Problems of Organizing Critical Thinking Training for University Students

Zhanar S. Bekbayeva
Saken Seifullin Kazakh Agricultural Technical University

Alexander N. Solovyev
Moscow Automobile and Road Construction State Technical University (MADI)

Nina V. Chechetkina
Academy of Civil Defence Ministry of the Russian Federation for Civil Defense, Emergencies and Elimination of Consequences of Natural Disasters

Aleksandr A. Bolshakov
Russian State Agrarian University – Moscow Timiryazev Agricultural Academy

Liudmila V. Sosina
Russian State Agrarian University – Moscow Timiryazev Agricultural Academy

The paper aims to determine the factors that hinder forming and developing critical thinking of students and ways to overcome them in higher education. First, it is a problem of low motivation and a low level of self-regulation in critical thinking training. These problems reduce the effectiveness of all those methods and techniques for forming critical thinking that teachers use. We propose applying differentiated learning (multilevel learning) as one of the most effective ways to solve the problem of organizing critical thinking training. Moreover, we consider that at the beginning of training, it is necessary to determine the personal qualities of students, such as purposefulness, self-discipline, perseverance, tolerance, academic motivation, and self-regulation of cognitive activity. During the learning process, it is necessary to use multilevel tasks and exercises to cover all categories of students. This is because these tasks are based on some volitional qualities of the personality and motivation for learning. This approach is systemic and makes it possible to achieve high efficiency in teaching critical thinking.

Keywords: critical thinking, vocational training, vocational education, differentiated learning, multilevel learning, individualized learning

INTRODUCTION

In the digital space and information society, a person must possess critical thinking competencies to conduct productive professional activities. Moreover, a person necessitates forming critical thinking in

everyday life when assessing any life situation, looking for a solution to a situation that has arisen, making a final decision, etc. (Moore, 2013; Halpern, 2014).

At the present stage, forming critical thinking should be a mandatory part of higher education. This is due to the modern educational environment, which includes a vast amount of information that requires students to use effective cognitive strategies of critical thinking for its processing (Angeli & Valanides, 2009; Galiev, Abdyrov, Yesekeshova & Sagalieva, 2016).

Documents adopted by members of the European Higher Education Area (2012) emphasize the need to train students to think critically and define it as part of genuine student-centered learning. Numerous programs focused on forming critical thinking have been developed and used in universities around the world.

A trend towards traditional teaching and a focus on educational content rather than student-centered learning strategies prevail in higher education systems of many countries despite their adherence to the Bologna Convention (Alberts, 2009; Johnson, 2007; Johnson & Pigliucci, 2004; Momsen, Long, Wyse & Ebert-May, 2010; Solovyev, Petrova, Prikhodko & Makarenko, 2017). Students must improve effective strategies and cognitive skills of critical thinking in every class, regardless of the content of the discipline (Association of American Colleges and Universities [AAC&U], 2013).

Recognizing the importance of critical thinking for students, we address the necessary cognitive skills of critical thinking for effective information processing (Kubrushko et al., 2018).

Inference, analysis, generalization, and evaluation are critical thinking foundations (Facione, 2013). R. Ennis identifies 12 basic skills that make it possible to judge whether a person has critical thinking abilities (Ennis, 1991). These skills are related not only to intellectual skills but also to some personal characteristics, such as the ability to be tolerant of other points of view (Ennis, 1991).

Within the research, we distinguish the following critical thinking skills: (1) skills of analysis and synthesis; (2) ability to find cause-and-effect relationships; (3) ability to reason; (4) ability to assess; (5) skills of self-assessment; and (6) skills of self-correction.

There are some obstacles in organizing critical thinking training at universities. A low level of academic motivation and self-regulation is one of the most significant factors. This leads to an increase in the number of poorly performing students. More than that, the load on teachers of higher education increases during classes.

