D5.2 Report on STEM skills assessment

(Public)

Project Acronym: EDU-ARCTIC

Project Title:

“Edu-Arctic – Innovative educational program attracting young people to natural sciences and polar research”

NUMBER — 710240 — EDU-ARCTIC

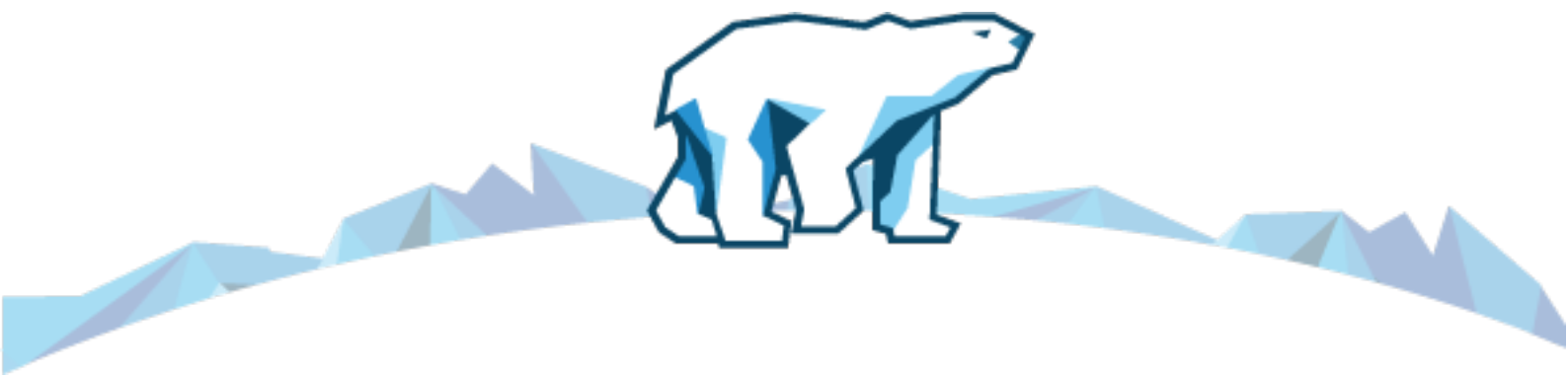
Document information summary

Date:	17.06.2019
Leader Partner:	UVSQ
Main Author(s):	Joanna Kodzik, Jan Borm
Reviewed by:	Agata Goździk
Target audience:	Consortium members, REA/EC, other interested parties
Delivery date:	month 36
Version:	v.2

This project (EDU-ARCTIC) has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 710240.
The content of the document is the sole responsibility of the organizer and it does not represent the opinion of the European Commission, and the Commission is not responsible for any use that might be made of information contained.

TABLE OF CONTENTS

Executive summary 3
1. Introduction 4
2. Methodology 4
3. Objectives – categories to be measured 5
4. Evaluation of the CAWI survey "After-skills assessment" 6
5. Evaluation question by question 16
6. General evaluation 75
7. Evaluation in relation to the objectives 76
8. Comparisons between the "entry-skills assessment" and "after-skills assessment" surveys ... 77
9. General Conclusion of Report on STEM skills assessment 86
APPENDIX: Evaluation of the "entry-skills assessment" survey question by question 87



Executive summary

This document contains Deliverable D.5.2 “Report on STEM skills assessment” which is part of WP5 Evaluation and Impact. The document fulfils several basic goals:

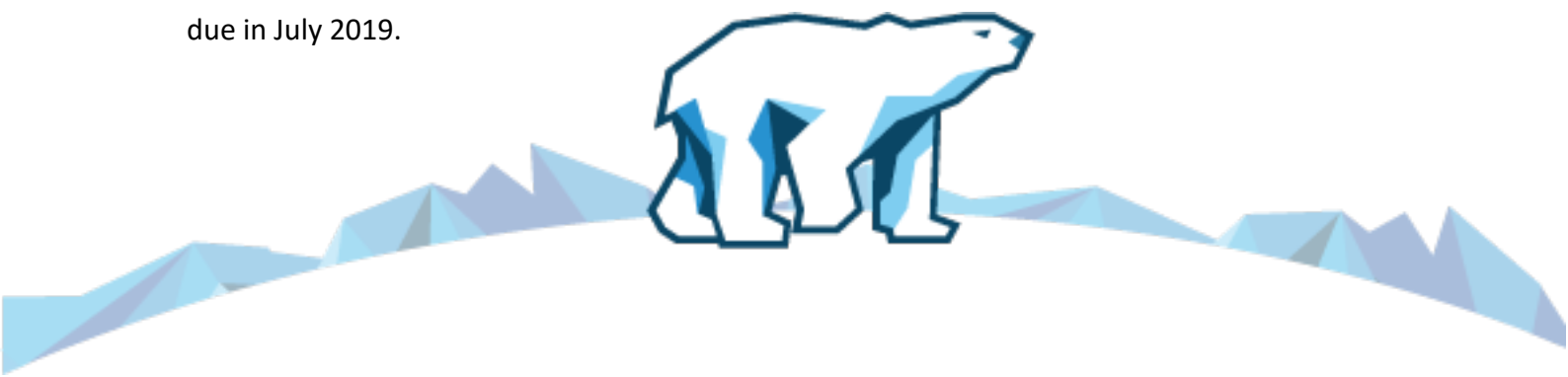
- measurement of enhancement of knowledge about science and scientific research
- measurement of enhancement of knowledge about nature, geography, natural resources, history, social and political specificities, increase of sensitivity to environmental issues and climate change
- measurement of differences of impact on boys and girls of the EDU-ARTIC project
- measurement of pupils’ interest in STEM after taking part in the EDU-ARCTIC project
- measurement of increase of skills in the EDU-ARCTIC project
- main results from the survey

The largest group of teachers esteemed that the EDU-ARCTIC project has had a significant impact on the increase of the level of pupils' knowledge about issues related to the Arctic, on the level of understanding of scientific issues and scientific language among pupils and level of interest in STEM and scientific careers among pupils.

Generally speaking, there are no significant differences between girls and boys in the achieved level of knowledge about issues related to the Arctic, the level of understanding of scientific issues and scientific language among pupils and the level of interest in STEM and scientific careers after the participation in the EDU-ARCTIC project. However, the clear progression of girls’ interest in STEM and careers as a scientist are a significant result of the project, just like the marked increase in knowledge about the Arctic, environmental issues and climate change. Regarding the interest of young people in STEM and their skills in related subjects, as well as knowledge about the Arctic, the project’s objectives have been achieved.

The target audiences of this document are Consortium members, REA/European Commission (EC) and other interested parties.

The final conclusions and remarks concerning the project’s impact and fulfilment of particular objectives of the action will be presented in details in the deliverable D5.4 *Impact Assessment*, due in July 2019.



1. Introduction

This report is part of the final evaluation report as mentioned in the Grant Agreement, WP 5, Task 5.3. This document contains the evaluation of the results of the after-skills-assessment survey in comparison to the entry-skills-assessment survey. The after-skills assessment survey was created as step 4 of the project evaluation - in order to measure the young generations' STEM skill improvement after having taking part in the educational program - as outlined in the deliverables D 5.1 Evaluation plan including KPIs, page 4.

2. Methodology

The premises the evaluation is based on are elaborated in detail in D5.1 Evaluation plan including KPIs, page 5 and 6).

The evaluation process was conducted with the use of the following 2 research techniques:

2.1 CAWI (Computer Assisted Web Interviews)

For the evaluation of EDU-ARCTIC and the Main survey in particular, specific computer assisted web interviews were developed. Participants fill in an on-line questionnaire received via Internet. This technique relies on the following principles: 1. anonymity 2. the opportunity to participate in the study at any time convenient for the respondent.

The target groups of the "After-skills assessment" survey are: 1. a wider group of potential respondents, 2. specific target groups (see D.5.1.). The respondents were defined as "teachers", according to deliverable D 5.1 based on decisions of the consortium (no dates). The reasons for focusing on teachers, rather than pupils are given in D 5.1. There were some other details required from the teachers like "teacher´s country" and "teacher´s sex". The survey allows to collect information about "the average age of your pupils" and "the number of schoolgirls and schoolboys". In the after-skills assessment survey, the term "your pupils" means "only pupils who participated in the EDU-ARCTIC project on a regular basis". The entry-skills and after-skills assessment surveys were uploaded on the portal.

The entry-skills assessment survey was available for all teachers, who registered before 28.03.2018, within 60 days after the registration to the EDU-ARCTIC program.

The after-skills assessment survey was made available to teachers, who had been participating actively in the program for at least one year (they registered to the program before 31.12.2017. and gained at least 200 EDU-GAME points). The EDU-GAME points were granted to teachers for their participation in various activities offered by the program. The exact information on the number of points per each activity may be found on: https://program.edu-arctic.eu/edu_games (e.g. for participation in one online lesson a teacher received 40 points). In the after-skills assessment survey the answers were gathered from teachers who got a minimum of 240 and maximum of 26728 EDU-GAME points.

2.2 Key Performance Indicators (KPIs)

KPIs represent a set of values against which to measure items. The set of values was defined for each question separately. The surveys are based on the so-called SMART criteria: specific, measurable, achievable, realistic, time-bound. The application of these criteria is standard methodological practice in evaluations of surveys designed to collect and analyse empirical data. The relation of these criteria to the construction of the EDU-ARCTIC surveys is explained in D5.1.

3. Objectives – categories to be measured

Thanks to the KPI values, an evaluation of the 3 main categories of targets discussed below is possible. In each category the relevant KPIs for the "After-skills assessment" survey (D 5.1) have been applied.

3.1 Measurement of the project's direct results

3.1.1 Enhancement of knowledge about science and scientific research, as well as their place in the modern world (target: + 15% compared to input level) measured by "After-skills assessment" survey for teachers (see D 5.1, point 3: method of measurement, p. 7).

3.1.2 Enhancement of knowledge about nature, geography, natural resources, history, social and political specificities concerning polar regions and increase of sensitivity to environmental

issues and climate change (+ 15% compared to input level) – measured by "After-skills assessment" survey for teachers (see D 5.1, point 3: method of measurement, p. 7).

3.1.3 Establishing strong links between the worlds of research and young people/society to increase their ability to understand scientific messages and scientific language (+20% compared to input level) – measured by "After-skills assessment" survey for teachers (see D 5.1, point 3: method of measurement, p. 7).

3.2 The project's impact upon the engagement of young people in STEM activities

3.2.1. Increase of the number of young people interested in STEM and scientific career (target: + 25% compared to input level) – measured by "After-skills assessment" survey for teachers (see D 5.1, point 3: method of measurement, p. 8).

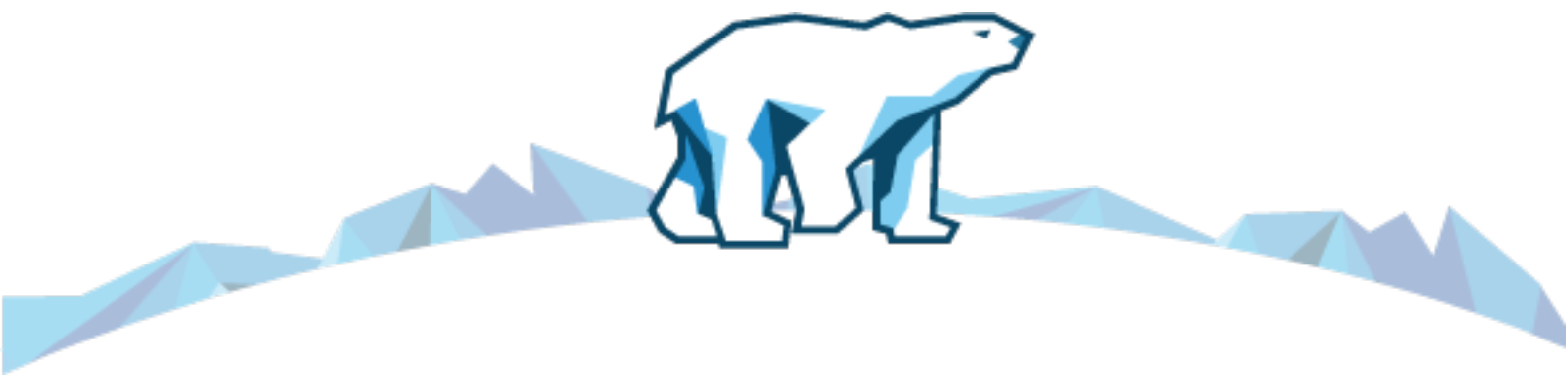
3.2.2. Increase of the number of girls interested in scientific careers (+ 20% compared to input level) – measured by "After-skills assessment" survey for teachers (see D 5.1, point 3: method of measurement, p. 8).

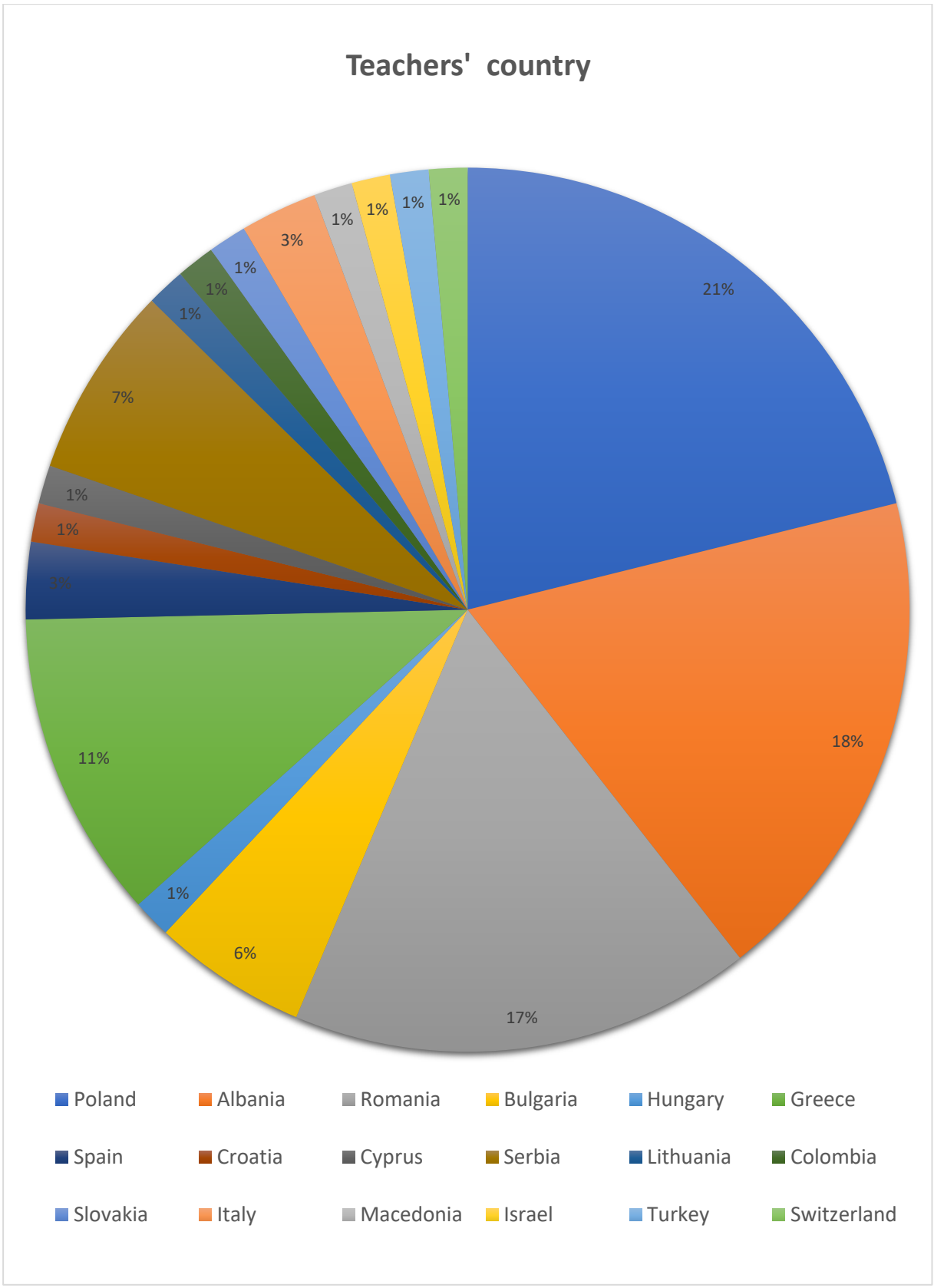
4. Evaluation of the CAWI survey "After-skills assessment"

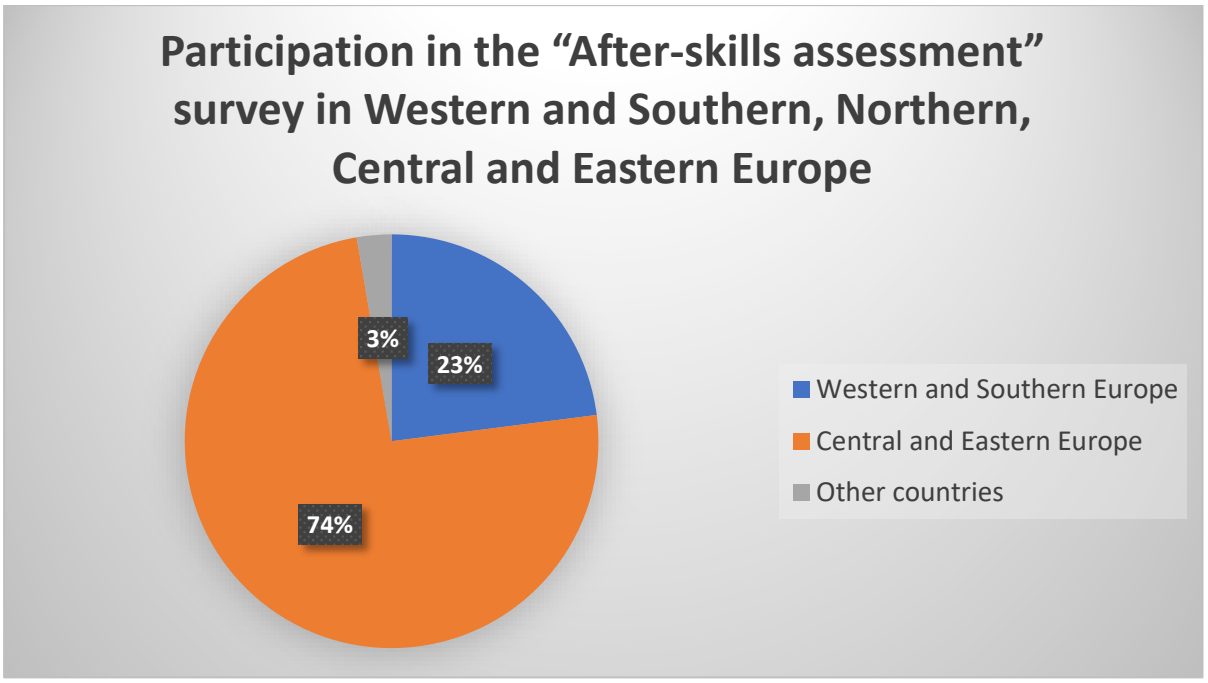
The evaluation report draws on the results of the "teacher_cawi_after_skills_assessment_COMPLETED-1" (excel-file sent to UVSQ by Anna Wielgopolan, 19.04.2019, 9:37, document created by AW 19.04.2019) and "cawi_main_survey_desk" (pdf-file, sent to UVSQ by Agata Goździk, 5.3.2018, 16:37, document created by AG, 25.01.2017). The first file contains 73 anonymous teacher CAWI surveys, filled in by teachers from 21 countries from Western and Southern Europe - Greece, Spain, Cyprus, Italy, Israel, Switzerland, Belgium, United Kingdom; Central and Eastern Europe – Poland, Albania, Romania, Bulgaria, Hungary, Croatia, Serbia, Lithuania, Latvia, Slovenia, Macedonia and also from Colombia and Turkey during the period 26.02.2019-16.04.2019. The 16 surveys with partial responses (which are not part of the 73 complete surveys) cannot be included in this evaluation for lack of representativity. Indeed, in terms of standard

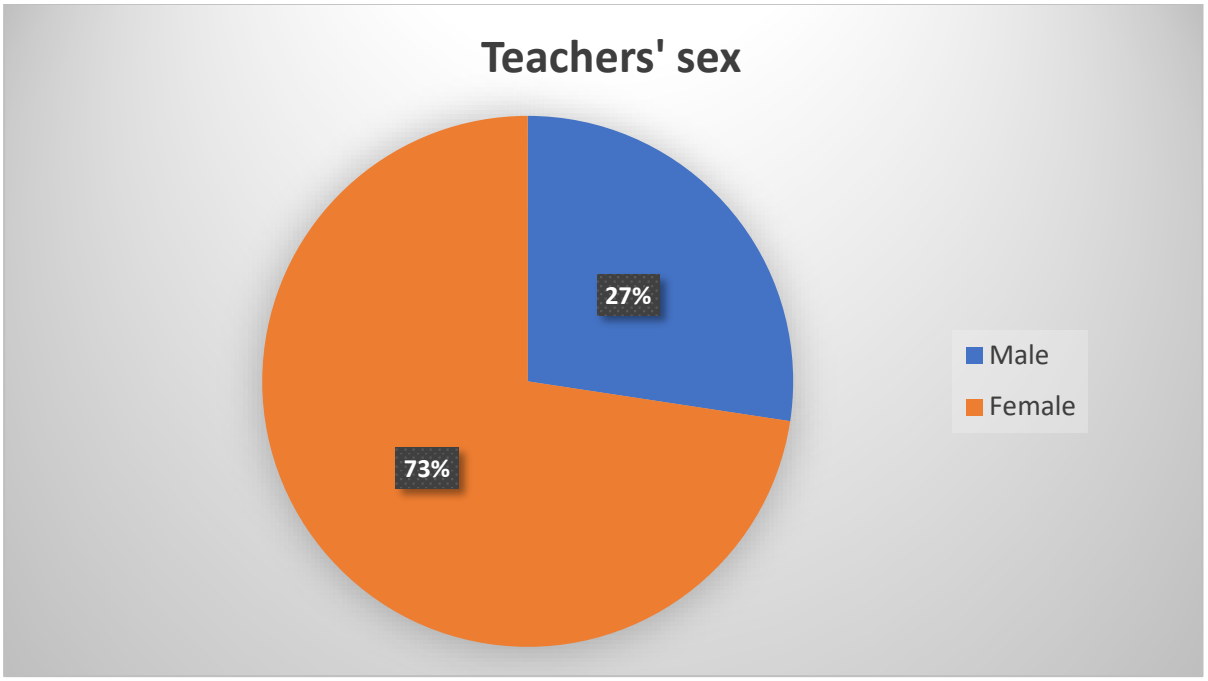
methodology, partially filled-in surveys cannot be evaluated and are therefore not taken into account here. The second document contains a template/ description of the “After-skills assessment” survey.

The three countries most largely represented in this survey are Poland (21%), Albania (18%), and Romania (17%). 11% of the surveys were filled in by teachers from Greece. 3-6% of the surveys were filled in by teachers from Spain, Serbia, Bulgaria and Italy; out of the total number of surveys, the ones filled in by teachers coming from Hungary, Israel, Switzerland, Slovenia, Cyprus, Latvia, Lithuania, United Kingdom, Croatia, Belgium, Macedonia, Colombia and Turkey represent 1% of the total. Most of the surveys were therefore filled in by teachers from Central and Eastern Europe (74%). 23% of the surveys were filled in by teachers from Western Europe. No surveys were filled in by teachers from Northern Europe. 73% of the teachers who filled in the survey are women and 27% men.

