Interest Cannot Be Forced
The Role of Academic Motivation and Teaching Styles in the Development of Students' Critical Thinking

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Abstract

In a situation of a sharp increase in the volume of information, often including a large number of false facts of various nature (disinformation), critical thinking becomes one of the competencies, the formation of which is decided by the scientific and educational community. Scientists identify academic motivation and teaching styles as factors associated with the development of critical thinking. The relationship between these factors and critical thinking has previously been studied only in relation to the dichotomous scale of academic motivation, consisting of intrinsic and extrinsic motivation. The relationship of other types of motivation identified in the theory of self-determination E.L. Desi and R.M. Ryan has not been studied. This study, conducted on a sample of economics students at the Russian National Research University (4,867 students), is intended to contribute to this discussion. Authors determine which teaching style leads to the activation of learning motivation, identified within the theory of self-determination. In addition, which types of learning motivation are predictors of the development of critical thinking. The analysis was carried out using the method of multivariate regression with the inclusion of variables of mediators. This will allow to identify teaching methods associated with the activation of the necessary types of motivation, and, as a result, an increase in the educational results associated with them. However, despite the authors' attempts to identify additional types of academic motivation positively associated with CT within the subscale of extrinsic motivation, it was proved that only types of intrinsic motivation were positively associated with the construct under study. They are activated when the constructivist style of teaching is applied, which, among other things, explains its effectiveness in relation to the development of a given construct.

Keywords

critical thinking, intrinsic motivation, extrinsic motivation, amotivation, constructivist teaching style, traditionalist teaching style.

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Modern students study, acquiring their first professional skills and communicative competencies in the context of growing integration of information technologies into everyday life and the education system. They have received unlimited access to sources of information, which number is constantly increasing. On the one hand, students can get acquainted with the latest achievements of science and practice without any hindrance, on the other hand, the information flows contain a lot of unreliable and poorly structured information that can be used to manipulate public opinion. Moreover, the Internet usage in the course of intellectual activity affects people's perception and evaluation of themselves: research results indicate that under the conditions of using digital technologies, test subjects give higher estimates of their own cognitive abilities than when working without the Internet, and the flow of their thinking processes change as well [Schuur van der et al., 2015; Hamilton, Yao, 2018]. Modern person, more than ever, needs a tool, allowing him to resist the influence of the media, not to yield to manipulation, detect misinformation, make deliberate decisions, formulate evidence-based conclusions. One of such tools is critical thinking.

The concept of 'critical thinking' is polysemantic. R. Sternberg carried out the analysis of existing definitions, which made it possible to identify three key scientific areas that determine the study of this construct: philosophy, psychology and pedagogy [Sternberg, 1986]. Philosophers consider the ideal critical thinker. Psychologists focus on how a person conceives in real situations. Educationalists, based on classroom experience, determine the basis of the definition of critical thinking on the taxonomy of educational outcomes; that is, critical thinking skills are at the top levels of this classification. For instance, in the most popular B. Bloom's taxonomy [Bloom et al., 1956], such skills are analysis, synthesis and evaluation.

Along with the cognitive component of critical thinking, the authors include a dispositional component in the construct. Dispositions of critical thinking are personality traits that raise the possibility that a person will think critically [Valenzuela et al., 2011]. Given the complexity of operationalization of the dispositional component of critical thinking and its evaluation, however, we restrict ourselves to considering its cognitive component in this paper.

One of the authors of this work in the dissertation research conducted a content analysis of the definitions of critical thinking, for-

mulated by the most cited foreign and Russian authors, through the prism of the pedagogical approach [Koreshnikova, 2021]. This competence was strictly considered in relation to working with information. The author's definitions were analyzed to identify such skills as argument analysis (analysis), evaluation of evidence (evaluation), formulation of conclusions and/or decision-making (synthesis). These skills are present in more than 50% of definitions. Therefore, although critical thinking is a complex and multifaceted construct, common components are found in most of its definitions.

Thus, in this study, critical thinking is understood as competence, which includes the skills of searching for information, selecting arguments and formulating evidence-based conclusions.

This competence is not formed automatically along with other educational outcomes [Terenzini et al., 1995], its formation requires purposeful work [Halpern, 1998]. Knowledge about the predictors of critical thinking development is necessary for such work to be effective.

In the field of education, academic or learning motivation stands out as a key factor positively related to the level of educational results of students [Buckley, Doyle, 2017; Abramovich, Schunn, Higashi, 2013]. Academic motivation, like critical thinking, has multiple definitions. In this study, academic motivation is defined as a complex multidimensional structure, stimulating students to successfully complete teacher's assignments and achieve learning goals [Gordeeva, Sychev, Osin, 2014. P. 98].

The contribution of academic motivation to the implementation of educational activities is comparable to the contribution of intelligence [Gordeeva, Sychev, Osin, 2014]. However, research results indicate that students' academic motivation decreases during the learning process [Darby et al., 2013; Pan, Gauvain, 2012]. This conclusion is of the highest importance for the development of critical thinking, since it has been previously proven that the lack of academic motivation can become an obstacle to the formation of this competence [Kaplan, Maehr, 2007; Ingle, 2007]. At the same time, students' critical thinking does not progress during university studies without purposeful efforts, this statement has been established empirically [Arum, Roksa, 2011; Loyalka et al., 2021].

