Modern Teaching Methods Adapted to University Education

Mihaela Andrei
Faculty of Automation, Computers Sciences, Electrical and Electronics Engineering, "Dunarea de Jos" University of Galati, Romania, https://orcid.org/0000-0001-7149-8756

Alina Pricopie-Filip
Faculty of Automation, Computers Sciences, Electrical and Electronics Engineering, "Dunarea de Jos" University of Galati, Romania, https://orcid.org/0000-0002-1985-3439

Veronica Filimon
Cross Border Faculty, "Dunarea de Jos" University of Galati, Romania,
https://orcid.org/0000-0001-8235-4918

Abstract: The didactic strategy is given by the set of methods and techniques by which the cooperation between the teacher and students, between students and teacher, between students and students is achieved to obtain the anticipated results. For a positive result of the didactic approach, there must be a good didactic strategy capable of leading to the achievement of the proposed objectives and competencies. Didactic methods and procedures take the main place because they contribute to stimulating the student's thinking and feelings and lead him to develop learning techniques capable of increasing his chances of success in the profession for which he is preparing. In the didactic process, a multitude of methods are used, either traditional or modern. The multitude of methods forces the selection of the appropriate ones for the types of lessons, the proposed objectives and competences, the established learning methods. The category of traditional methods cannot be abandoned, nor can only modern methods be used. Each of these has their role in the learning paradigm that cannot be ignored but, on the contrary, considered. Following the pandemic, communication and teamwork problems appeared in student lives. In the present work, some modern methods adapted to university education are presented.

Keywords: Teaching Methods, Modern Methods, Thinking Hats Method, Higher Education.

Citation: Andrei, M., Pricopie-Filip, A., & Filimon, V. (2022). Modern Teaching Methods Adapted to University Education. In A. Ben Attou, M. L. Ciddi, & M. Unal (Eds.), *Proceedings of ICSES 2022--International Conference on Studies in Education and Social Sciences* (pp.635-658), Antalya, Türkiye. ISTES Organization.

Introduction

We live in a society characterized by several special coordinates: digitalization of every segment and component of socio-professional life; globalization of all sectors of activity; knowledge condensed into principles, skills and

competences; the interdisciplinary approach to any theme of general interest; enhancing the possibilities of adaptation and socio-professional mobility; the complex development of the modern human personality through the higher level of general culture and specialized/professional culture. These are some benchmarks in a constantly changing world.

Technology knows a continuous progress and, therefore, scientific research in the field has an accentuated dynamic, in a short time new components, new performances, new standards of technological achievements appear. As a result, the novelty requires the improvement of the teaching system and application methods, as well as the students' acquisition of individual learning methods to face the challenges in the post-training period, in adult life. The changes appear in all activities every time, so we must be flexible and adaptive. To achieve this objective for young people especial, the teacher has an important role in students' life. He must develop them some skills necessary to face the challenges that appear in their personal and professional life (D'Angelo, 2022). Thus, in addition to scientific information, a student must also acquire the ability to integrate his knowledge in the context (Jumari et al, 2022), to solve the existing problems with analytical and critically thinking (Sachou, 2013). Among the skills that must be developed in education system we mention: communication, critical thinking, time-management (Rata et al., 2022), problem-solving (DeDecker et al., 2022), logic & reasoning, analytical & evaluative (Student infographics, 2016), creativity (Matina, 2022), collaboration, and of course technical skills for future engineering (Akdim, 2022). Some of these are summarized in Figure 1, with a short definition. Four of them: critical thinking, creativity, collaborative and communicative forms a model named 4C 21st century skills (Hasanah et al., 2023).

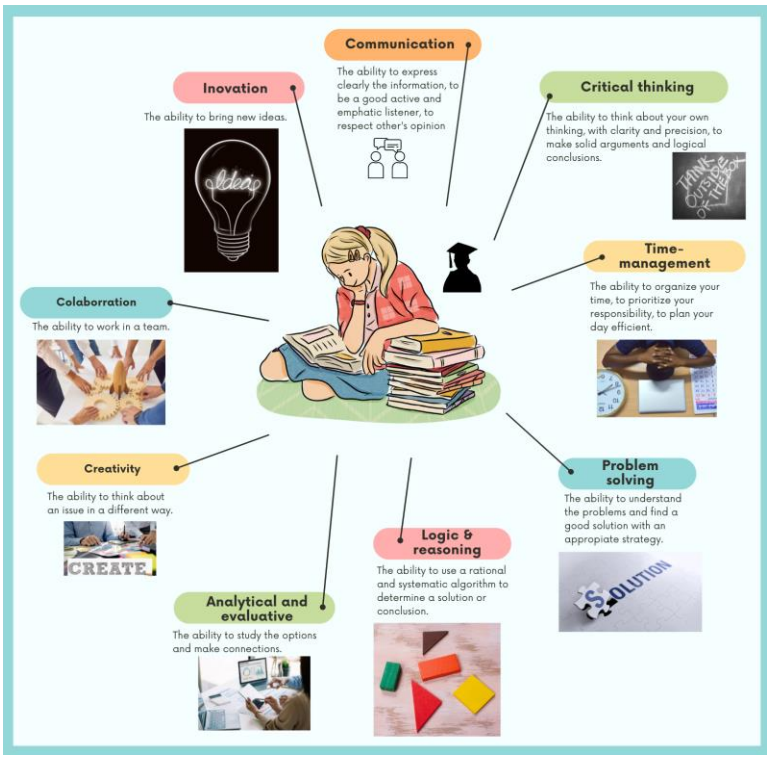

Figure 1. Students' Skills

Some of these skills are developed in family, some in the friends' group, but the most important part in school. It is well known that education is also outside the classroom. In this paper the higher education is in discussion, so we will refer to students, more exactly the electronics engineering students. As we said before, to build an adaptive a flexible young, the teachers play an important role and they must help the students in improving and developing the mentioned skills. This is realized by using in the didactic process, in addition to traditional methods, some innovative ones. In this way, the education quality is enhanced (Nicolaide, 2012), and the future engineer has all the assets to be good professional (Jumari et al., 2022).

This paper presents a teaching methods classification and some new modern teaching methods adapted to higher education, used on electronics engineering students in a technical faculty from Romania. These students need a refresh especially after the pandemic period, even if some teachers tried to motivate and engaged their students in many activities in online learning (Alasmari, 2022, Mishra et al., 2022). They forgot to collaborate, to work in team, to communicate with their colleagues or with their teachers, in general they forgot to live (Hasanah et al., 2023). So, it is mandatory to bring something new and interactive in didactic process. The presented methods are oriented on teamworking, and to have a comparation between modern and traditional approach, some classical methods are mentioned. In the last section, a vision of the technical engineering students on the methods used is presented.

