Report on the Results gathered from the Evaluation Questionnaire for Teachers (BG)

The analysis is based on the results from **42** respondents; questionnaires collected in July and August 2011.

Question no. 1:

1. Which kind of topics in science education would you consider to be more appealing for students? (e.g. traditional or basic subjects, problems of global importance or scale, topics oriented towards high technologies and innovation, subjects of special importance for human life or improvement of the human condition, topics significant for business applications or future development, other, etc.)

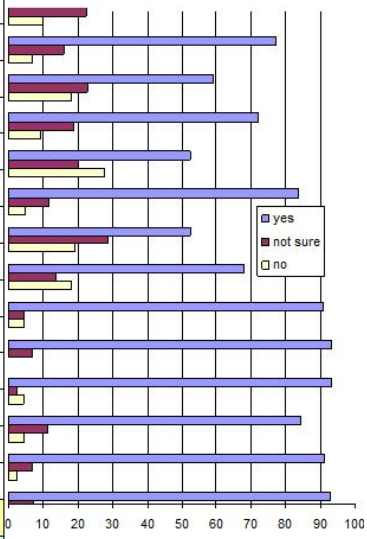
- The majority of teachers indicate that **all topics** are appropriate and appealing to students, but they must comply with the age and interests and to be presented in an attractive manner. Respondents believe that the topics are more intriguing when demonstrating their direct impact on *how they can make human life easier*.
- Respondents believe that the topics should be **illustrated and explained with examples** and issues of particular importance to human life, improving conditions of human existence, oriented to the current modern discoveries in the fields of high technology and innovation, topics of importance for use in business, future personal and universal development.
- Some of those interviewed believe that for students below seventh grade is good to learn traditional or basic parts of the material in all natural sciences, and also to include topics on issues of global concern. For high-school students is good to include issues-oriented high-tech subjects of particular importance to human life or such that improve the conditions of human existence, as well as topics of importance for use in business or future development.

Question no. 2:

2. Which of the extracurricular topics should be integrated with science topics?

Results are presented in the chart below:

	yes	not sure	no
Optical instruments and how they work	67,50	22,50	10,00
The use of lasers	77,27	15,91	6,82
How CDs and DVDs store and play sound and image	59,09	22,73	18,18
Organic and ecological farming without use of pesticides and artificial fertilizers	72,09	18,60	9,30
How radios and TVs work	52,50	20,00	27,50
How mobile phones can send and receive messages	83,72	11,63	4,65
Life and death and human soul	52,38	28,57	19,05
Why we can see the rainbow	68,18	13,64	18,18
The ozone layer and how it may be affected by humans	90,91	4,55	4,55
How technology helps us to handle waste, garbage and sewage	93,18	6,82	0,00
How energy can be saved or used in a more effective way	93,18	2,27	4,55
How gene technology prevent diseases	84,44	11,11	4,44
Very recent inventions and discoveries in science and technology	91,11	6,67	2,22
Nanotechnology and its uses	92,86	7,14	0,00
Total	77,32	13,58	9,11
	yes %	not sure %	no %



The most of the interviewed teachers are interested in the following subjects:

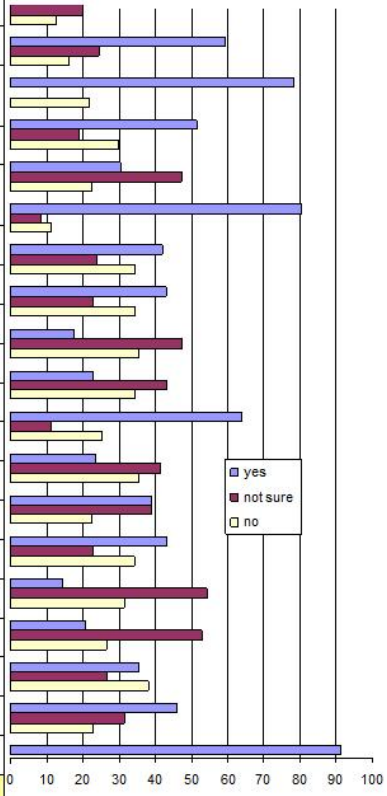
- How technology helps us to handle waste, garbage and sewage – 93.18%
- How energy can be saved or used in a more effective way – 93.18%
- Nanotechnology and its uses – 92.86%
- Very recent inventions and discoveries in science and technology – 91.11%
- The ozone layer and how it may be affected by humans – 90.91%