Thus, the necessity to search for factors, determining the maintenance of a high level of academic motivation among students as one of the conditions for the formation of critical thinking is on the agenda. In particular, foreign researchers evaluate the possibilities of such a means of boosting students' learning motivation as teaching style, distinguishing between constructivist (activity-based) and traditional (knowledge-based) approaches to learning [Kwan, Wong, 2015].

These researches have established that the interrelation between the constructivist learning environment and critical thinking is mediated by academic motivation [Ibid.]. However, the impact of

the traditionalist teaching style on the dynamics of learning motivation has not been studied before. The subtypes of learning motivation identified within the framework of the self-determination theory were also not evaluated either [Deci, Ryan, 1985].

It is impractical to directly transfer the results of foreign studies on critical thinking to the Russian reality, since critical thinking is a culturally conditioned construct [Willingham, 2008]. When deciding what to believe and what to do in a given situation, a person relies on the norms and rules already established in the society, which he lives in. Therefore, for example, in those cultures where stability is an ideal, critical thinking skills are not considered as necessary to the same extent as in cultures striving for continuous development and self-improvement.

The purpose of this study is to determine what teaching style contributes to the activation of a particular type of academic motivation among students as a predictor of the development of their critical thinking. The purpose leads to a key research question: which of the types of academic motivation, identified within the framework of the self-determination theory [Deci, Ryan, 1985], mediate the interrelation between critical thinking and teaching styles as constructivism and traditionalism? Having answered this question, we will be able to identify the style or styles of teaching that contribute to the strengthening of precisely those types of motivation that are positively associated with the development of critical thinking and, accordingly, with an increase in educational results.

This paper has the following structure: the first section substantiates the relationship between critical thinking and academic motivation, the second section introduces definitions of teaching styles and reveals their association with critical thinking and academic motivation among students, the third section presents the methodology of analysis, the fourth section exemplifies the results of the analysis, the fifth section provides the discussion, followed by description of the limitations of the study.

1. Relationship between Academic Motivation and Critical Thinking

According to the concept proposed by D. Kahneman [2014], there are two systems that responsible for decision making in the human psyche. System 1 is quick thinking that works automatically, requiring little to no effort. Quick thinking works on the basis of associations between concepts and representations. This type of thinking is more operational and less costly from a cognitive point of view than thinking system 2 [Valenzuela, Nieto, Saiz, 2011]. System 2 is slow thinking that requires attention and conscious mental effort.

Critical thinking, as an alternative to quick thinking, belongs to system 2. This thinking is intentional, while people activate their cognitive resources (memory, attention) and exercise metacogni-

tive control (monitoring and evaluation) of the application of rules and logical principles. Therefore, critical thinking is generally considered more costly in terms of time, energy, concentration and effort [Ibid.].

Researchers emphasize the importance of motivation for activating cognitive and metacognitive resources necessary for critical thinking [Norris, 2003; Perkins, Jay, Tishman, 1993]. The positive relationship between motivation and critical thinking was confirmed by the studies conducted in American colleges [Garcia, Pintrich, 1992; Ingle, 2007]. The formation of critical thinking is higher among students motivated by an internal goal orientation. Internal purposefulness turned out to be an important positive predictor of critical thinking among students studying biology and social sciences, but not among those who study English.

In all previous studies, a dichotomous scale of motivation is used: internal motivation is opposed to external motivation. With regard to the study of the conditions for the formation of critical thinking, it seems promising to evaluate students' motivation in accordance with the self-determination theory [Deci, Ryan, 1985] as a point in a continuum that includes 1) amotivation, 2) extrinsic motivation, which can be external, introjected, identified and integrated, and 3) intrinsic motivation.

The source of extrinsic motivation is not related to the activity itself; it is, for example, a reward or encouragement [Deci, Ryan, 1985]. Behavior driven by external motivation is completely dependent on external stimuli, and such dependence can negatively affect educational outcomes [Howard et al., 2021]. With the transition to introjected motivation, the significance of external stimuli decreases. The identified motivation already allows the student to partially realize the meaning of educational activity. The highest level of extrinsic motivation constitutes integrated motivation, in which the motive is already embedded in the personality structure, but this process is not yet fully realized by the subject of educational activity [Deci, Ryan, 1985].

The sources of intrinsic motivation can be the pleasure from performing an activity itself and interest in it, as well as curiosity. According to the self-determination theory, intrinsic motivation is based on a person's striving for autonomy (the desire to independently choose a strategy for personal actions), competence (the need to feel successful, coping with tasks) and connection with significant people (the desire to be understood and accepted by them). The achievement of these goals determines a person's subjective well-being. Judging by the results of separate studies, it is the development of intrinsic motivation that is positively associated with the level of critical thinking [Lepper, Henderlong, 2000].

Thus, E. Deci and R. Ryan represent intrinsic and extrinsic motivation not as opposites, but as interrelated phenomena — this is the differentiation between the self-determination theory from other concepts of motivation. Among the current foreign and domestic works devoted to critical thinking, it turned out to be impossible to find those that would be based on the theory of E. Deci and R. Ryan, however, we consider it promising in this particular field of research. In particular, it is promising to apply it in searching for the answers to the concerns facing researchers of educational practices. For example, in existing educational systems, learning is founded primarily on external stimuli. The teacher does not always manage to activate the intrinsic motivation of the student — fails to interest, to arouse curiosity among students. Is it possible to increase educational results by motivating students merely with external stimuli? In studies in which extrinsic motivation is presented as a single construct, without the division adopted in the self-determination theory, it has been found that it does not contribute to the development of critical thinking or contributes less to it than intrinsic motivation [Kaplan, Maehr, 2007; Ingle, 2007]. Nevertheless, if we consider different types of extrinsic motivation, differing in the degree of internalization of the motive in the personality structure, it may be possible to single out the type of extrinsic motivation that contributes to the development of critical thinking comparable to intrinsic motivation.