Traditional versus Modern Education

In the educational process, the two co-participants in the didactic act are like two components of an electric circuit: the power source (battery, generator etc.) which is the teacher and the consumers (light bulbs...) which are the students. But they do not have a relationship if there are not the connecting threads, in accordance with specific goals and conditions, which together with the other two elements previously enumerated, compose an operative system capable of placing the learning situations in a logical and natural order as we represented in Figure 2.

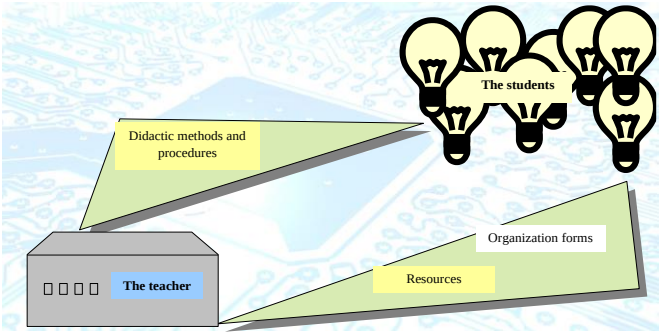

Figure 2. Didactic Approach

The information and skills transfer from teacher to student is evident in the didactic process. This is also made in the opposite direction, from the student to the teacher. Only in this way do we have respectful relationships, as

well as the types of intelligent, capable, active, generous people. The method chosen by the teacher to achieve the educational objectives is called didactic strategy. In detail, the didactic strategy is given by the set of methods and means by which the cooperation between the teacher and students, between students and teacher, between students and students. It is a different technique from teacher to teacher and becomes mastery or even educational art when it is perfectly constructed.

There are some clearly differences between generation (Bernad-Cavero & Llevot-Calvet, 2018), so the new one needs a new perspective and a new methodology to have good results. In Table 1 are summarized some characteristics for each generation. This table was reproduced from (Bernad-Cavero & Llevot-Calvet, 2018). Starting from these points of reference, traditional teaching must be changed and adapted to the new generation. In conclusion, it is time for innovation. There are 3 types of "new": a new method, a modernized one and a modified one. So, the education methodology has 3 aspects: traditional, modern and innovative.

Table 1. Differences between Generations

Twentieth century generation	New generation
Books (reading)	Display (visual perception)
Small steps, gradual movement	Nonlinearity
Single tasking	Multitasking
Linear approach	Hyper media
Independence	Connection
Passive school	Active school, school as game
Reality	Fantasies
External technology	Internal technology
Fact awareness	Know how to find something necessary

In traditional education the transfer is made in one way: from teacher to student. The process is teacher-centered, the transmitted information is subject-specific and more theoretical. The students take notes and finally the have a competitive exam, with some reproductive knowledge (Yuchtman, 2017). Modern education is student-centered, the transfer is made in both ways, the classes are interactive, the practice is also included and, the most important, the skills presented in Figure 1 are developed (Del Campo et al., 2012). The advantage of this system is that not only the students benefit from these modern and innovative methods, but also teachers, because they must develop some skills and be open-minded to practice this type of education (Samuel and Rahman, 2018).

The multitude of methods forces the selection of the appropriate ones for the types of lessons, the proposed objectives and competences, the established learning methods. The category of traditional methods cannot be abandoned, nor can only modern methods be used. Everyone has their role in the learning paradigm that cannot be ignored but, on the contrary, considered. There is an interdependence between them that makes their ensemble a mechanism built from many cogwheels, like in Figure 3. One trains the others, and the mechanism works. A defective or absent one lead to the termination of the activity or to its poor functioning. Using this mechanism,

the education become active, and it implies more the students in the didactic process. In addition to their technical knowledge, they also develop the metacognitive knowledge (Močinić, 2012).

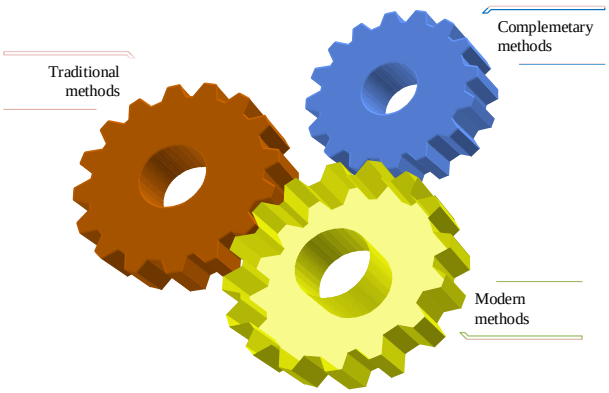

Figure 3. The Mechanism of Didactic Methodology

This active strategy involves the interdisciplinarity too because it is very helpfully in engineer training. "The strongest argument for interdisciplinarity it is the very fact that life is not divided into disciplines" (J. Moffett). The content of the above motto, "life is not divided by disciplines", is the most solid argument for the imposition of the term interdisciplinarity in education. It tries to achieve cooperation between disciplines and a special treatment to form personalities with clear and unified images of the environment in which they live.

The objectives of interdisciplinarity are cognitive, notional, and social in nature. Through this approach, certain correlations are made between notions studied in different disciplines, but which have certain points in common. Also, a fixation and a systematization of the knowledge acquired in different situations is carried out. There is a development of thinking and especially of its enrichment with a new attribute - flexibility. The ability to freely communicate the acquired knowledge as well as the created correlations is cultivated. And last but not least, it is a way of learning teamwork and applying the acquired knowledge in practice. The cooperation and interpenetration of disciplines at certain levels gave rise to certain terms within the concept:

- *monodisciplinarity* - it is, in fact, the traditional form of organization and independent teaching of contents for each individual discipline.
- *pluridisciplinarity* - is a way of approaching a phenomenon, body or process in its entirety;
- *multidisciplinarity* – is an overlap of those elements from different disciplines that can cooperate only to highlight the common points;
- *transdisciplinarity* - is a way of interpenetration of those disciplines that, over time, can reach the situation of constituting a new discipline;
- *interdisciplinarity* – consists in the fact that the study material from one discipline transfers to another discipline, in addition to information, and methods of teaching and observing reality.

It can be noted that a single science cannot encompass all the problems, to give a unified picture of all the phenomena and processes of the surrounding world. At the interdisciplinary level, horizontal transfers of

knowledge provided in programs, courses, or evaluation tests, of didactic methods and procedures are configured, contributing to the realization of concepts with truth value. Interdisciplinarity can also be seen in non-formal activities. This form of learning has some advantages:

- ensures sustainable learning because it depicts the surrounding world in its entirety;
- enters the training on the student supporting the motivation and interest in learning concepts from several points of view;
- forms the habit of learning using the interactions and correlations between the subjects studied;
- creates certain mental structures and certain behaviors capable of transfer and adaptation;
- opens the way to achieving a higher level of knowledge;
- provides clarifications and opportunities to correlate the disciplines languages entered into cooperation.