For this question we have to mention that all of the proposed subjects have score quite above 50% (average: 77.32%)

Question no. 3:

3. Do you have any knowledge about nanotechnology? If yes, which of the curriculum topics are related with nanotechnology?

	yes	not sure	no
Chemicals, their properties and how they react	67,50	20,00	12,50
Parts of human body and how the systems work	59,46	24,32	16,22
Structure of DNA, genetic studies, heredity and how genes influence how we develop reproduction in humans	78,38	0,00	21,62
How plants and animals grow and reproduce	51,35	18,92	29,73
How people, animals, plants and the environment depend on each other	30,56	47,22	22,22
Atom, molecules and chemical bonding	80,56	8,33	11,11
Light and its nature	42,11	23,68	34,21
Radioactivity and its effects	42,86	22,86	34,29
The nature of sound and its properties	17,65	47,06	35,29
Velocity and the relationship between velocity, time and road	22,86	42,86	34,29
The structure of cell, mitosis and meiosis	63,89	11,11	25,00
Simple machines and how they ease our lives	23,53	41,18	35,29
Electricity and its properties	38,89	38,89	22,22
Optics and how they are used in our daily lives	42,86	22,86	34,29
Structure of Earth and how earthquakes happen	14,29	54,29	31,43
Clouds, rain and the weather	20,59	52,94	26,47
Sustainable energy and its sources	35,29	26,47	38,24
heat and temperature	45,71	31,43	22,86
Technology and its interaction with science	91,43	0,00	8,57
Total	41,87	30,08	28,05
	yes %	not sure %	no %



The **3 most popular** answers are:

- Technology and its interaction with science – 91.43%
- Atom, molecules and chemical bonding – 80.56%
- Structure of DNA, genetic studies, heredity and how genes influence how we develop reproduction in humans – 78.38%

The teachers distinguished also:

- Chemicals, their properties and how they react – 67.50%
- The structure of cell, mitosis and meiosis – 63.89%
- How plants and animals grow and reproduce – 51.35%

The question contains an open field “Other [topics], please specify…” under which some of the respondents added the following:

- Diagnosis and treatment in medicine; tumor treatment
- Production of certain food products such as nutritional supplements
- Production of passive nano-materials as titanium dioxide in sunscreen cream and other cosmetic products
- Surface coatings such as silver in food products, clothing, disinfectants and household appliances, paints, varnishes and other

Most of these additional topics (if not all) are not included in the general curriculum for science subjects.

Note to Q3: We should to note that the way the question is asked does not allow analyzing whether the results show personal or professional opinion of the respondents according to the subject they teach. We are not able to separate objective opinion associated with the professional competence of the interviewed teachers related to educational content and the curriculum to the subjective opinion related to personal competence of the surveyed.

Also, since no data was collected about the subject which respondents teach, no proper analyze of the results obtained in percentages can be performed.

Question no. 4:

4. Which science topics do you think that should be supported with experiments for a meaningful and permanent learning?

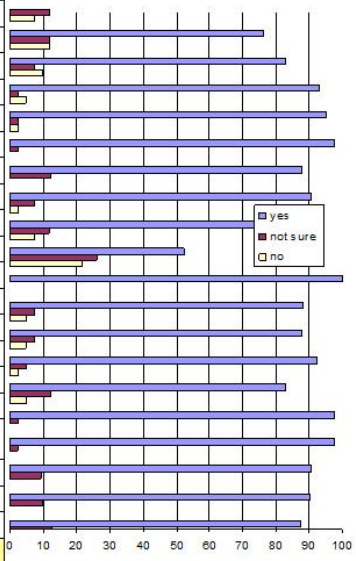
The variety of answers to this question indicates the interest of respondents to this matter:

- Chemistry and the environment, physics and astronomy, biology and health education;
- Sustainable energy and its energy sources;
- Electricity and its properties;
- Optical phenomena and their use in everyday life;
- Simple machines and how they make life easier;
- Areas related to health;
- Energy sources;
- Technologies;
- Optics;
- Atomic and Nuclear physics;
- Magnetism;
- Structure of the cell;
- Examination of samples of materials produced by nanotechnology or those with nanocoatings.