Based on the self-determination theory, several research tools have been developed, including the Scale of Academic Motivation (ScAM) [Gordeeva, Sychev, Osin, 2014]. The authors of this scale refined the original questionnaire proposed by E. Deci and R. Ryan and divided intrinsic motivation into subtypes by virtue of the concept of achievement motivation presented in the works of T.O. Gordeeva [2013; 2006]. "Intrinsic educational motivation is a relatively homogeneous formation and is set by motives based on the desire to meet a person's needs in cognition, achievement and self-development" [Gordeeva, Sychev, Osin, 2014. P. 99]. The authors also noted that when identifying the types of extrinsic motivation, E. Deci and R. Ryan did not take into account one of the most characteristic subtypes of academic motivation as self-esteem motivation: "the desire to achieve respect and recognition of significant others, as well as self-esteem by achieving high results in activities" [Ibid., p. 100]. Using confirmatory factor analysis, the authors identified 7 scales, three of which are attributed to intrinsic motivation. These scales are associated with the desire for self-development and achievement, as well as with cognitive activity. The authors attributed three scales to extrinsic motivation; these are the scales of introjected and external motivation, as well as the scale of self-esteem. There are no scales of integrated and identified motivation

in ScAM, there is a scale of amotivation. This is the model that was applied in this study.

2. Teaching Styles

There are several options for categorizing teaching styles. We adhere to the classification proposed by M. Brooks and J. Brooks [Brooks, Brooks, 1999]. They distinguish two main styles: traditionalist (knowledge-based) and constructivist (activity-based).

The theory of constructivism originated and was formed abroad. In Russia, the activity-based theory is more popular, which followers are P.Ya. Galperin, A.N. Leontiev, N.F. Talyzina, and others. Domestic researchers draw a parallel between these theories [Falikman, 2016; Lectorsky, 2011]. In the 1960s, having laid the basis for the theory of activity, D.B. Elkonin developed the concept of developmental learning, in which frameworks "the student is considered not as an object of the teacher's educational influence, but as a self-changing subject of learning" [Davydov, Repkin, 1997. P. 2]. In the 1960s and 1980s, on its basis, D.B. Elkonin and V.V. Davydov conducted a number of studies.

Constructivist and traditionalist teaching styles differ on three main grounds. Firstly, by the way students acquire knowledge. In constructivist teaching, the student is invited to try to solve the task independently, so the student constructs knowledge himself under the guidance of a teacher. Within the framework of the traditionalist teaching style, the student receives ready-made, often dogmatic knowledge from the teacher and in most cases does not evaluate it, taking it for granted, and does not reflect on his cognitive efforts. For some number of disciplines that require mastery of basic facts, this approach is appropriate, nonetheless it is not suitable for the development of critical thinking.

The second reason for the differences between the selected styles lies in the methods of working with students. For the traditionalist style, the major form of teaching is a lecture, the material presented by the teacher at the lecture must be reproduced by the student on the exam. To solve tasks, students are given a pre-made algorithm, and they learn to apply it. The tasks themselves normally have no practical orientation, as they are designed to assess the assimilation of information. In constructivist teaching, the teacher creates an interactive educational environment in which the student takes an active position. The formative assessment built into the educational process in such teaching is of fundamental importance.

The third criterion for making distinctions is working with the content. In constructivism, the emphasis is on the concept of content as a whole, whereas in traditionalism, content is a consistent presentation of topics. Both teaching styles are rarely found 'in their pure form', in most instances there is the predominance of one of them in the teacher's work.

The purpose of constructivist teaching is to promote the development of critical thinking, self-regulation, and the application of acquired knowledge into practice [Driscoll, 2005]. Research indicates that the use of constructivist teaching style is indeed associated with the development of critical thinking [Koreshnikova, Frumin, 2020; Ernst, Monroe, 2004], while the application of traditionalist style hinders the development of the studied competence [Lekalakala-Mokgele, 2010; Koreshnikova, Frumin, 2020].

Researchers use motivation for learning activities as a mediating factor to explain the empirically revealed relationship between the level of critical thinking and teaching style [Kwan, Wong, 2015]. It is believed that constructivist teachers appeal to the intrinsic motivation of students, arousing their curiosity and interest in learning, whereas in the traditionalist educational environment external stimuli are employed, such as assessments, rewards, punishments [Schunk, 2012]. At the same time, students with a high level of intrinsic motivation are more likely to emerge critical thinking skills [Lepper, Henderlong, 2000].

The main hypothesis of this study is that the constructivist learning environment is associated with the development of critical thinking and this relationship is mediated by the activation of intrinsic motivation, which increases the probability of developing critical thinking to a greater extent than extrinsic motivation.

The traditionalist teaching style is positively associated with extrinsic motivation, in which the development of critical thinking is less probable than with intrinsic motivation [Kaplan, Maehr, 2007; Ingle, 2007]. At the same time, the traditionalist style of teaching is more widespread among teachers [Koreshnikova, Frumin, Pashchenko, 2020]. Perhaps, by examining separate subtypes of extrinsic motivation, it will be possible to identify the very subtype that makes a contribution to the development of critical thinking comparable to the contribution of intrinsic motivation. In the future, this will allow us to designate teaching methods that contribute to the activation of this type of extrinsic motivation, and thus strengthen the educational results associated with critical thinking.