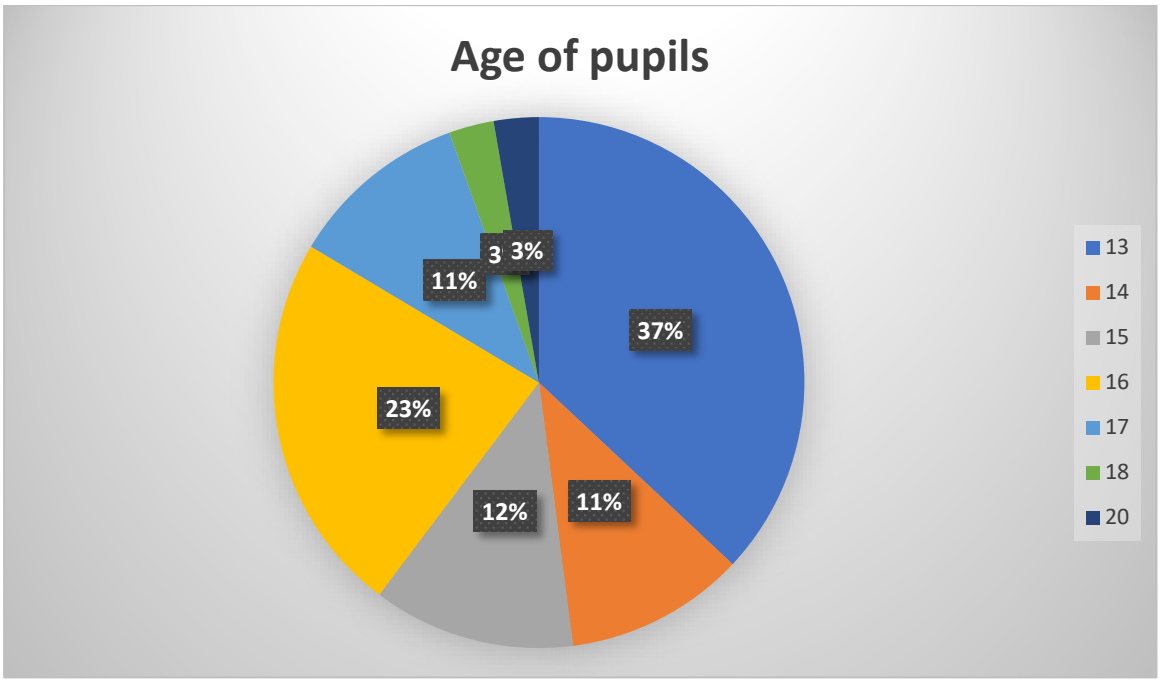



Teachers' country
21%
18%
17%
6%
1%
11%
3%
1%
1%
7%
1%
1%
1%
1%
3%
1%
1%
1%
Poland
Albania
Romania
Bulgaria
Hungary
Greece
Spain
Croatia
Cyprus
Serbia
Lithuania
Colombia
Slovakia
Italy
Macedonia
Israel
Turkey
Switzerland



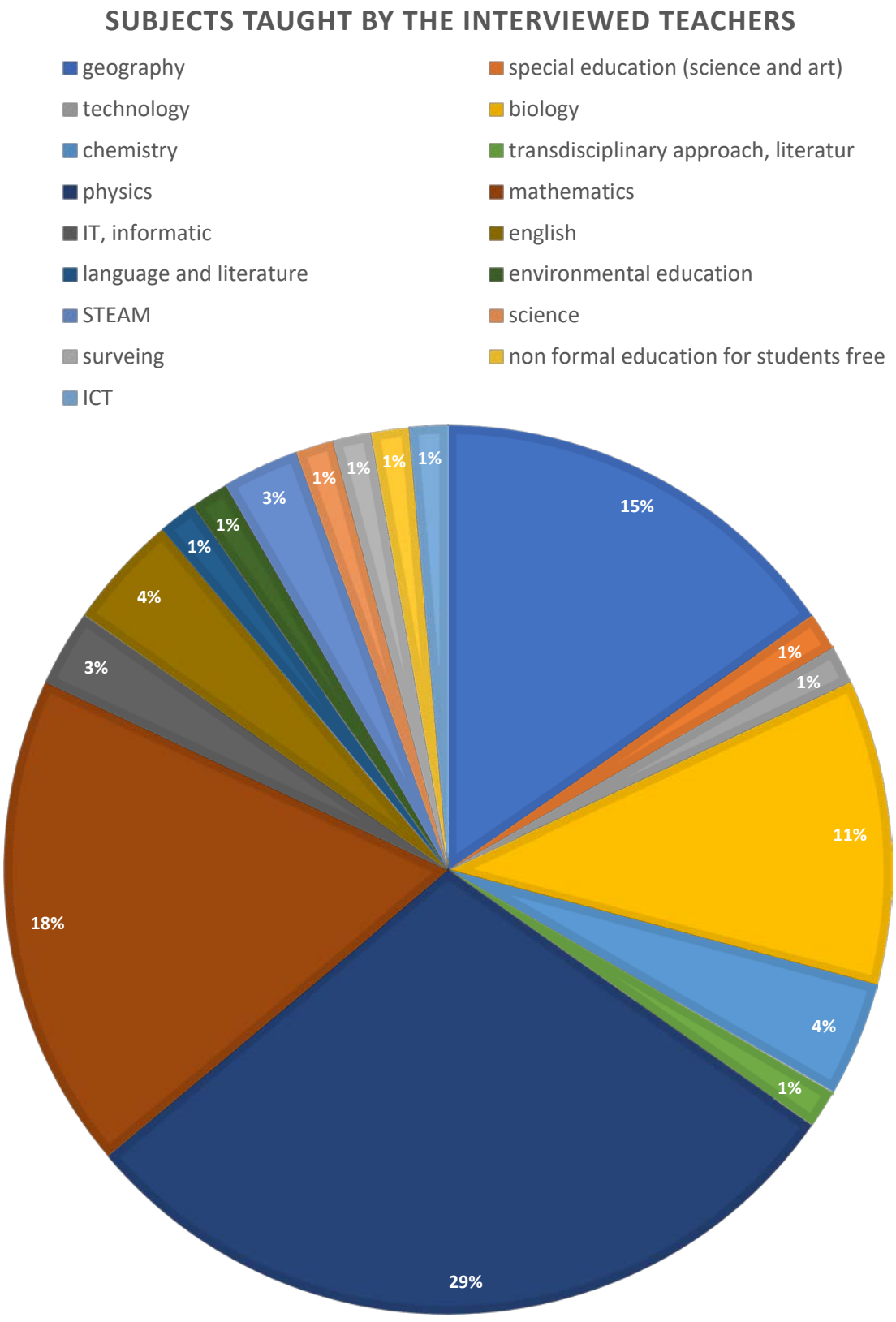


The "age of the pupils in their class" reported by the teachers varied between 13-20 years. The single largest group of interviewed teachers – 27 – indicated the age of 13 years. Nobody indicated 19, two indicated 18 years and 20. Thus, the majority of teachers have pupils in the age group of 13 to 17.



The total number of schoolgirls indicated by teachers is 1776 and 1652 schoolboys.

Most surveys were filled in by teachers teaching natural sciences (including 29% physics, 18% mathematics, 15% chemistry), 4 surveys from Human sciences (English, Literature and Language).


SUBJECTS TAUGHT BY THE INTERVIEWED TEACHERS
geography
special education (science and art)
technology
biology
chemistry
transdisciplinary approach, literatur
physics
mathematics
IT, informatic
english
language and literature
environmental education
STEAM
science
surveing
non formal education for students free
ICT
15%
1%
1%
11%
4%
1%
29%
18%
3%
4%
1%
1%
3%
1%
1%
1%
1%

The survey contains 3 categories: (1) STEM SKILLS (2) KNOWLEDGE ABOUT SCIENCE AND SCIENTIFIC RESEARCH, AS WELL AS THEIR PLACE IN THE MODERN WORLD, (3) KNOWLEDGE ABOUT NATURE, GEOGRAPHY, NATURAL RESOURCES, HISTORY, SOCIAL AND POLITICAL SPECIFICTIES CONCENRING THE ARTIC AND INCREASE OF SENSITIVITY TO ENVIRONMENTAL ISSUES AND CLIMATE CHANGE

In the first category, there are 7 sections containing each two multiple choice questions:

1) LEARN AND APPLY CONTENT
2) INTEGRATE CONTENT
3) INTERPRETATION AND COMMUNICATION OF INFORMATION
4) ENGAGE IN INQUIRY
5) ENGAGE IN LOCAL REASONING
6) COLLABORATE AS A TEAM
7) APPLY TECHNOLOGY APPROPRIATELY

In the second category, there are 5 questions: four multiple choice and one question about three aspects: formulating research questions, choice and justification of the research hypothesis, execution of research.

The third category contains one question about the level of the pupils' knowledge in the following domains: knowledge about nature, geography, natural resources, history, social and political specificities concerning the polar regions, sensitivity to environmental issues and climate change.

The questions allowed to collect the subjective opinion of anonymous teachers from 22 European countries, as well as Colombia, on pupils' use of the acquired knowledge and practice, pupils' interest in issues related to the Arctic, pupils' capacity

1) to integrate knowledge various fields of mathematics and natural science,
2) to explain external phenomena,
3) to correctly interpret the results of experiments and research,
4) to use scientific language,
5) pupils' enthusiasm in getting involved in research or experimental processes,
6) their capacity to independently design the experimental research process, to conclude,
7) to realize tasks within a group,

8) to engage willingly in various tasks of the group,
9) to use willingly modern technology.

Finally, teachers were asked about their opinion on whether modern technology has an impact on raising the effectiveness of learning processes among their pupils.

The second category covers the following aspects:

1) pupils' interest in scientific careers
2) their interest in STEM
3) their knowledge about the vocational tasks of a professional scientist
4) their knowledge about the conditions of work of a professional scientist.

The third category covers the knowledge of pupils about the Arctic in a certain number of subjects (nature, geography, natural resources, history, social and political specificities, sensitivity to environmental issues and climate change).

The following items were collected in particular:

CATEGORY 1: STEM SKILLS

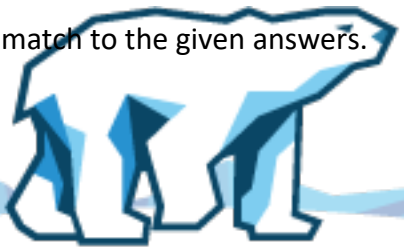
LEARN AND APPLY CONTENT

1. Do your pupils use the acquired knowledge in practice? Please put the proper number of schoolgirls and schoolboys that match to the given answers.

2. Are your pupils interested in issues related to the Arctic? Please put the proper number of schoolgirls and schoolboys that match to the given answers.

INTEGRATE CONTENT

1. Do your pupils integrate knowledge from various fields of mathematics and natural sciences (e.g. they use information obtained on other subjects while participating in your lesson)? Please put the proper number of schoolgirls and schoolboys that match to the given answers.
2. 2. Do your pupils explain external phenomena (e.g. natural, social, etc.) using the concepts acquired during the act of learning? Please put the proper number of schoolgirls and schoolboys that match to the given answers.



INTERPRETATION AND COMMUNICATION OF INFORMATION

1. Do your pupils correctly interpret the results of experiments, results of research? Please put the proper number of schoolgirls and schoolboys that match to the given answers.
2. Are your pupils able to use scientific language, which you use in a class (e.g. use the same terminology)? Please put the proper number of schoolgirls and schoolboys that match to the given answers.

ENGAGE IN INQUIRY

1. Are your pupils enthusiastically involved in research processes or experimental processes which you propose during your lesson? Please put the proper number of schoolgirls and schoolboys that match to the given answers.
2. 2. Do your pupils independently design the experimental, research process? Please put the proper number of schoolgirls and schoolboys that match to the given answers.

ENGAGE IN LOGICAL REASONING

1. Can your pupils logically conclude? Please put the proper number of schoolgirls and schoolboys that match to the given answers.

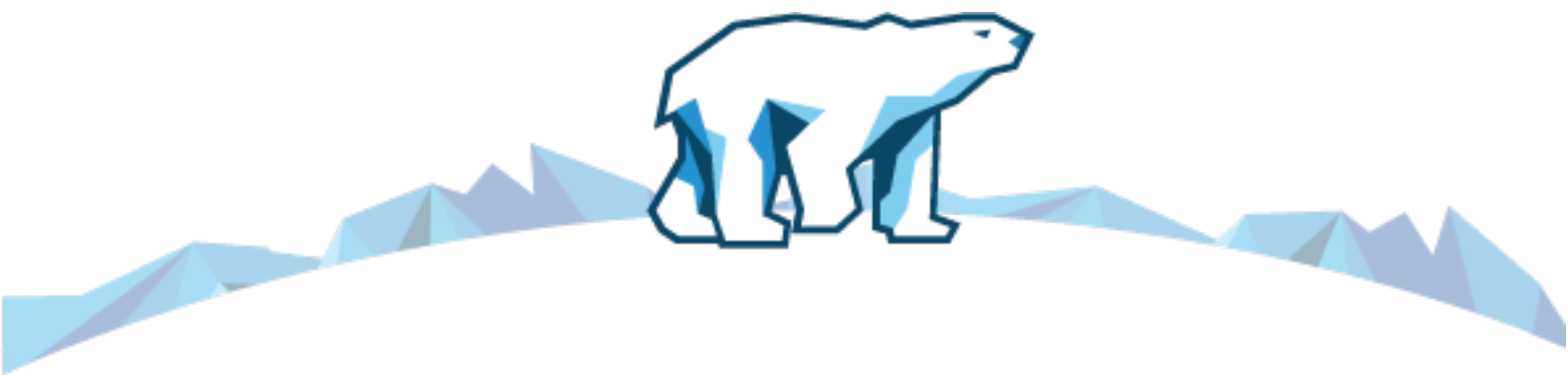
COLLABORATE AS A TEAM

1. Can your pupils realize tasks within group? Please put the proper number of schoolgirls and schoolboys that match to the given answers.
2. 2. Are your pupils willingly engaged in various of tasks within group? Please put the proper number of schoolgirls and schoolboys that match to the given answers

APPLY TECHNOLOGY APPROPRIATY

1. Do your pupils willingly use modern technologies in order to learn? Please put the proper number of schoolgirls and schoolboys that match to the given answers.
2. Do you think modern technologies have an impact on raising the effectiveness of learning process among your pupils? Please select the most appropriate.

CATEGORY 2: KNOWLEDGE ABOUT SCIENCE AND SCIENTIFIC RESEARCH, AS WELL AS THEIR PLACE IN THE MODERN WORLD



1. Please find below specified elements of the research process. Please rate how well your pupils are able to realize each one of these.

Formulating research questions	Choice and justification of the research hypotheses	Execution of research

2. Are your pupils showing interest in scientific careers? Please put the proper number of schoolgirls and schoolboys that match to the given answers.
3. Are your pupils showing interest in STEM? Please put the proper number of schoolgirls and schoolboys that match to the given answers.
4. Have of your pupils got a knowledge about the vocational tasks of a professional scientist? Please put the proper number of schoolgirls and schoolboys that match to the given answers.
5. Do your pupils know anything about the conditions of work of professional scientists (e.g. possibilities of employment, salary, requirements to obtain a degree)? Please put the proper number of schoolgirls and schoolboys that match to the given answers.

CATEGORY 3: KNOWLEDGE ABOUT NATURE, GEOGRAPHY, NATURAL RESOURCES, HISTORY, SOCIAL AND POLITICAL SPECIFICITIES CONCERNING THE ARCTIC AND INCREASE OF SENSITIVITY TO ENVIRONMENTAL ISSUES AND CLIMATE CHANGE.

1. Please find below a list of specific issues and concepts related to the Arctic. Please rate the level of knowledge of your pupils for each item.

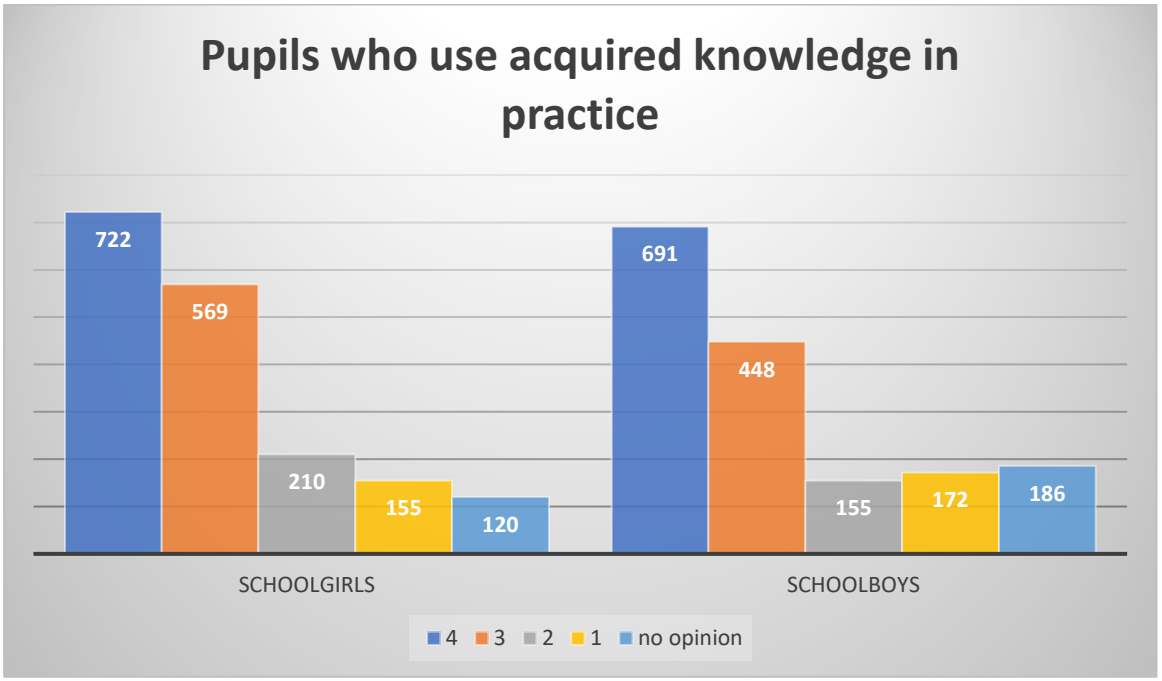
- Knowledge about nature
- Geography
- Natural resources
- History
- Social and political specificities concerning polar regions
- Sensitivity to environmental issues
- Climate change

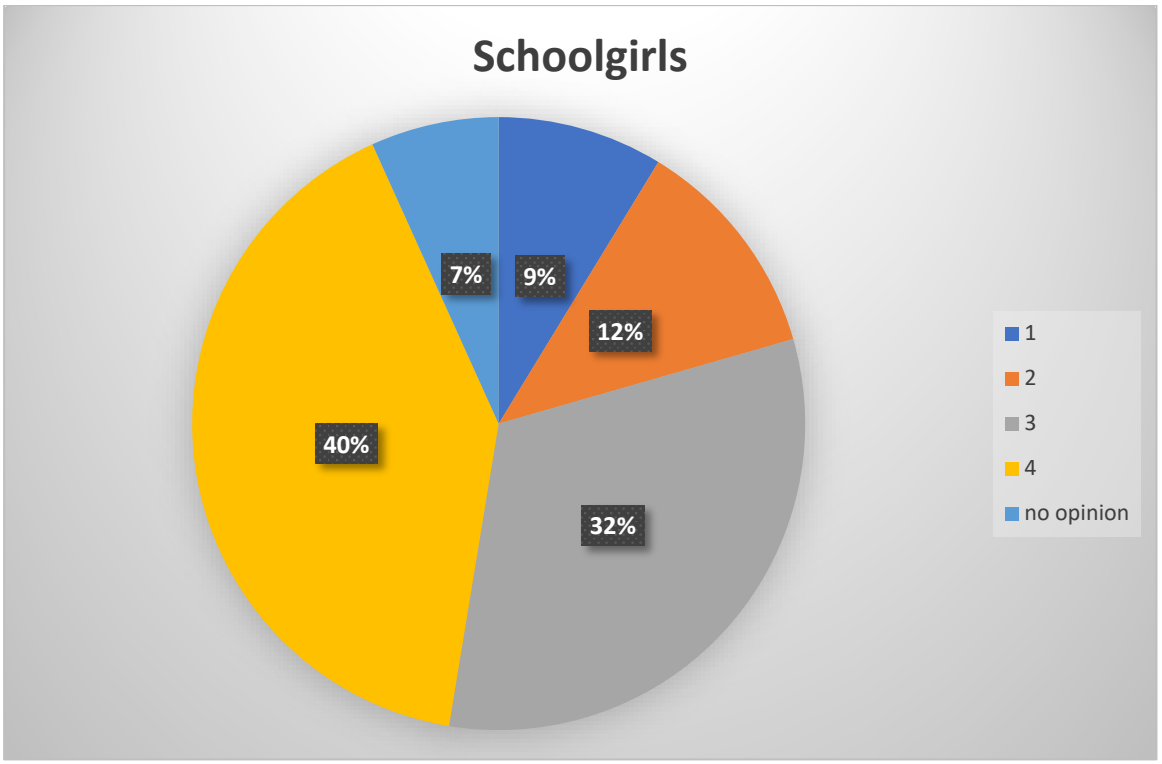
5. Evaluation question by question

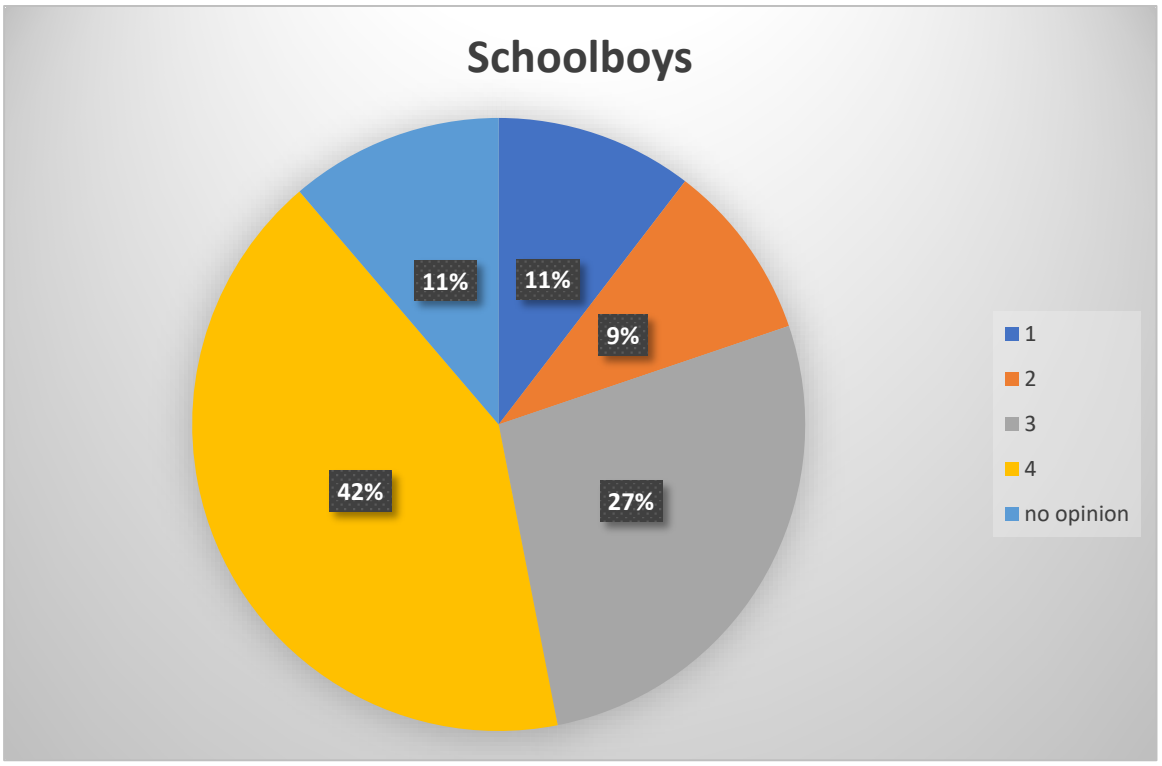
CATEGORY 1: STEM SKILLS
LEARN AND APPLY CONTENT

1. Do your pupils use the acquired knowledge in practice? Please put the proper number of schoolgirls and schoolboys that match to the given answers.