Teaching Methods Classification

The educational process is essentially a set of instructional actions. These involve both the teacher and the student in a relationship whose ultimate goal is the young training. But the relationship is complete in the present case, if the teacher manages to engage the student in an effort of learning and thinking, in an act of effective living and manifestation. It is not enough for the teacher to simply transmit some information. The student must be involved in a more or less directed learning situation, so that he can discover certain aspects and relate them to practical elements. This is done with the help of teaching methods.

A multitude of methods are used in didactic process. Their large number as well as their varied use have imposed all kinds of classifications, according to certain criteria. Most classifications are made according to the criteria that consider their use over time, the degree of generality, the fundamental functions, the methods of intervention on the intellect, the degree of training of the learners, the mode of communication, the didactic purpose, the registers in which they act, etc. In Table 2 is a near-complete picture of this classification, depending on the source that generates school-type learning.

Table 2. Teaching Methods Classification

The criterion	Method type	Examples
Historical	a) Traditional methods	- exposition, conversation, exercise, story, description, lecture, conference etc.
	b) Modern methods	- algorithmizing, problematization, brainstorming, clusters, programmed learning, thinking hats etc.
The generality degree	a) General methods	- exposition, conversation, lecture, master class etc.
	b) Specific methods	- moral exercise etc.

The criterion	Method type	Examples
The education process bilaterality	a) Teaching methods	- exposition, conversation, description, demonstration, explanation, I know-I want to know-what I learned etc.
	b) Learning methods	- exercise, role-playing games, learning on simulators etc.
The fundamental function	a) Transmission and assimilation of new knowledge methods	- exposition, conversation, exercise, story, description, lecture, conference etc.
	b) Training skills and abilities methods	- exercise, algorithmizing etc.
	c) Consolidation methods	- exercise, practical test, portfolio etc.
	d) Evaluation and self-evaluation methods	- oral, written, and practical tests - systematic observation, investigation, project, portfolio, self-evaluation etc.
	e) Application methods	- practical test, portfolio, modeling method etc.
The way of work organizing	a) Individual work methods	- programmed training, activity method based on cards, algorithmizing, project etc.
	b) Teaching-learning in groups methods	- cooperative learning, role play, dramatization, project etc.
	c) Frontal methods	- the conversation, the modeling method etc.
	d) Teamwork methods	- didactic game, practical activities etc.
	e) Combined methods	- practical activities etc.
The mental activity determination method	a) Algorithmic methods	- algorithmizing etc.
	b) Heuristic methods	- conversation etc.
The learner's participation degree	a) Active methods	- brainstorming, laboratory work, exercise, problem solving, modeling, debate, didactic game, computer-assisted training etc.
	b) Passive methods	- storytelling, description, explanation, lecture, learning with audio-video means etc.

The opposition between mechanical and conscious learning	a) Methods based on reception	- explanation etc.
	b) Methods that mainly belong to directed discovery	- problematization, demonstration, case study etc.
	c) actual discovery methods	- practical test, experiment, modeling method etc.
The education fields	a) methods for the formation and development of intellectual education	- exposition, conversation, exercise, story, description, lecture, conference etc.
	b) specific methods of physical education	- explanation, demonstration, game etc.
	c) methods specific to moral-civic education	- case study, modeling, brainstorming, thinking hats, problematization etc.
	d) methods specific to ecological education	- description, case study, explanation, Venn diagram, cube etc.
	e) methods specific to aesthetic education	- analysis, conversation, comparison, case study, demonstration etc.
	f) methods specific to laboratory applications	- description, explanation, demonstration, practical test, thinking hats, I know - I want to know - what I learned etc.
Oral communication	a) Expository methods	- the lecture, description, conference, exposition, exposition with an opponent, information, instruction, micro-symposium, radio instruction, theoretical demonstration etc.
	b) Interrogative methods	- heuristic conversation, interview, debate, group consultation, seminar, colloquium, brainstorming etc.
	c) problematization method	- problematization etc.
Written communication	a) Explanatory reading	- working with the text, slow reading, problematic reading etc.
	b) Independent reading	- working with the text or the document, slow reading, fast reading, critical reading, selective reading, synthetic reading etc.

Communication based on internal language	Personal reflection	- the essay etc.
Oral - visual communication (image, sound, word)	Instruction through films	- training with the help of TV shows or video films
Reality exploration	a) Direct exploration methods	- systematic observation, experiment, case study, learning by discovery etc.
	b) methods of indirect exploration	- demonstration, modeling etc.
Didactic purpose	a) Methods of teaching new material	- lecture, lecture-debate, master class, explanation, demonstration etc.
	b) Methods of fixing knowledge	- conversation, exercise, discussion, debate, Phillips 66 etc.
	c) Methods of training skills and abilities	- exercise, algorithmizing etc.
	d) Verification and evaluation methods	- the investigation, the project, the portfolio, the written tests, the tests, the control/verification list etc.
	e) Methods of developing critical thinking	- evocation, realizing the meaning, reflection, closing, expansion, thinking map, brainstorming, the retrieval procedure, the double log, the LOTUS technique, conversation, thinking hats, Venn diagrams, horoscope method, the 5-minute essay, the evaluation sheets, interviews, independent investigations, data collection
	f) Collaborative learning methods	– ice breaking techniques – methods for solving problems and debating - Bingo, Badge, Graffiti, Special Collector, Treasure Hunt - Mosaic, Phillips 66 Meeting, graphic method
	g) Exercises for solving problems and discussions	- More heads together, group discussion, group consensus

The register in which it operates	a) Methods for the symbolic register	- logical-mathematical modeling, algorithmizing, exercise, computer-assisted training etc.
	b) Methods for the figural register	- description, observation, demonstration
	c) Methods for the action register	- experiment, reading, documentation, design, investigation, report etc.
Action (operational, instrumental, practical)	a) Methods based on real, authentic, effective action	- the exercise, the case study, the project, the research-action theme, the practical works etc.
	b) Methods based on fictitious action, simulation	- role-playing games, dramatization, learning through simulation and simulators etc.
Rationalization	Operationalization methods	- activity with cards, algorithmizing, programmed training, computer-assisted training etc.

Modern Methods used in Technical Higher Education

The didactic action begins with its end. Thus, the teacher first plans what he is going to teach, as well as the results he intends to achieve for those he instructs. Therefore, establishing the transformations of his students, he elaborates a work methodology. Practically, the action finality occupies an important role in defining the teaching method. The method becomes a tool for organizing learning conditions. With its help, a connection is created between students and teacher, but also between students and students. There is also a compatibility between the teacher's personality and the chosen method, because each teacher attaches himself to some methods and neglects others or adapts his methods to the class he teaches and depending on the situation.