3. Research Methodology

3.1. Sampling and Research Procedure

The study, which results are presented in this paper, is the part of the WiWiKom International project on assessing economic literacy among students, carried out in 2020. The study involved 5,123 students out of 6,921 undergraduate students of the National Research University who studied in programs related to Economics or Management; totally, 1,627 first-year students, 1,879 second-year students and 1,617 third-year students were selected. Females made up 57% of the sample. The mean age of students is 19.2 years, the age range is from 18 to 23 years.

Before conducting the WiWiKom study, students received motivational letters informing them that in accordance with the decision of the University management, testing and a survey would be carried out as a part of the University's research program and participation in all tests is mandatory. Students were carefully informed that their individual results would not be available to teachers and their personal data would be replaced with identification numbers to manage the results.

The study was conducted in an online format and consisted of testing economic literacy and questioning of the students. In the questionnaire, in addition to socio-demographic questions, there were questions aimed at assessing students' level of critical thinking, teaching styles and educational motivation.

The self-assessment method was applied to determine the level of critical thinking, motivation of students and teaching styles. We specified the level of development of critical thinking in this way, since in Russia there are no standardized, valid and reliable tools for evaluating the studied construct at the level of higher education [Volkov, 2015]. Specialists of the Centre for Psychometrics and Measurements in Education of the HSE Institute of Education are currently engaged in the development of such a tool.

It would be incorrect to employ evaluation tools developed abroad due to the cultural conditionality of the studied construct [Willingham, 2008]. Foreign tests need to be adapted to the Russian reality, which is comparable in financial and time costs to the development of a new tool. In addition to time and financial factors, the composition of the construct is of importance. Critical thinking is a polysemantic concept, and each tool is aimed at evaluating a unique set of indicators of the measured construct. In our case, critical thinking was considered in regard to working with information and included the search for information, the selection of arguments and the formulation of conclusions.

3.2. Variables

Scales are formed from the questions evaluating key variables as critical thinking, teaching styles, and academic motivation. The scales were not standardized.

The level of critical thinking development was judged on the basis of students' self-assessment on the ability to search for information, the ability to work with arguments, and the ability to draw conclusions. The questions, making up this scale, are presented in Appendix 1.

Scales of traditionalism and constructivism were applied to evaluate teaching styles. Answering questions on these scales, students rated the degree of their agreement with statements about teaching styles, taking into account the work of most of the teachers they

studied with. The questions incorporated into the scales are presented in Appendix 1.

Academic motivation was assessed by means of the Scale of Academic Motivation [Gordeeva, Sychev, Osin, 2014]. The questionnaire consists of seven scales that reveal:

- intrinsic motivation, including
  - motivation of cognition (reliability — Cronbach's alpha = 0,80);
  - motivation of achievement (reliability — Cronbach's alpha = = 0,84);
  - self-motivation (reliability — Cronbach's alpha = 0,79);
- extrinsic motivation, including:
  - self-esteem motivation (reliability — Cronbach's alpha = 0,71);
  - introjected motivation (reliability — Cronbach's alpha = 0,74);
  - external motivation (reliability — Cronbach's alpha = 0,68);
- amotivation (reliability — Cronbach's alpha = 0,87).

The correspondence of the empirical structure of the models with their theoretical prototypes was verified using the method of confirmatory factor analysis (CFA). In creating the CFA model of academic motivation, the author's structure was fully complied [Gordeeva, Sychev, Osin, 2014]. The questionnaire items related to the CFA models of traditionalist and constructivist teaching styles are presented in Appendix 1. The CFA model of critical thinking incorporates all the questions included in the corresponding questionnaire.

Table 1. **Model quality indicators**

Item #	Consent Statistics	Values of Consent Statistics for the Critical Thinking Scale	Values of Consent Statistics for the Scale of Constructivism as a Teaching Style	Values of Consent Statistics for the Scale of Traditionalism as a Teaching Style	Values of Consent Statistics for the Scale of Motivation
1.	CFI	0,991	0,991	0,998	0,957
2.	TLI	0,900	0,901	0,906	0,910
3.	SRMR	0,052	0,039	0,052	0,047
4.	RMSEA	0,103 (CI 90% = = 0,99, 0,107)	0,084 (CI 90% = = 0,080, 0,088)	0,134 (CI 90% = = 0,130, 0,138)	0,201 (CI 90% = = 0,197, 0,205)
5.	N	4986	4961	4973	5015
6.	Reliability — Cronbach's Alpha	0,83	0,82	0,72	See in the text

To assess the quality of the models, the Comparative Fit Index (CFI), the Tucker—Lewis Index (TLI), the Standardized Root Mean

