

**LATIP 2021****International Conference on Language and Technology in the Interdisciplinary Paradigm****OPEN INNOVATION MODEL OF IMPROVING CRITICAL  
THINKING COMPETENCE IN UNIVERSITY STUDENTS**

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**Abstract**

The article explores the possibilities of introducing the Open Innovation concept into educational practices. The aim of the study is to shape the Open Innovation model which will enable the improvement of critical thinking competence in students in the learning environment. The research was carried out on the basis of the Open Innovation paradigm and problem-solving approach to the critical thinking competence. The critical thinking competence framework based on the logics of problem solving (identifying the problem, representing the problem, selecting an appropriate strategy, implementing the strategy and evaluating solutions) is viewed as a complex system of interconnected functional and structural components: critical thinking dispositions, metacognitive critical thinking skills, critical thinking operational skills and reflective critical thinking skills which function for cognitive, developmental, interactive and creative purposes with reference to problem solving. Meaningful learning, active thinking-based learning, cooperative thinking, competitive learning and critical thinking challenges are the main pedagogic principles underlying the Open Innovation model in education. The Open Innovation model is an open system of problem-solving activities realized at four sequencing stages: diagnostic stage, cognitive stage, operational stage and a stage of reflection, and it is aimed at the improvement of the critical thinking competence components. The novelty of the study is associated with the conceptualization of the Open Innovation model in the educational context.

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## **1. Introduction**

The educators of the 21<sup>st</sup> century put emphasis on the importance of effectively organized learning environment where they are not only teaching students professional knowledge and skills but also helping them improve their soft skills such as communicative competence, social intelligence, problem-solving, critical thinking and team working skills. They are essential for career success in any area (Hodges & Burchell, 2003; Majid et al., 2012; Mitchell et al., 2010). To meet the challenges of the twenty-first century, current classroom pedagogy should exploit principles of effective business practices and define new strategies to enhance students' knowledge, competency, deep motivation and problem-solving abilities (Howells et al., 2012). Educators explore pedagogical possibilities of business innovative technologies to adopt their principles in creating effective learning environment.

The Open Innovation approach was introduced into business practices by Chesbrough (2003). In business, open innovation embraces external ideas and knowledge in conjunction with internal developments. In education, open innovation strategies promote students' involvement in collaborative, competitive and meaningful knowledge creation processes in which students can both "give" their knowledge and skills and "take" the advantages of other students' expertise while solving a problem in learning settings. Moreover, working in Open Innovation teams, students develop their competencies which are in need in workplaces.

We believe that the Open Innovation approach to educational practices is a way to support students' critical thinking. The critical thinking competence includes a set of thinking abilities and attributes like being able to analyze situations and draw conclusions based on the knowledge and problem-solving skills, being open-minded and able to approach the situation from different angles. This competence is considered to be essential at work or in studies (Braun, 2004; Halpern, 1998; Klaczynski, 2001).

## **2. Problem Statement**

Literature review shows that little research has been done in relation to innovative development of critical thinking competence in students. The concept "Open Innovation" has not been widely adopted in educational practices yet. In our work, an attempt is made to apply the Open Innovation approach to the improvement of critical thinking competence in university students.

## **3. Research Questions**

The research problem sets out the following research questions:

- What is critical thinking competence in relation to problem solving?
- What are the main structural components of the critical thinking competence?
- What are the key elements of the Open Innovation Model?
- What are the sequencing activities on each stage of the Open Innovation Model?

#### **4. Purpose of the Study**

The purpose of our study is to conceptualise the theoretical Open Innovation model which will enable the improvement of the critical thinking competence in students. In accordance with the purpose of the study, we set out the following research tasks:

- to specify the concept “critical thinking competence”;
- to design the framework of the critical thinking competence;
- to identify pedagogical principles underlying the Open Innovation model;
- to define the sequencing stages of the Open Innovation model.

#### **5. Research Methods**

The study is based on the Open Innovation paradigm (Chesbrough, 2003) applied to the educational context. Conceptual ideas about critical thinking (Klooster, 2001), problem-solving approach to critical thinking (Newell & Simon, 1972), collaborative learning (Vygotsky, 1978), competitive learning (Bartz, 2018), meaningful learning (Braun, 2004) are methodologically important for conceptualization of the Open Innovation model of the improvement of the critical thinking competence.

#### **6. Findings**

The concept of critical thinking has been a focus of study and causes controversy among researchers in the field of psychology and pedagogy. There are numerous definitions of critical thinking based on different approaches. For example, critical thinking is viewed as the highest level of comprehension, acquisition and internalization of knowledge in the process of cognition (McGuinness et al., 2006); a combination of skills of logical thinking (Halpern, 1998; Ennis, 1987); a blend of higher order thinking skills like analytical thinking, creative thinking and assessing thinking (Kulamikhina et al., 2018); thinking abilities to clarify and analyze arguments, and assess their validity (Ennis, 1987).

Based on the problem-solving approach, we define critical thinking as a dynamic intellectual process of purposeful thinking of an individual to solve a problem by using skills of analysis, synthesis, evaluation, interpretation and argumentation of information obtained from observation, after reflection, or during communication.

