INSTRUCTION FOR ACADEMIC STAFF ON THE APPLICATION OF BLOOM'S TAXONOMY

Introduction

The education system is one of the most essential areas contributing to human capital formation. However, education experts and public representatives point out that the crisis that has developed over the last 50 years, including in third world countries, has also affected the field of education.

In order to eliminate the root causes of this, the education system needs to be adapted to the requirements of the age. However, it is necessary to fundamentally revise the content of the educational process, to put the student at the center and to teach students how to acquire and work with knowledge rather than repeating what they hear or read. Researches show that students get the most out of the training process when they discuss or explain the content to each other rather than memorizing the text.

This instruction can be considered as an excellent material for those involved in the training process in order to increase the pedagogical and psychological skills of young teachers who have just joined the audience. It can also be used for planning the training process and conducting training courses.

1. A brief history of Bloom's Taxonomy

Taxonomy is a Greek word (''taxis-order, nomos-rule,law'') and studies the principles, goals and methods of classification. In learning theory, there is a need to categorize educational objectives in order to design and evaluate the goals more effectively. One of the most cited methods in this direction is Bloom's Taxonomy. Bloom's Taxonomy is one of the effective tools that educators use to develop critical thinking skills in the teaching process. This term was first introduced in 1954 by Benjamin Bloom and his colleagues Max Englehart, Edward Furst, Walter Hill and David Crathall in their book "Taxonomy of Educational Objectives", and defined as a pyramid that includes cognitive skills such as "knowledge, comprehension, application, analysis, synthesis and evaluation".

In the taxonomy revised in 2001, the skill of "synthesis" was renamed "creation" and was considered last, replacing the skill of "evaluation". One of the differences between the original taxonomy and the revised taxonomy is that in the original taxonomy the levels are expressed by nouns, while in the second one they are described by verbs.

2. Training objectives and training outcomes

In order to properly structure and control the training process, it is important to clearly define the consequences of how the student should demonstrate the acquired knowledge and skills. It is also necessary to distinguish between the aims and outcomes of education. When formulating training objectives the teacher explains what the content of the training process is. For this, it is necessary to manage the educational process itself, as well as to use the educational results that allow planning its content, evaluating its effectiveness, choosing the right educational and evaluation methods.

The expression of the purpose of studying the subject depends on the level of mastery of the teacher-specialist and the purpose of teaching the subject, which should be reflected in the curriculum.

The purpose of the training meets the following criteria:

- reflects general statements of the teacher's intention (covers the content of the training);
- reflects the long-term outcome of acquiring the necessary knowledge and skills;
- often uses abstract commands and phrases such as "evaluate", "understand" and "recognize";
- expressed in 3-5 sentences.

Training outcomes are descriptions of specific knowledge, skills or experiences to be demonstrated at the end of a particular training activity, such as a lecture, seminar, course or program. Well-designed training outcomes should include a description of knowledge and skills that can be measured and assessed and should focus on how the student will apply new knowledge in a real-world context, rather than on the student's ability to repeat knowledge.

The training outcome has two parts. The first part indicates *what needs to be mastered* in the training process and the second part describes *what the student needs to demonstrate* in order to show that they have indeed successfully mastered the material. For example, the training outcome could be formulated as follows: "The student can explain how the law of supply and demand works." In this case, "the operation of the law of supply and demand" is a description of the material studied and "being able to explain the operation" is a description of what the student needs to demonstrate as a result of the training process.

Properly designed training outcomes should have the following characteristics:

- encourage the active role of students in the training process;
- show what abilities students should be able to demonstrate at the end of the training process;
- be consistent with the educational objectives;
- relate assessment methods to the content of the education and the training process;
- students should be informed in advance about the final outcome of the training process;
- explain to students how the acquired knowledge and skills will be applied in practice;

- be measurable and verifiable in order to verify the success of the training process;
- be covered in 5-10 paragraphs.

In order to define effective and specific training objectives so that new knowledge can be created from existing knowledge at the end of the training process, the following should be taken into account:

1. Using verbs that have a concrete meaning and show an action that has a measurable outcome;

Wrong option: The student who successfully mastered the lesson understands the meaning of the law of supply and demand. The verb *"understand"* here is not specific enough, which makes it impossible to assess mastery of the law of supply and demand.

Correct option: Upon successful completion of the lesson, a student describes the impact of the law of supply and demand on the formation of market prices. Here the verb *"to understand"* is replaced by the verb *"to describe"* because this verb means to state the precise result of the description.

