like to earn good grades" (No. 29), and "Hard work in school is very important for me" (No. 30). In other words, students categorically disagreed with those statements that express a feature characteristic of themselves. Such a contradiction can arise when students exhibit social desirability in their answers, pay insufficient attention when filling in the questionnaire, or interpret the meaning of the same judgments differently.

We will now turn our attention to how much students tended to use all of the available answer categories across their responses. In most cases, more than 80 percent of students expressed their agreement with judgments of school climate if such statements were positive, and the same percentage disagreed if the statements were negative. Because of this statistic it is possible to conclude that students filled out answer categories in a unilateral fashion for practically all statements.

In addition, for most of the judgments some of the answer categories were almost never selected, that is, they are useless in terms of identifying the respondents' opinion. This observation applies to the following judgments in particular: "The teacher is able to get students to listen to him" (No. 5), "I feel isolated from my classmates" (No. 14), "I feel uncomfortable and out of place at school" (No. 17), "I feel lonely at school" (No. 19), and "The classes that I took at school were a waste of time" (No. 24). The reasons may include problems with categories (category redundancy) or how the judgments are worded. Because the scale here consists of four points, we believe that the second reason is the more important one here. When answer categories function this way, it leads to the loss of information about respondents. In most cases, the way that the judgments are worded makes students more likely to agree with them and thus hinders the goal of differentiating students and assessing school climate.

3. Conclusions and recommendations

For the last one hundred years education researchers have focused on the question of school climate. Despite the various approaches that have been used to define it and its components, it is possible to identify the main characteristics of this construct. First of all, school climate is in the eye of the beholder. It cannot be described using objective school characteristics and processes. Secondly, it is a latent property of the school that cannot be measured directly. However, it is manifested through a number of indicators. Thirdly, school climate is stable over time. The following are the four main dimensions of school climate that are most often encountered in various studies: physical (perception of the material environment), cultural (the system of norms and rules), social (relationships between agents in the school), and individual (the attitude of students to learning and a sense of belonging to the school).

Of the existing Russian-language questionnaires, the student questionnaires that are used in PISA studies include the most comprehensive dimensions of school climate. However, our psychometric analysis revealed significant shortcomings in this

instrument. First of all, the structure of indices that measure the school climate turned out not to be what the creators of the questionnaire assumed it would be. It is not possible to say with certainty whether the questions reflect the indicators of school climate that are proposed in the questionnaires or whether the respondents are expressing their opinion about other phenomena when answering these questions. The "Attitude towards School: Learning Outcomes" and "Attitude towards School: Learning Activities" indices are particularly problematic from this point of view. Secondly, some of the analyzed judgments were formulated in such a way as to elicit most students' agreement or disagreement with them without revealing any differences in how students perceive the subject of the question. Thirdly, the answer categories are unbalanced for most of the judgments. Respondents tended to choose the same answer categories and not other ones. It is impossible to use these judgments to differentiate between the responses of students and, consequently, to define the nature of school climate.

For the PISA study questionnaire to more accurately measure the characteristics of the school climate, the following steps should be taken: the judgments should be made more precise and specific so that they can more accurately capture the attitude of students to the subjects of interest. Some of the students should be able to recognize themselves in these statements since they often encounter the described phenomenon, and another group of students, on the contrary, should not be able to recognize the described statement as being typical of or present in their experience. Judgments should be added for the "Attitude towards School: Learning Activities" and "Attitude towards School: Learning Outcomes" factors that relate strictly to these factors and are not associated with several other factors at the same time.

In addition, it is worth reviewing how judgments are grouped into indices to ensure that each index measures one construct and the judgments cannot be broken into several groups. To provide a more accurate assessment of school climate, the questionnaire should add judgments that reflect how the physical dimension of school is perceived (for example, the

characteristics of the school building, the number of students, the number of classrooms, and the kind and amount of equipment). In addition, it could be very informative to take into account the point of view of teachers and others who participate in the learning process when assessing school climate.

It is impossible to analyze the significance of school climate to educational achievement without a valid and reliable Russian-language instrument. This study should be considered as the starting point for the further improvement of a Russian-language instrument for measuring school climate that is used as part of a PISA study or for the creation of a separate instrument that is designed to measure this parameter.

Notes

1. See, for example, the website of the National School Climate Center: http://www.schoolclimate.org/climate/
2. timss.bc.edu
3. pisa.oecd.org
4. This paper uses data from the "Education and Career Trajectories" panel study (http://trec.hse.ru/). This study was made possible thanks to support from the Basic Research Program of the National Research University "Higher School of Economics."
5. With the exception of a few cases, one class was interviewed in each of the participating schools. Therefore, hereinafter we will use "school" and "class" synonymously.
6. In these studies, a rotational design is used to formulate the questionnaires: not all respondents receive some of the questions on the questionnaire. The representativeness of the sample is not changed. In our case a total of 2,625 students answered questions about school climate. For more information about rotational design, please see: Organisation for Economic Cooperation and Development and Programme for International Student Assessment, *PISA 2012 Technical Report* (Paris: OECD, 2012), https://www.oecd.org/pisa/pisaproducts/PISA-2012-technical-report-final.pdf
7. The recommended values are: RMSEA < 0.05, CFI > 0.9, TLI > 0.9, SRMR < 0.05.
8. Since the intermediate models differ from each other rather weakly, we have given only the initial and final models in Table 1 to save space. We would be happy to share the results of the intermediate models with anyone who writes to us.

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