	Schoolgirls	Schoolboys
4 – Definitely use it	722	691
3 – Tend to use it	569	448
2 – Tend not use it	210	155
1 – Definitely do not use it	155	172
I have no opinion	120	186





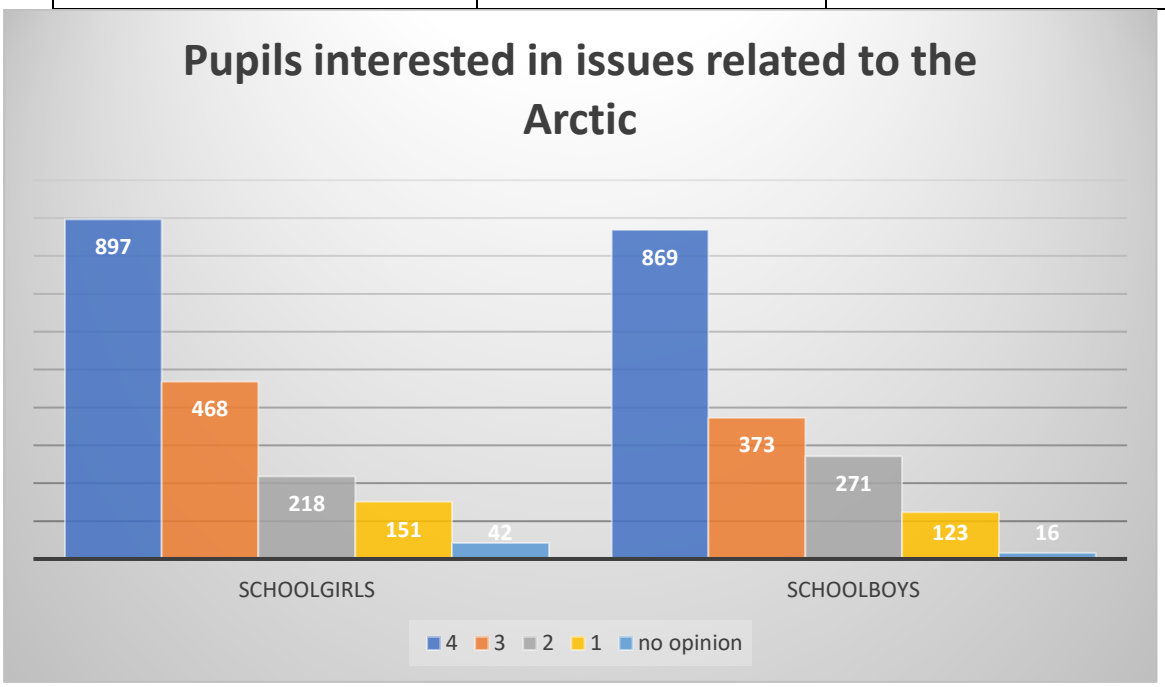


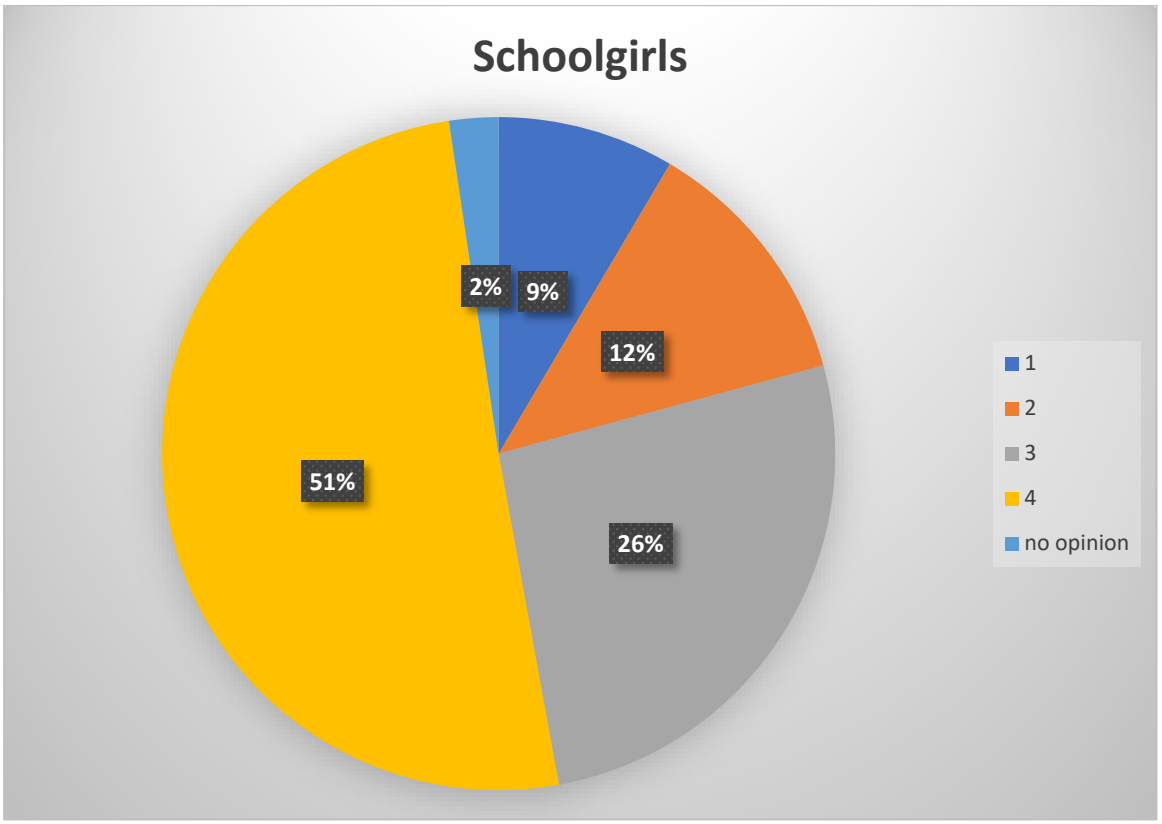
Remark: Teachers esteemed that relatively more boys than girls “definitely use“ acquired knowledge in practice:

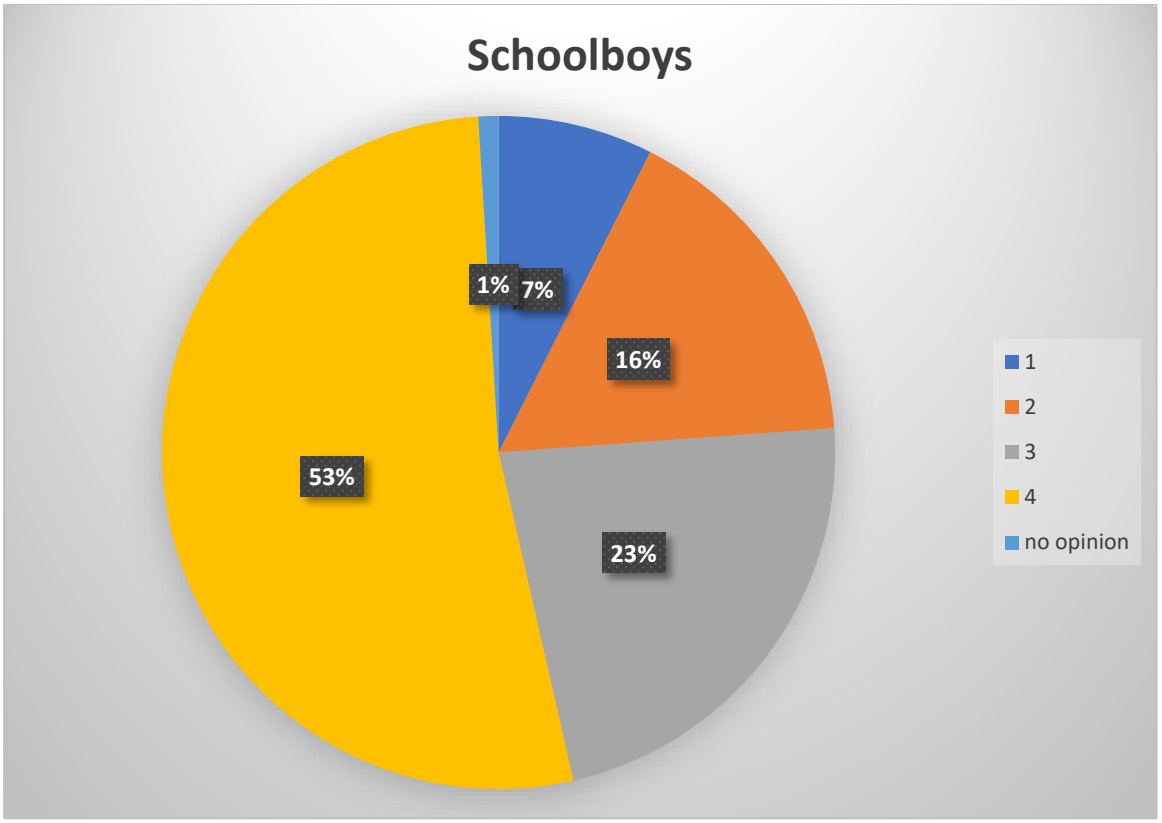
1) girls: 722 (40% of all girls), 2) boys: 691 (42% of all boys). If one takes the total of girls and boys teachers expressed opinions about, 722 girls represent 21% of the total of pupils and 691 boys 20%.

2. Are your pupils interested in issues related to the Arctic? Please put the proper number of schoolgirls and schoolboys that match to the given answers.

	Schoolgirls	Schoolboys
4 – Definitely interested	896	869
3 – Quite interested	468	373
2 – Not very interested	218	271
1 – Definitely not interested	151	123
I have no opinion	42	16







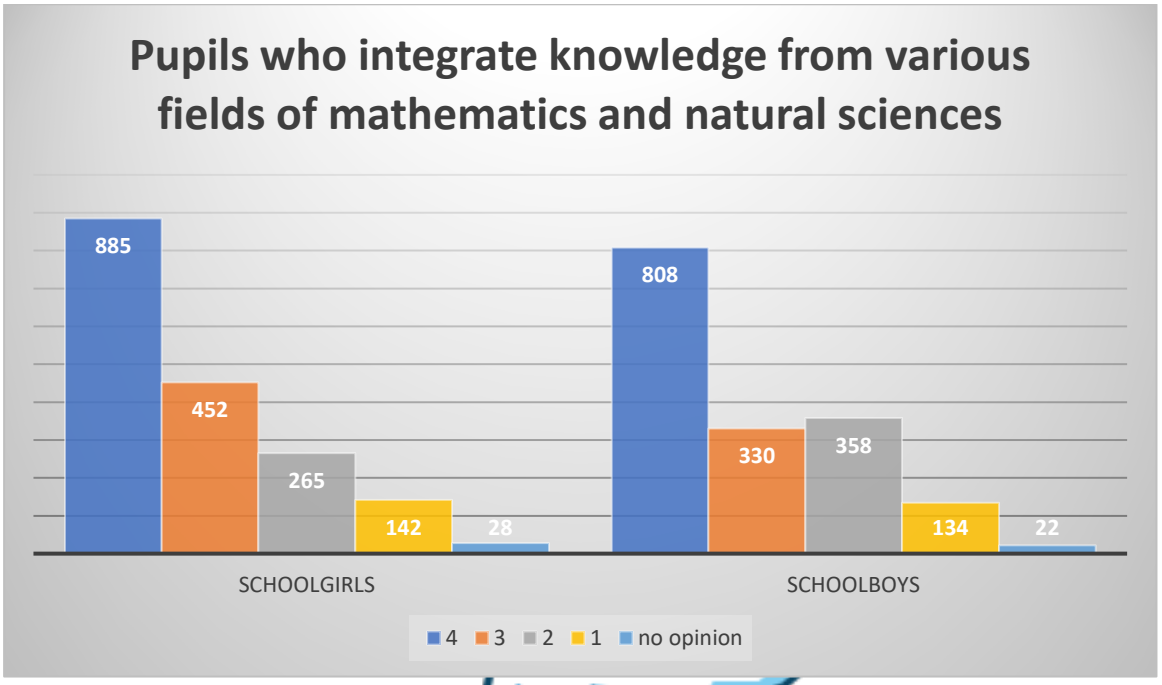
Remark: Teachers esteemed that relatively more boys than girls are “definitely interested“ in issues related to the Arctic:

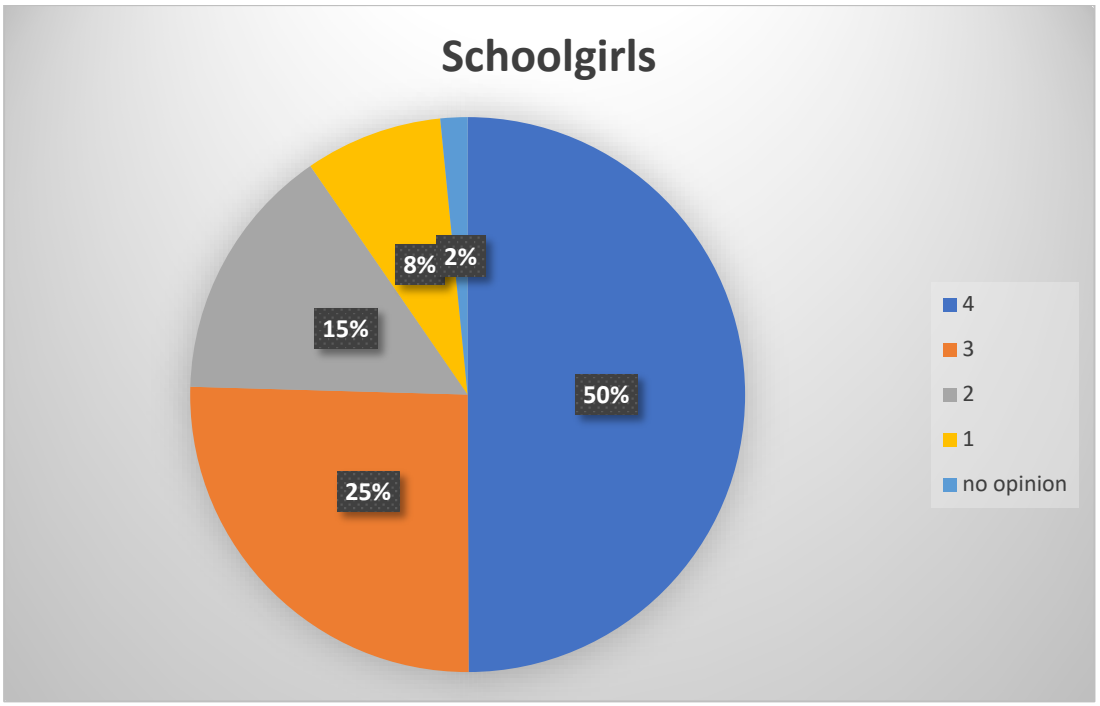
1) girls: 896 (51% of all girls), 2) boys: 869 (53% of all boys). If one takes the total of girls and boys teachers expressed opinions about, 896 girls represent 26% of the total of pupils and 869 boys 25%.

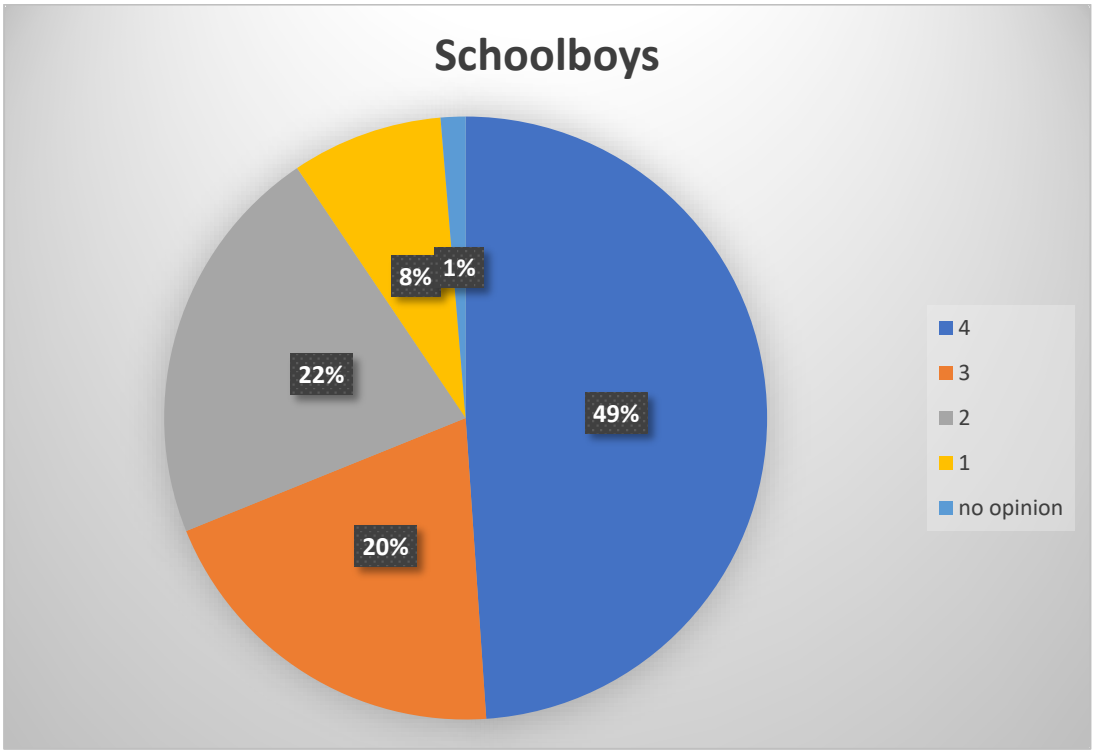
INTEGRATE CONTENT

1. Do your pupils integrate knowledge from various fields of mathematics and natural sciences (e.g. they use information obtained on other subjects while participating in your lesson)? Please put the proper number of schoolgirls and schoolboys that match to the given answers.

	Schoolgirls	Schoolboys
4 – Definitely integrate	885	808
3 – Often integrate	452	330
2 – Rarely integrate	265	358
1 – Definitely do not integrate	142	134
I have no opinion	28	22





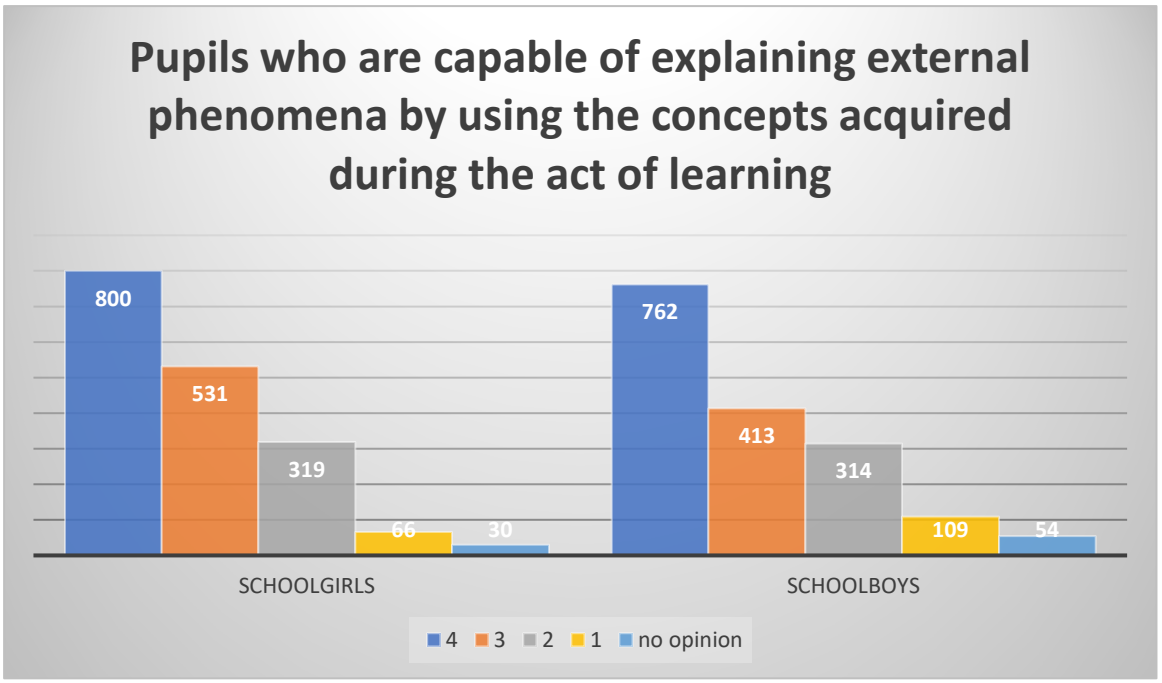


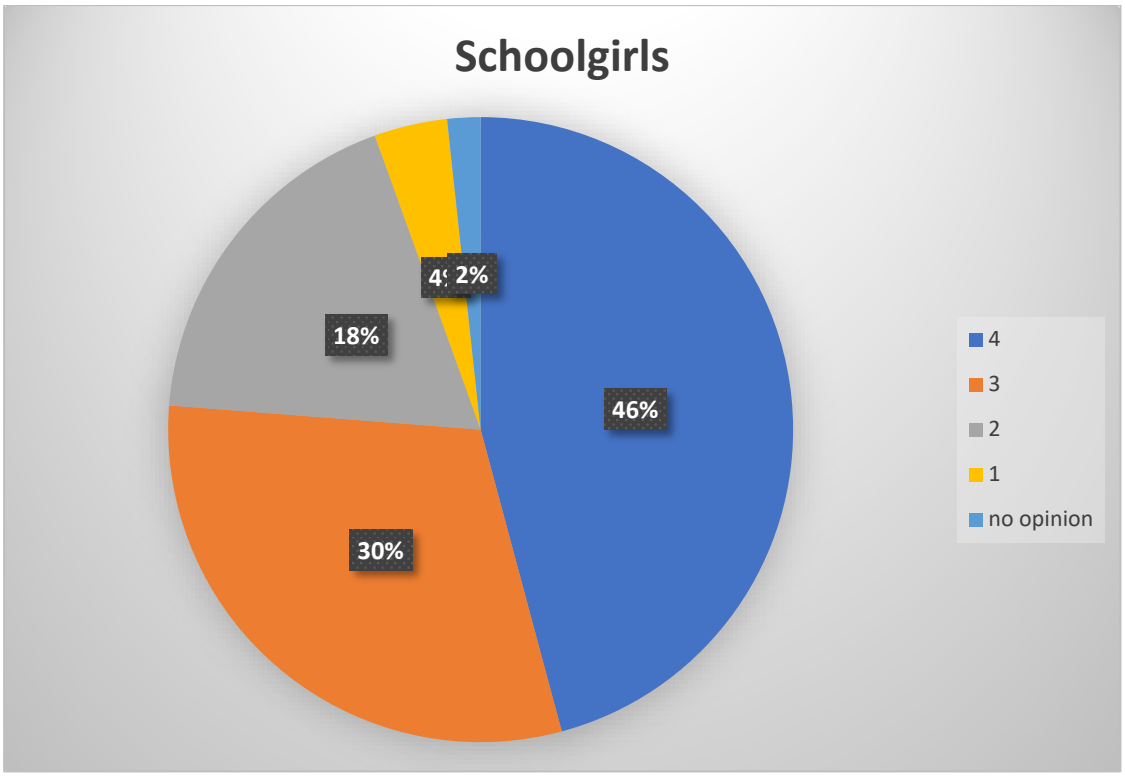
Remark: Teachers esteemed that more girls than boys “definitely integrate“ knowledge from various fields of mathematics and natural sciences:

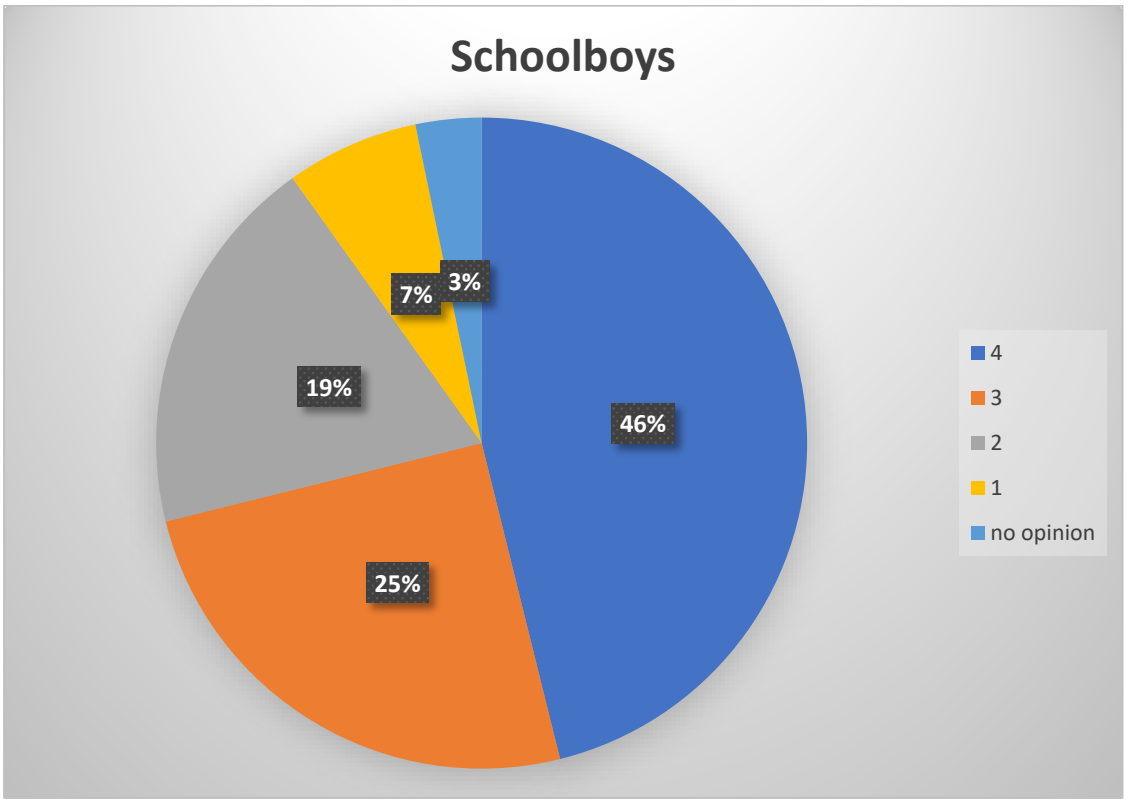
1) girls: 885 (50% of all girls), 2) boys: 808 (49% of all boys). If one takes the total of girls and boys teachers expressed opinions about, 885 girls represent 26% of the total of pupils and 808 boys 23%.

2. Do your pupils explain external phenomena (e.g. natural, social, etc.) using the concepts acquired during the act of learning? Please put the proper number of schoolgirls and schoolboys that match to the given answers.

	Schoolgirls	Schoolboys
4 – Definitely explain	800	762
3 – Often explain	531	413
2 – Rarely explain	319	314
1 – Definitely do not explain	66	109
I have no opinion	30	54




Schoolgirls
46%
30%
18%
4%
2%
4
3
2
1
no opinion


Schoolboys
46%
25%
19%
7%
3%
4
3
2
1
no opinion

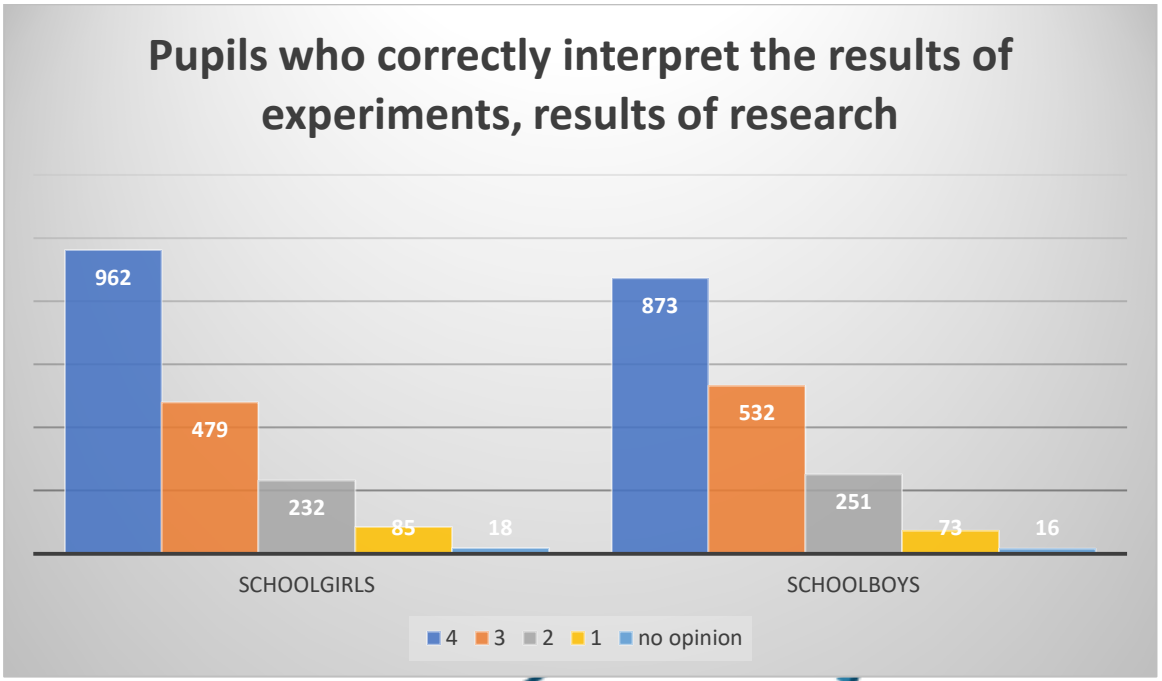
Remark: According to teachers' estimation there is an equal percentage of girls and boys who can "definitely explain" external phenomena:

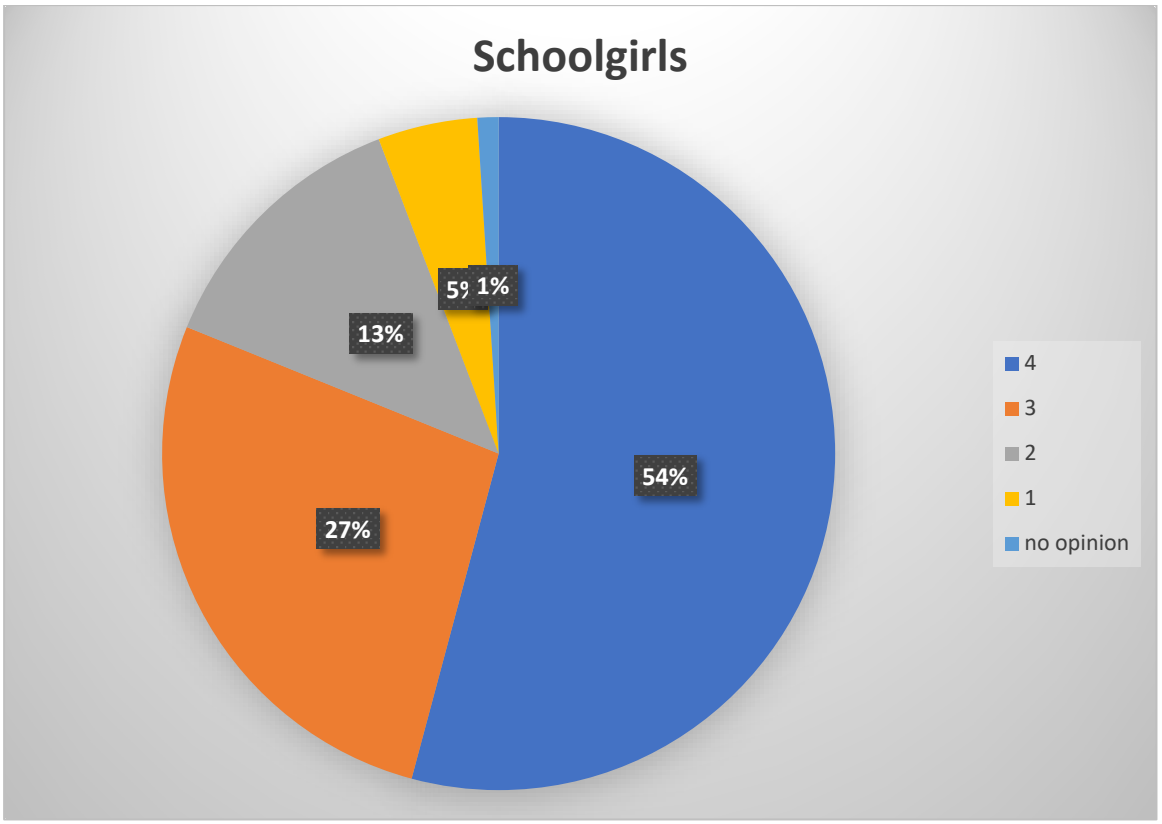
1) girls: 800 (46% of all girls), 2) boys: 762 (46% of all boys). If one takes the total of girls and boys teachers expressed opinions about, 800 girls represent 23% of the total of pupils and 762 boys 22%.

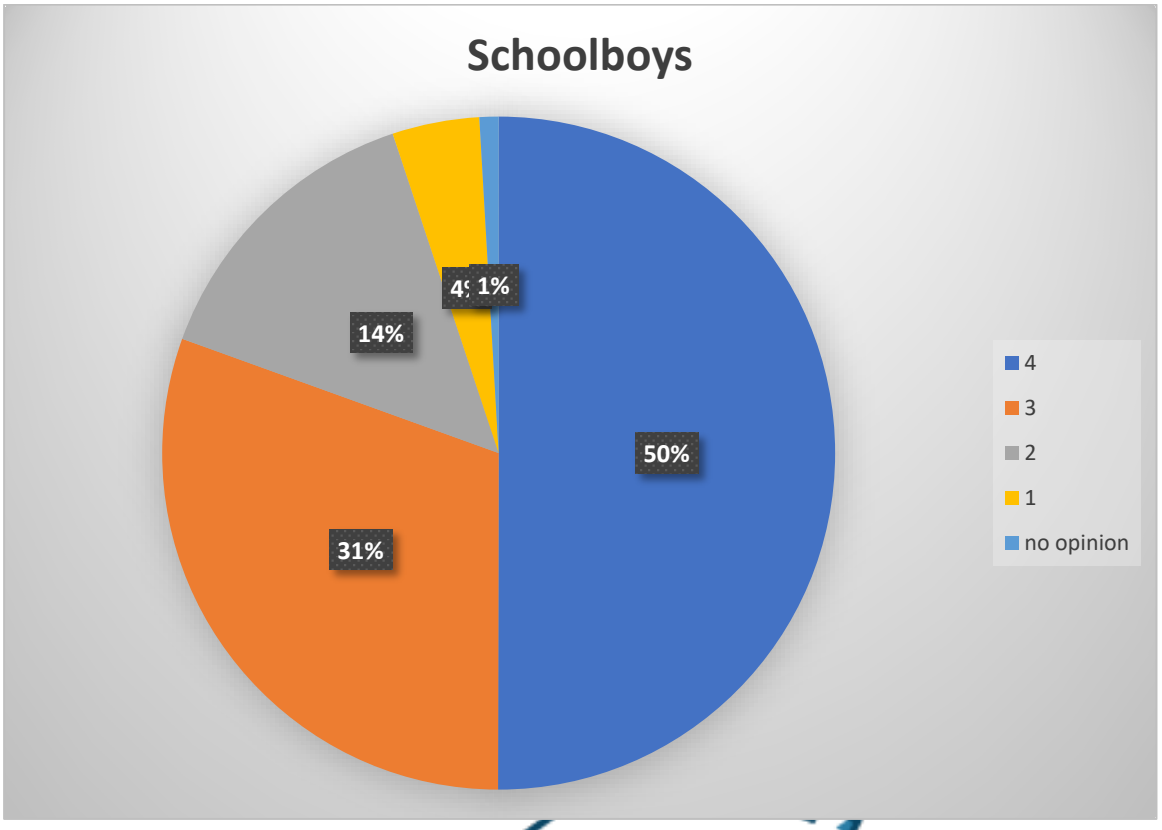
INTERPRETATION AND COMMUNICATION OF INFORMATION

1. Do your pupils correctly interpret the results of experiments, results of research? Please put the proper number of schoolgirls and schoolboys that match to the given answers.

	Schoolgirls	Schoolboys
4 – Definitely yes	962	873
3 – Rather yes	479	432
2 – Rather no	232	251
1 – Definitely no	85	73
I have no opinion	18	16




Schoolgirls
54%
27%
13%
5% 1%
4
3
2
1
no opinion

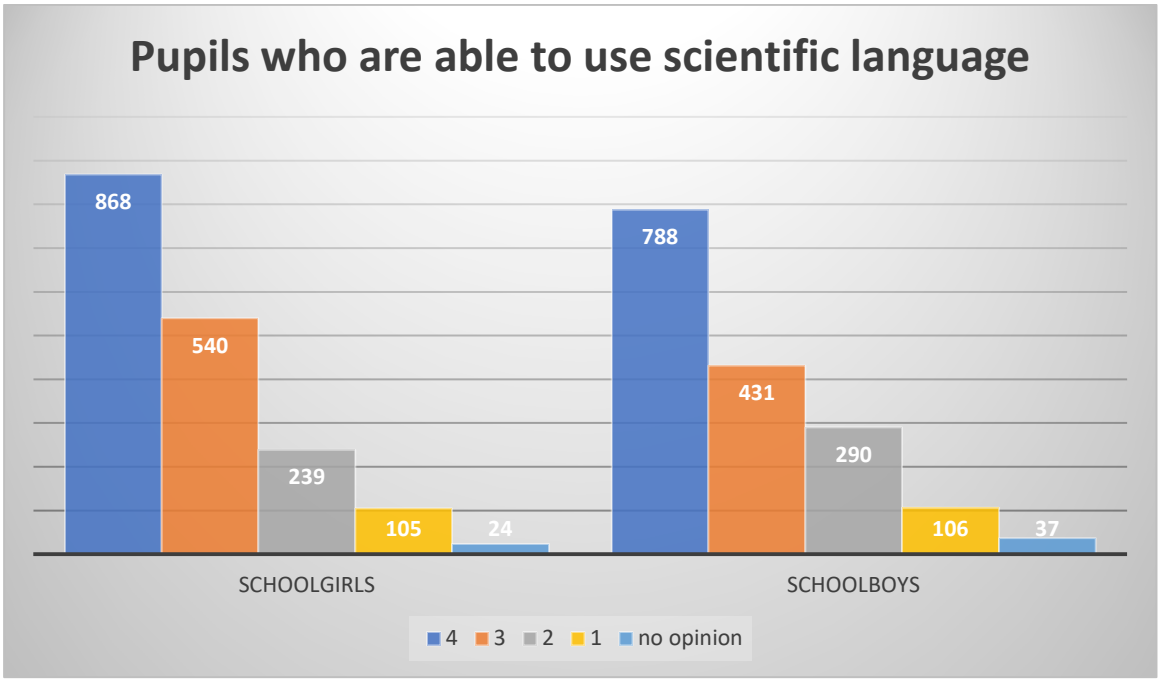

Schoolboys
50%
31%
14%
4% 1%
4
3
2
1
no opinion

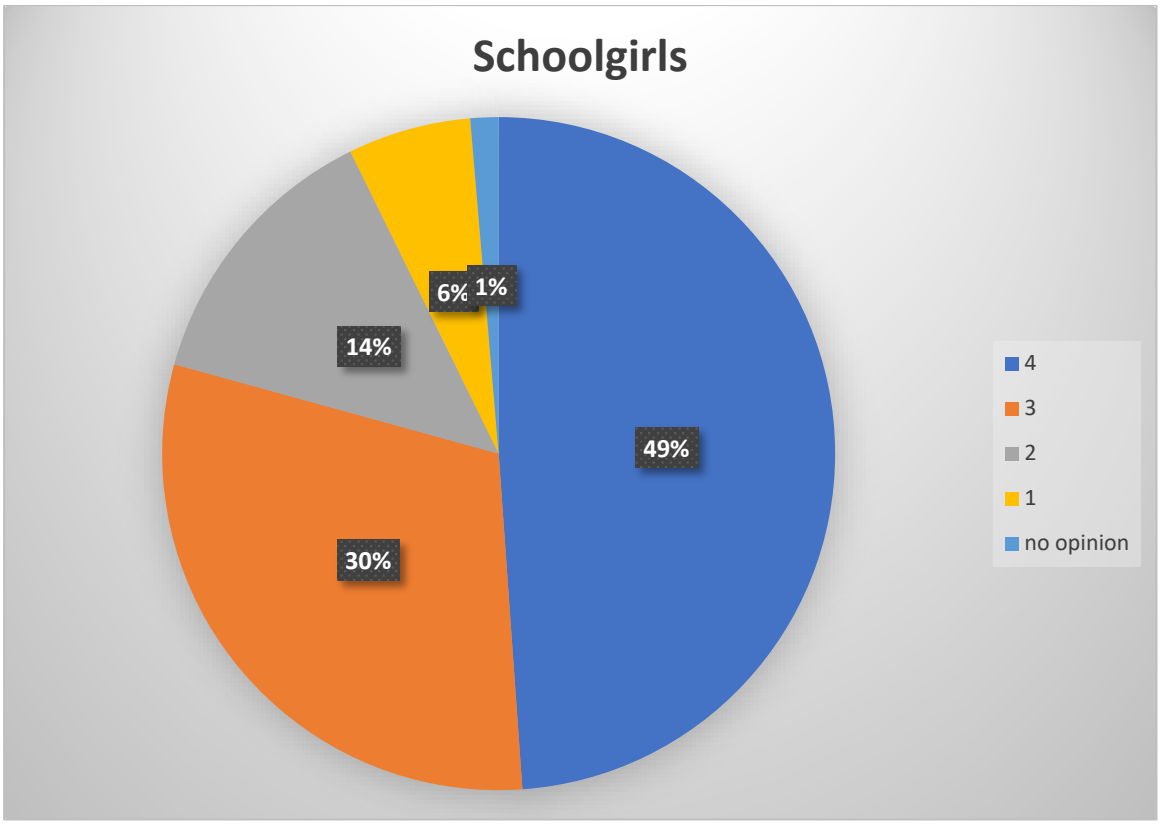
Remark: Teachers esteemed that more girls than boys “definitely correctly interpret“ the results of experiments and research:

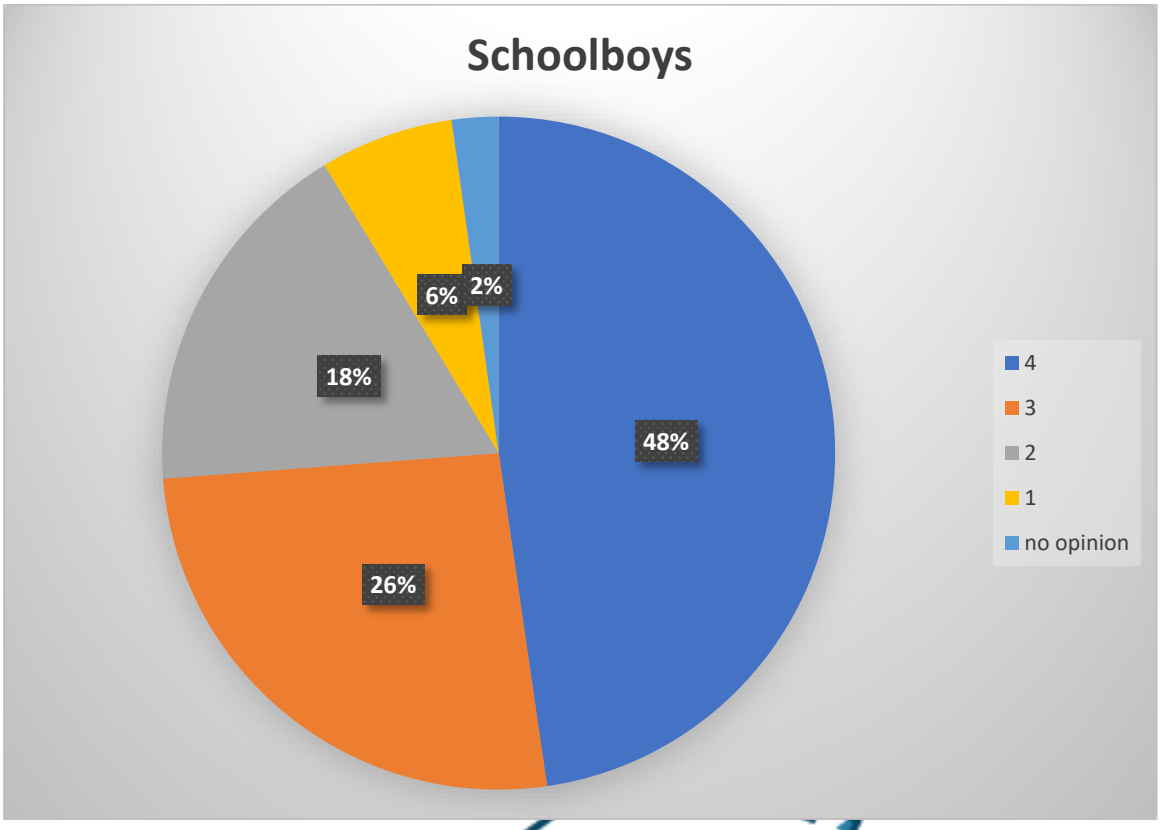
1) girls: 962 (54% of all girls), 2) boys: 873 (50% of all boys). If one takes the total of girls and boys teachers expressed opinions about, 962 girls represent 28% of the total of pupils and 873 boys 26%.

2. Are your pupils able to use scientific language, which you use in a class (e.g. use the same terminology)? Please put the proper number of schoolgirls and schoolboys that match to the given answers.