2. Formulate sufficiently specific criteria for the assessment of the student's mastery of the subject.

Traning outcomes reflect different levels of subject mastery. The training process, built on the basis of correctly stated training outcomes, familiarizes the student with the entire content of the subject studied and makes it possible to gradually move on to more complex aspects.

To check the effectiveness of the training outcomes, the teacher can self-check by answering the questions listed in Table 1.

Table 1. Training outcomes assessment list

Questions	*Yes*	*No*
Are the training outcomes consistent with the subject objectives?		
Do the training outcomes meet the following? - detailed and specific - measurable or identifiable - result-oriented		
Is an assignment defined to assess the achievement of each training outcome?		
Can the training outcomes be used to improve the content of the qualification or subject?		

3. General information about Bloom's Taxonomy

Bloom's Taxonomy is the most widely used tool for the accurate formulation of training outcomes. Bloom's taxonomy is a hierarchical structure of six processes, where each successive level allows for a deeper assimilation of knowledge. This taxonomy can be used to formulate training outcomes both for the specialty as a whole and for individual subjects and topics.

Bloom's taxonomy covers *three areas of study*:

- cognitive learning (cognitive or mental skills)

- affective learning (emotions and emotional relationships)
- psychomotor learning (physical or practical skills).

Knowledge itself is divided into *four forms* depending on the characteristics of its content:

- factual knowledge
- conceptual knowledge
- procedural knowledge
- metacognitive knowledge.

3.1. Factual Knowledge

It is the knowledge of the basic elements that the student needs to demonstrate after starting the topic or when solving problems related to the topic.

Factual knowledge consists of two sub-types:

- terminological knowledge
- information about specific elements and details.

a) Terminological knowledge is knowledge about specific verbal, non-verbal signs or symbols (words, numbers, pictures). This knowledge mediates the student's understanding of the content of the subject studied and expresses his/her knowledge. Examples include knowledge about the alphabet, symbols used in mapping, symbols used in transcription, scientific terminology, etc.

b) information about events, places, people, information sources refers to knowledge about *specific details and elements*. Based on this, it is possible to clarify and elaborate information about processes and events, to clarify the picture of what is happening. These include *information about the main goods produced and exported in a given country, the most important places, names and events mentioned in the news*.

3.2. Conceptual knowledge

Conceptual knowledge reflects the properties of the interrelationships between the main elements in the constituent parts of more complex structures. Conceptual knowledge includes:

a) *Knowledge of categories and classifications* is knowledge of existing and accepted ideas about the relationships between basic elements in science. For example, parts of speech, knowledge of the periods of geological development of the world, etc.

b) *Knowledge of principles and generalization of propositions* is knowledge of regularities and principles involving certain categories and classifications. Through them, generalizing properties of certain processes, facts or events are explained. This includes, for example, *knowledge of the fundamental principles of law or the fundamental laws of physics.*

c) *knowledge of theories, models and structures* - knowledge of the various paradigms and concepts by which science describes or predicts any group of phenomena. Examples include the

theory of the movement of tectonic plates, the theory of the division or control of forces and the theory of equilibrium systems.

3.3. Procedural knowledge

Procedural knowledge consists of knowledge about the criteria for using different skills, algorithms, techniques and methods as well as research methods. If factual knowledge and conceptual knowledge together constitute the "what?", procedural knowledge answers the question "how?". This includes:

a) Knowledge of special skills and algorithms reflects the order in which a certain sequence of actions is performed to solve a particular problem. For example, knowledge of the rules for solving quadratic equations or *the rules for conjugating verbs*.

b). *Knowledge of specific techniques and methods* includes knowledge of scientific methods and research methods. Unlike certain skills and algorithms that result in a fixed outcome, some procedures are considered this type of knowledge when they do not result in a single predetermined answer or solution. For example, *knowledge of research methods in the social sciences or knowledge of different methods of literary criticism* fall into this genre.

c) Knowledge about the criteria that guide the use of appropriate procedures: It is knowledge about the definition of the conditions that help to select a precise method, algorithm or procedure in a given situation. For example, this includes *knowledge of the criteria that determine how to solve algebraic equations.*