Question no. 5:

5. Science education should involve the following:

	yes	not sure	no
Make pupils aware of the unlimited aspects of science	80,95	11,90	7,14
Be able to use scientific equipment skillfully	76,19	11,90	11,90
Be able to demonstrate experiments	82,93	7,32	9,76
Use information technology	92,86	2,38	4,76
Expect pupils to use the proper terminology correctly	95,24	2,38	2,38
Link new science learning to everyday experiences	97,62	2,38	0,00
Help pupils to understand the importance of science in modern business applications	87,80	12,20	0,00
Encourage pupils to try out their own ideas in experiments	90,48	7,14	2,38
Teach pupils to understand science concepts	80,95	11,90	7,14
Frequently revise previous learning	52,38	26,19	21,43
Show how classroom learning relates to phenomena in outside world and everyday life	100,00	0,00	0,00
Explain to pupils how to use thescientific knowledge and why theirscience activity is important	88,10	7,14	4,76
Help pupils become aware of the benefits and misuses ofscience	87,80	7,32	4,88
Relate each new idea (concept) to ones the pupils have already learnt	92,50	5,00	2,50
Use visits to industry to supportscience learning	82,93	12,20	4,88
Use field trips to supportscience learning	97,55	2,44	0,00
Develop a personal interest inscience /e.g. find new and exciting scientific topics to enrich their understanding of new horizons/	97,62	2,38	0,00
Enable the pupils to integrate with everyday lives and problems ofglobal importance, scientific/technological achievements	90,48	9,52	0,00
Raise awareness related to the nanotechnology by introducing short talks at the last 10 minutes of learning unit	90,24	9,76	0,00
Offer short reports on modern achievements in science at the micro- and nano-level to be added to every learning unit	87,50	12,50	0,00
Total	87,54	9,00	3,46
	yes %	not sure %	no %



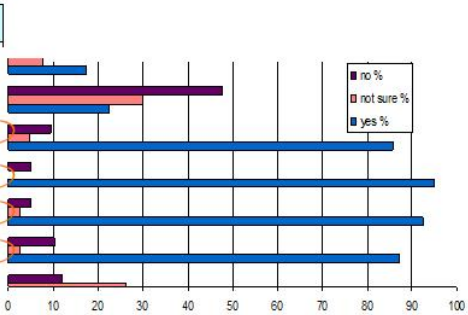
- Show how classroom learning relates to phenomena in outside world and everyday life – 100%
- Link new science learning to everyday experiences – 97,62%
- Develop a personal interest in science /e.g. find new and exciting scientific topics to enrich their understanding of new horizons/ - 97.62%
- Use field trips to support science learning – 97.56%

For this question we have to mention that all of the proposed subjects have score quite above 50% (average: 87.54%)

Question no. 6:

6. The most effective ways to teach a particular scientific topic in a modern way generally would be:

	no %	not sure %	yes %
Formal lessons	75,00	7,50	17,50
Reading textbooks	47,50	30,00	22,50
Watching clips and documentaries	9,52	4,76	85,71
Interactive computer based tools	5,13	0,00	94,87
Direct experiments using measuring equipment	5,00	2,50	92,50
Pre-recorded or filmed experiments with explanations	10,26	2,56	87,18
Less structured experiments	11,90	26,19	61,90
Total	23,40	10,64	65,96
	yes %	not sure %	no %



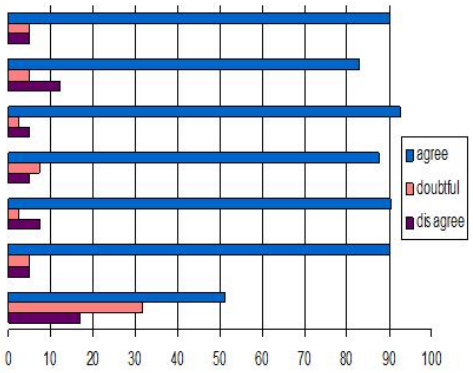
- Interactive computer based tools – 94.87%
- Direct experiments using measuring equipment – 92.50%
- Pre-recorded or filmed experiments with explanations – 87.18%
- Watching clips and documentaries – 85.71%

Only 17.50% of the interviewed teachers think that *formal lessons* are the effective way of teaching scientific topics.