Also, the methods are suitable for some disciplines and not for others. (Mohiuddin et al., 2020) made a study of the most used teaching methods in four higher educational domains: Art and Humanities (AH), Medical Education (ME), Science and Engineering (SE) and Social Science (SS). This research presents a list of significant methods used in every aforementioned domain and can be adapted to diverse situation, are not used exclusively for a specific discipline: brainstorming, Business/computer/game simulations, Cooperative learning group, Demonstration, Discussion sessions, E-learning, Flipped classroom, Group discussion, Industrial training, problem-solving, role playing etc.

In this section are presented some new modern and innovative teaching methods adapted to technical higher education and applied with electronic engineering students. These are used to improve the students' skills

presented in Figure 1, especially those who develop communication, collaboration, creativity, and teamwork. For some methods is given an application example from *Computer architecture* laboratory.

A. Problem solving

In many cases the accent was on methods that implies teamwork, using for example cooperative problem-based learning (Woods, 2014), because these are playing an important role in metacognitive skills, like problem-solving skills (Jumari et al, 2022). The base method is named problem-solving or training through problems. This is used more and more in practice due to the multiple instructive-educational values it has. It consists in the production of problem-situations which, in order to solve them, involve the students in a process of thinking and investigation through the states it causes: amazement, curiosity, probing, research, developing hypotheses, finding of solutions. The concept of situation-problem is embodied from the state of contradiction, conflict, disagreement between two realities of knowledge: the knowledge and experiences previously acquired and the constituents of the new, the unknown being difficult to penetrate or remaining an enigma for a long time.

Creating problem situations is the first and most important thing. It must contain an intellectual weight (the student not knowing how to explain the process, the phenomenon), a conflicting state (two aspects incompatible with each other) and a disagreement (a paradox between previously acquired knowledge and new knowledge). Then, it is necessary to ask the student to solve the problem situation as follows:

- to identify the problem situation;
- to solve the problem situation;
- to propose new problem situations.

Finally, the method proves useful if it comes to the application of the knowledge thus acquired. This method has the following advantages:

- exploits the students' cognitive resources in a superior way;
- amplifies divergent thinking, demands a higher level of creative abilities;
- supports logical learning and the motivation for such learning.

Due to its formative values as well as interferences with other methods (conversation, explanation, demonstration, case study, exposition, experiment, debate), the problem-solving can be applied in the teaching of all educational subjects, in all stages of the didactic process and at the level of all cycle's schools.

B. Thinking hats method

Another method for collaboration and teamwork, with many benefits in all content areas and also in adult life, is Six Hats Thinking Strategy (Mahoney et al., 2022). It is called in this was because the students interpret certain roles, depending on the color of the chosen hat. They will say what they think about the topic under discussion, the nuances being imposed by the color of the hat. The original method was proposed by de Bono (deBono, 1999). Even there are 20 years from then, the method can be reinterpreted and adapted in many forms and it can be considered a modern one. The functions for the six hats are:

- The white hat, neutral and direct, does nothing but inform. The student wearing it is neutral; he is

focused on the facts from the lesson, on the visualized images that he must relate without any interpretation, without any opinion.

- The red hat, having and offering an emotional perspective on the content of the lesson, says what he feels about everything that happened from an emotional, sentimental point of view. The student who wears it must generate emotional states among all the participants in the lesson, motivation to support learning.
- The black hat, with a certain caution, points out mistakes, what is bad, what risks, what dangers are on the horizon. He only highlights them and does not appreciate or argue them.
- The yellow hat, the one that shines the didactic act, giving it a valuable and optimistic perspective, expresses the hope that the benefits of instruction are values for students. The wearer tries to secure suggestions, proposals, thought patterns on a logical foundation.
- The green hat, the emblem of creative thinking, suggests new ideas, variants of solving tasks or possible alternatives.
- The blue hat has a multiple role: defining the problem, directing the questions, gathering information, formulating the main ideas, building the thinking process and respecting the rules.

This method allows the hats to be taken over, one by one, by other students. In this way, the most wonderful thing happens: people change their perspective of thinking, feelings, attitudes from a certain moment in time and then embrace, at another time, other points of view expressed by other people wearing other hats. Among the advantages of this method can be mentioned:

- stimulation of thinking;
- encouraging the ability to encourage;
- the development of intelligence;
- formation of decision-making capacity;
- contributes to the formation of the socialization capacities of the participants, of tolerance and respect for each opinion issued in the collective. The important thing is that an exploration of reality based on cooperation is reached, even if apparently a contradictory participation is observed.

We propose the application of this method to *Computer Architecture* laboratory in the following form. The main objective was to energize (and involve all students in the activity) the practical activities, at the ROM Memory theme, for the presentation of the constructive types of ROM memories. Thus, the students were divided into 6 groups as follows:

- White hat team – objective – 5 students. They presented the 5 types of ROM memories: MROM, PROM, EPROM, EEPROM, FLASH ROM, as they were described without any additional information and opinions. The students took into account the production technology (with transistors, fuses, etc.), the way of writing, erasing, etc., but without bringing personal additions, opinions about them, giving us only the objective information from theory.
- The red hat team - personal opinion - 1 student, who, based on the information received from the white team, expressed his own opinion about the presented memos, choosing one of them as the most

advantageous (only from his point of view! !).

- Yellow hat team – optimistic – 2 students. The 2 people made available to their colleagues the advantages of the studied memoirs.
- Black hat team – pessimistic – 2 students. This team was responsible for presenting the disadvantages for each type of memory.
- Green hat team – inventive – 2 students. The green team had the task of finding a solution to combine the types of memos stated, taking into account the advantages and disadvantages mentioned by the other colleagues, so as to obtain an advantageous variant both from a financial and qualitative point of view.
- Blue hat team - coordinator - 2 students. The blue hat was responsible for choosing the best memory option, which memory was then used for the practical measurements.

C. Brainstorming

This method is also called storm in the brain because the term brainstorming is based on two English words: brain which means brain and storm which means storm. It is a method applicable to group activity, thus becoming a group activity technique (Kalyani & Rajasekaran, 2018). The moments of the method are as follows (Miron, 2008):

- first of all, the subject of the topic to be studied is established;
- the task to be solved, in fact, of a problem-situation is presented;
- students are divided into several groups;
- then the students are asked to produce as many ideas as possible based on the principle quantity generates quality, without any irony regarding the idea of any colleague; ideas are written on the board;
- time is required for clarifying ideas; its duration is established by mutual agreement;
- at the time of resumption, the ideas are reread, analyzed and grouped according to certain criteria;
- the ideas expressed are evaluated;
- each group chooses the ideas that can solve the problem under discussion and displays them;
- the final solution for the proposed problem is concluded.

The brainstorming method is used because it has a high degree of training students in their own training, determines the ability to search and express ideas, stimulates creativity and the desire to work in a team. Choosing a subject favorable to the application of this method, organizing students for the activity, creating motivation for issuing as many ideas as possible and removing inhibiting situations, as well as fixing the moment and methods of evaluating the solutions found are attributes of the teacher's work.