3.4. Metacognitive knowledge

It is knowledge about the cognitive process and cognitive subject matter as a whole. Metacognitive knowledge includes:

a) Strategic knowledge: Knowledge of basic strategies for learning, reasoning and problem solving. These strategies describe how students can remember what they have learned, how they can use sources of information and how they can apply what they have learned in class or independently. Thanks to this knowledge, students can independently plan the cognitive process, assess their level of knowledge and adjust it by repeating and reinforcing positions that are difficult to understand. It also includes knowledge of how to solve cognitive problems, i.e. knowledge of general scientific methods such as deduction and induction, rules of argumentation, etc. Examples include organizational and cognitive strategies such as *various memorization methods, charting, self-checking, etc.*

b) Various cognitive issues, including contextual and conventional knowledge. This relates to This knowledge is about the conditions under which certain ways of thinking can be applied, in which context they can be understood correctly or incorrectly, and so on. Knowledge about cultural and social norms that influence the application of certain strategies can thus be attributed here.

c) *Self-awareness* is an idea about how well students reflect on their level, both the extent of their own knowledge and the various assessment methods they have to pass. This type of knowledge includes: knowledge about what a person himself understands and what he does not understand, knowledge about what his personal interest is in the process of performing a certain assignment, etc.

4. Stages of Cognitive Process

According to Bloom, the cognitive process consists of six levels. These are: remembering, understanding, applying, analyzing, evaluating and creating. A description of each level and examples of assignments are reflected in the rest of this section.

Remembering

In Bloom's taxonomy, the first level is about retention of the information received and the remaining five levels are about creative application of knowledge. If we ask the student to repeat the material he/she has learned, that is, to simply recall the information he/she has already received, his/her cognitive abilities such as memory are called upon. At this point the student can use the skills of correct selection/identification and reproduction.

a) *identification* **-** It is the comparison of information received with previously known information. It involves identifying and rephrasing the information you already have. It serves to retrieve information from long-term memory to ensure that previously acquired knowledge is aligned with new information.

Task example: determining the correspondence between the term and its definition presented in the two lists; determining whether the information provided is correct or incorrect, or selecting the most appropriate of the various options.

b) *reproduction - It is the retrieval of information from long-term memory to find an answer to a specific question.*

Example of a task: Giving a definition to answer an open question, performing a mathematical operation, identifying details about some event or person.

Understanding

It is the ability to make connections between new information and information acquired in the previous learning process. Understanding takes the following forms:

a) *İnterpretation* = is the transformation of information from one form of expression into another, e.g. expressing in your own words material described in numerical form and vice versa. Tasks can be prepared in the form of both open and closed questions.

b) *Description* = is giving examples of specific phenomena or events that belong to a more general category based on specific signs. Examples of tasks aimed at assessing this skill: providing one or more specific examples, choosing a descriptive example from a list.

c) *Classification* = the definition of a category to which these or other facts or events with relevant characteristics can be attributed. Tasks can be prepared in the form of determining to which category these or other phenomena can be attributed, selecting any category from a given classification, or comparing a list of any phenomenon or event with another category.

d) *Summarizing* = expressing the meaning of the information presented in one or more sentences. The student may be asked to give a title to the section presented as homework or to choose a title from a list.

e) *Inference* = the selection of a principle or rule that is common to a variety of facts or situations. An example of a task for this would be to consider all relevant facts or circumstances together.

f) Comparison = finding similarities or differences between related elements of any object, phenomenon or event. For this, it is necessary to show the correspondence between the parts of the objects being compared.

g) Explanation = carried out by building a cause-and-effect model. The assessment of this capability involves reasoning (determining the cause of the event), detecting difficulties (finding a deficiency in the system that causes inactivity), making changes (searching for the necessary conditions to achieve a new result), as well as predicting (Determining how changes occurring in one part of the system affects the whole system).

Applying

It is the application of specific procedures to complete tasks or solve problems. Applying is therefore closely related to procedural knowledge. Depending on the complexity of the problem being solved, applying can be divided into two categories:

a) Problem solving – at this point, the emphasis is not on techniques and methods, but on specific skills and algorithmic knowledge, as well as on the solution of already known types of tasks.

It consists of performing a specific sequence of steps and is aimed at achieving a predetermined result.

b) Applying - is the solution of a specific problem that the student must first understand it. It focuses on choosing the most appropriate way or method to solve a problem that the student does not initially know. For this, the student needs to identify the methods of solving the problem and only after that start performing the task. The student deals with conceptual knowledge as well as procedural knowledge and uses techniques such as understanding and creating as well as applying.

