

## **The Application of Bloom's Taxonomy in the Research of the Junction between Comprehensive and High School from the Viewpoint of Education of Critical Thinking**

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### **Abstract**

*Aplikace Bloomovy taxonomie ve výzkumu propojení základních a vysokých škol z hlediska výchovy ke kritickému myšlení. – Kritické myšlení při vzdělávání je velmi důležité jak v základních školách, tak na nejvyšším stupni vzdělávací soustavy. Nicméně problém výchovy ke kritickému myšlení z hlediska propojení základních a vysokých škol byl v litevských školách analyzován jen problematicky. Proto je důležité, na jakém základě můžeme zkoumat koordinaci mezi vysokými a základními školami v aspektu výchovy ke kritickému myšlení.*

V odpovědi na tuto otázku, článek zdůvodňuje Bloomovu aplikaci taxonomie vzdělávacích cílů při zkoumání daného problému. K jeho řešení je použita analýza odborné literatury, dotazníkové šetření a metody odborné evaluace. Výsledky analýzy ukazují, že Bloomova taxonomie zvyrazňuje rozdíl mezi vysokým a základním vzděláváním ve všech oblastech poznávání. Použití tohoto nástroje také ukazuje statisticky významné rozdíly mezi vysokoškolským vzděláváním a dalšími oblastmi studia.

**Keywords:** formation of critical thinking, taxonomy of educational objectives, Benjamin Bloom

**Klíčová slova:** formování kritického myšlení, taxonomie vzdělávacích cílů, Benjamin Bloom

### **Introduction**

The education of critical thinking is very important both, in comprehensive and high school. It should be a continuous process in the whole educational system; therefore, the smooth transit between comprehensive and high school is especially important. In Lithuania, lots of attention is being given to the education of critical thinking at comprehensive school. That is proved in a number of publications on the topic, such as by Visockienė (2002), Penkauskienė (2001); Butkienė, Laurinciukienė (1997) and others. However, it was impossible to find any works analysing education techniques of critical thinking as well as problems of their application in the high schools of Lithuania. There is a serious lack of research about the junction between comprehensive and high school. Naturally, a problem comes up: on what base peculiarities of the junction between comprehensive and high school, in the context of succession of the education of critical thinking, can be sifted.

To solve this problem, the **goal** of the article is chosen: *to validate the usage of Bloom's taxonomy in the research of the junction between comprehensive and high school from the viewpoint of the education of critical thinking.*

Subsequently, the following tasks are set:

1. To prove theoretically the possibilities of the usage of Bloom's taxonomy in the research of the junction between comprehensive and high school from the viewpoint of the education of critical thinking.
2. To reveal the relevance and applicability of Bloom's taxonomy through the method of expert evaluation.
3. To evaluate whether Bloom's taxonomy reveals the problems about the juncture between comprehensive and high school practically, using the method of a questionnaire.

The research methods applied in this article are as follows: the analysis of scientific literature, expert evaluation and a questionnaire.

### **Theoretical confirmation**

According to Arends (1998), there is not, and there cannot be a single, universal way of learning, so for the development of critical thinking, a variety of methods can be used: converging education, learning through cooperation, learning of concepts, heuristic education and Bloom's taxonomy. According to Visockienė, Siauciukienė (2000), Bloom (1965) and Paul (1993), these methods are chosen because:

- converging education emphasises the wholeness of a student's thinking and emotions, creating the conditions for the development of creative forces, i.e. by affecting the student's positive feelings, overcoming fear, anxiety, undervaluation of oneself, etc;
- Bloom's taxonomy of knowledge goals helps consciously apply analysis, synthesis and evaluation, constantly improving the processes of thinking;
- learning through cooperation not only encourages solving problems as a team but also generates a need to coordinate your thoughts, thinking, actions with other people's thinking, thoughts, and actions;
- learning of concepts spans the process of knowledge construction, which helps arrange information, based on the concepts learned earlier;
- the base of heuristic education is solving problems, which allows the development of intellectual skills.