D. JIGSAW method (Mosaic)

It is the method used by team learning and especially by experts because each student receives a specific load, a specific task, a field in which they must become an expert (Mohiuddin et al., 2020). For understanding, here are the stages found in the application of this method (Miron, 2008):

1 Preparation of the study material: the topic to be learned is chosen, it is divided into 4 or 5 sub-topics

and for each sub-topic a helping material is elaborated in the form of affirmative statements, in the form of questions or in the form of lacunar text;

2 Organization of the student body and expert groups: the group of students is organized into learning teams of 4-5 people and each student in the team receives a number and has the mission to learn the sub-theme that corresponds to his number by himself, for this those with the same number gather at the same mass and becoming experts in the learned problem; here, the students present an individual report on what they have learned independently, the misunderstandings are clarified and the manner in which they will transmit the accumulated knowledge to the other members of the initial team is established. After that, the experts return to the original teams and convey the information or demonstrate the ideas with the help of the word or denominator teaching aids (computer, diagrams, drawings, photos, etc.). Teammates are encouraged to ask questions, discuss, and implement the plan of ideas.

3 Evaluation: after the students have made sure that they have learned what was transmitted, they are convinced that they can demonstrate the solidity of the training. The teacher uses various forms of evaluation: oral (in the form of questions) or written (report, essay, or evaluation sheet). By using this method, students gain cognitively, affectively, and socially, training skills of cooperation, expression, listening, creative thinking, problem solving, etc.

The above presented methods are considered modern and innovative for teamworking. Because we want to see the students' opinions about the modern and traditional methods, bellow we make a short description of the classical methods used and evaluated in the end by them.

E. Conversation

One of the most used traditional teaching methods is conversation. Through the dialogue created between the teacher and the student, thinking is activated so that the acquisition of knowledge, its fixation and systematization, the formation of skills are carried out at the level that allows the achievement of the objectives of the educational process. The conversation can be:

• catechetics (of reproduction of previously acquired knowledge) – is used when updating anchor ideas or when providing feedback;

• heuristics (for acquiring new knowledge) – it is used to discover statements, solutions, examples or to make demonstrations through which the students are led to arrive at the formulation of the ideas that the teacher could have presented on their own (Miron, 2008).

According to the didactic purpose, the conversation is classified as follows:

For the method to be effective, the questions involve compliance with certain requirements (Miron, 2008): be correctly formulated, simple and accessible; be addressed to the whole group; not to suggest the answer; be gradual and varied; to stimulate thinking operations; be followed by a pause to construct the answer. Since it is said that the keystone of the heuristic conversation is illustrated by the question, modern didactics, wanting to update this method, recommends that at certain times questions with a reproductive function predominate, and at

other times, questions with a productive function; the convergent questions that encourage analyses, comparisons, syntheses, associations of ideas, the divergent questions that direct thinking along original trajectories and the finding of new and varied solutions, the evaluation questions that require the issuing of value judgments, as well as those of anticipation, of prediction.

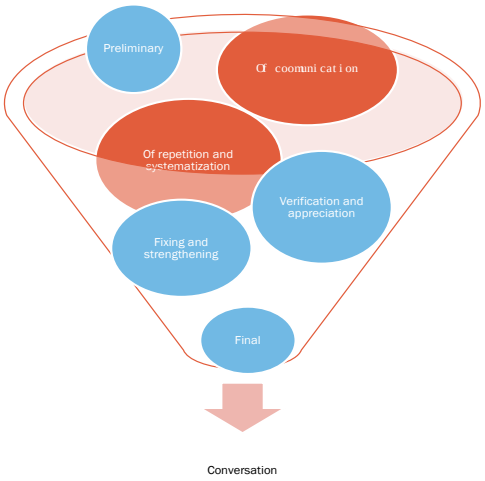

Figure 4. Conversation Classification

F. Description

Through this method, both the teacher and the students present with words the images and characteristic aspects of some objects, schemes, circuits, phenomena etc., in order to reach the generalizations needed in life. Its efficiency increases when it is made on the basis of didactic material appropriate to the subject under discussion and specific graphic representations. The advantages of this method consist in developing the ability to understand, the ability to retain what is described and the formulation of some generalizations. It also presents a disadvantage: it proposes a much too directed and interpreted observation.

G. Explanation

It is a variant of the oral presentation, necessary for both the teacher and the students, which requires a short time and aims to clarify a scientific truth with clear arguments. It only applies to parts of the content that are more difficult to understand. To achieve the purpose for which it is used as quickly as possible, an inductive or deductive approach is used, the one that best corresponds to the understanding of the phenomenon, the principle, some laws specific to the field. This method helps students highlight the basic elements of the studied phenomena, but also the logical links between them to interpret the reality studied correctly, scientifically, develops their thinking operations and facilitates the integration of new acquisitions into their own cognitive system.

H. Learning through discovery

It is one of the methods of exploring reality or its substitutes that is based on the cognitive effort of the students and obliges them to an active and interactive participation in the didactic process. The student acquires the stature

of a "researcher", a situation in which the scientist finds himself, the professional researcher, causing him to acquire knowledge as well as similar behaviors specific to scientific research. Often, discovery is associated with problematization or is an extension of it. When the problem under discussion is studied, the student extracts the data and reorganizes it, then analyzes the connections between them, tries solutions and, through those attempts, he can discover the solution which can be rule, legitimacy, correlation, knowledge, procedure, technique and so on It can also be supplemented by other methods such as observation, experiment, scheme research, etc. And when it refers to a substitute for reality, it is completed with demonstration, modeling, simulation, etc.

İ. Systematic observation

Among the methods of direct exploration of reality is systematic observation. The term is of Latin origin. The word "serv" with the prefix "ob" formed the new word with the meaning "to have before the eyes", "to have an eye on", "to search". In order to reveal the characteristic aspects of an object, a phenomenon, its structure and functioning, as well as the connections with other bodies, phenomena or processes, this method is applied which provides perceptions of the object in attention and, consequently, the information necessary about it.

The student thus gets data about the appearance of the studied objects and is not satisfied with that. He goes further, towards reflection, and operates with certain data of interpretation, because naturally he asks himself questions with reference to certain aspects and tries to give answers to these questions. In the observation process, the student has the observation plan, provided by the teacher, with a rich content: the purpose of the observation, the tasks related to appearance, structure, relationships between components, interactions of the object with the environment, observation strategies, technical means, such as and the way of recording the results. After becoming familiar with it, the actual observation takes place. Following this operation, the student proceeds to process the collected data, develop ideas and formulate conclusions. The student or engineer does not forget to capitalize on the observations made to give them value and liveliness. Systematic observation is also associated with other methods such as investigation, experiment, project, case study, within teaching-learning methods, or is used independently, when it comes to spontaneous observation or in research activity, hence borrowed. Among the advantages, we list: – increases the volume of information; - develops the spirit of observation; - forms the scientific spirit; – increases the sensitivity for an aspect or a field; – produces intellectual feelings; - develops the ability to capitalize on immediate observations.