Analyzing

Analyzing - helps to deepen and evaluate knowledge acquired at previous levels of education or to create new knowledge. Analyzing helps students to separate fact from opinion, justify their conclusions, distinguish what is important from what is unimportant, identify how ideas are related to each other, separate important ideas from unnecessary ideas or issues, and find evidence to support their goals; it involves breaking the material under study into its constituent parts and learning how these parts relate to each other and to the structure as a whole.

a) *Differentiation* - the process of determining a single structure by the importance of its different parts and determining their roles. As an assignment, students can be asked to highlight the main stages of a particular process or the main points of any narrative.

b) *Organization* – the establishment of mutual relationship and sequence between the constituent elements of the structure. Organization is used in conjunction with differentiation, which is necessary first to separate the constituent parts and then to show their relationship to each other. An example of organization is the description of a historical period in which the cause-and-effect relationship between separate events is revealed. In any research, the separation of its constituent parts (hypothesis, method, data and conclusion) can be proposed as an assignment.

c) *Attribution* - is the identification of the author's point of view, i.e. the process of deconstruction. In contrast to understanding, attribution emphasizes the author's motives as well as understanding what the author meant. To test student’s knowledge, students can either be asked to answer the question with a list of possible options that explain the author's intentions, or they can be asked to list "agree"/"disagree" response options with opinions about the author's intentions.

Evaluating

Evaluating - a judgment based on criteria or standards. In this case, criteria such as quality, efficiency, effectiveness and sustainability can be used. These can be qualitative or quantitative standards. Standards are also applied to criteria (to determine whether this or that process is of

sufficient quality). Evaluation is divided into testing (according to the degree of regularity and consistency) and criticism (according to external rules or expectations).

Verification - serves to detect internal inconsistencies or errors in any process or product. Verification takes place when determining the extent to which the result differs from the initial conditions, whether the given hypothesis has been verified, whether the material presented has contradictory parts.

To determine the effectiveness of the plan, planning (from the category "creation"), applying (from the category "applying") and verification need to be applied together.

Criticism - is an evaluation against external criteria or standards, taking into account both positive and negative aspects of the topic under study. Examples of criticism can be tasks that involve assessing the effectiveness of solutions to any problem.

Creating

It is the combination of elements in order to create a new product, structure. This process can be divided into three stages:

- Creation of the problem for the student's understanding and find possible solutions;
- Decision planning during the preparation of the study plan;
- Implementation of the decision that the student has successfully completed the plan.

Generation – to put forward working hypotheses for problem solving. You can use methods such as the task of predicting possible outcomes or the task of finding possible solutions to a problem to assess students' abilities.

Planning – the development of a method to solve a specific problem. An assignment involving the development of a research plan can be proposed to assess student knowledge.

Preparation – i.e. the preparation of a final product that meets certain criteria. *Example of a task*: preparing a project. When performing a practical task, all the listed cognitive processes do not take place in isolation from each other, but in interaction. Therefore, if it is necessary to write an essay, the student must first memorize the information available to him/her, then plan, write the essay and critically evaluate its content.

5. Application of Bloom's Taxonomy in Evaluation

In order to formulate appropriate questions and tasks to refer to Bloom's taxonomy in the evaluation process, table 4 can be consulted.

Table 4. Examples of questions and tasks according to the levels of Bloom's taxonomy

Taxonomy level	Questions	Task type
Remember	- What is the meaning of "....."? - Who or what was "....."? - Explain why the event "....." took place? - Is the statement "....." true or false?	- Discuss your definition - List all the things mentioned in the text - Make a suitable simile for "..." - Prepare a chart showing the most important facts
Understand	- Can you give an example of what you mean...? - Who do you think...? - How would you put it in your own words? - Who was the main character in "....."?	- Prepare a chart of similarities and differences - Tell the story in your own words - Explain what the main idea is - Write a short final report.
Apply	- What do you think the end result will be? - What additional information can you collect about "....."? - What is the relationship between "....." and "....."? - What do you think will be the effect if "...."?	- Make a list of the necessary steps to reach the final result - Explore different methods that might be suitable - Discuss the topic as a group - Discuss next steps with a group of friends
Analyze	- What other possible outcomes do you see? - What is the likelihood of problems? - How do you compare your experiences with what is presented? - How does "....." relate to your daily life?	- Draw a graph showing the selected data. - Draw a diagram showing the source of the problem. - Explain in the form of a report how this or that event is related to the topic we are working on - Discuss with your groupmate how "....." relates to your experience
Evaluate	- Do you think the appearance of "....." is good or bad? - Is there a more appropriate solution? - How can you defend your position? - How effective was the appearance of "....."?	- Prepare a proposal to express your idea - Prepare a guide to the five rules you think are important - Write down your attitude towards the activity - Name and plan the marketing campaign
Create	- How can you extend your results? - What other problems need to be solved? - How can you give an example of what you want to say? - How do you distinguish "...." from "....."?	- Prepare a guide to the five rules you think are important - Draft the changes you might propose - Relate what you have learned to what you have studied in other subjects - Make a block diagram

Source: Preville (2018).