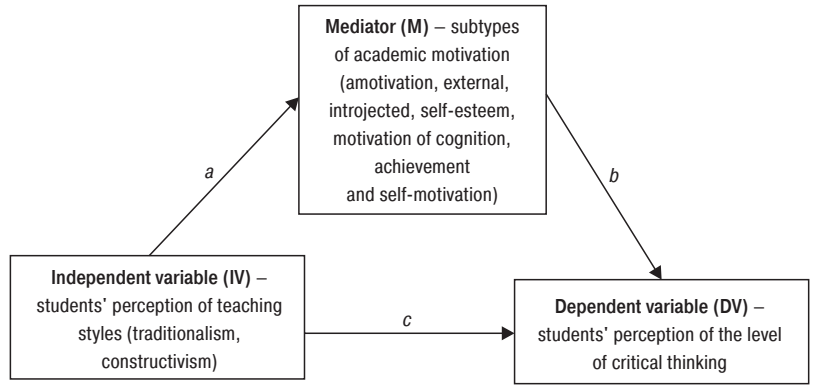
Squared Residual (SRMR), the Root Mean Square Error of Approximation (RMSEA) with a confidence interval of 90% (CI: 90%) were used. When interpreting these indices, the recommendations of several authors were followed [Byrne, 2016; Hair et al., 2014; Marsh, Hau, Wen, 2004]: CFI and TLI ≥ 0.90, SRMR and RMSEA ≤ 0.8. The data obtained show that the quality indicators are within acceptable values for all scales (Table 1).

3.3. Analysis Strategies

Relationships between variables were assessed by means of multivariate regression with stepwise inclusion of each variable. At the first stage, the analysis of the relationship between independent variables and critical thinking was carried out without taking into account control variables. Then the control variables were added to the model one by one.

To test the mediation relationship between critical thinking, motivation subtypes and teaching styles, mediator variables were created that explained the relationship between dependent and independent variables (partially or completely) [Baron, Kenny, 1986]. The final model is shown in Figure 1.

Figure 1. **Model of regression equations for testing the mediation connection**



To assess the effect of mediation, it is required to monitor that the relationship between the independent and dependent variables weakens when the mediator variable and the independent variable are simultaneously included in the regression equation [Baron, Kenny, 1986]. Regression models are generated separately for each mediator.

The analysis was conducted using Stata Statistical Software Release 15.

4. Research Results

The results of regression analysis with the inclusion of mediator variables are presented in Table 2.

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 2. **The results of assessing the relationship between students' perception of their level of critical thinking (CT), cognitive motivation and teaching styles**

Variables	(1) Path c	(2) Path b	(3) Path a	(4)
	Critical thinking	$CT^1 = \beta_{oj} + \beta_{1j}(M^2) + + CV^3 + \sum ij$	$M = \beta_{oj} + \beta_{1j}(TS^4) + + CV + \sum ij$	$CT = \beta_{oj} + \beta_{1j}(TS) + + \beta_{2j}(M)\ CV + \sum ij$
Cognitive motivation				
Constructivism (the scale is not standardized)	0.14*** (0.02)		0.25*** (0.02)	0.11*** (0.02)
Cognitive motivation		0.13*** (0.02)		0.10*** (0.02)
Constant	–0.38*** (0.05)	–0.36** (0.07)	2.17*** (0.06)	–0.58*** (0.08)
Number of observations	4,889	4,911	4,958	4,886
R-squared	0.05	0.07	0.09	0.11
Traditionalism (the scale is not standardized)	0.01 (0.02)		–0.16*** (0.03)	
Constant	–0.01 (0.05)		–3.14*** (0.03)	
Number of observations	4,897		4,969	
R-squared	0.004		0.08	
Achievement motivation				
Constructivism (the scale is not standardized)	0.14*** (0.02)			0.10*** (0.02)
Achievement motivation			0.16*** (0.13)	0.14*** (0.11)
Constant	–0.38*** (0.05)		–0.43** (0.05)	–0.66*** (0.07)
Number of observations	4,889		4,908	4,885
R-squared	0.04		0.08	0.10
Traditionalism (the scale is not standardized)				
Constant				
Number of observations				
R-squared				
Self-motivation				
Constructivism (the scale is not standardized)	0.14*** (0.02)			0.11*** (0.02)
Self-motivation		0.11*** (0.13)		0.09*** (0.02)

Variables	(1) Path c	(2) Path b	(3) Path a	(4)
	Critical thinking	$CT^1 = \beta_{oj} + \beta_{1j}(M^2) + + CV^3 + \sum ij$	$M = \beta_{oj} + \beta_{1j}(TS^4) + + CV + \sum ij$	$CT = \beta_{oj} + \beta_{1j}(TS) + + \beta_{2j}(M)\ CV + \sum ij$
Constant	–0.38*** (0.05)	–0.31*** (0.06)		–0.55*** (0.07)
Number of observations	4,889	4,907		4,885
R-squared	0.04	0.08		0.11
Traditionalism (the scale is not standardized)			–0.15*** (0.02)	
Constant			3.06*** (0.04)	
Number of observations			4,967	
R-squared			0.07	
Self-esteem motivation				
Constructivism (the scale is not standardized)	0.14*** (0.02)		0.20*** (0.02)	0.14*** (0.02)
Self-esteem motivation		–0.02 (0.01)		–0.00 (0.01)
Constant	–0.38*** (0.05)	–0.05 (0.05)	1.96*** (0.06)	–0.38*** (0.06)
Number of observations	4,889	4,908	4,957	4,886
R-squared	0.04	0.03	0.08	0.06
Traditionalism (the scale is not standardized)			–0.08 (0.03)	
Constant			2.65*** (0.05)	
Number of observations			4,967	
R-squared			0.03	
Introjected motivation				
Constructivism (the scale is not standardized)	0.14*** (0.02)		–0.01 (0.01)	0.14*** (0.02)
Introjected motivation		–0.10*** (0.01)		–0.10*** (0.02)
Constant	–0.38*** (0.05)	0.21*** (0.03)	2.11*** (0.04)	–0.17*** (0.05)
Number of observations	4,889	4,906	4,885	4,885
R-squared	0.04	0.03	0.07	0.09
Traditionalism (the scale is not standardized)			0.12*** (0.03)	
Constant			1.88*** (0.05)	
Number of observations			4,967	
R-squared			0.03	