We can conditionally divide university teachers into two groups. Teachers of the first group work mainly with low performing students. However, practice shows that teachers do not pay enough attention to the “good students” in such groups. That is why these students lose interest in the discipline, and their academic performance may decline. According to our observations, most teachers form another group. They focus on working with only successful, talented students. As a result, many low performing and underperforming students are expelled due to their exam results. Overcoming these extremes necessitates improving the qualifications of university teachers in organizing personalized learning and using various innovative technologies (Kubrushko & Nazarova, 2013).

It is impossible to achieve complete differentiation of teaching in forming critical thinking of students when each student has a personal task in terms of complexity. In our pedagogical experiment, we used tasks of three levels of difficulty. Multilevel learning involves all students and keeps high-achieving students interested in their studies. Low-performing students, who begin their studies by completing assignments of the first (lowest) level, gain confidence in their abilities over time and move on to completing assignments of the next (higher) levels.

MATERIALS AND METHODS

Using the systemic approach, we aimed to develop and experimentally test the scientific and methodological foundations for forming critical thinking in students of poly-lingual groups.

Forty-five students of the educational program V057 Software Engineering at Saken Seifullin Kazakh Agricultural Technical University (Nur-Sultan, Kazakhstan) took part in the pedagogical experiment. At the initial stage of the experiment, we determined the level of critical thinking skills, motivation, and self-

regulation of students. According to the results, we identified the experimental (22 people) and control (23 people) groups of students.

In the control group, the level of self-regulation skills is higher. In particular, 17 people (74%) have a high and medium level of self-regulation, while in the experimental group, only ten people (45%) have similar indicators. As an experimental group for testing the methodology we propose, we chose a group of students with low self-regulation indicators and motivation.

We developed theoretical and practical tasks of different complexity in the subject *Psychology* for students of the experimental group. Preliminary testing of their knowledge of basic concepts allowed students to get admission to the tasks of the corresponding complexity. This stage is necessary, as it allows teachers to check the assimilation of the theoretical concepts of the topic. Besides, we determined the critical thinking level among students in the control and experimental groups based on the critical thinking test by L. Starkey (2004) adapted by E. L. Lutsenko (2014). In addition, we determined their level of self-regulation (Osnitsky, 2010). According to E. E. Lysenko and L. I. Nazarova (2019), mastering skills and means of conscious self-regulation of activity helps individuals cope with difficulties, which arise from external circumstances and their internal unpreparedness when they are performing tasks.

We used quantitative methods for processing the experimental results with the following indicators: (1) average indicator (Av), reflecting a quantitative assessment of the growth of critical thinking of students, and (2) indicator of absolute growth (G), reflecting the difference between the initial and final values of developing critical thinking of students.

RESULTS

For improving the quality of teaching critical thinking when forming the professional competence of students, we used special (teaching, developing, and controlling) multilevel tasks for the independent work of students:

- At the level of "standard" – knowledge, abilities, skills, and competencies that meet the educational standard;
- At the level of creativity – applying the acquired knowledge, abilities, and skills in other situations and conditions of functioning of the objects studied, as well as developing sensitivity to innovation, creativity, and creative thinking, etc.;
- At the research level – applying the acquired knowledge, abilities, skills, competencies, and experience of creative solving tasks and problems for (1) technologically structured research, (2) implementation of new ideas and technologies, and (3) obtaining, improving, and developing theories, methodology, and knowledge (Fig. 1).

Such task cards can include theoretical questions, tasks, and assignments of varying difficulty and complexity. Additionally, the columns of these cards contain questions, tasks, and assignments aimed at forming critical thinking and research, practical, analytical, creative, and other abilities.

The difficulty and complexity of theoretical questions, tasks, and assignments change vertically and horizontally (from left to right). In most cases, this technique helps to create conditions for transiting to the next level.