Our component analysis of the critical thinking competence is based on Klooster’s (2001) conceptual ideas about critical thinking. According to the researcher, critical thinking is an individual thinking process and each participant formulates ideas, assessments and beliefs individually. Information is the starting point and not the result of critical thinking. Knowledge creates a motive without which a person cannot think critically. Critical thinking begins with asking questions and clarifying the problem that needs to be solved. Critical thinking involves persuasive reasoning. A critically thinking person finds their own solution to the problem and supports this solution with reasonable argumentation. Critical thinking is a social activity. Every idea is tested and improved when it is shared with others.

In the context of problem solving, we define the critical thinking competence as a combination of knowledge, skills and attributes of a critical person so that one can find, analyze, compare, evaluate,

systematize, generalize and interpret necessary information in order to solve a problem. Being equipped with the critical thinking competence, students are able to deal with non-standard situations in the learning process.

The critical thinking competence framework is a complex system of interconnected structural and functional components representing different types of critical thinking skills: critical thinking dispositions, metacognitive critical thinking skills, critical thinking operational skills and reflective critical thinking skills which function for cognitive, developmental, interactive and creative purposes with reference to problem solving. The suggested framework of the critical thinking competence follows the stages in problem solving: identifying the problem, representing the problem, selecting an appropriate strategy, implementing the strategy and evaluating solutions (Newell & Simon, 1972).

Critical thinking dispositions include individual values and motives which influence a person's desire to build the habit of thinking well about options and consequences when they make decisions and solve problems. Thinking dispositions are character attributes and attitudes that promote thorough thinking. According to Perkins and Salomon (2012), there are seven dispositions which are important for critical thinking: to be broad-minded and adventurous; to be curious and oriented towards problem-finding; to seek understanding and build explanations; to be strategic; to be intellectually careful; to seek and evaluate reasons; and to be metacognitive (Perkins & Salomon, 2012).

Metacognitive critical thinking refers to two complementary aspects: knowledge about cognition and self-regulation. It includes knowledge about thinking processes and thinking strategies, and an ability to plan, monitor, adjust thinking in relation to task demands and evaluate thinking outcomes (Kuhn, 2009).

Critical thinking operations can be of various types: cognitive, creative and interactive, and are based on specific skills and abilities. The skillful thinker can think precisely, rationally and logically noting connections between facts and formulating strong arguments (Botsoeva & Mosina, 2020). With reference to problem solving, the skillful thinker demonstrates the following cognitive operational skills: identifying and clarifying situations, generating alternative solutions, selecting and implementing a solution strategy, evaluating and checking how well a solution solves the problem (McGuinness et al., 2006). The creative problem solving engages the use of such techniques as brainstorming in generating possible solutions to the problem, and blending two or more ideas to generate new and creative syntheses (Isaksen & Treffinger, 2004). Interactive thinking operations during shared thinking of the problem-solving prompt establish a community of thinkers in groups.

Reflective critical thinking is required on all stages of problem solving: at the planning, monitoring and evaluating phases of completing a task. For example, a person needs to reflect on the information they receive through observation, experience, and other forms of communication to solve problems (Akhmetzhanova et al., 2020); reflectively evaluate the effectiveness of the thinking strategy they are using or have just used, or make a solution while considering and analyzing options.

The structural components of the critical thinking competence are interconnected with the functional ones. The cognitive function is associated with the actualization of existing knowledge about the problem, search, comprehension and internalization of problem-related information. Thinking activities aimed at finding and processing new information result in the internalization of the new

knowledge. Consequently, students gain the ability to interpret, systematize and independently apply this knowledge to standard and non-standard situations.

The developmental function is connected with the progress of critical thinking skills such as analysis, comparison, generalization, etc. The interactive function is to ensure the exchange of information between the participants in problem solving situations. Joint activities allow building such a model of interaction between participants when they influence each of others' behavior.

The creative function is to do with non-standard thinking in a new situation. This function actualizes the student's creative potential and ability to generate new ideas, construct new knowledge.

The development of critical thinking competence will be effective through the use of innovative strategies. The attempts have been made to adopt business technologies by educators in order to enhance learning performance of students. For example, Gunarathne (2019) has made a research and proved the learning effectiveness of Open Innovation strategies in education. The author concludes that success of the Open Innovation in education is determined by the use of open learning technologies, active learning methods, learning challenges set for students, and the ability to manage own learning experience by students. Besides, learning effectiveness is promoted through collaboration between the actors of the learning process (Gunarathne, 2019). The Open Innovation strategy has centered on the two main elements which can be described by the "give-and-take" approach in relation to the knowledge and skills. It means more open, networked world for participants (Chesbrough, 2003). "When developing new products, companies involve people from the outside environment of the organization so that they offer their ideas, make comments, and, thereby, improve the final product" (Chesbrough, 2003, p. 15). Collaboration, competition, interchange are the key concepts of the Open Innovation paradigm (Howells et al., 2012).

In our study, the Open Innovation Model suggests collaborative development of critical thinking competence based on the principles of meaningful learning, active thinking-based learning, cooperative thinking, competitive learning and critical thinking challenges.