	Schoolgirls	Schoolboys
4 – Definitely are able	868	788
3 – Rather are able	540	431
2 – Rather are not able	239	290
1 – Definitely not able	105	106
I have no opinion	24	37




Schoolgirls
49%
30%
14%
6%
1%
4
3
2
1
no opinion


Schoolboys
48%
26%
18%
6%
2%
4
3
2
1
no opinion

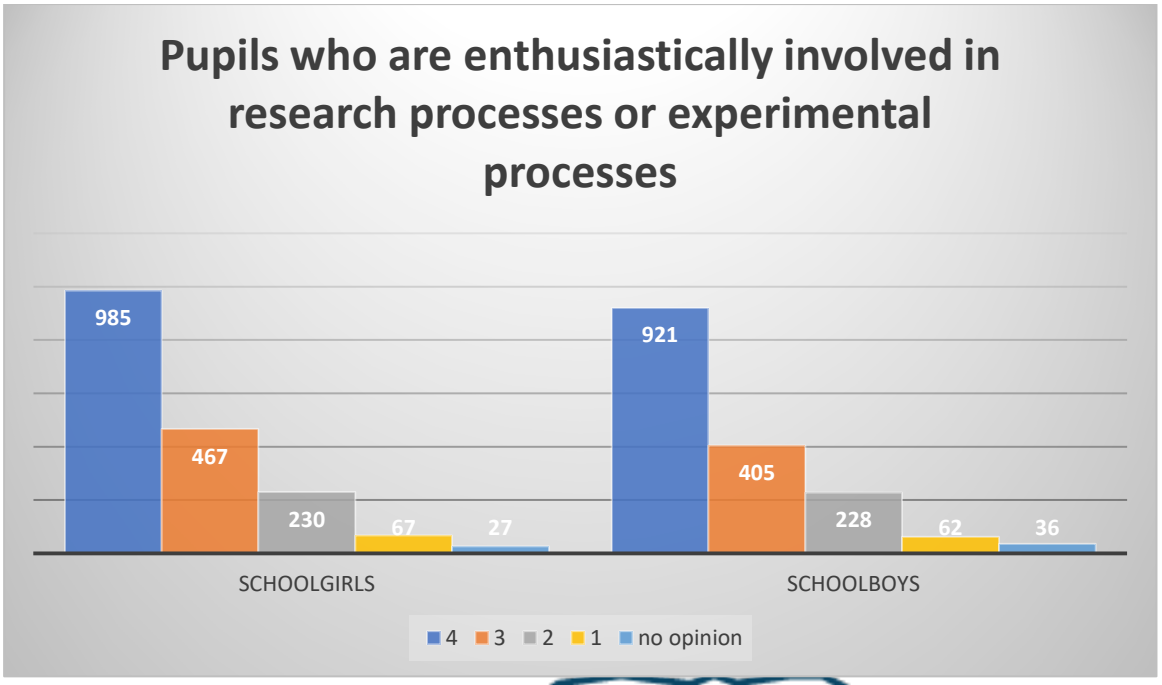
Remark: Teachers esteemed that more girls than boys “are definitely able“ to use scientific knowledge:

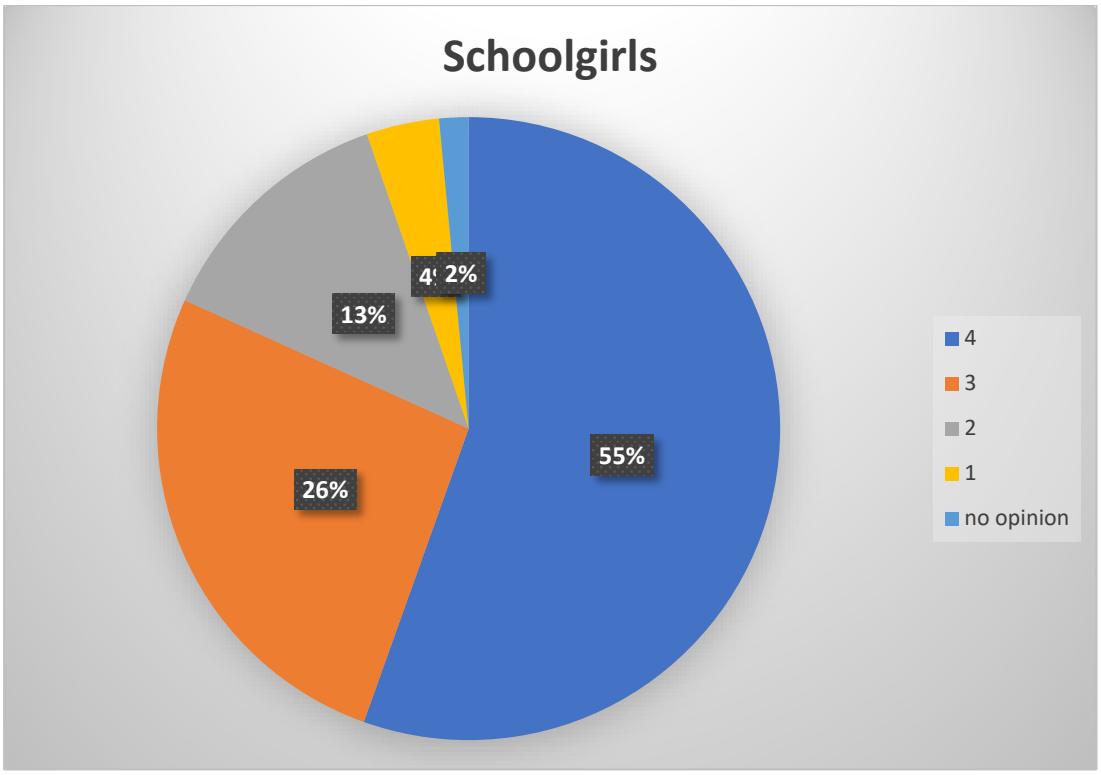
1) girls: 868 (49% of all girls), 2) boys: 788 (48% of all boys). If one takes the total of girls and boys teachers expressed opinions about, 868 girls represent 25% of the total of pupils and 788 boys 22%.

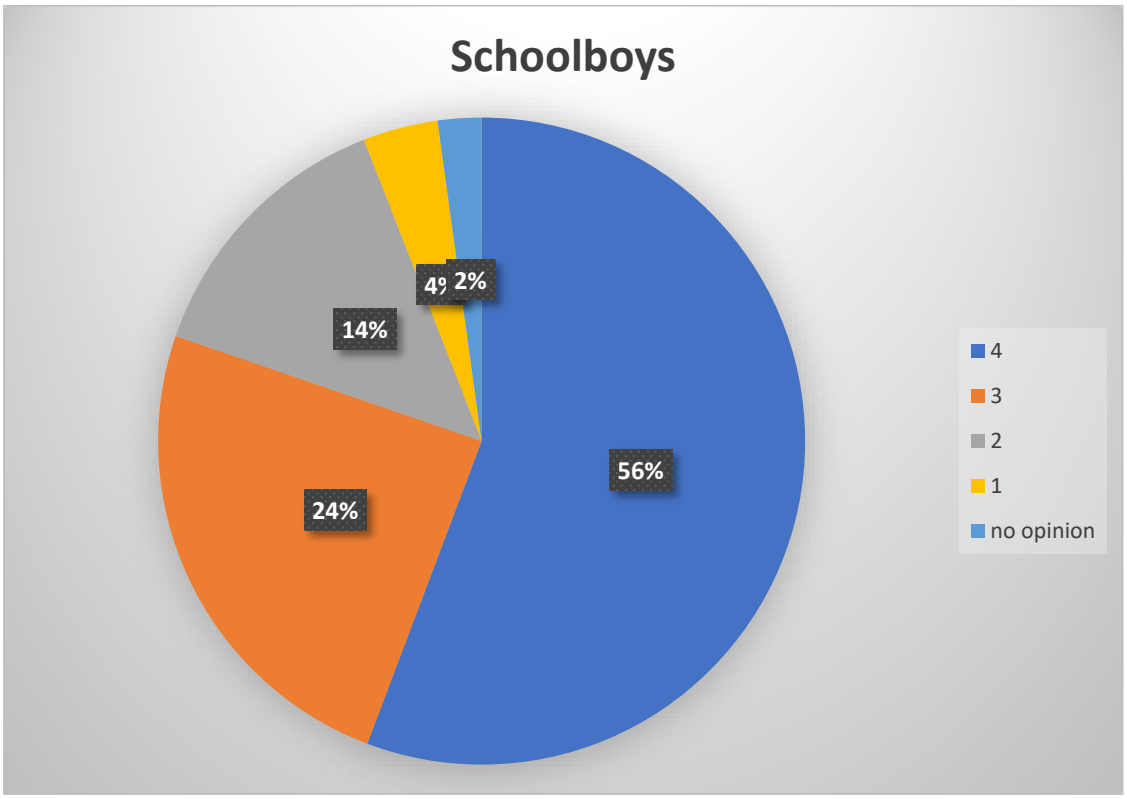
ENGAGE IN INQUIRY

1. Are your pupils enthusiastically involved in research processes or experimental processes which you propose during your lesson? Please put the proper number of schoolgirls and schoolboys that match to the given answers.

	Schoolgirls	**Schoolboys**
4 – Definitely are involved	985	921
3 – Rather are involved	467	405
2 – Rather are not involved	230	228
1 – Definitely not involved	67	62
I have no opinion	27	36





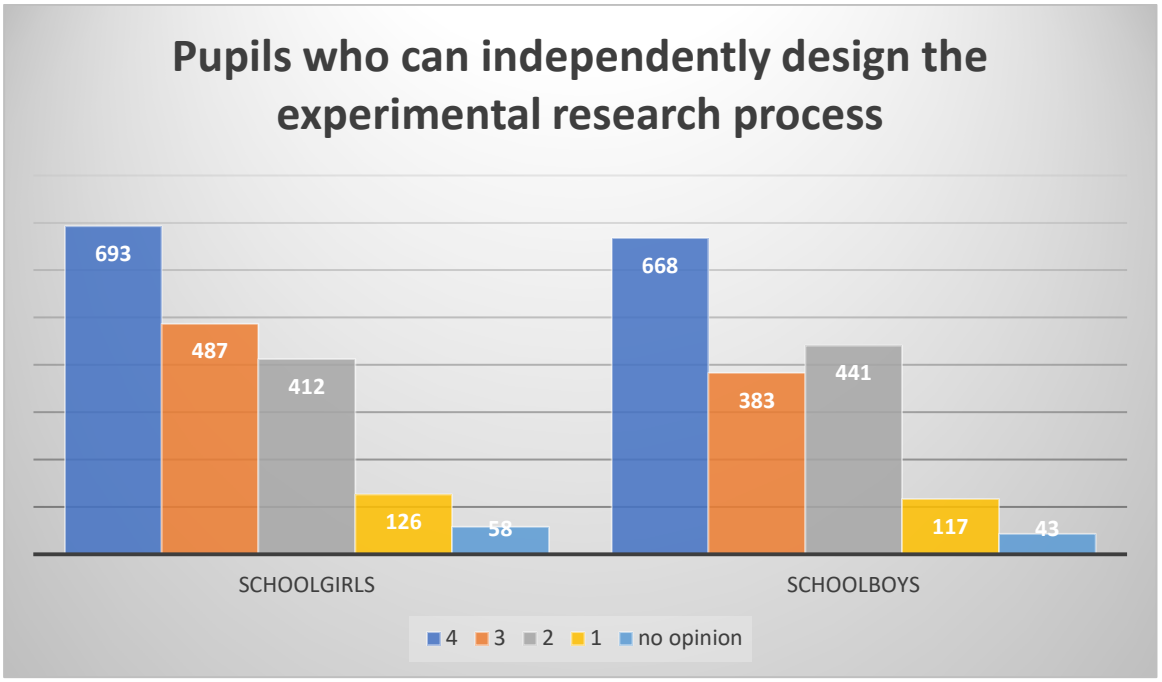


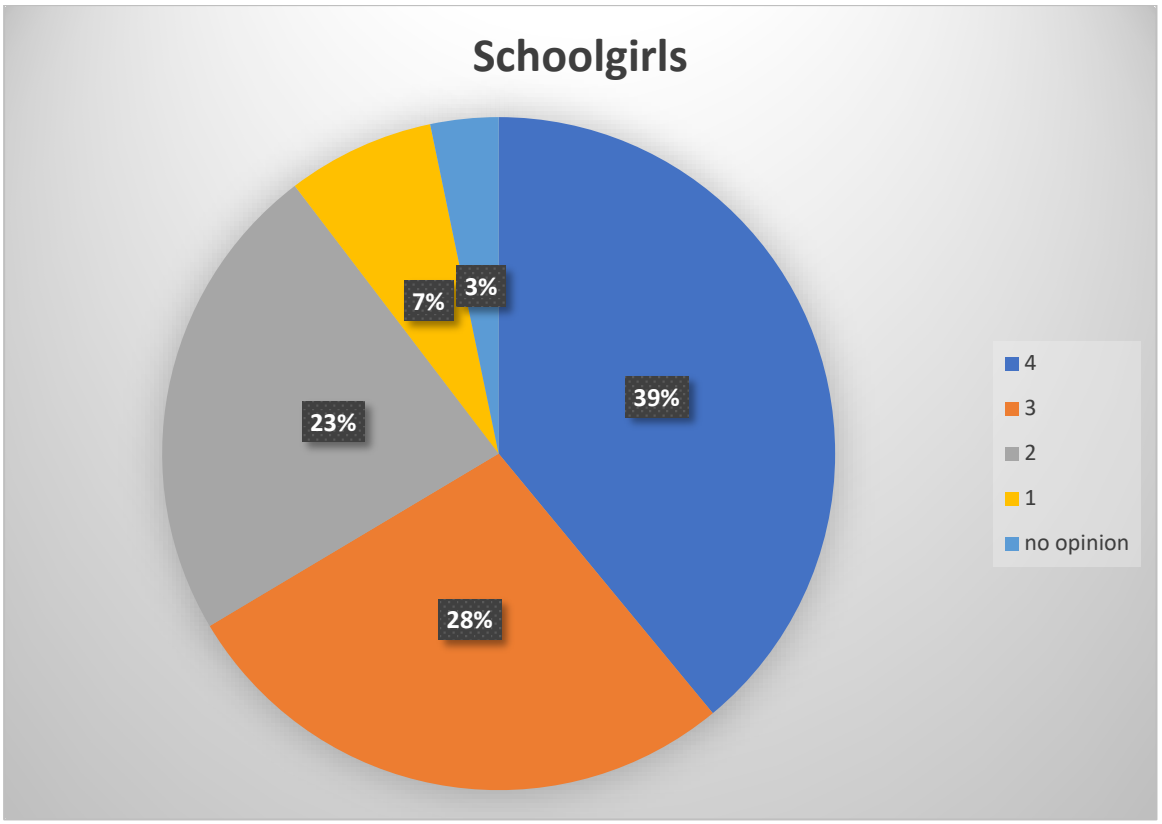
Remark: Teachers esteem that relatively more boys than girls “are definitely enthusiastically involved “ in research processes or experimental processes:

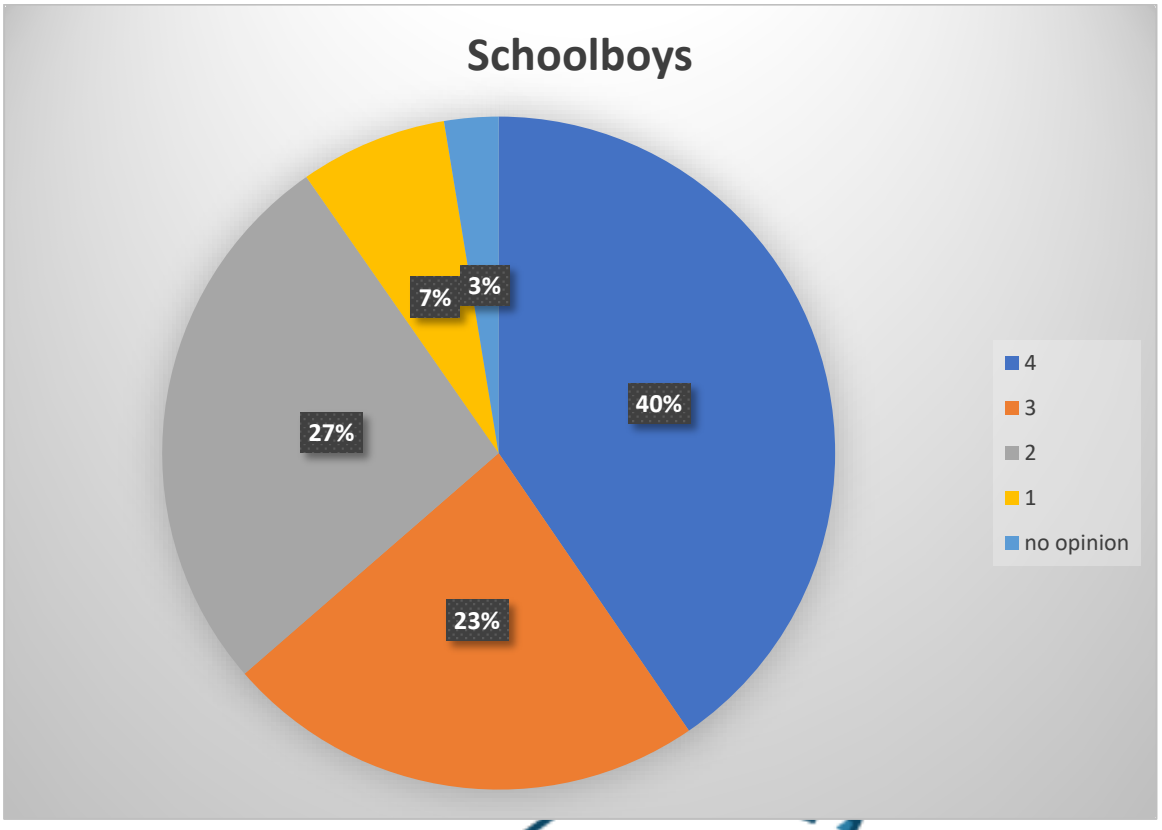
1) girls: 985 (55% of all girls), 2) boys: 921 (56% of all boys). If one takes the total of girls and boys teachers expressed opinions about, 985 girls represent 29% of the total of pupils and 921 boys 27%.

2. Do your pupils independently design the experimental, research process? Please put the proper number of schoolgirls and schoolboys that match to the given answers.

	Schoolgirls	Schoolboys
4 – Definitely designed	693	668
3 – Rather designed	487	383
2 – Rather do not designed	412	441
1 – Definitely do not designed	126	117
I have no opinion	58	43




Schoolgirls
39%
28%
23%
7%
3%
4
3
2
1
no opinion


Schoolboys
40%
23%
27%
7%
3%
4
3
2
1
no opinion

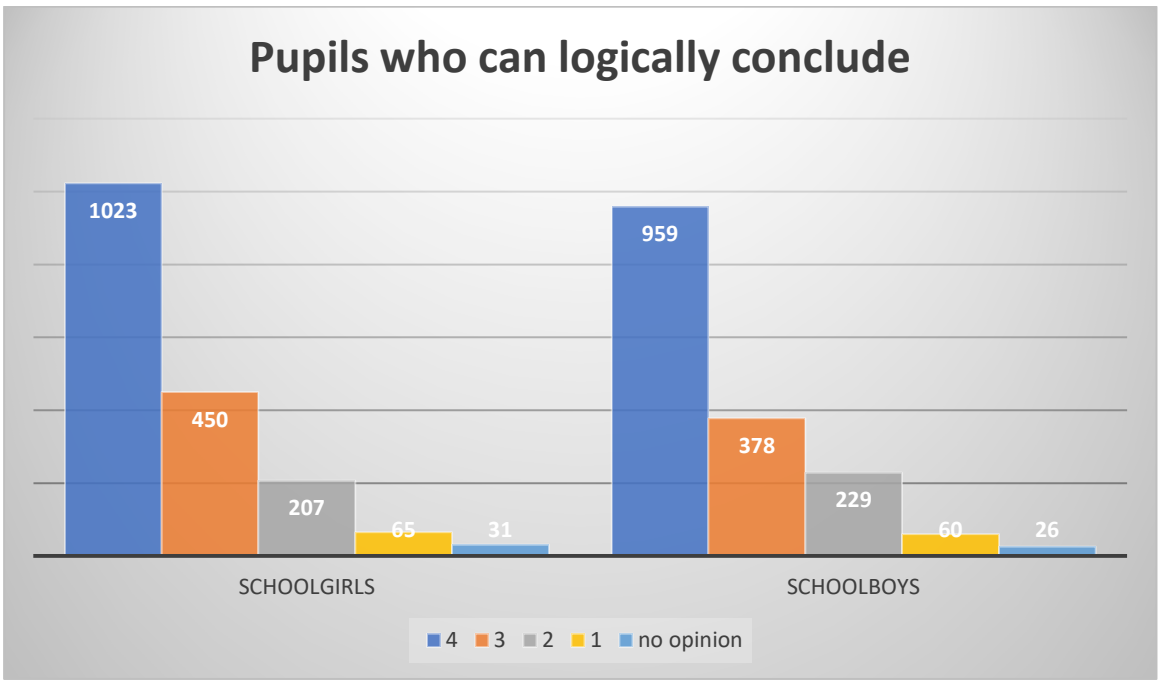
Remark: Teachers esteem that relatively more boys than girls “independently design“ the experimental or research processes:

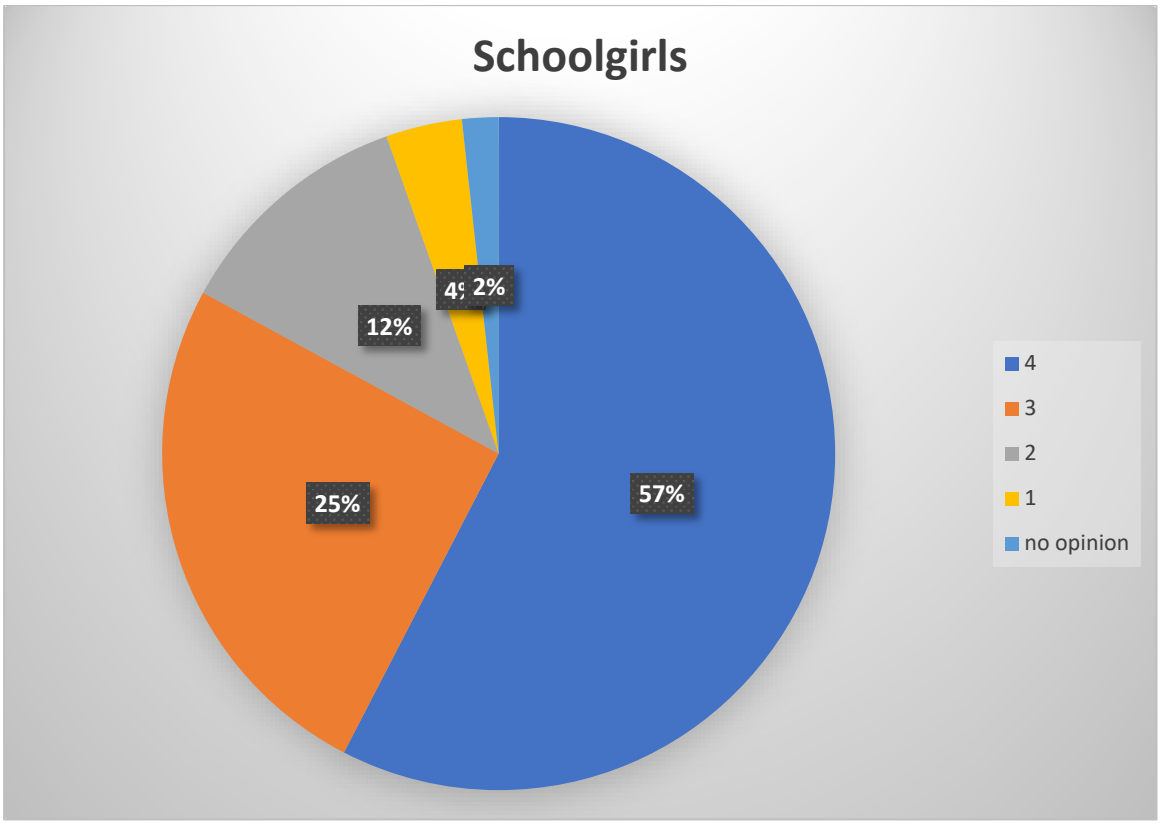
1) girls: 693 (39% of all girls), 2) boys: 668 (40% of all boys). If one takes the total of girls and boys teachers expressed opinions about, 693 girls represent 20% of the total of pupils and 668 boys 19%.