Question no. 7:

7. Please, rate the importance of the following tools for an online virtual lab:

Q7		disagree	doubtful	agree
a	Texts	17,07	31,71	51,22
b	Images	5,00	5,00	90,00
c	Video	7,32	2,44	90,24
	Simulations	5,00	7,50	87,50
e	Interactive simulations	5,00	2,50	92,50
f	Procedures to carry out experiments with the students	12,20	4,88	82,93
h	Resource library	5,00	5,00	90,00
	Total	8,13	8,48	83,39
		yes %	not sure %	no %



The importance is rated as follows:

Interactive simulations	92,50%
Video	90,24%
Images	90,00%
Resource library	90,00%
Simulations	87,50%
Procedures to carry out experiments with the students	82,93%
Texts	51,22%

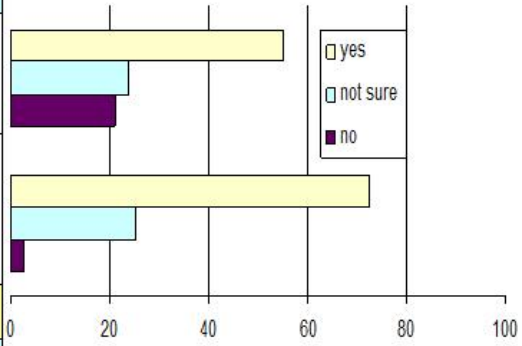
The question contained an open field “Other [tools], please specify…” which was not filled in by any of the 42 respondents whose answers have been taken in consideration for this analysis.

Note to Q7: This question is not sufficiently clearly defined – It does not provide definition of what does “an online virtual lab” means. As shaped the question suggests own interpretation of the respondents and does not allow analysis of the results.

Question no. 8:

8. What type of lab approach you prefer?

	yes	not sure	no
Cook-book type laboratory activities (step-by step instructions) to verify scientific facts.	55,26	23,68	21,05
Inquiry-based laboratory activities (students decide how to conduct the activity, and have to explore in order to figure out how the world works).	72,50	25,00	2,50
Total	64,10	24,36	11,54
	yes %	not sure %	no %



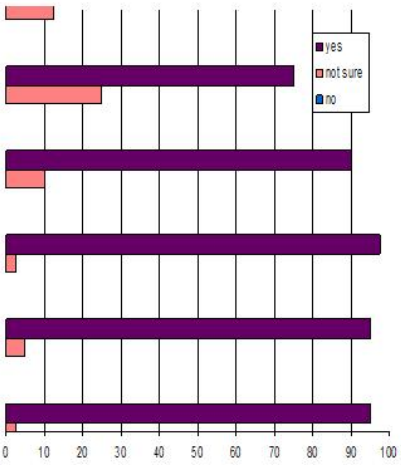
- 72,50% of the teachers prefer *Inquiry-based laboratory activities* (students decide how to conduct the activity, and have to explore in order to figure out how the world works);
- 55.26% prefer *Cook-book type laboratory activities* (step-by step instructions) to verify scientific fact

The overall result is over 100%, which means that **some of the interviewed teachers pointed both answers**.

Question no. 9:

9. What do you think that the appropriate activities in a laboratory would be?

Q9		yes	not sure	no
a	Students should get involved with scientifically oriented questions	87,50	12,50	0,00
b	Students should have (be provided with) the ability to determine what data allows them to develop and evaluate scientific explanations.	75,00	25,00	0,00
c	Students should have (be provided with) the ability to formulate their own explanations from the evidence they have obtained.	90,00	10,00	0,00
d	Students should have (be provided with) the ability to expand upon their findings and relate those findings to similar situations.	97,50	2,50	0,00
e	Students should have (be provided with) the ability to communicate their experimental findings to others in class via written laboratory reports.	95,00	5,00	0,00
f	Students should be able to have access to experiments on-line which cannot be done in a laboratory	95,00	2,50	2,50
Gen	Total	90,25	9,32	0,42
		yes %	not sure %	no %

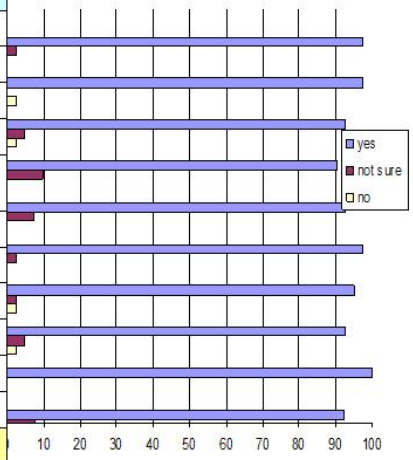


90.25% of all interviewed teachers think that **all of the subjects** pointed in that question are appropriate activities in a laboratory.