Variables	(1) Path c	(2) Path b	(3) Path a	(4)
	Critical thinking	$CT^1 = \beta_{oj} + \beta_{1j}(M^2) + + CV^3 + \sum ij$	$M = \beta_{oj} + \beta_{1j}(TS^4) + + CV + \sum ij$	$CT = \beta_{oj} + \beta_{1j}(TS) + + \beta_{2j}(M)\ CV + \sum ij$
External motivation				
Constructivism (the scale is not standardized)	0.14*** (0.02)		–0.18*** (0.02)	0.12*** (0.02)
External motivation		–0.13*** (0.01)		–0.11*** (0.01)
Constant	–0.38*** (0.05)	0.21*** (0.03)	2.12*** (0.05)	–0.14*** (0.05)
Number of observations	4,889	4,907	4,958	4,886
R-squared	0.04	0.03	0.08	0.06
Traditionalism (the scale is not standardized)			0.21*** (0.02)	
Constant			1.25*** (0.04)	
Number of observations			4,968	
R-squared			0.07	
Amotivation				
Constructivism (the scale is not standardized)	0.14*** (0.02)		–0.43*** (0.02)	0.09*** (0.02)
Amotivation		–0.12*** (0.02)		–0.10*** (0.02)
Constant	–0.38*** (0.05)	–0.38*** (0.05)	2.28*** (0.08)	–0.16*** (0.05)
Number of observations	4,889	4,906	4,956	4,885
R-squared	0.05	0.07	0.09	0.11
Traditionalism (the scale is not standardized)			0.27*** (0.02)	
Constant			0.60*** (0.05)	
Number of observations			4,966	
R-squared			0.08	

[1] Critical thinking.
[2] Motivation.
[3] Control variables.
[4] Teaching style.

The results shown in Model 1 (Table 2, Column 2) approve that the relationship between constructivism in teaching and critical thinking is positive and statistically significant. At the same time, the connection of traditionalism and critical thinking is statistically

insignificant, so further study of the mediation effect was carried out only for the case of the constructivist style of teaching. To conclude that there is a mediation effect, it is important that the relationship between the dependent and the independent variable weakens when a mediator variable is added, and in the case of traditionalism, such relationship is not initially present.

The results presented in Model 2 (Table 2, Column 3) indicate a positive and statistically significant relationship between critical thinking and cognitive motivation, achievement motivation and self-motivation. There is no such relationship in self-esteem motivation. Critical thinking is statistically significantly and negatively associated with other subtypes of external motivation as introjected motivation and external motivation. The relationship with amotivation is also negative and statistically significant.

The results in Model 3 (Table 2, Column 4) reveal a statistically significant positive relationship between constructivism in teaching and cognitive motivation, as well as achievement motivation and self-motivation. Constructivism has no connection with self-esteem motivation and introjected motivation. The relationship with external motivation and amotivation is negative and statistically significant. The results presented in the same model (Table 2, Column 4) demonstrate that the relationship of traditionalism in teaching with cognitive motivation, as well as with achievement motivation and self-motivation is negative and statistically significant. There is no relationship with self-esteem motivation. The relationship with introjected motivation, external motivation and amotivation is positive and statistically significant.

The results provided in Model 4 with mediation (Table 2, Column 5) show that when controlling the subtypes of motivation, the relationship between constructivism and critical thinking weakens, while being statistically significant for cognitive motivation, achievement motivation, self-motivation, external motivation and amotivation. Whereas the relationship between constructivism in teaching and critical thinking does not change for self-esteem motivation and introjected motivation, when controlling the subtypes of motivation.

Thus, the relationship between the constructivist style of teaching and critical thinking is mediated by the following subtypes of motivation: motivation of cognition, achievement motivation and self-motivation (intrinsic motivation), external motivation (extrinsic motivation) and amotivation. However, it should be taken into consideration that the relationship of the constructivist teaching style and external motivation as well as amotivation is negative and statistically significant, that is, mediation is not aimed at raising the level of critical thinking, but at lowering it. The connection mediator between critical thinking and constructivism in teaching, aimed

at increasing the level of critical thinking, is the subtypes of intrinsic motivation — motivation of cognition, motivation of achievement and self-motivation.

5. Discussion

This study is the first to analyze the relationship of students' perception of their level of critical thinking, as well as teaching styles, with different types of academic motivation identified within the framework of the self-determination theory [Deci, Ryan, 1985] on the Russian sample. We judged the level of critical thinking and teaching styles on the basis of students' self-assessment, however, for brevity, the terms 'critical thinking' and 'teaching style' can be used hereinafter instead of 'students' perception of critical thinking' or 'students' perception of teaching style'. The types of academic motivation were measured using the Scale of Academic Motivation [Gordeeva, Sychev, Osin, 2014]. The ScAM advantage over other tools is that motivation is evaluated comprehensively: the scale measures amotivation, extrinsic motivation (external, introjected, self-esteem motivation) and intrinsic motivation (cognitive, achievement motivation and self-motivation). The study proved that subtypes of intrinsic motivation are positively related to critical thinking, while the remaining types of motivation are either unrelated or negatively related.