The Technical Engineering Students View of Modern Teaching Methods

To see the students' vision on traditional vs. modern teaching methods, we applied a short questionnaire with only 3 questions, to a sample of 64 technical engineering students, 23 from the 3rd year of study and 41 from the 2nd. Of these, 39 were male gender and 25 females. The questionnaire included the following items:

1. Which approach do you find more attractive?
    - **a)** Traditional
    - **b)** Modern

2. I like the method the most: a) Problem solving; b) Thinking hats method; c) Brainstorming; d) JIGSAW; e) Conversation; f) Description; g) Explanation; h) Learning through discovery; i) Systematic observation
3. I like modern methods because:
    - **a)** I retain information faster
    - **b)** I know my colleagues better
    - **c)** I learn to collaborate
    - **d)** I communicate more easily
    - **e)** Teaching is more entertaining
    - **f)**We interact more
    - **g)** Teamwork is developed

Frequencies Analysis

The analysis was done in IBM SPSS Statistic. Figures 5, 6 and 7 and tables 3, 4, 5 show the percentages for the answers to each item. It is observed that most students prefer modern methods, the most loved being *Thinking Hats*, and 2 of the methods (*Description* and *Explanation*) do not appear at all in the answers. Regarding the advantages of the new methods, with the highest percentage are *I learn to collaborate,* and *We interact more*.

Table 3. Responses for Item1

Method	Frequency	Percent
Traditional	12	18,8
Modern	52	81,3
Total	64	100,0

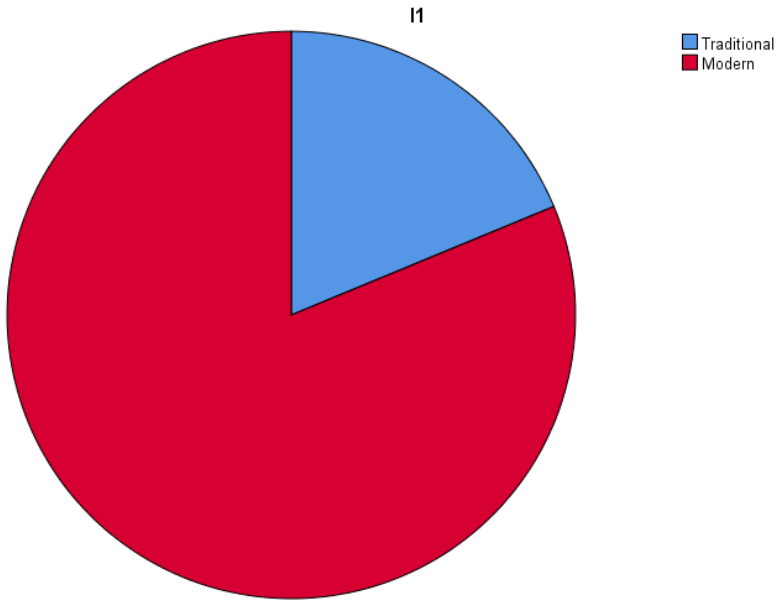

Figure 5. Traditional vs Modern Teaching

Table 4. Responses for Item2

Method	Frequency	Percent
Problem solving	7	10,9
Thinking hats	31	48,4
Brainstorming	9	14,1
JIGSAW	8	12,5
Conversation	1	1,6
Learning through iscovery	3	4,7
Systematic observation	5	7,8
Total	64	100,0

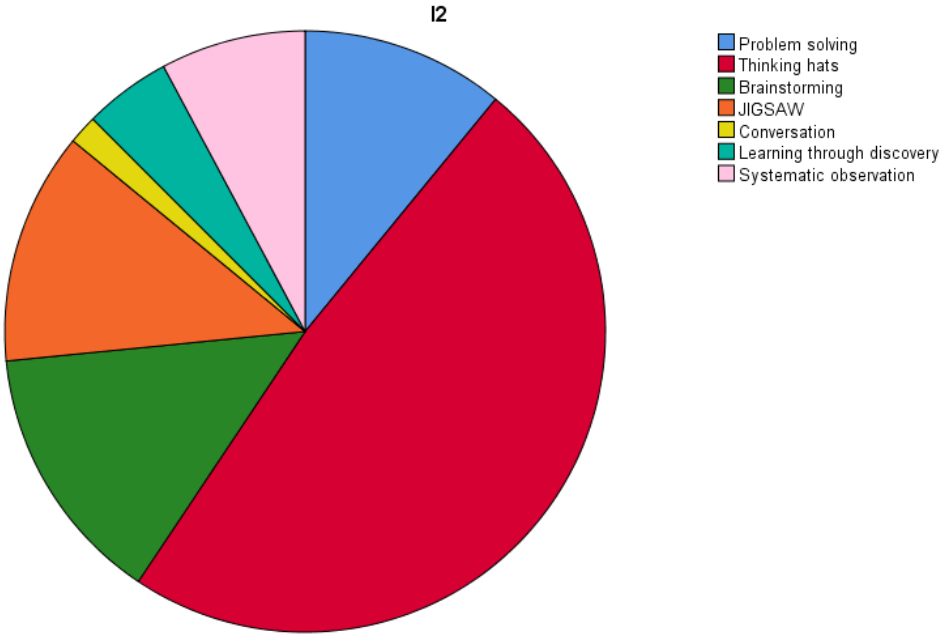

Figure 6. The Prefered Methods

Table 5. Responses for Item 3

Advantage	Frequency	Percent
I retain information faster	7	10,9
I know my colleagues better	8	12,5
I learn to collaborate	13	20,3
I communicate more easily	10	15,6
Teaching is more entertaining	8	12,5
We interact more	13	20,3
Team work is developed	5	7,8
Total	64	100,0

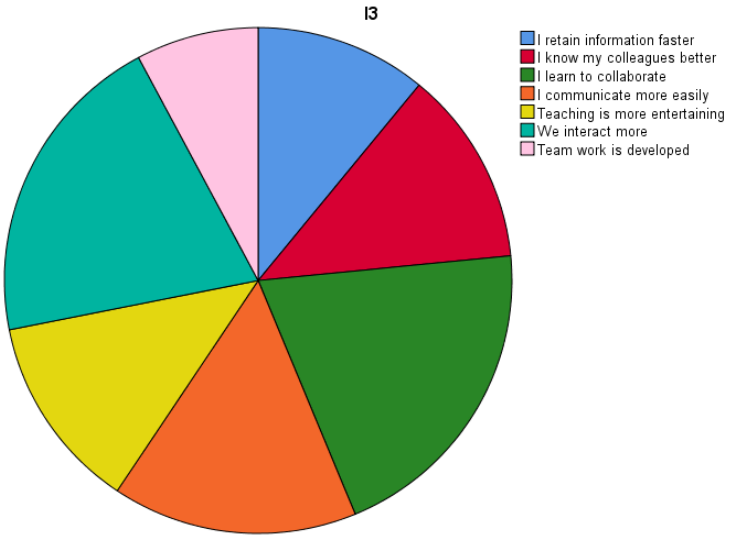

Figure 7. The Advantage of the Modern Methods

Crosstabs Analysis

To see the gender influence on the considered variables we used Crosstabs. The results are showed in the bellow figures and tables. It can be observed that are are the same values for JIGSAW method and there is no difference between male and female opinion about the advantage of the modern methods "I know my colleagues better". The best score was obtained for modern teaching approach for both genders and the preferred method was Thinking Hats. The male students choose "Interact more", for item 3, and the females "I learn to collaborate". For those 3 items we used ANOVA and the results showed that there is a significant difference for the teaching approach. The results are presented in Table 9. Mean is noted with M and standard deviation with SD. $p < 0.05$ in Item 1 case so, there is a significant difference between male and female opinion about traditional vs modern teaching methods.