All these methods can be successfully applied in the education of critical thinking, *however, a question arises: would it be possible to reveal the concord in the junction of comprehensive and high school with the help of these methods.* To reveal the concord, it would be necessary to:

- find out what critical thinking abilities are developed in comprehensive school, and what – in high school;

- compare the expression of these skills in the junction between comprehensive and high school.

Considering these criteria, it's possible to state that the most effective way to achieve this goal would be the one that emphasises the development of critical thinking abilities. However, both, in comprehensive and high school, the same abilities must be developed, otherwise, the development of critical thinking will not be a continuous process, i.e. there will be no concord in the aspect of the development of critical thinking. Therefore, knowing the peculiarities of the application of each process of the development of critical thinking, it is possible to confirm their suitability for the research of the concord in the junction of comprehensive and high school. Summing up the stated thoughts, it's possible to say that:

- **converging education** is not suitable for the research of critical thinking abilities and the revelation of the concord between comprehensive and high school at the same time, as it emphasises the unity of emotions and thought, and the openness to learning activities;

- **learning through cooperation** is also not suitable for the solution of the first problem, as it reveals the coordination of contemplation, thoughts, and work while solving the problems in a team, and emphasises the shifting role of the teacher;

- **learning of concepts**, according to Gage, Berliner (1994), spans the process of systematization of knowledge and the organisation of information into understandable and complex cognitive structures (by creating analogies, picturing by diagrams or maps), therefore, it's not quite suitable, as it only emphasises the abilities to synthesise knowledge;

- **heuristic education** can be applied, but there are doubts whether the concord of comprehensive and high school will be properly revealed, as it gives the possibility to solve problems and think solo and independently;

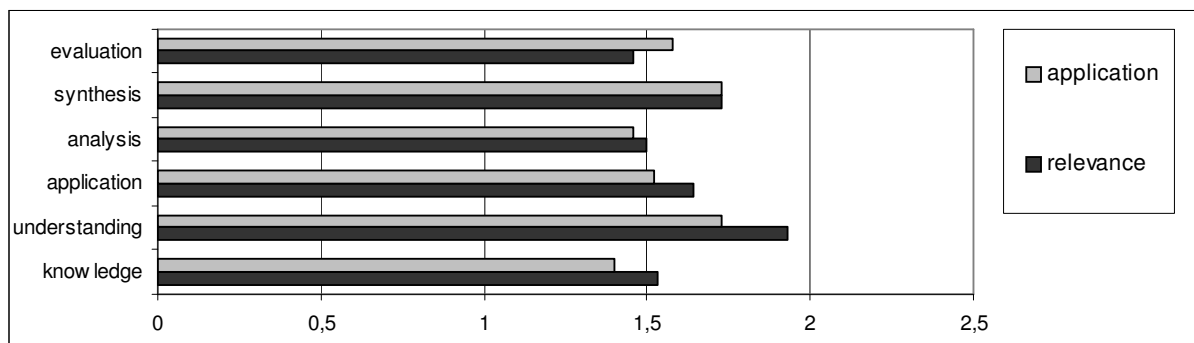
- **Bloom's taxonomy of knowledge goals**, according to Metfessel, Michael & Kirsner (1969) describes the possibilities of improving thinking processes and a conscious application of analysis, synthesis, and evaluation, therefore, it is possible to use it. Also, developing and researching critical thinking by converging education, learning through cooperation, learning of concepts and heuristic education, the goals of the education (from the recalling of knowledge to the solving of problems) are realised according to all the domains of Bloom's taxonomy of knowledge goals. It is like a base of all the examined ways used to develop critical thinking, which, with the help of converging education, learning through cooperation, learning of concepts and heuristic education, allows realising the goals of learning on knowledge, comprehension, application, analysis, synthesis, and evaluation domains. Furthermore, not only in comprehensive, but also in high school, the goals are emphasised according to all the domains of Bloom's taxonomy of knowledge goals.