The results obtained confirm and develop the findings of other studies. Earlier studies have shown that intrinsic motivation contributes more to the development of critical thinking than extrinsic one [Kaplan, Maehr, 2007; Lepper, Henderlong, 2000; Garcia, Pintrich, 1992]. However, the authors of these works applied a dichotomous scale of motivation, comparing intrinsic motivation with extrinsic motivation. This study indicates the transition from a statistically significant positive relationship of critical thinking with subtypes of intrinsic motivation through the absence of a significant relationship with self-esteem motivation to a statistically significant negative relationship with introjected and external motivation as subtypes of extrinsic motivation, as well as with amotivation. The data obtained can be interpreted as follows: if a teacher activates any other types of motivation during the educational process, except intrinsic one, the level of critical thinking will not even increase, but may decrease. The fact of a decrease in the level of critical thinking during the process of studying at universities has been empirically proven in a number of research [Arum, Roksa, 2011; Loyalka et al., 2021].

With the involvement of a constructivist style of teaching, the indicators of intrinsic motivation subtypes among students increase, as well as the likelihood of developing critical thinking rises. It is intrinsic motivation in its various forms that mediates the connection between the constructivist style of teaching and critical thinking.

The course of this study also confirmed that teachers who mainly practice the traditionalist teaching style predominantly work with extrinsic motivation — external and introjected [Gordeeva et al., 2018; Meece, Blumenfeld, Hoyle, 1988] — this teaching style is not connected with the development of critical thinking.

External motivation, whereby behavior is completely dependent on external stimuli (rewards or punishments), also mediates the relationship between the constructivist style of teaching and students' perception of their level of critical thinking. Nevertheless, this meditation is not aimed at increasing the level of critical thinking, but at lowering it. The similar mediator is amotivation, while introjected motivation, which is characterized by a partial shift away from the demands put forward by the external environment, as well as self-esteem motivation which appear as an eagerness to achieve recognition and respect of significant people, are not communication mediators.

Thus, it was not possible to identify additional types of academic motivation positively associated with critical thinking within the subscale of extrinsic motivation. It is only intrinsic motivation that is positively related to the development of students' critical thinking. It is activated when applying the constructivist style of teaching and is one of the factors explaining its effectiveness in relation to the development of critical thinking.

The resulting relationships can be explained by the nature of teaching styles. Through academic work with students, the constructivist teacher organizes the educational space in such a way that the student finds himself in the center of events and independently constructs knowledge under the guidance of the teacher. This is an active educational process, which is aimed at working with the knowledge already available to the student to build new knowledge and comprehend incoming information [Gredler, 1997; Schunk, 2012]. Each student comprehends information in his own system of representations, based on his own cognitive strategies and knowledge, therefore, the new skills are formed as a result of learning will be diverse for different students. In this case, cognitive engagement and educational outcomes are more strongly associated with intrinsic motivation than with extrinsic one [Garcia, Pintrich, 1992; Ingle, 2007].

From the conceptual point of the developmental education of D.B. Elkonin and V.V. Davydov, based on the activity theory, "the transformation of a student into a subject, interested in self-change and capable of it, makes up the main content of the development process <...> A student can participate in the educational process as one of the subjects if he can independently find and critically evaluate general ways of solving the problems that arise before him" [Davydov, Repkin, 1997. P. 2].

Only the teacher who has developed organizational and subject-logical competencies at the proper level is able to use the constructivist style of teaching [Koreshnikova, Frumin, 2020]. A teacher with a developed organizational competence is able to organize students' educational activities in such a way as to stimulate their interest in learning and improve the level of intrinsic motivation, as a result of which the process of knowledge construction is initiated [Feldman, 1989]. The antipode of organizational competence is disciplinary one. A teacher with a developed subject-logical competence reveals the concept of the subject to students, and does not teach subject topic after topic [Ibid.], he has a logical-subject analysis, that is, he presents the educational content in the form of a logical sequence of educational tasks — such a course alignment is also associated with an increase in the level of intrinsic motivation [Kwan, Wong, 2015]. In terms of the concept of developmental education, the primary mission of a teacher is to organize, correct and direct the educational and research activities of students [Davydov, Repkin, 1997. P. 2].

6. Limitations and Perspectives of the Study

Within the framework of this study, self-assessment questionnaires with predefined categories were applied as a tool for assessing students' critical thinking, as well as teaching styles. In the sociology of education, there is a widespread perception of low validity of subjectively assessed indicators [Porter, 2013]. Nevertheless, recent studies have proved that self-assessment methods provide valid indicators of educational outcomes [Zilvinskis, Masseria, Pike, 2017; Thomson, 2017]. Students' self-assessment is frequently used as a tool to determine the quality of education even in international comparative studies: *Student Experience at a Research University* (USA), *College Student Experience Questionnaire* (China), *College Student Survey* (USA), *National Student Engagement Survey* (USA).

The analysis was carried out on a sample of students from a major national research university. The invariance of the relationships obtained with respect to other universities has not been studied. However, universities operating under conditions of strong normative regulation of their activities are similar to each other [Boguslavsky, Neborsky, 2014], so extrapolation of the findings is possible.

The study is non-experimental in nature, its design is correlational. Since we were not able to divide the participants into a control and experimental groups, as well as control the variables, the data obtained do not allow us to draw causal conclusions and evaluate the effects.

Due to the identified limitations, in the long term it is planned to conduct a similar study using standardized tools for assessing

critical thinking of university students, which is currently under development stage. A quasi-experimental study and the use of a representative sample of students are planned.