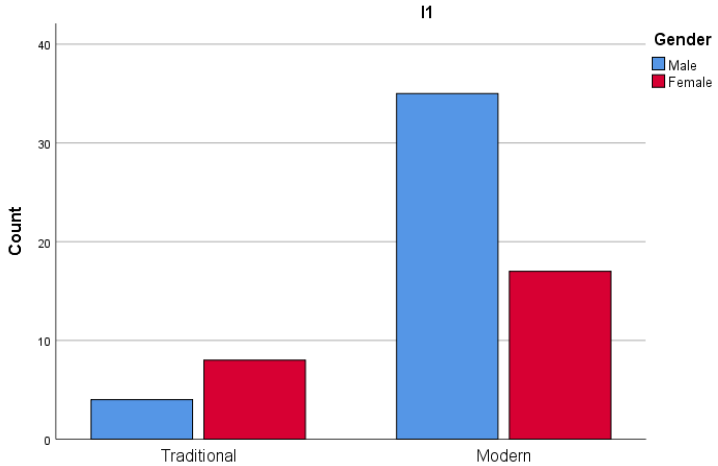

Figure 8. Gender Influnce on Teaching Approach

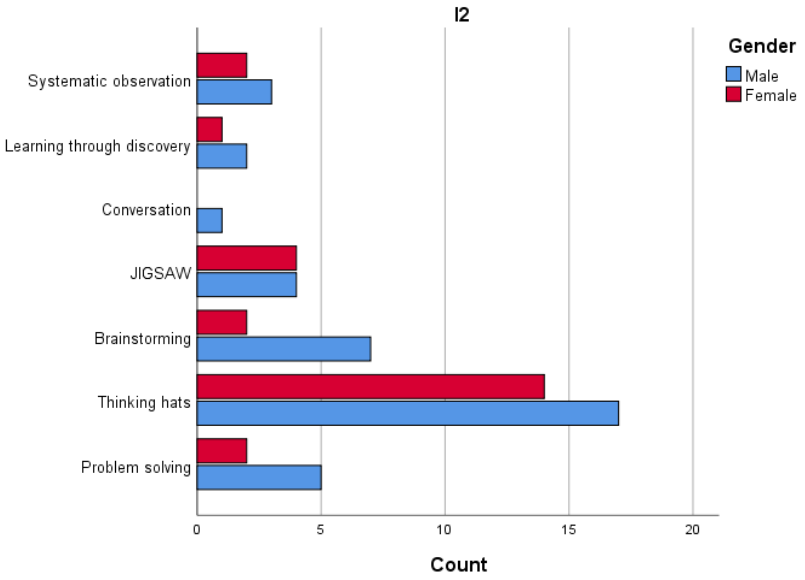

Figure 9. Gender Influnce on Prefered Method

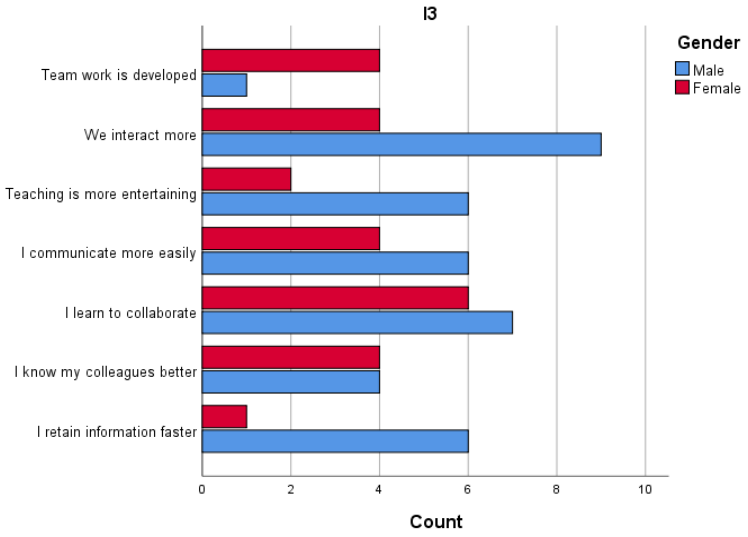

Figure 10. Gender Influnce on Advantages on Modern Methods

Table 6. I1*Gender Crosstabulation

			Gender		
			Male	Female	Total
I1	Traditional	Count	4	8	12
		% within Gender	10,3%	32,0%	18,8%
	Modern	Count	35	17	52
		% within Gender	89,7%	68,0%	81,3%
Total		Count	39	25	64
		% within Gender	100,0%	100,0%	100,0%

Table 7. I2*Gender Crosstabulation

			Gender		
			Male	Female	Total
I2	Problem solving	Count	5	2	7
		% within Gender	12,8%	8,0%	10,9%
	Thinking hats	Count	17	14	31
		% within Gender	43,6%	56,0%	48,4%
	Brainstorming	Count	7	2	9
		% within Gender	17,9%	8,0%	14,1%
	JIGSAW	Count	4	4	8
		% within Gender	10,3%	16,0%	12,5%
	Conversation	Count	1	0	1
		% within Gender	2,6%	0,0%	1,6%
	Learning through discovery	Count	2	1	3
		% within Gender	5,1%	4,0%	4,7%
	Systematic observation	Count	3	2	5
		% within Gender	7,7%	8,0%	7,8%
Total		Count	39	25	64
		% within Gender	100,0%	100,0%	100,0%

Table 8. I3*Gender Crosstabulation

			Gender		
			Male	Female	Total
I3	I retain information faster	Count	6	1	7
		% within Gender	15,4%	4,0%	10,9%
	I know my colleagues better	Count	4	4	8
		% within Gender	10,3%	16,0%	12,5%
	I learn to collaborate	Count	7	6	13
		% within Gender	17,9%	24,0%	20,3%
	I communicate more easily	Count	6	4	10
		% within Gender	15,4%	16,0%	15,6%
	Teaching is more	Count	6	2	8
	entertaining	% within Gender	15,4%	8,0%	12,5%
	We interact more	Count	9	4	13
		% within Gender	23,1%	16,0%	20,3%
	Team work is developed	Count	1	4	5
		% within Gender	2,6%	16,0%	7,8%
Total		Count	39	25	64
		% within Gender	100,0%	100,0%	100,0%