Question no. 10:

10. If you were to create your own laboratory, the students should be able to:

Q10		yes	not sure	no
a	Make observations	100,00	0,00	0,00
b	Pose questions	97,56	2,44	0,00
c	Have access to an e-Library (other sources of information	97,56	0,00	2,44
d	Plan investigations	92,68	4,88	2,44
e	Reviewing what is already known in light of experimental evidence.	90,24	9,76	0,00
f	Use (virtual) tools to gather, analyze and interpret data	92,68	7,32	0,00
h	Propose answers, explanations, and predictions	97,56	2,44	0,00
i	Communicate the results	95,12	2,44	2,44
j	Identify assumptions	92,68	4,88	2,44
k	Use critical and logical thinking	100,00	0,00	0,00
l	Consider alternative explanations	92,50	7,50	0,00
Gen	Total	95,32	3,79	0,89
		yes %	not sure %	no %



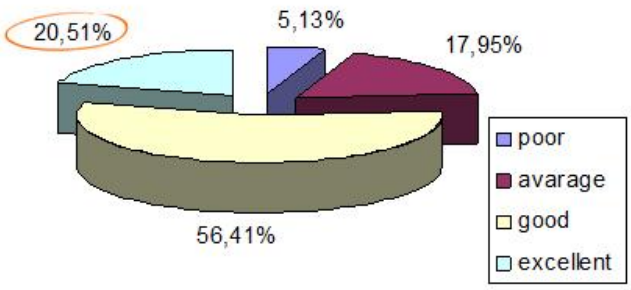
100% of the teachers answer that the students should be able to *Make observations* and *Use critical and logical thinking*.

The other scours are also very high – average 95.32%!

Question no. 11:

11. How well are you able to manage with using ICT tools for teaching Science topics?

	poor	avarage	good	excellent
11. How well are you able to manage with using ICT tools for teaching Science topics?	5,13	17,95	56,41	20,51



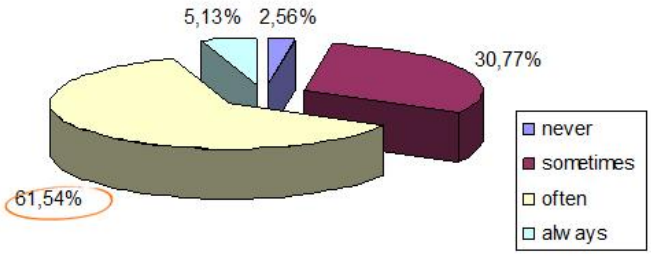
Only **20.51%** declare are **excellent** in managing ICT tools, but **56.41%** declare they are **good** in managing ICT tools.

Note to Q11: This question is not sufficiently precisely defined and is shaped in a way that suggests own interpretation of the respondents. What does using "ICT tools for teaching Science topics" means for each respondent? Some teachers may understand just using PPT… This assumption is partially supported also by the answers of the Q14 below.

Question no. 12:

12. To what extent do you implement ready-made ICT tools for teaching Science topics?

	never	sometimes	often	always
12. To what extent do you implement ready-made ICT tools for teaching Science topics?	2,56	30,77	61,54	5,13



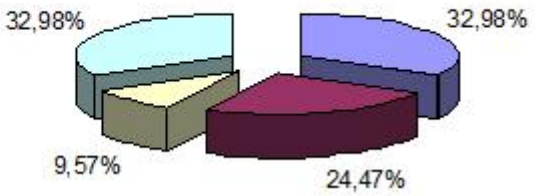
61.54% declare using ready-made ICT tools for teaching Science topics.

Note to Q12: The question failed to ask which are the sources for "ready-made ICT tools for teaching Science topics". Collecting this information would have been useful as a contribution to the contents of the NTSE virtual repository.