*To sum up, this analysis of scientific literature shows that it is possible to apply this method in revealing the peculiarities of the juncture between comprehensive and high school from the aspect of the development of critical thinking.*

### The results of expert evaluation

For a more thorough reasoning, expert evaluation is employed, whose goal is to evaluate the definite relevance and the importance of the domains of Bloom's taxonomy of knowledge goals. 15 experts were questioned, that is, employees of Ministry of Education and Science, employees of Kaunas District Municipalities, employees of high school and the director of Modern Didactics Centre. They evaluated domains of Bloom's taxonomy of knowledge goals as: 1) relevant; 2) quite relevant; or 3) irrelevant. Also, they had to specify how they would apply them while solving the mentioned problem: 1) apply with no exceptions; 2) apply in some cases; 3) wouldn't apply it at all.

According to the results of the experimental research it is possible to present the important conclusion: all Bloom's cognitive goals of taxonomy domains are relevant and applicable enough (figure 1).



**Figure 1.** The comparison of Bloom's taxonomy cognitive domains with their relevance and from the point of their applicability

With reference to the experimental evaluation analysis of data it is possible to propose that the main cognitive domains are **evaluation, analysis and knowledge**; the most applicable are **knowledge, analysis and application**. According to the experts, knowledge and analysis are relevant and applicable. The standpoint of the respondents could be interpreted as follows: the cognitive domain "knowledge" is relevant and applicable, owing to the fact that without it the thinking itself is impossible, i.e. without knowledge we are unable to educate the capabilities of critical thinking.

Since the experts hold the opinion that the most actual cognitive domain is "evaluation", it is possible to make an assumption that they refer to the interpretive module of Lithuania's educational system which emphasizes the theory of constructivism. They highlight the education of critical thinking because critical thinking cannot exist without evaluation (Paul 1993). The least relevant criterion is "comprehension". Unappreciated knowledge cannot exist, therefore, this experts' opinion could imply their reference to reproductive pedagogy. Cognitive domains differ in their attitude of relevance and application; however, "synthesis" is equally relevant and applicable. The significance of relevance and applicability of other cognitive domains are out of synapse. *Consequently, presumption can be made that the experts evaluate the relevance of the cognitive domains on*

*the basis of educational aims, whereas the importance of usage is measured according to the requirements of the examinations.*

It is interesting that the cognitive domain “knowledge” is more relevant and more meaningful in a viewpoint of usage than “comprehension” and “synthesis”. This viewpoint can be interpreted in two ways:

- The background of other capabilities of the critical thinking is knowledge because without knowledge it is impossible to analyze, synthesize and evaluate.
- It might be assumed, that it could be the occurrence of the reproductive pedagogy: after all knowledge does not exist without comprehension. As stated by Paul (1993), the process of attaining is inherent from the process of comprehension.

To conclude, according to the aspect of critical thinking, Bloom’s taxonomy of cognitive objectives can be applied to analyze peculiarities of junction of comprehensive and high school because:

- it is the background of critical thinking which enables to realize the educational objectives such as knowledge, perception, usage, analysis, synthesis and evaluation domains through the learning cooperatively and through heuristic and conceptual learning as well;
- in comprehensive and high school educational objectives are realized according to all cognitive domains (knowledge, comprehension, application, analysis, synthesis and evaluation);
- The expert evaluation shows that all Bloom’s taxonomy cognitive domains are relevant and applied in practice. *The most relevant Bloom’s taxonomy cognitive domains are evaluation, analysis and knowledge, and the most applicable are knowledge, analysis and application.*

### **Results of the questionnaire**

It is obvious that in high school more attention should be given to such thinking activities as analysis, synthesis and evaluation. However, requirements to a school-leaver and to a first grade student should not differ too much, otherwise, the student will face invincible difficulties. Unfortunately, practice shows that this is a rather frequent phenomenon: there is a high rate of students who are eliminated from some of the faculties. Therefore, it is important to find out if Bloom’s taxonomy discloses differences of cultivation of critical thinking aspects at comprehensive and high school.

A questionnaire of the students was carried out. The survey was divided into two stages. During the first stage a poll was carried out. 90 second grade students studying at the faculty of mechanics of Kaunas University of Technology were asked to assess which competences are emphasized at comprehensive and high school according to all domains of Bloom’s taxonomy. After redrafting of the technique, the second stage – where students of four universities of Lithuania took part in a survey – was carried out.