Table 9. ANOVA summary for gender and those 3 items from questionnaire

	Item	M	SD	F	p
1	Male	1.90	.307	4.945	.030
	Female	1.68	.476		
2	Male	3.1795	2.304	.010	.919
	Female	3.1200	2.2605		
3	Male	3.8462	1.8287	.560	.457
	Female	4.200	1.8708		

Conclusion

For an engineering student is important also to receive the technical information necessary at its future job, but to develop some important skills to manage every situation in its life. Thus, you cannot have performances knowing only certain knowledge in the field in which you are active, if you do not have a broader vision of life, if you cannot make correlations between the information learned in different disciplines, if you are not creative, if you do not have a critical thinking or if you cannot work and collaborate within the team. There are a various teaching method who can develop these skills, these are not developed only in school period, it is a life learning process. The presents paper describes some modern methods adapted and used in higher education. Also, it is made a comparative analysis of them, and a vision of the technical students is also presented. We applied a short questionnaire on a group of 64 students, in second and third year of study, male and female. The results showed that the modern teaching approach is preferred, because they can collaborate and interact more. The most loved method was Six Thinking Hats. A significant gender difference was obtained for item1, traditional vs modern approach. In conclusion, students love modern teaching methods, and it is mandatory for professors to integrate modern and interactive methods into their teaching style in order to offer to their students a unique experience and a thorough preparation for adult life.

References

Akdim, M., Alami, A., Selmaoui, S., Sabiri, A., Akdim, H. (2022), The Field Skills' Development through Teaching Environmental Interactions in High School: Draa-Tafilalet Region, Morocco. *Education Sciences*, *12*, 772. https://doi.org/10.3390/educsci12110772

Alasmari, N. (2022). ELF Teachers' Practices and Challenges Towards Implementing Critical Thinking Skills Online During COVID-19 Pandemic, *Journal of Language Teaching and Research*, Vol. 13, No. 6, pp. 1269-1278

Bernad-Cavero, O., & Llevot-Calvet, N. (2018). *New Pedagogical Challenges in the 21st Century: Contributions of Research in Education*. IntechOpen.

D'Angelo, S. (2022), Building resilience now and for the future: Adolescent skills to address global challenges. Dev Policy Rev, 40: e12670. https://doi.org/10.1111/dpr.12670

deBono, E. (1999). Six thinking hats. New York, NY: Back Bay Books.

DeDecker, S., Chouvalova, A., Gordon, K., Clemmer, R., & Vale, J. (2022). Memorization: Friend or Foe when Solving Problems in STEM Undergraduate Courses. *Proceedings of the Canadian Engineering Education Association (CEEA)*. https://ojs.library.queensu.ca/index.php/PCEEA/article/view/15945

Del Campo, J.M., Negro, V., Núñez, M. (2012). Traditional Education vs Modern Education. What Is The Impact Of Teaching Techniques' Evolution On Students' Learning Process?, *INTED2012 Proceedings*, pp. 5762-5766.

Hasanah, U., Astra, I. M., & Sumantri, M. S. (2023). Exploring the need for using science learning multimedia to improve critical thinking elementary school students: Teacher perception. *International Journal of Instruction*, 16(1), 417-440.

Jumari, N.F., Mohd-Yusof, k., Phang, F.A., and Rahman, N.F.A. (2022), Success factors in developing metacognitive skills among engineering students, *AIP Conference Proceedings 2433*, 020018

Kalyani, D., & Rajasekaran, K. (2018). Innovative teaching and learning. *Journal of applied and advanced research*, *3*(1), 23-25.

Mahoney, J., Patterson, L., Hall, C. (2022). De Bono's Six Hats Thinking Strategy for All Content Areas, *Kentucky Teacher Education Journal: The Journal of the Teacher Education Division of the Kentucky Council for Exceptional Children*: Vol. 9: Iss. 1, Article 4

Matina, S.S. (2022), *Using Blended Technology as a tool to enhance entrepreneur's creativity and innovation within SMMEs* (Master dissertation), North-West University

Miron, C. (2008). Didactics of Physics, Bucharest University Publishing House

Mishra, L., Gupta, T., & Shree, A. (2020). Online teaching-learning in higher education during lockdown period of COVID-19 pandemic. *International journal of educational research open*, *1*, 100012. https://doi.org/10.1016/j.ijedro.2020.100012

Močinić, S. N. (2012). Active teaching strategies in higher education. *Metodički obzori: časopis za odgojno-obrazovnu teoriju i praksu*, *7*(15), 97-105.

Mohiuddin, K., Islam, M. A., Sharif, M., Nur, S., Talukder, Md. S., & Alghobiri, M. A. (2020). Enumeration of Potential Teaching Methods in Higher Education: A Cross-Disciplinary Study. *Education Research International*, *2020*, 8870412. https://doi.org/10.1155/2020/8870412

Nicolaides, A. (2012). Innovative teaching and learning methodologies for higher education Institutions. *Educational research*, *3*(8), 620-626.

Rață, B.-C., Ciolcă, C., Butnariu, M., Rață, G., Rață, M., Drăgoi, C. C., Robu, V., & Mihăilescu, L. (2022). Building Time Management Skills through the Teaching Practice Activity. *Revista Romaneasca Pentru Educatie Multidimensionala*, *14*(3), 88-100. https://doi.org/10.18662/rrem/14.3/599

Sachou, M. E. (2013, June). Innovative methods of teaching. In *The Future of Education: Materials of International conference (Florence, Italy 13-14 June, 2013). Mode access to article: http://conference. pixel-online. net/foe2013/common/download/Paper_pdf/083-ITL13-FP-Sachou-FOE2013. pdf.*

Samuel, A. B., & Rahman, M. M. (2018). Innovative teaching methods and entrepreneurship education: A review of literature. *Journal of Research in Business, Economics and Management*, *10*(1), 1807-1813.

Student infographics (2016), https://elearninginfographics.com/28-skills-really-ready-student-infographic/

Woods, D. R. (2014). Problem-Oriented Learning, Problem-Based Learning, Problem-Based Synthesis, Process Oriented Guided Inquiry Learning, Peer-Led Team Learning, Model-Eliciting Activities, and Project-Based Learning: What Is Best for You? *Industrial & Engineering Chemistry Research*, *53*(13), 5337–5354. https://doi.org/10.1021/ie401202k

Yuchtman, N. (2017). Teaching to the tests: An economic analysis of traditional and modern education in late imperial and republican China. *Special Issue: A New Economic History of China*, *63*, 70–90.