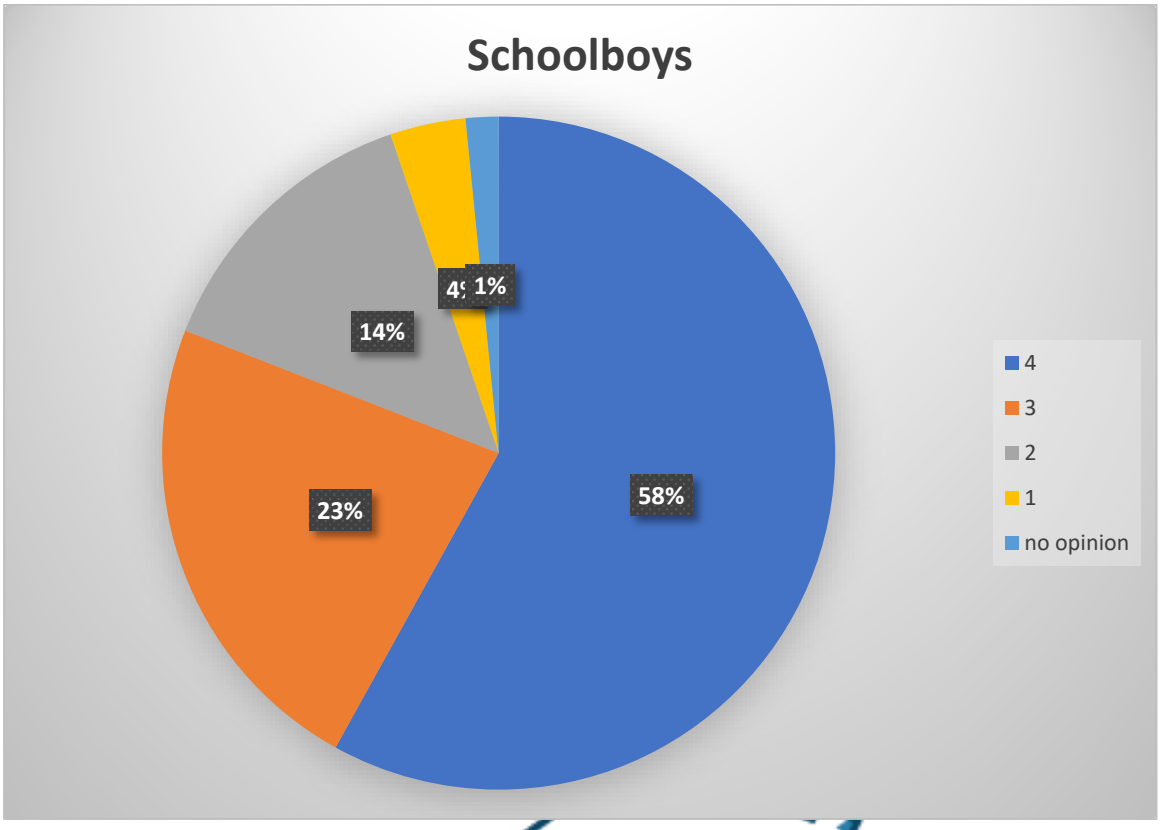
ENGAGE IN LOGICAL REASONING

1. Can your pupils logically conclude? Please put the proper number of schoolgirls and schoolboys that match to the given answers.

	Schoolgirls	**Schoolboys**
4 – Definitely can	1023	959
3 – Rather can	450	378
2 – Rather cannot	207	229
1 – Definitely cannot	65	60
I have no opinion	31	26







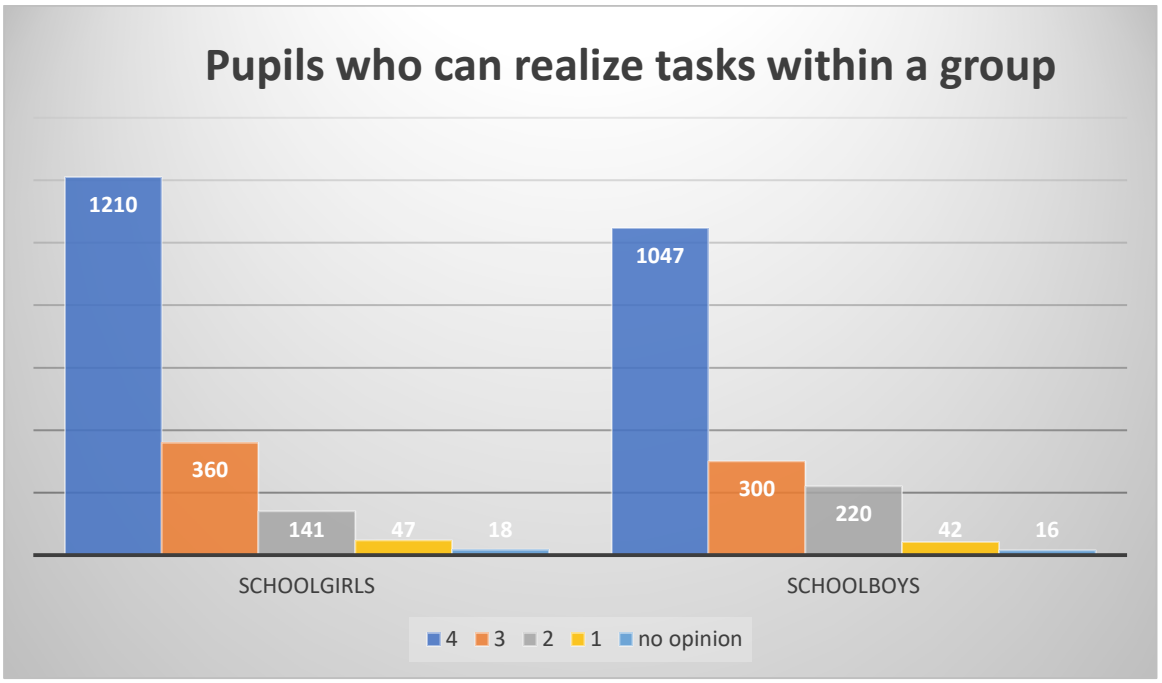
Remark: Teachers esteemed that more boys than girls “definitely can“ logically conclude:

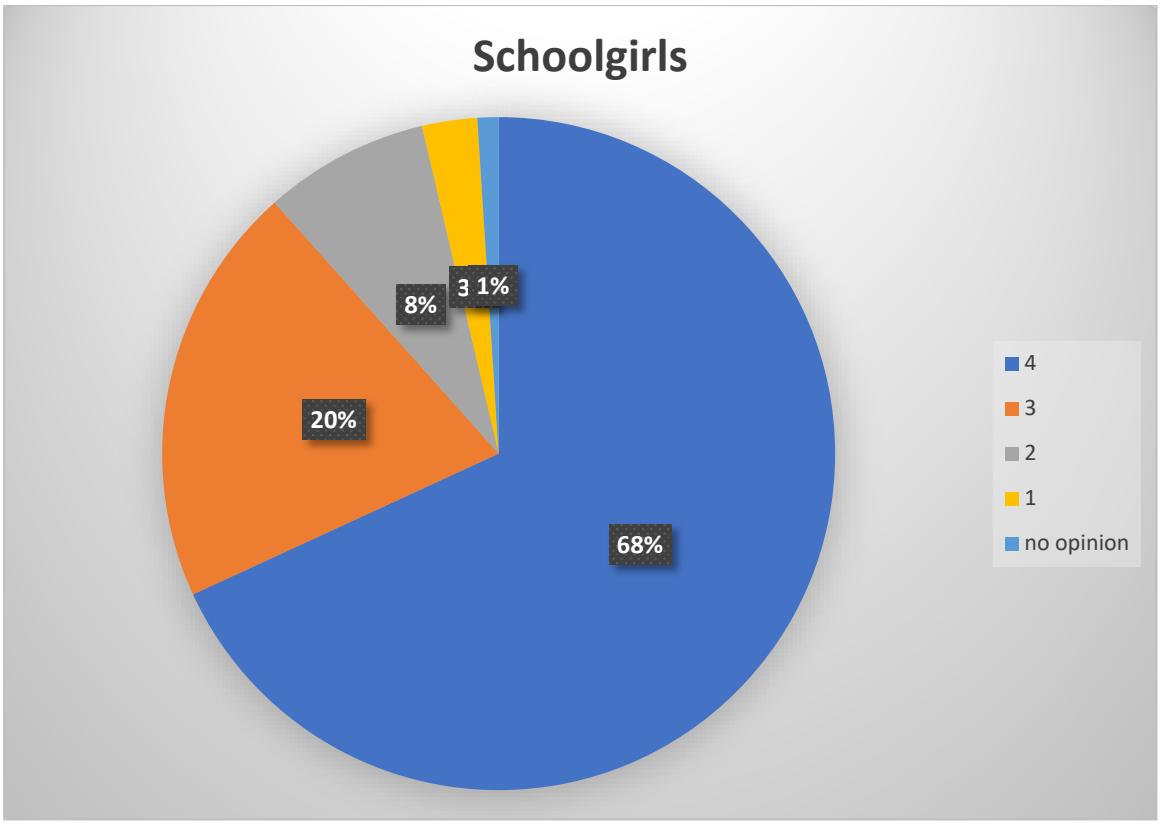
1) girls: 1023 (57% of all girls), 2) boys: 959 (58% of all boys). If one takes the total of girls and boys teachers expressed opinions about, 1023 girls represent 30% of the total of pupils and 959 boys 28%.

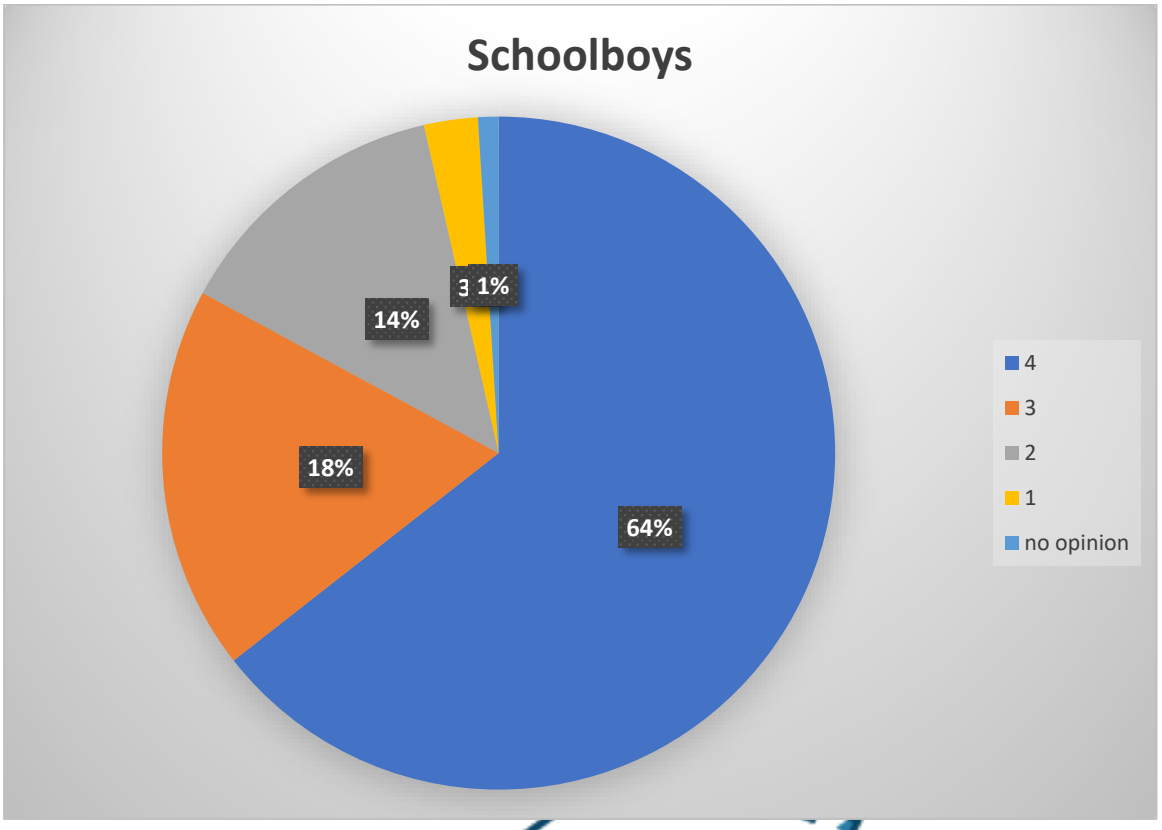
COLLABORATE AS A TEAM

1. Can your pupils realize tasks within group? Please put the proper number of schoolgirls and schoolboys that match to the given answers.

	Schoolgirls	Schoolboys
4 – Definitely can	1210	1047
3 – Tend to be able	360	300
2 – Tend not to be able	141	220
1 – Definitely cannot	47	42
I have no opinion	18	16




Schoolgirls
3 1%
8%
20%
68%
4
3
2
1
no opinion

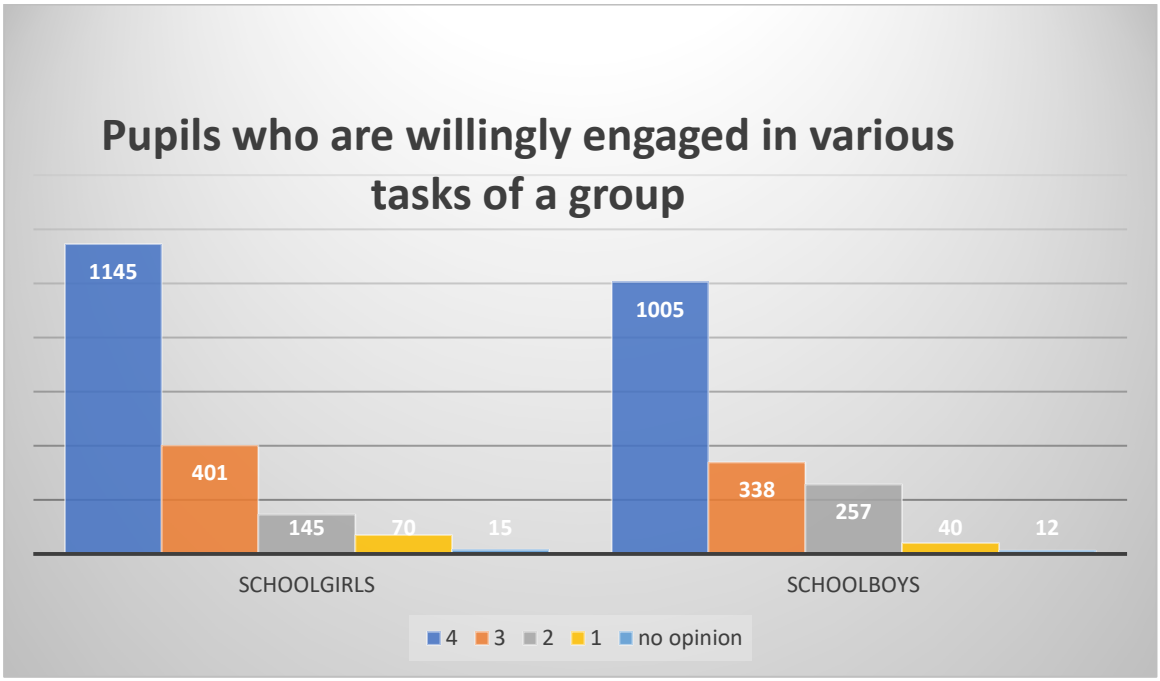

Schoolboys
3 1%
14%
18%
64%
4
3
2
1
no opinion

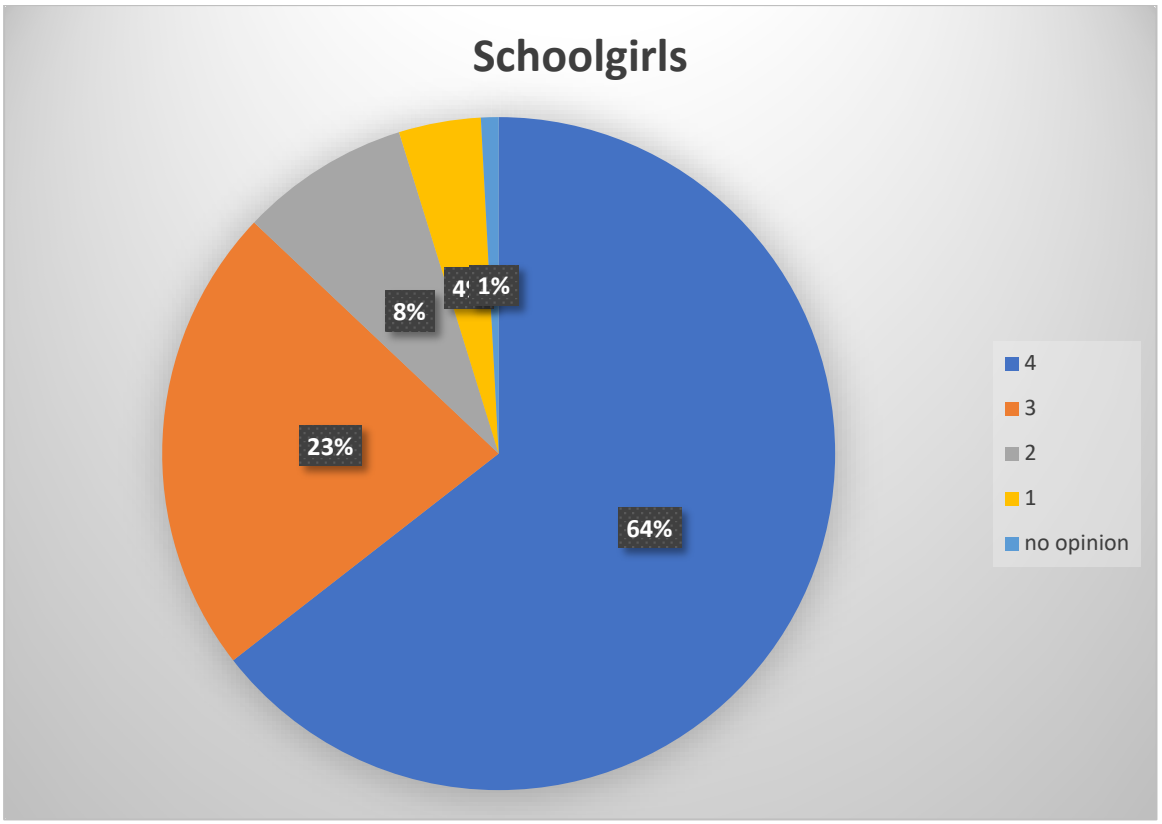
Remark: Teachers esteem that more girls than boys “definitely can“ realize more tasks in a group:

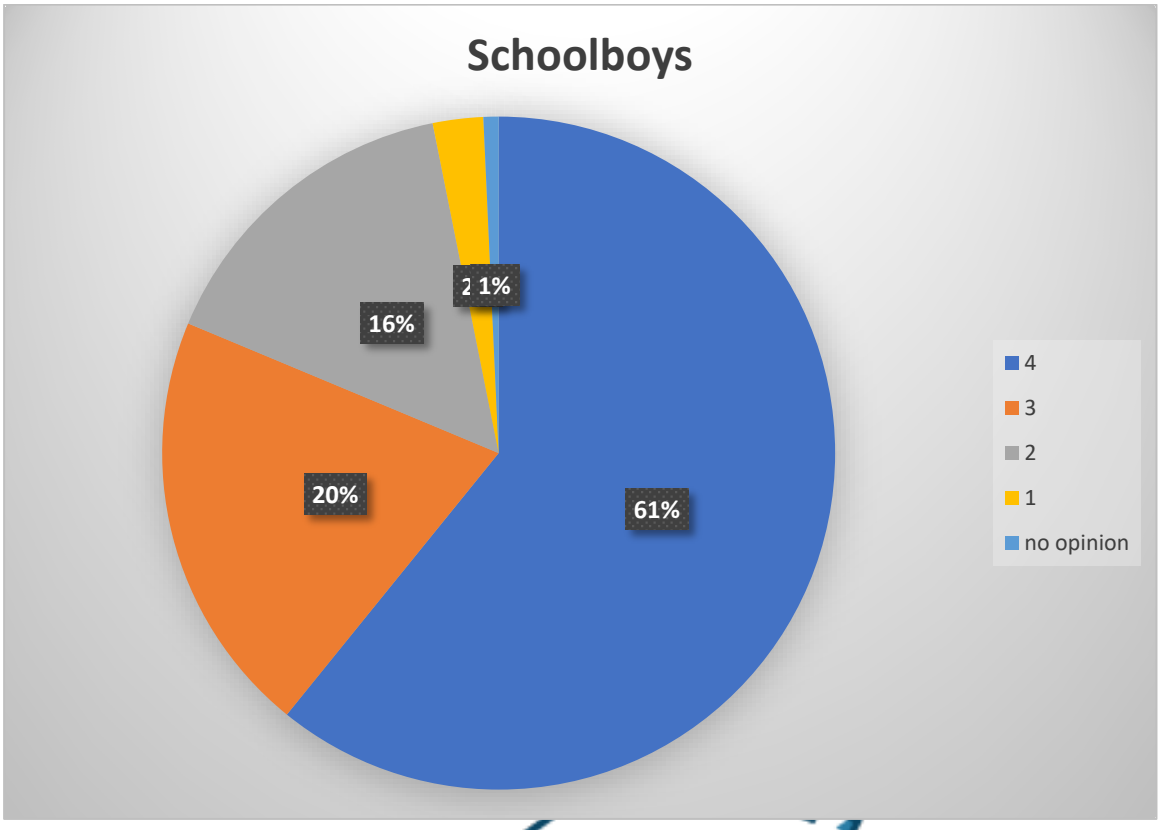
1) girls: 1210 (68% of all girls), 2) boys: 1047 (64% of all boys). If one takes the total of girls and boys teachers expressed opinions about, 1210 girls represent 35% of the total of pupils and 1047 boys 30%.