Grip of the survey is based on these principles:

1. Four biggest universities in Lithuania were chosen: Vilnius University, Vytautas Magnus University, Kaunas University of Technology and Vilnius Gediminas Technical University.
2. At each university four fields of studies were chosen: sciences of physics, technology, arts and social studies.
3. 20 second grade students of each field were questioned. Students were chosen randomly.
4. The reason, why the second grade students were chosen, is that they graduated comprehensive schools just a year ago and they have already studied at the university for one year, subsequently, they are able to assess requirements of both educational institutions.

This way 320 students were questioned. The aim of the analysis is to survey if Bloom's taxonomy points out differences of cultivation of critical thinking aspects at comprehensive and high school. The questionnaire was based on cognition domains of Bloom's goals of cognition taxonomy. Students assessed every requirement in a scale of ranks. Evaluation system of 4 marks was used; 0 – never, 1 – sometimes, 3 – often, 4 – always.

The results of the survey showed:

1. The cultivation of critical thinking at comprehensive and high school differs in all domains of Bloom's taxonomy (table 1).

*Table No. 1.*

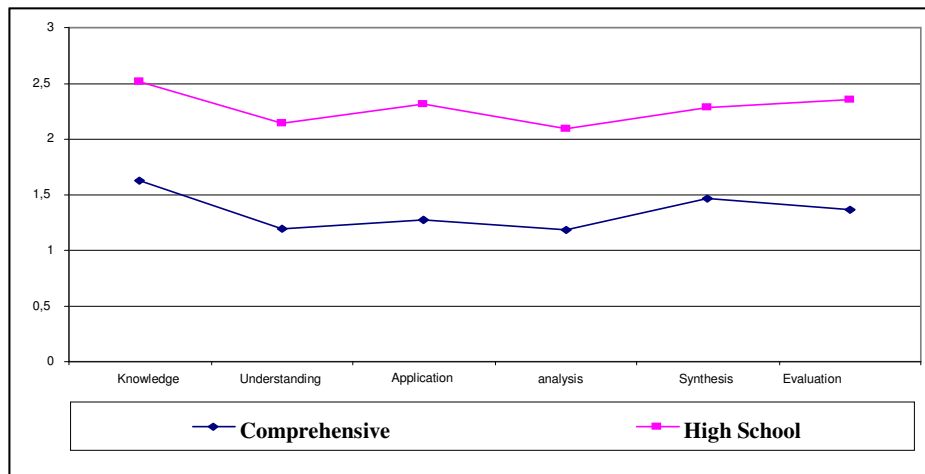
**Statistical characteristics of evaluation of domains of Bloom's taxonomy**

	<b>Statistical Characteristics</b>	<b>Knowledge</b>	<b>Cognition</b>	<b>Practice</b>	<b>Analysis</b>	<b>Synthesis</b>	<b>Evaluation</b>
<b>Comprehensive school</b>	Mean	1,63	1,19	1,27	1,18	1,46	1,36
	Standard deviation	0,62	0,68	0,8	0,68	0,70	0,72
	Mode	2	1	1	1	1	1
<b>High School</b>	Mean	2,52	2,14	2,31	2,09	2,28	2,35
	Standard deviation	0,63	0,69	0,78	0,69	0,73	0,69
	Mode	3	2	2	2	2	2

The second table shows that, according to the mode, teachers of comprehensive school require recalling knowledge quite often. All other domains of cognition were assessed as “sometimes”. Therefore, it can be presumed that only episodic attention is given to cognition, practice, analysis, synthesis and evaluation of knowledge, and, subsequently, there is no system. Whereas at high school, according to the students, recalling of knowledge is required “always”, and cognition, practice, analysis, synthesis and evaluation of knowledge is a frequent phenomenon. Knowledge is a foundation of thinking. Knowledge is essential to

successful cultivation of other processes of thinking (synthesis, analysis), but it is strange that at high school this is the priority comparing to other thinking activities.

Evaluation of domains of Bloom's taxonomy is equal at comprehensive and high school. Most attention is paid to recalling the knowledge, whereas cognition and analysis of knowledge are not treated as the least important ones at both institutions. Subsequently, the same tendencies in cultivation of critical thinking aspects can be traced at comprehensive and high school. However, the difference still exists, as at comprehensive school just episodic attention is given to cognition, practice, analysis, synthesis and evaluation of knowledge, whereas at high school these fields are really important.