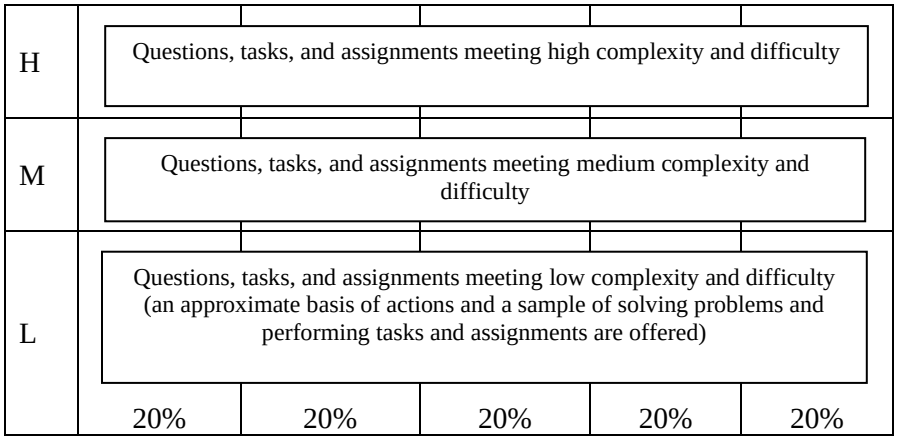
If the card contains five questions (Fig. 1), students can score 100 points by solving 100% of the tasks. At the medium level, students have to solve the problems of the first and second levels. If students want to obtain the maximum (for each case) rating, they need to solve problems at all levels.

These educational and developmental cards also have the functions of self-organization and self-regulation (critical assessment of one's capabilities, choice of a certain level, referring to a textbook and using the proposed samples of problem-solving if it is necessary, "home" work with such cards), and control and assessment (self-control and self-assessment) function.

For presenting the cards, we used a computer with an integrated program. This program provided teaching theory, control and assessment of its mastering, and assessment of solving problems proposed. After the students studied theory, the program offered tests with theoretical questions. In the case of

satisfactory answers, students received access to problem-solving. Thus, students could work with cards for independent work in their free time and receive specific points for their rating.

FIGURE 1
A TASK CARD FOR INDEPENDENT WORK OF STUDENTS, WHERE: H – HIGH LEVEL, M – MEDIUM LEVEL, L – LOW LEVEL; THE CARD HAS FIVE VERTICAL COLUMNS



As the skills and abilities of self-management, we identified the following:

- Self-organization of independent, cognitive, research, creative, and other activities;
- Independence (cognitive, research, creative, in practical activity, etc.);
- Self-control of the process and results, as well as the quality and effectiveness of training, behavior, interpersonal relationships, compliance with moral, ethical, and other rules and guidelines, and mental, physical, and emotional state);
- Critical self-assessment of the learning process and its results, educational, scientific, and other achievements, behavior, position in a team and society, and social, personal, and professionally significant personal traits;
- Reflection aimed at critical analysis and improving the quality of the activities and behavior.

At the initial stage of the experiment, we determined the level of critical thinking skills, motivation, and self-regulation of students. According to the results, we identified the experimental and control groups of students. Moreover, we organized multilevel critical thinking training for students and developed tasks of different complexity in the subject *Psychology*.

The teachers participating in the experiment built the pedagogical activity on the principles of humanization, cooperation, and support of the individuality of students. They also used the platform Google Classroom for testing students.

At the beginning of the experiment, we did not find significant differences in the control and experimental groups based on the results of the critical thinking test. However, we found considerable differences in indicators when studying the self-regulation skills of students. In the control group, the level of self-regulation skills is higher. Notably, 17 people (74%) have a high and medium level of self-regulation, while in the experimental group, only ten people (45%) have similar indicators. As an experimental group for testing the methodology we propose, we chose a group of students with low self-regulation indicators and motivation.

During the main stage of the experiment, the teachers built their interaction with students using cooperation principles. Encouragement and support were the primary methods for motivating learning. Students with low indicators of self-assessment and self-regulation received assignments of low complexity. These assignments allowed students to feel more confident in their abilities while completing these tasks and then choosing the exercises of a more challenging level.

As a result, the teachers noted the positive dynamics in academic performance and the development of mental operations of critical thinking among the students of the experimental group.