Question no. 13:

13. What is the purpose of using Nano-tech experiments in your classroom by the use of ICT?

	%
To let students understand the core aspects of the nano-technology	32,98
To provide students with nano-tech examples	24,47
To verify hypothesis, theories or models from nano-technology area	9,57
To raise the students' motivation for learning nano-technology	32,98

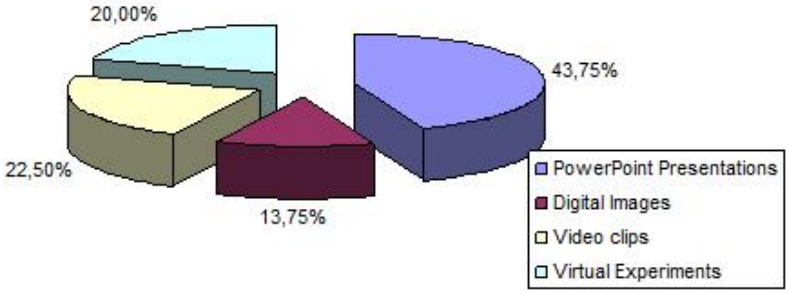


The highest rates are for: *To let students understand the core aspects of the nano-technology* and *To raise the students' motivation for learning nano-technology* (each with 32.98%). Seem strange that the *motivation for learning nano-technologies* is ranged higher than the answer "to provide students with nano-tech examples" which would be the expected answer for teachers in an average schools. Possible explanation for such results would be the assumption that most of the respondents teach in specialized schools for which students choosing a career in the field of sciences is more likely.

Question no. 14:

14. What kind(s) of ICT tools do you use for presenting Science/Nano-Tech experiments in your lessons?

Q14		%
a	PowerPoint Presentations	**43,75**
b	Digital Images	**13,75**
c	Video clips	**22,50**
d	Virtual Experiments	**20,00**



43.75% declared they use PowerPoint Presentations. Unfortunately the formulation of the question do not allow making a relevant conclusion whether this answer is an indication for the *type of the prevailing sources* which are accessible to the respondents or for the level of their ICT competences.

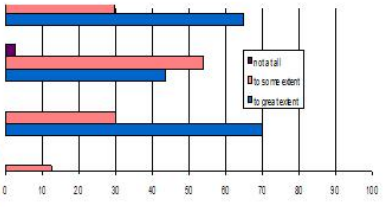
The question contained an open field "Other [ICT tools], please specify…" which was not filled in by any of the 42 respondents whose answers have been taken in consideration for this analysis. However, put after a relatively exhaustive enumeration, this question was addressing the **type** of the ICT tools (supposedly) used by the respondents.

> ***Note to Q14:*** It was necessary for those who pointed in their answer that they use "virtual experiments" to have also sub question to identify the sources they use. This information would have been useful as a contribution to the contents of the NTSE virtual repository.

Question no. 15:

15. Evaluate (on a scale from 1 to 3) how important are ICT tools to you for the purpose of promoting an inquiry based/creative learning environment in Science teaching?

Q15		not at all	to some extent	to great extent
a	as a method to explain the "Inquiry Based Science Education" concept	5,41	29,73	64,86
b	as a way for better planning of an experiment	2,56	53,85	43,59
c	as a channel for guiding students to explain scientific aspects and propose hypothesis for investigation	0,00	30,00	70,00
d	as a method to enhance creativity in teaching and learning process	0,00	12,50	87,50
Gen	Total	1,92	31,41	66,67



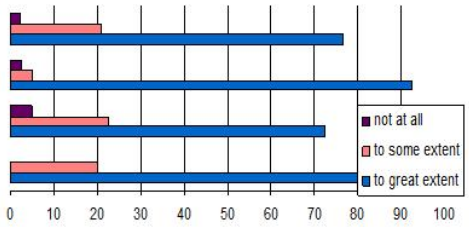
87.50% vote for ICT being *a method to enhance creativity in teaching and learning process*, and **70%** for it being a *channel for guiding students to explain scientific aspects and propose hypothesis for investigation*.

It has to be mentioned that above 50% (average: 66.67%) of the respondents rated the importance of the ICT tools for all aspects of the inquiry based/creative learning mentioned in this question.

Question no. 16:

16. Evaluate (on a scale from 1 to 3) how do you consider collaboration* using ICT for teaching Science / Nano-Tech topics?