1. Meaningful learning. When students are engaged intellectually and emotionally in the learning process, they develop high motivation that is linked to the goals and objectives. In addition, students understand their future learning outcomes. So, they become more effective in gaining and internalizing new knowledge and skills (Braun, 2004). The use of authentic materials, thought-provoking content and instruction contribute to meaningful learning environment in the classroom.

2. Active thinking-based learning. Theorists of cognitive development point out that people learn through their authentic experience and reflection (Dewey, 1938; Vygotsky, 1978). So students have to be more involved in discussion, analysis, synthesis, reflection and evaluation practices through speaking, listening, writing and reading.

3. Cooperative thinking. Thinking activities in cooperative settings give students more opportunities for their development (Vygotsky, 1978). The shared nature of thinking means that students can scaffold one another's thinking and capitalize on one another's resources and skills (Ashman & Gillies, 2003). With this "give-and-take" approach, students can achieve far better results and make better solutions in problem solving than if they were trying to solve a problem on their own (Klaczynski, 2001).

4. Competitive learning. The competitive learning principle can be applied to individual or group learning when the results are assessed on the same criteria and compared. The competition can also be used between groups working on the same problem-based task. Being a highly valuable instrument in business, competition can also bring benefits to the classroom. Competitive learning places emphasis on the quality of the solution to a problem, which can be challenging to students; it may increase learning motivation due to emotional involvement of the participants. When used between groups, it often creates intense cooperation among members within a group that helps team working (Bartz, 2018).

5. Critical thinking challenges. Mental activities need to be organized and promoted in the learning environment. This can be done through the use of critical thinking challenges such as Socratic questions, thinking maps, problem-based tasks. Thinking challenges prompt students to think in deeper ways and engage them in analysis, synthesis, or evaluation. Besides, they serve as motivators and organizers of higher-order thinking.

Based on the framework of the critical thinking competence and following the stages in the problem-solving process, we determine 4 stages of implementation of the Open Innovation Model aimed at the improvement of critical thinking competence: a diagnostic stage, a cognitive stage, an operational stage and a stage of reflection.

The diagnostic stage is aimed at critical thinking dispositions. At this stage, students learn about the situation and try to identify the problem. They need to understand personal, educational, or professional significance of the problem. Socratic questions can stimulate students' thinking process at the start. Exploratory-type Socratic questions help find out what students know or think about the topic or situation, preparing students for further analysis of the problem. They are prompted to raise questions that need answers to formulate the problem. For example, "What are the facts?", "What is the problem?"

At the cognitive stage, the activities are aimed at the development of metacognitive critical thinking skills. The main question to be asked by students is "What can we do to solve the problem?" In order to answer it, students have to select a thinking strategy to solve the problem and plan the whole process of working on a problem. For example, thinking maps are an excellent challenging strategy. There are different types of thinking maps, most of them are of flexible structure so that students can expand the map while planning. This stage involves collaboration between students, a lot thinking and self-regulation work. The result of this work is the creation of a map of concepts and an action plan, which convey the understanding of the problem, and further problem-solving activities.

The operational stage is to do with critical thinking operational skills and reflective thinking skills. At this stage, students think about possible solutions to the problem and evaluate consequences of each option until they choose the best solution. The students are engaged in cooperation and group competition. They practice different types of thinking skills like analysis, synthesis, or evaluation skills; learn to work in a team and under pressure of high competition.

The reflective stage focuses mainly on the reflective critical thinking skills. Students are involved in mutual- and self-assessment procedures which promote a better understanding of their thinking strengths and weaknesses (Prokhorova et al., 2020).

Thus, in our study, the Open Innovation model is a system of problem-solving thinking activities realized at sequencing stages and aimed at the improvement of structural components of critical thinking

competence (critical thinking dispositions, metacognitive critical thinking skills, critical thinking operational skills and reflective critical thinking skills). This model is an open system whose elements can be constantly enriched or supplemented in the process of problem solving.

## 7. Conclusion

The study was aimed at conceptualization of the Open Innovation model of improvement of critical thinking competence in students in educational process. We analyzed educational opportunities of the Open Innovation business technology and elaborate pedagogic principles underlying the Open Innovation model in education (meaningful learning, active thinking-based learning, cooperative thinking, competitive learning and critical thinking challenges).

The concept of the critical thinking competence is viewed in the context of problem solving approach, and defined as a combination of cognitive abilities, critical thinking skills and attributes of a critical person able to solve problems.

The critical thinking competence framework is a complex system of interconnected structural components representing different types of critical thinking skills: critical thinking dispositions, metacognitive critical thinking skills, critical thinking operational skills and reflective critical thinking skills, and functions (cognitive, developmental, interactive and creative) with reference to problem solving. The suggested framework of the critical thinking competence follows the logics of problem solving

The Open Innovation model is an open system of problem-solving activities realized at four sequencing stages: diagnostic stage, cognitive stage, operational stage and a stage of reflection, and aimed at the improvement of components of the critical thinking competence.

The Open Innovation model offers valuable benefits for education industry. It promotes students' motivation, communication, teamwork, competition and self-regulation in the learning environment.

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