We quantified the results of the pedagogical experiment using the ratio method. That is, we identified the percentage of students who were at one or another level of critical thinking at the beginning and end of the experiment (Table 1). In particular, we examined the dynamics in the level of critical thinking using the following indicators of time series (Ergazina, 2006):

- Average indicator (Av), that is, a quantitative assessment of critical thinking of students calculated through the formula:

$$Av = (a+2b+3c) / 100, \quad (1)$$

where: a, b, c – percentage of students at low, medium, and high critical thinking levels.

TABLE 1
COMPARATIVE RESULTS IN DIAGNOSING CRITICAL THINKING LEVELS BEFORE AND AFTER THE EXPERIMENT

Groups	Stages of the experiment	Total, people	Levels						Av
			high		medium		low		
			people	%	people	%	people	%	
Control	beginning	23	4	17	11	48	8	35	1.82
	end		4	17	13	57	6	26	**1.89**
Experimental	beginning	22	3	13	12	55	7	32	1.81
	end		5	23	12	55	5	22	**2.01**

- Indicator of absolute growth (G), reflecting the difference between the initial and final values of the critical thinking level (or a different criterion) of students calculated through the formula:

$$G = I_{end} – I_{beg}, \quad (2)$$

where: I_{end} – final value of the indicator;
I_{beg} – initial value of the indicator.

- Coefficient of the effectiveness of the experimental methodology (C_{eff}) calculated through the formula:

$$C_{eff} = Av_{(e)} / Av_{(c)}, \quad (3)$$

where: $Av_{(e)}$ – average value of the experimental group;
$Av_{(c)}$ – average value of the control group.

Table 2 shows the indicator of absolute growth (G), reflecting the difference between the initial and final values of the critical thinking level among students of the experimental and control groups.

TABLE 2
SUMMARY TABLE OF INDICATORS OF THE ABSOLUTE GROWTH IN THE CRITICAL THINKING LEVEL AMONG STUDENTS

Groups	Indicators of absolute growth (G)				
	By levels (%)			By Av	By C_{eff}
	high	medium	low		
Control	0	9	-9	0.07	
Experimental	10	0	-10	0.20	**2.85**

Using quantitative methods for information processing, we found that the method of teaching critical thinking we proposed showed significant indicators of its effectiveness.

DISCUSSION

We found that dividing tasks and exercises into low, medium, and high levels (in our case, the level of "standard," creativity, and research) is of great difficulty during the research.

For understanding the difference between the level of "standard" and creativity, it is enough to do the following:

- Study the object functioning in the conditions changed considering the factors influencing it in the environment;
- Solve nonstandard professional problems and tasks;
- Take the necessary actions if one asks the question *What will happen if ...?*;
- Independently develop, justify, and show ways to implement any idea or innovation, etc.

The level of research goes beyond the usual characterization of the research skills. Implementing professional activities requires an integrated dynamic system of knowledge, skills, and competencies. In the context of innovative development of the economy and society, developing and promoting ideas, technologies, methods, and actions necessitate creativity and basic knowledge. However, the technologically adjusted process with the research activity as its driving force is necessary for the birth of new knowledge and the embodiment of innovation.

In addition, forming a potentially productive indicative basis for ongoing and forthcoming actions requires appropriate research of the initial situation and a critical analysis of the process and its expected results.

Students must be able to do the following when conducting research activities:

- Analyze;
- Simulate;
- Consider the object of the study functioning and developing not only in the given but also in the changed conditions;
- Identify, study, and consider external and internal, objective and subjective, and direct and indirect influencing factors;
- Continuously monitor the process and the results obtained;
- Identify and study problems and problem situations, and find their solutions;
- Reliably forecast the state of the object studied based on the research;
- Identify, critically evaluate, and confirm through research the suitability of progressive ideas and innovations.

CONCLUSION

Thus, teaching cognitive strategies of critical thinking requires excellent skills and professionalism from teachers in structuring educational material from low to high complexity (with at least three levels of

difficulty) and building interaction with students based on the personalized approach and the principle of supporting personal individuality.

Forming these general specific skills (competencies) ensures high quality and efficiency in developing critical thinking of students. Moreover, the "multilevel" training presented is an important means and mechanism for effective forming not only critical thinking competencies but also the professional competence of students in general.

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