Bloom's taxonomy makes it possible to associate question types according to learning levels (Table 5). For this, it is sufficient to follow the steps below in order.

1. Define the learning/training outcome;
2. Identify the active verb (specific types of verbs);
3. Identify the appropriate level of Bloom's taxonomy;
4. Formulate an appropriate assessment method.

Table 5. The relationship between Bloom's learning levels and question types.

Learning/training outcome	*Verb*	*Taxonomy level*	*Assessment method*
Lists the factors that create an advertising strategy	Listing	Remember	Open question
Analyzes the marketing factors affecting a specific tourist product	Analyzing	Analyze	Discussion
Prepares the development plan of the touristic destination	Preparing	Create	Essay

Source: Preville (2018).

Table 6 can be referred to select the appropriate evaluation method for any level of the taxonomy.

Table 6. Adaptation of evaluation methods to Bloom's taxonomy level

	Remembering	*Understanding*	*Applying*	*Analyzing*	*Evaluating*	*Creating*
Test questions with more than one correct answer	+	+	+	+/-	-	-
True-false type questions	+	+	-	-	-	-
Coordination	+	+	-	-	-	-
Short answer/worded answer	+	+	+	+/-	-	-
Essay, discussion	-	-	+/-	+	+	+
Oral assessment	-	-	+/-	+	+	+
Commenting	+/-	+/-	-	-	-	+
Preparation of the project proposal	-	-	+	+/-	-	+
Conducting research	-	-	-	+	+	+

Symbols					
+	Apropriate	-	Not apropriate	+/-	Partially appropriate

Source:: Preville (2018).

Appendix 1 presents a list of verbs that can be used for the stages of the cognitive process. When classifying each question, it is necessary to determine the type of the most complex cognitive process that will be used in solving it. That is, when solving the question, first the necessary definition is memorızed and then it is analyzed. This type of question belongs to the highest category or level of analysis.

It should be noted that every subject in the higher education process may not cover all stages of Bloom's taxonomy. It depends on the degree of importance of the subject for the specialty. On the other hand, profiled subjects for specialization should cover all six levels of Bloom's taxonomy as much as possible.

Appendix 1. Verbs on the stages of the cognitive process

Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
repeating		changing	examining	releasing	mixing
matchıng	categorizing	editing	separating	appraising	blogging
memorizing	annotating	sketching	breaking down	ranking	modifying
bullet poıntıng	associating	integrating	dividing	editorıalızıng	making
telling	converting	demonstrating	categorizing	justifying	directing
copying	paraphrising	preparing	prioritizing	grading	composing
defining	identifying	calculating	classifying	considering	devising
highlighting	relating	solving	linking	weighting	simulating
reciting	justifying	constructing	discriminating	persuading	managing
tabulating	distinguishing	using	illustrating	reframing	inventing
recording	extending	runnıng	calculating	predicting	developıng
retelling	indicating	transferring	appraising	interpreting	role playing
quoting	estimating	interviewing	concluding	valuing	formulating
listing	solving	assessing	deducing	defending	buıldıng
recognizing	journalling	determining	determining	detecting	orating
finding	expressing	reenacting	comparing	arguıng	planning
repeating	explaining	displaying	rating	deciding	devising
networkıng	reporting	choosing	inferring	selecting	negotiating
visualizing	discussing	charting	ordering	detecting	programming
describing	inferring	explaining	questioning	commenting	producing
numbering	selecting	completing	experimenting	critiquing	groupıng
recalling	summarizing	discovering	surveyıng	validating	constructing
labelling	commenting	experimenting	deconstructıng	scoring	assembling
locating	repeating	examining	contrasting	recommending	adapting
	interpreting	uploading	criticizing	editorıalızıng	authorıng
	subscribing	scheduling	classifying	concludıng	originating
	classifying	administering	outlining	revising	facilitating
	describing	applying	testing		reconstructing
	generalizing				rewriting
	tagging				