**Figure 2.** Evaluation of cognition domains of students at comprehensive and high school

2. We checked the hypothesis about the subjection of evaluation of students from the sphere of studies, using the parameter of the independence of attributes  $\chi^2$ . We found out, that there are no differences among evaluations of students, who study physical, technological and humanitarian education. Nevertheless, there are essential differences, which are important for statistics, between the previous mentioned spheres and the evaluation of students who study social studies. Those students who study social studies notice that there is a less gap between high and comprehensive school, according to all domains of cognition. In conclusion, we can state, that the evaluation of students depend on the subject they are studying (table No. 2).

Table No. 2.

**Differences between the evaluations of students who study  
social studies and other kind of studies.**

Parameter	The subsection of the evaluation from the sphere of studies
Knowledge	$\chi^2 = 10.660$ ; $\alpha = 0,014 < 0,05$ . Statistical reliable relation
Cognition	$\chi^2 = 11.873$ ; $\alpha = 0,003 < 0,05$ . Statistical reliable relation
Application	$\chi^2 = 10,098$ ; $\alpha = 0,006 < 0,05$ . Statistical reliable relation
Analysis	$\chi^2 = 6,051$ ; $\alpha = 0,049 < 0,05$ . Statistical reliable relation
Synthesis	$\chi^2 = 3,213$ ; $\alpha = 0.360$ . Insignificant relation
Evaluation	$\chi^2 = 2,549$ ; $\alpha = 0.280$ . Insignificant relation

3. We tried to detect the differences among separate universities. We made the research of the hypothesis, which states that the evaluation of students depends on the university he/she studies. Nevertheless, the differences, that are significant to statistics, were found by evaluating the knowledge and the cognition.

In conclusion, we can state, that the gap between the comprehensive and high school, making a research of the education of the critical contemplation, according to Bloom's taxonomy and to all domains of cognition, was obvious. The significant differences to the statistics between the spheres of studies and separate universities were noticed. Subsequently, we can state, that Bloom's taxonomy is the correct tool to investigate the interface between the comprehensive and high school, according to the aspect of the education of critical contemplation.

### Conclusions

1. According to Bloom's taxonomy and his goals of cognition, we can examine the features between the comprehensive and high school, due to the aspect of the education of critical contemplation, as:

- ✓ It is the basics of the types of the education of critical contemplation, which lets realize the goals of studies in domains of cognition of the knowledge, conception, application, analysis, synthesis and evaluation, by the help of interfluent education, learning by collaboration, concepts and heuristic education;
- ✓ The aims, that are significant at comprehensive and high school, are placed according to all domains of cognition (knowledge, conception, application, analysis, synthesis and evaluation).

2. The results of the evaluation of the expertise indicate that all domains of Bloom's taxonomy and his goals of cognition are relevant and are applied in the practice. Evaluation,



analysis and knowledge are the most relevant domains of cognition of Bloom's taxonomy. Knowledge, analysis and application are the most applicable domains of cognition of Bloom's taxonomy.

3. The results of the research of the questionnaires indicated, that:

- ✓ There is no tune between the comprehensive and high school, according to the education of critical contemplation, as there is a significant gap, which is important to statistics, according to all domains of cognition. The same tendencies, according to the aspect of education of critical contemplation, are obvious both in comprehensive and high school. The main attention is paid to the reproduction, application and evaluation of the knowledge. Less attention is paid to the conception and analysis of knowledge.
- ✓ According to the four greatest universities of Lithuania, the significant differences, that are significant to the statistics, were detected while assessing the knowledge and conception. There are almost no differences between the evaluation of the students, who study physical, technological and humanitarian studies. Nevertheless, there were found significant differences to the statistics between the mentioned spheres and the evaluation of the students, who study social studies. Those students, who study social studies, notice that there is a less gap between high and comprehensive school, according to all domains of cognition.

The research, using Bloom's taxonomy, highlights the differences, so the taxonomy is the correct tool to investigate the interface between the comprehensive and high school on the basis of aspect of education of critical contemplation.

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