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Appendix 1

1. Questions aimed at assessing students' perception of their own level of critical thinking

Please rate how well you are able to do the following:

- evaluate the relevance of information;
- evaluate the reliability of information;
- define information that can be used as an argument;
- evaluate the persuasiveness of an argument;
- determine insufficient information in the argumentation;
- make a clear judgment based on the information provided for argumentation;
- develop valid conclusions;
- create explanations (answer the question "why?");

An ordinal scale with four categories of responses was used as response categories: "bad", "satisfactory", "good", "excellent".

2. Questions aimed at assessing teaching styles

Considering the work of most of the teachers you have studied with, as well as your educational experience, please rate the extent to which you agree with the statements below.

Traditionalist style of teaching:

- teachers expect that at classes students will mainly write down material (from dictation, from the blackboard);
- teachers emphasize the need to memorize facts (formulas, characteristics, etc.);
- it is more important for teachers that students learn certain facts, than how these facts can be applied;
- most of my classes are organized so that the teacher tells us the course material;
- teachers expect students to treat the information presented in class as indisputable facts.

Constructivist style of teaching:

- teachers show the interconnection between the taught material and practice;

- teachers focus not exceptionally on memorizing facts, but also on understanding the theories within which they arose;
- teachers at classes allocate time for students to participate in discussions;
- teachers invite students to ask questions and formulate their own hypotheses;
- teachers offer students to solve authentic problems at classes;
- teachers propose students to apply the skills acquired at classes into practice.

As response categories, students could choose "totally agree", "agree", "I can't agree or disagree", "disagree", "totally disagree".

3. Questions aimed at self-assessment of subtypes of academic motivation [Gordeeva, Sychev, Osin, 2014]

Why are you currently attending classes at the university?

- **Cognitive motivation**
  - I am interested in learning.
  - I like to study because it is interesting.
  - I just like to study and learn new things.
  - I really enjoy learning new material in class.
- **Achievement motivation**
  - Studying gives me pleasure, I like to solve difficult problems
  - I feel satisfied when I am in the process of solving complex educational problems
  - I like to solve difficult assignments and put intellectual effort
  - I just like to learn, solve complex problems and feel myself competent
- **Self-esteem motivation**
  - Whereas I want to prove to myself that I am capable of successfully studying at the university.
  - Because when I study well, it makes me feel worthy.
  - To prove to myself that I am a smart person.
  - Because I want to show myself that I can be successful
  - in studies.
- **Introjected motivation**
  - Because I am ashamed to study poorly.
  - Because my conscience compels me to study.
  - Whereas learning is my responsibility, which I cannot neglect.
  - Because, having entered the university, I have to attend classes and study.

- **External motivation**
  - I have no other choice, as attendance is monitored.
  - To avoid problems with the Dean's office and the session.
  - Because my close people will judge me if I do poorly in studies.
  - I have no choice, otherwise I will not be able to have a sufficiently secure life in the future.

- **Amotivation**
  - Honestly, I do not know, it seems to me that I am just wasting my time here.
  - I used to understand why I was studying, but now I am not sure if it is worth continuing.
  - I am attending the place, but I am not sure if I really need it.
  - I attend out of habit, why for, frankly speaking, I do not know exactly.

As response categories, students could choose "fully corresponds", "rather corresponds", "quite corresponds", "something in between", "rather does not corresponds", "completely does not corresponds".

Appendix 2 Descriptive statistics and correlations between variables included in the analysis

Variable name	Mean value	Standard deviation	Mother's education	Gender	Age	Level of training	Critical thinking	Teaching style — Traditionalism	Teaching style — Constructivism
Mother's education (0 = without higher education; 1 = with higher education)	0.87	0.34	1.00						
Gender (0 = male, 1 = female)	0.57	0.49	0.00	1.00					
Age	19.4	0.98	–0.08**	0.01	1.00				
Level of training	27.03	9.83	0.02	–0.14***	–0.03	1.00			
Critical thinking	2.07	0.55	0.05***	–0.07***	0.02	0.09***	1.00		
Teaching style — Traditionalism	1.78	0.81	–0.02	0.00	0.10***	–0.18***	0.01	1.00	
Teaching style — Constructivism	2.77	0.84	–0.02	0.10***	–0.12***	0.11***	0.11***	–0.26	1.00
Cognitive motivation	2.85	0.87	0.02	0.03	–0.10***	0.12***	0.11***	–0.15***	0.24***
Achievement motivation	2.68	0.98	0.02	0.00	–0.07***	0.17***	0.16***	–0.15***	0.21***

Variable name	Mean value	Standard deviation	Mother's education	Gender	Age	Level of training	Critical thinking	Teaching style — Traditionalism	Teaching style — Constructivism
Self-motivation	5,019	2.80	0.00	0.10***	–0.11***	0.10***	0.10***	–0.13***	0.24***
Self-esteem motivation	2.51	0.95	–0.03	0.15***	–0.08***	0.04**	0.02	–0.07***	0.18***
Introjected motivation	2.08	1.08	–0.01	0.12***	0.00	–0.07***	–0.11***	0.09***	–0.01
External motivation	1.62	0.99	–0.01	0.04**	0.08***	–0.11***	–0.13***	0.17***	–0.15***
Amotivation	1.08	1.07	–0.03	0.00	0.17***	–0.16***	–0.13***	0.20***	–0.34***

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

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