Q16		not at all	to some extent	to great extent
a	as a method to increase students' motivation	2,33	20,93	76,74
b	as a method to make learning content more attractive (by using virtual environments and multimedia tools)	2,50	5,00	92,50
c	as a way to make students more emotional	5,00	22,50	72,50
d	as a method to promote creativity based on collaborative work	0,00	20,00	80,00
Gen	Total	2,45	17,18	80,37
		not at all %	to some extent %	to great extent %



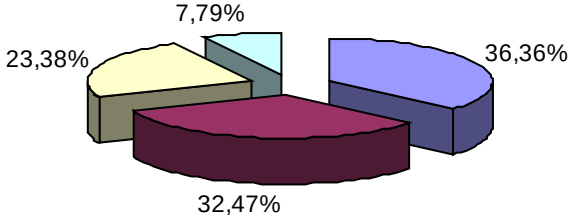
*This question in its variant in Bulgarian language contained additional specification "**collaboration with your colleagues or other specialists through ICT**" which is important to be taken in consideration when reading the data.

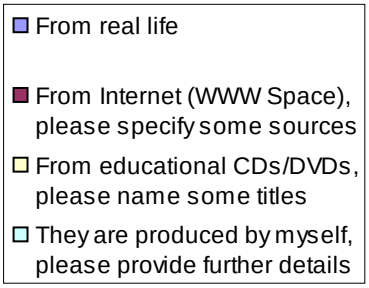
The importance of *collaboration using ICT* is considered most effective as a method to *make learning content more attractive* by **92,50%** of the respondents. However, the information added in the brackets puts a special emphasis on this answer, linking it with "using virtual environments and multimedia tools". This adds an ambivalent aspect on the results, as it is not clear if the leading motivation of the respondents was to emphasize in general on the role of the collaboration through ICT for making "learning content more attractive" or that they consider "using virtual environments and multimedia tools" in particular as necessary element of the collaboration.

It has to be mentioned that the use of ICT for collaboration is rated **above 50%** (average 80.37%) as important for teaching Science/Nano-Tech topics, incl. *as a way to make students more emotional*.

Question no. 17:

17. Where do you find good examples of Science experiments, appropriate to be presented in the classroom?





It is important to underline that the highest score here – 36,36% received the suggestion *from real life*, only then followed by the *internet* as a source for good examples.
We would suggest this result to be considered for verification of the respondents' answers concerning the use of ICT and the estimation of the role of the ICT tools.

With the view of Q17 it is also important to pay attention to the fact that none of the respondents mentioned a particular web-based source or educational CD actually used in his/her practice. The possible reasons for the lack of particular data about sources/ programs could be:
a/ the fact that Q17 is the last one within a pretty long questionnaire and the respondents were already too fatigued to go into details
or
b/ the lack of real implementation of ICT based tools in their practice.
However, we have no basis to support either of these two hypotheses.

General Notes

We should note that some of the questions in the questionnaire are not sufficiently clearly defined and are shaped in a way that suggests own interpretation by the respondents, resulting in a high percentage of subjectivity in the answers, because the question has not been understood correctly. This had not allowed deeper specification of the data meaning and more precise analysis of the answers.

Few questions in the questionnaire contain an open field ("please specify: ....") and most of these are added after fairly exhaustive enumeration (ref. Q6, Q7, Q14). As a consequence none of the 42 respondents whose answers have been taken in consideration for this analysis had mentioned any additional suggestion under these questions.

Only one question (Q17) contains direct request for specification of web-based resources and names of programs (educational CD/DVDs) used so far by the respondents and none of the respondents gave details on these. Several opportunities for placing open fields for sharing relevant information within other questions were missed, hence no data for constructive interpretation the results from Q17 are available.

More open fields and encouragement for sharing data and personal experience would have allowed also collecting useful information for the NTSE repository which will be part of the virtual lab.

The very high scores in the answers to some questions which show massive support to most of the enumerated statements raises doubts towards the relevance of asking such a question which (seems) contains all answers in itself or trigger answers "by default" (ref. Q9, Q10). Equally questionable is the contents of Q5 in which many of the suggestions are already defined by the national curriculum for teaching sciences.

A disadvantage for the analysis of the data was also the fact that the questionnaire does not provide data about socio-demographic and professional characteristics of respondents (e.g. number of years in the profession; subject taught; school level/age of students; big city/ small town; general school/ specialized school, etc., etc.) which limited the opportunities for more precise analysis of the data.