2. Are your pupils willingly engaged in various of tasks within group? Please put the proper number of schoolgirls and schoolboys that match to the given answers

	Schoolgirls	**Schoolboys**
4 – Definitely engaged	1145	1005
3 – Tend to be engaged	401	338
2 – Tend not to engaged	145	257
1 – Definitely are not engaged	70	40
I have no opinion	15	12




Schoolgirls
64%
23%
8%
4 1%
4
3
2
1
no opinion


Schoolboys
61%
20%
16%
2 1%
4
3
2
1
no opinion

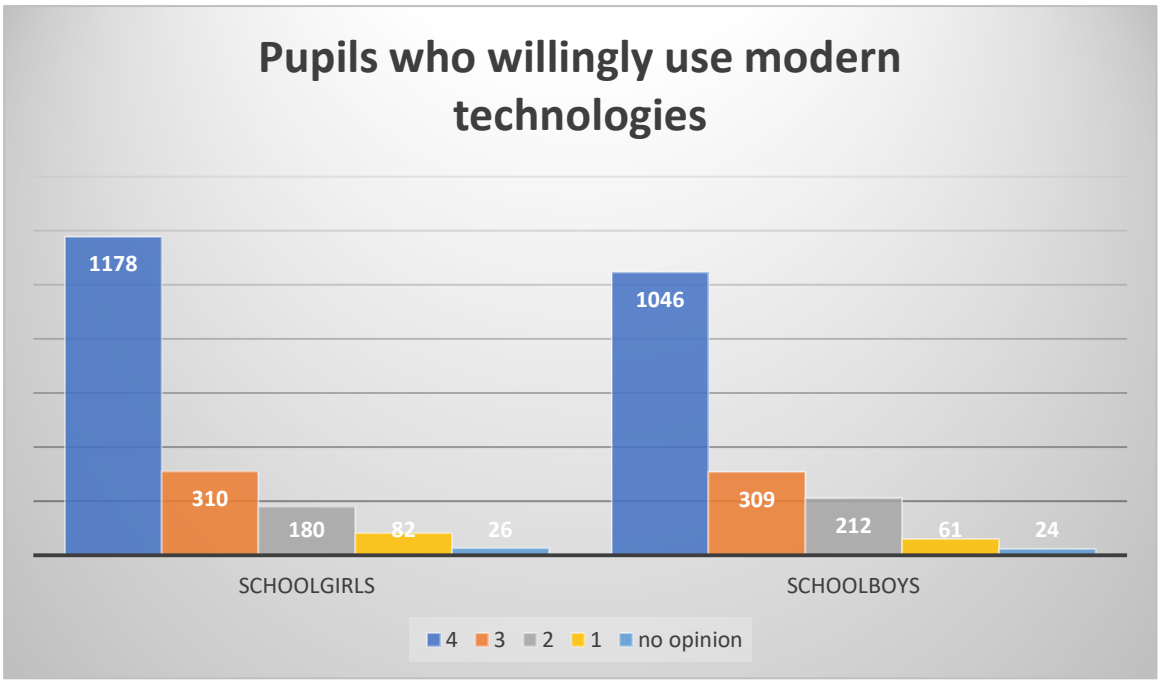
Remark: Teachers esteemed that more girls than boys “definitely can“ realize more tasks in a group:

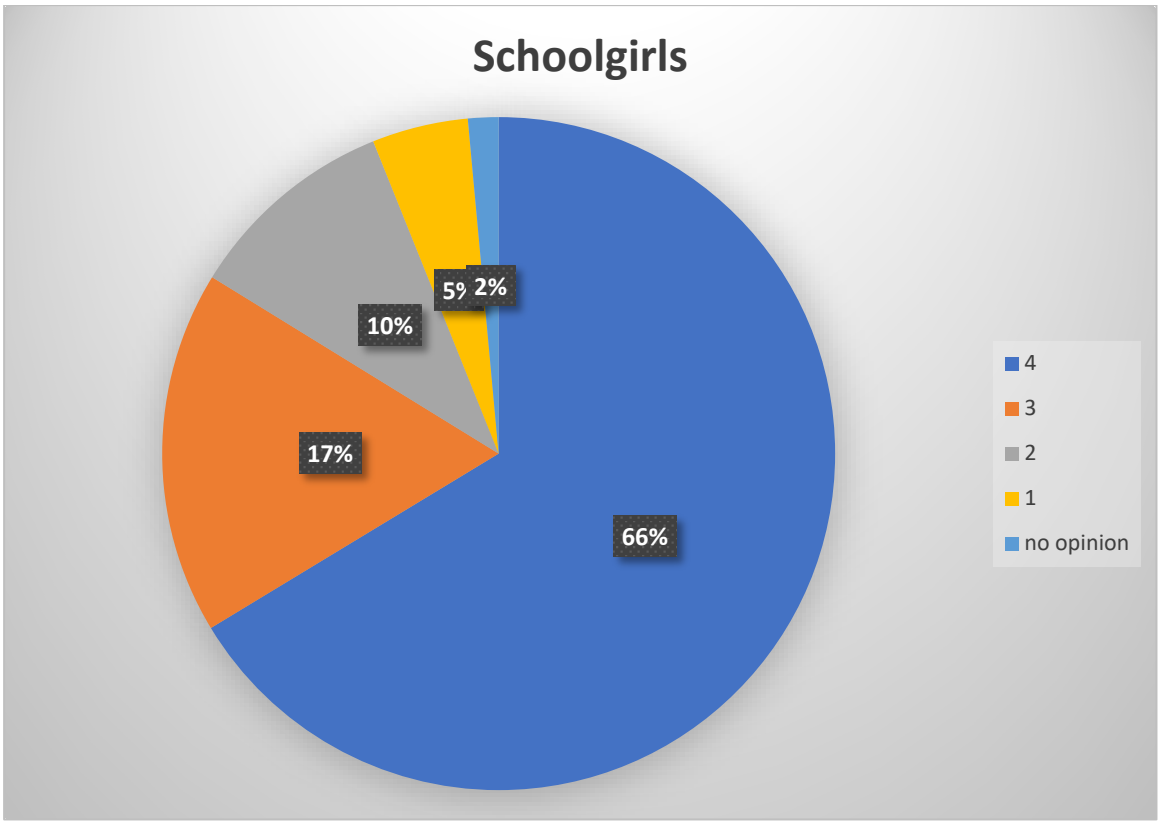
1) girls: 1145 (64% of all girls), 2) boys: 1005 (61% of all boys). If one takes the total of girls and boys teachers expressed opinions about, 1145 girls represent 33% of the total of pupils and 1005 boys 29%.

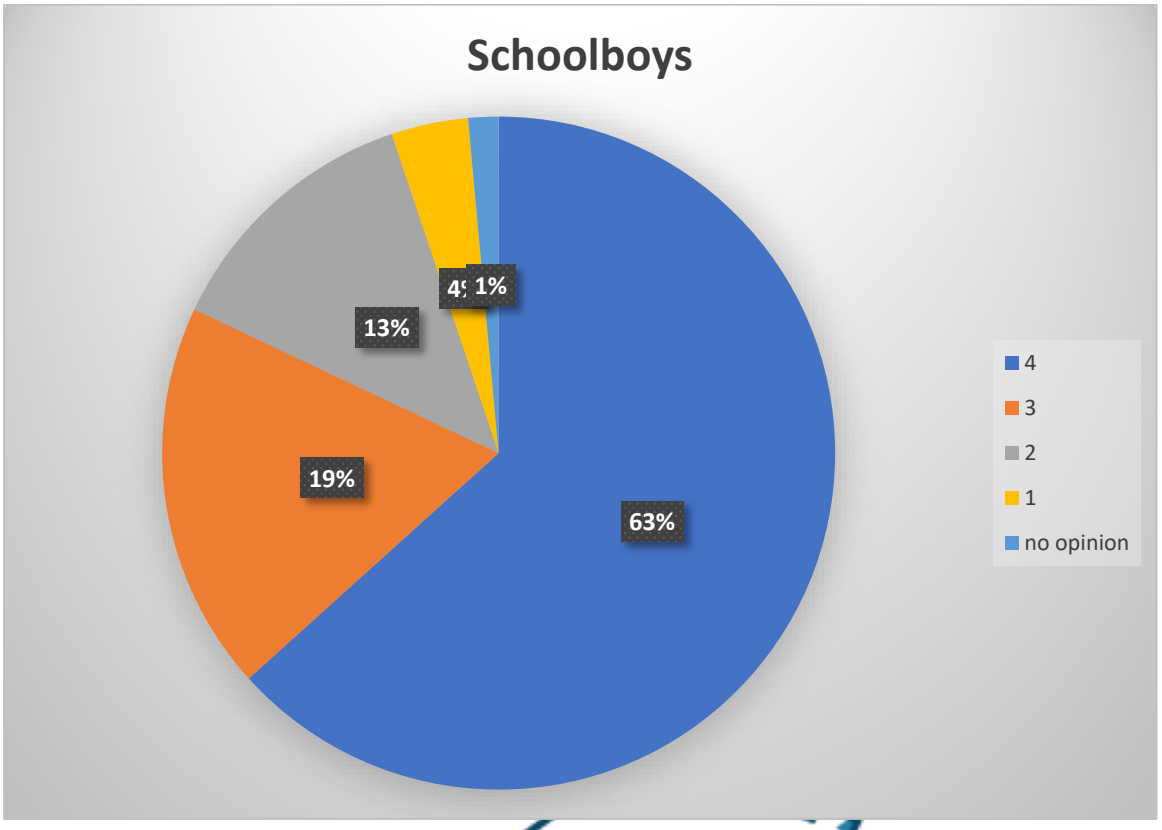
APPLY TECHNOLOGY APPROPRIATELY

1. Do your pupils willingly use modern technologies in order to learn? Please put the proper number of schoolgirls and schoolboys that match to the given answers.

	Schoolgirls	Schoolboys
4 – Definitely do so	1178	1046
3 – Tend to	310	309
2 – Tend not to	180	212
1 – Definitely are not use	82	61
I have no opinion	26	24




Schoolgirls
5% 2%
10%
17%
66%
4
3
2
1
no opinion

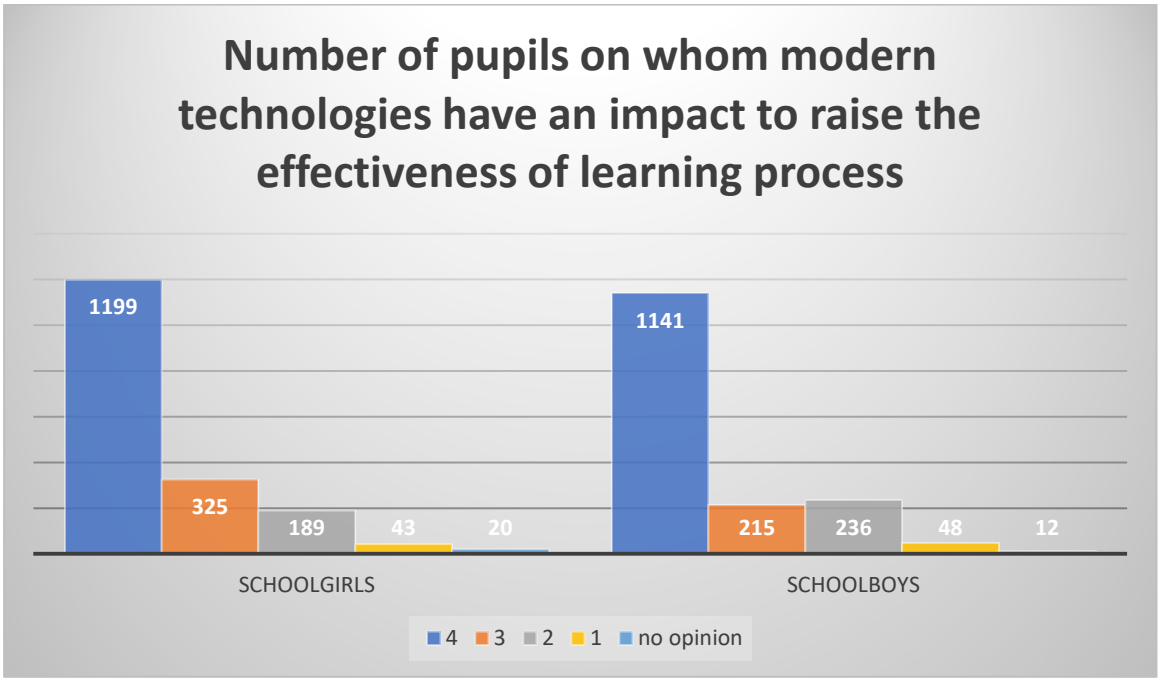

Schoolboys
4% 1%
13%
19%
63%
4
3
2
1
no opinion

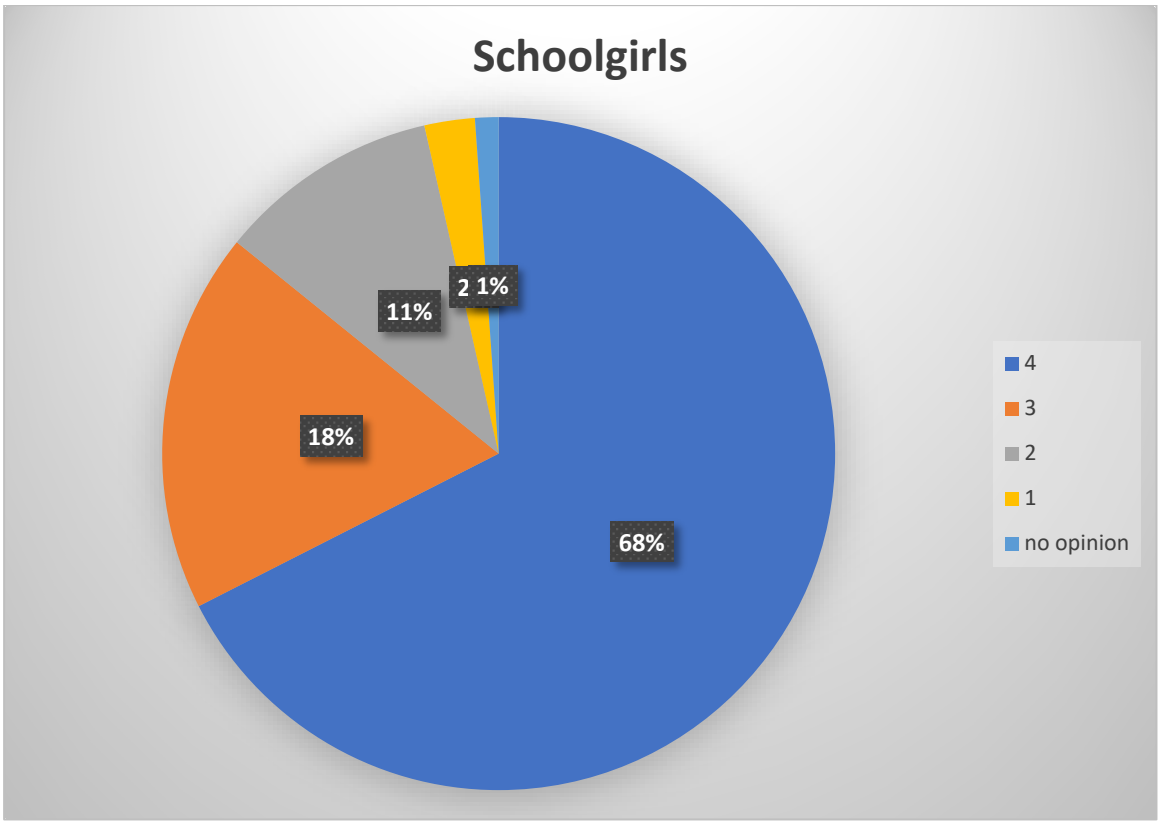
Remark: Teachers esteemed that more girls than boys “definitely use“ more willingly modern technologies:

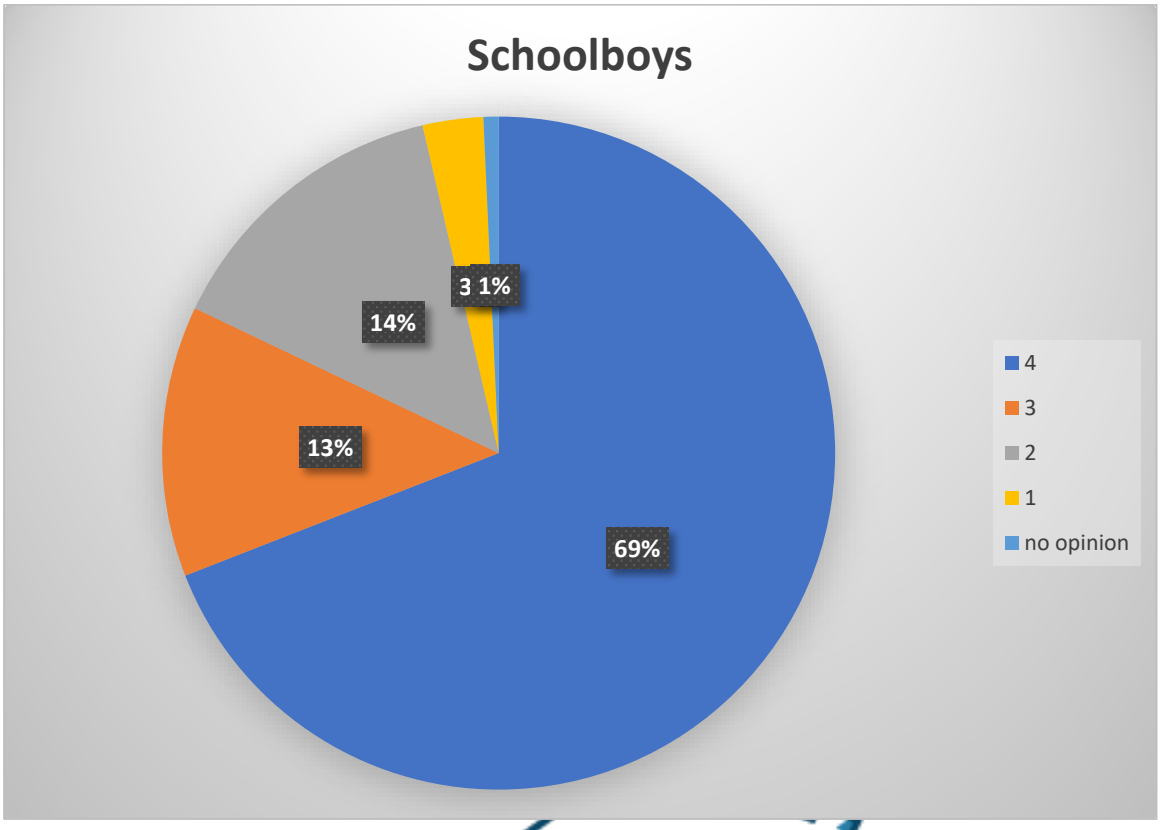
1) girls: 1178 (66% of all girls), 2) boys: 1046 (63% of all boys). If one takes the total of girls and boys teachers expressed opinions about, 1178 girls represent 34% of the total of pupils and 1046 boys 30%.

2. Do you think modern technologies have an impact on raising the effectiveness of learning process among your pupils? Please select the most appropriate.

	Schoolgirls	Schoolboys
4 – Yes, definitely	1199	1141
3 – Quite	325	215
2 – Not very much	189	236
1 – Definitely no	43	48
I have no opinion	20	12




Schoolgirls
2 1%
11%
18%
68%
4
3
2
1
no opinion


Schoolboys
3 1%
14%
13%
69%
4
3
2
1
no opinion

Remark: Teachers esteemed that modern technologies “definitely“ have a stronger impact on raising the effectiveness of learning processes among boys than girls:

1) girls: 1199 (68% of all girls), 2) boys: 1141 (69% of all boys). If one takes the total of girls and boys teachers expressed opinions about, 1199 girls represent 35% of the total of pupils and 1141 boys 33%.

CATEGORY 2: KNOWLEDGE ABOUT SCIENCE AND SCIENTIFIC RESEARCH, AS WELL AS THEIR PLACE IN THE MODERN WORLD

1. Please find below specified elements of the research process. Please rate how well your pupils are able to realize each one of these.

Scroll down list with a single choice with marks from 1 to 4 and separate for schoolgirls and schoolboys. Please put the proper number of schoolgirls and schoolboys that match to the given answers.

Formulating research questions

Question:

Knowledge about formulating research questions and hypothesis (Can your pupils formulate questions? Can your pupils formulate objectives of research? Can your pupils justify formulated objectives of research?)

Choice and justification of the research hypotheses

Question:

Knowledge about applying adequate tools and methods to test the hypothesis (Are your pupils familiar with the scientific method of verification in the area of STEM? Do your pupils know examples of research in the area of STEM? Do your pupils have knowledge about searching for reliable sources of information about scientific method and tools? Can they use these scientific method and tools effectively?)

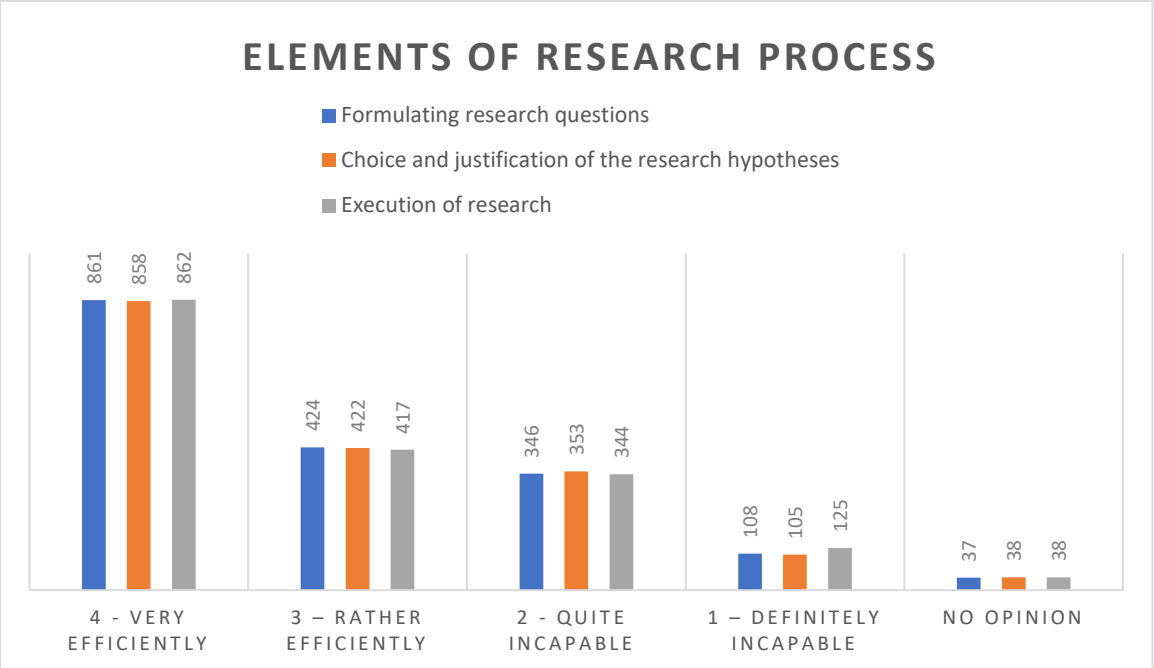
Execution of research

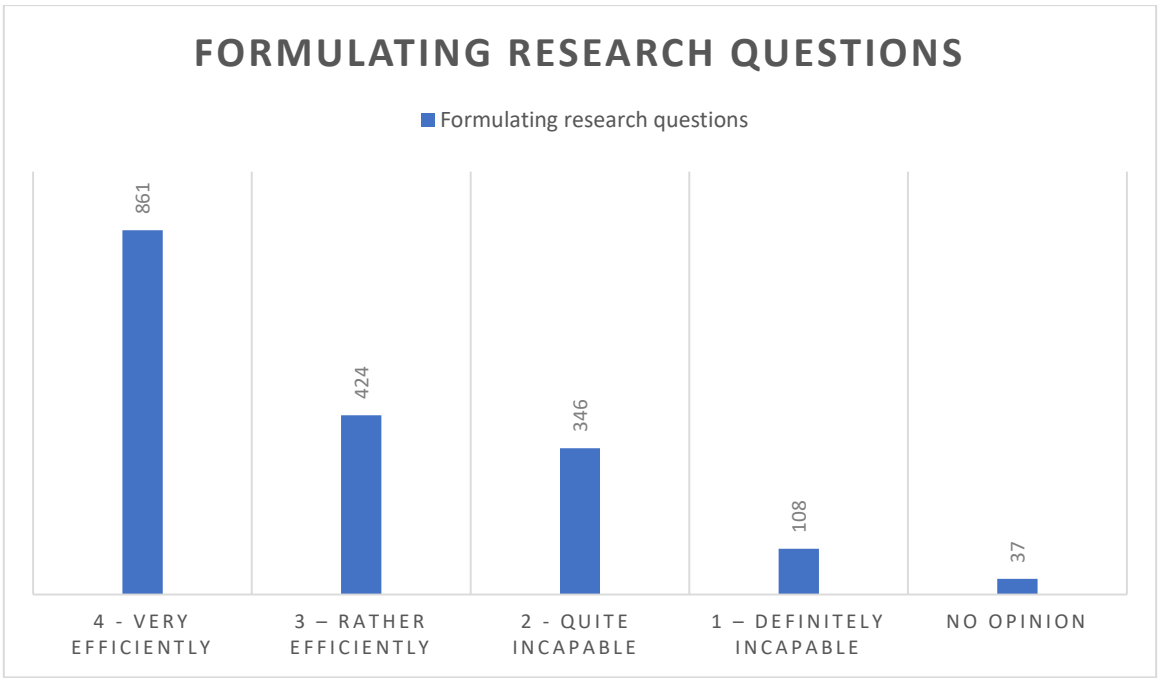
Question:

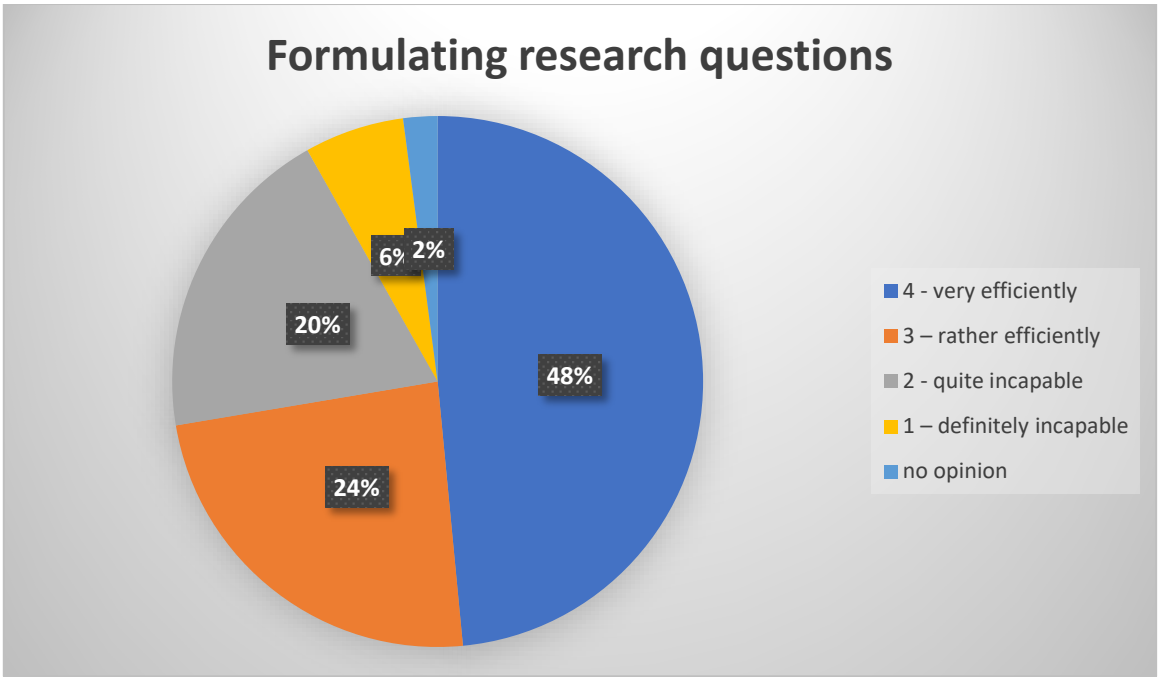
Can your pupils verify the quality of research results? (Whether the purpose, objective of the research was achieved, whether there is a need to another attempt, whether the resulting data are inconclusive or ambiguous?)

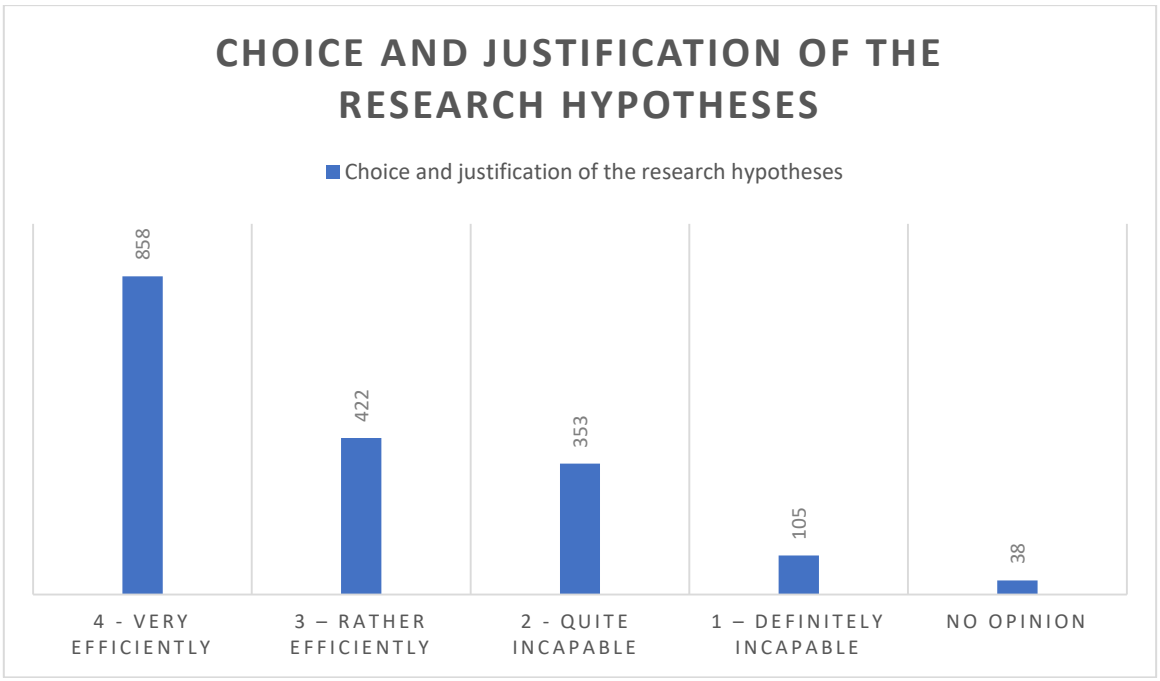
SCHOOLGIRLS

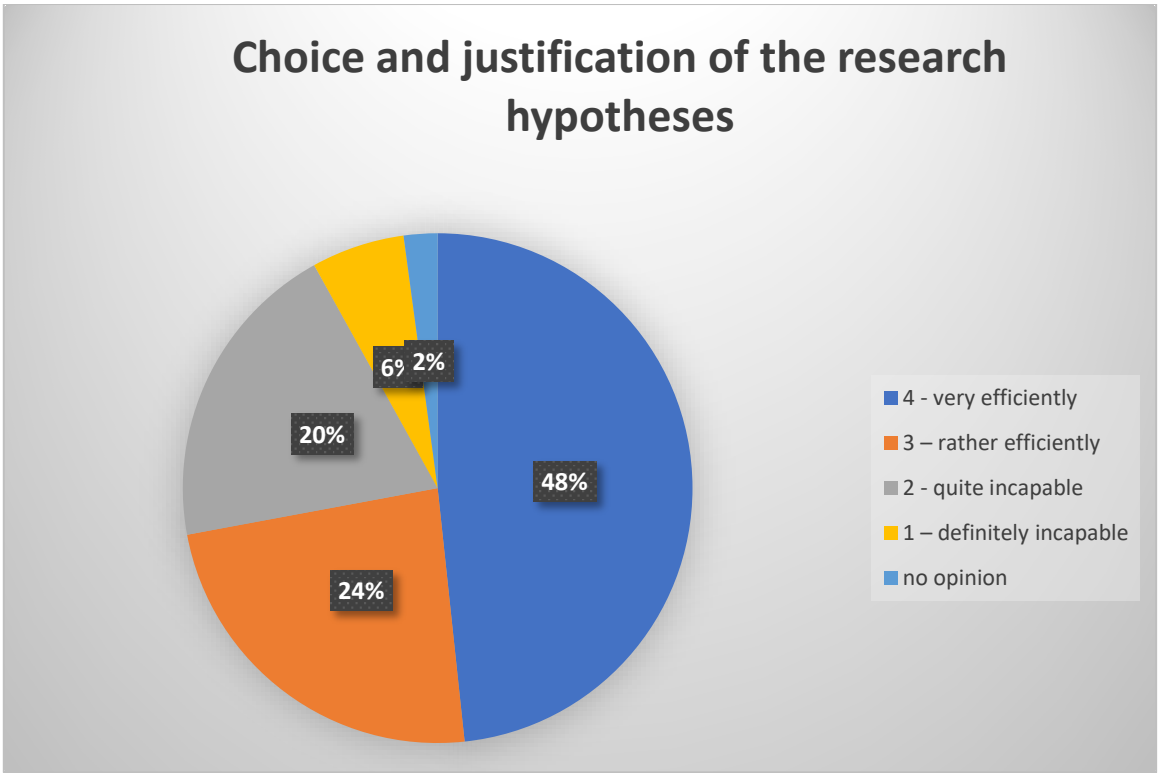
	Formulating research questions	Choice and justification of the research hypotheses	Execution of research
4 - very efficiently	861	858	862
3 – rather efficiently	424	422	417
2 - quite incapable	346	353	344
1 – definitely incapable	108	105	125
I have no opinion	37	38	38

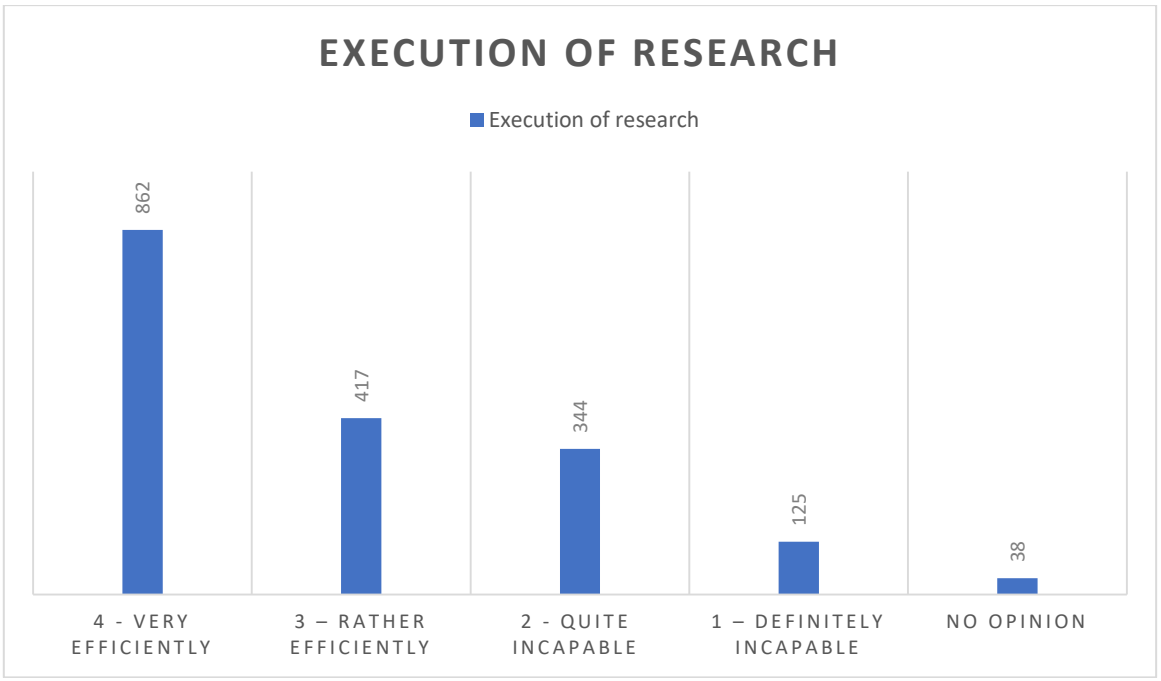


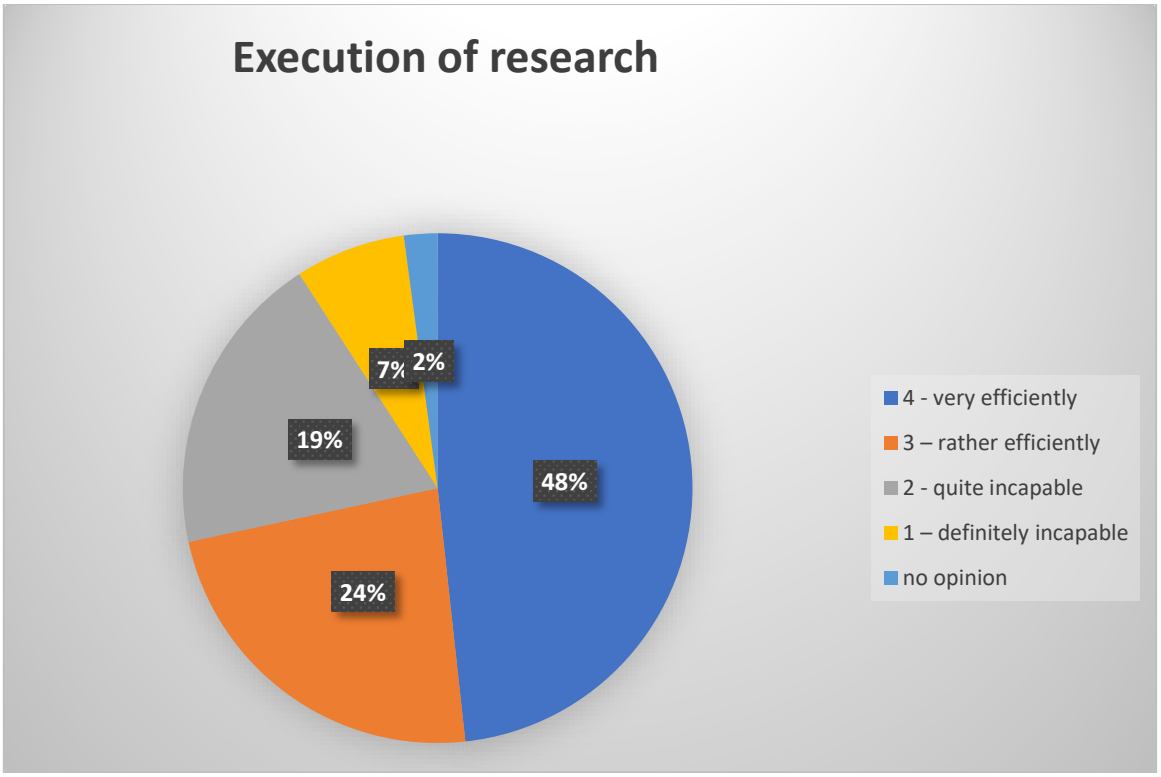

FORMULATING RESEARCH QUESTIONS
Formulating research questions
861
424
346
108
37
4 - VERY EFFICIENTLY
3 – RATHER EFFICIENTLY
2 - QUITE INCAPABLE
1 – DEFINITELY INCAPABLE
NO OPINION


Formulating research questions
48%
24%
20%
6%
2%
4 - very efficiently
3 – rather efficiently
2 - quite incapable
1 – definitely incapable
no opinion


CHOICE AND JUSTIFICATION OF THE RESEARCH HYPOTHESES
Choice and justification of the research hypotheses
858
422
353
105
38
4 - VERY EFFICIENTLY
3 – RATHER EFFICIENTLY
2 - QUITE INCAPABLE
1 – DEFINITELY INCAPABLE
NO OPINION

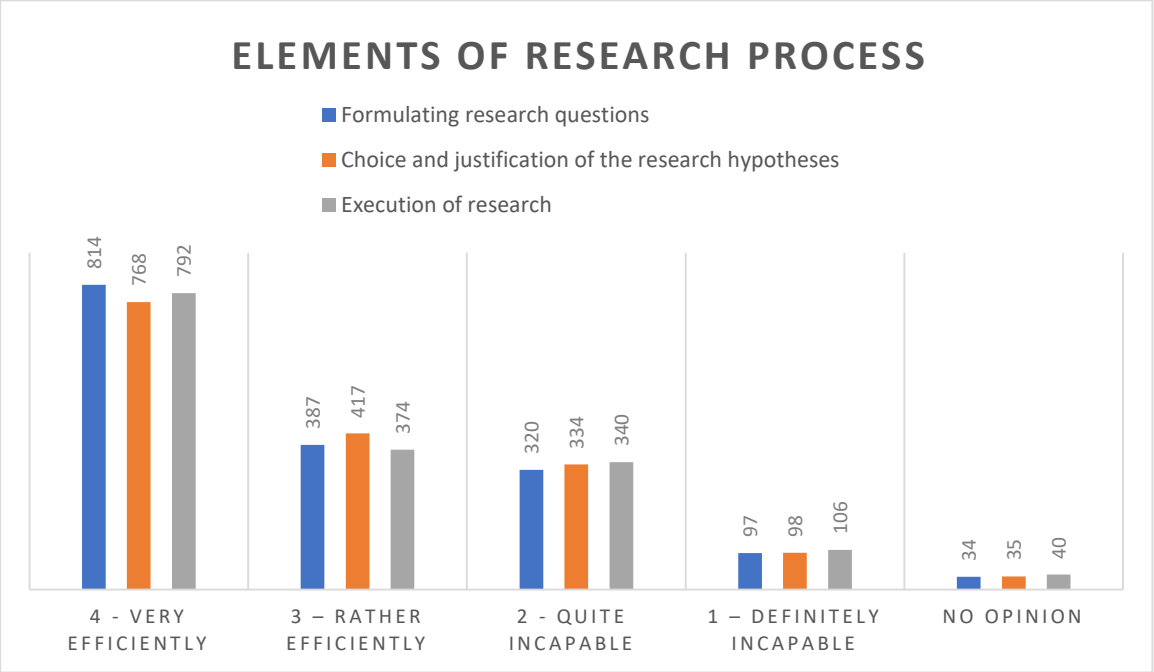

Choice and justification of the research hypotheses
48%
24%
20%
6%
2%
4 - very efficiently
3 – rather efficiently
2 - quite incapable
1 – definitely incapable
no opinion

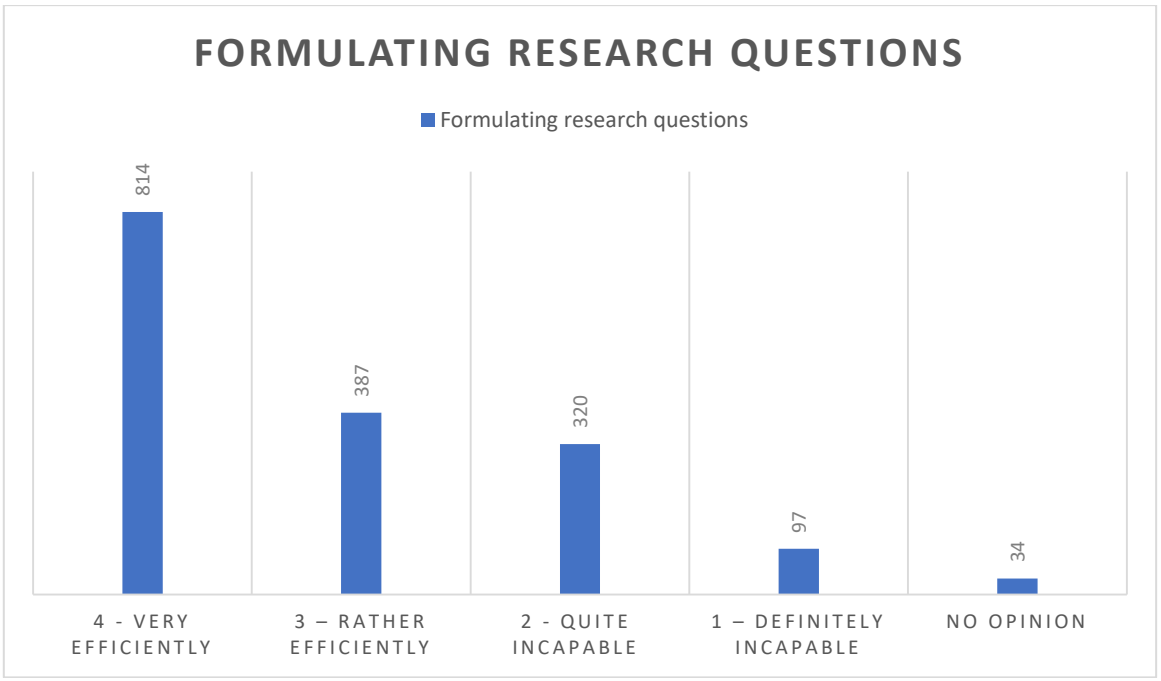

EXECUTION OF RESEARCH
Execution of research
862
417
344
125
38
4 - VERY EFFICIENTLY
3 – RATHER EFFICIENTLY
2 - QUITE INCAPABLE
1 – DEFINITELY INCAPABLE
NO OPINION

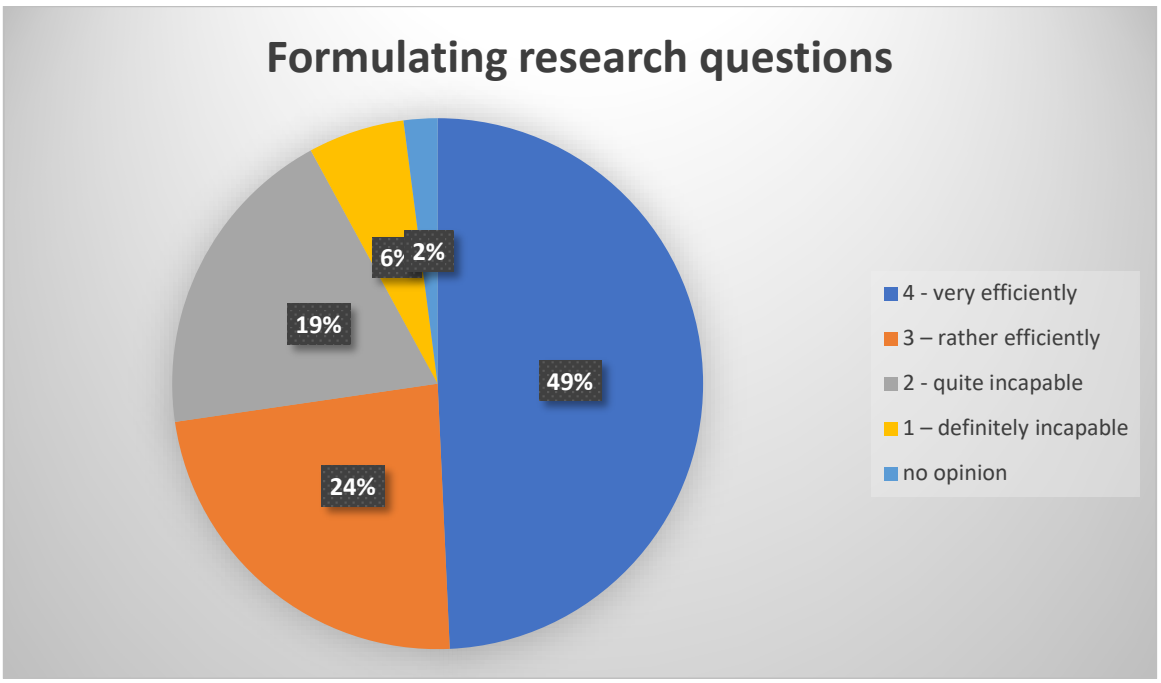

Execution of research
48%
24%
19%
7%
2%
4 - very efficiently
3 – rather efficiently
2 - quite incapable
1 – definitely incapable
no opinion

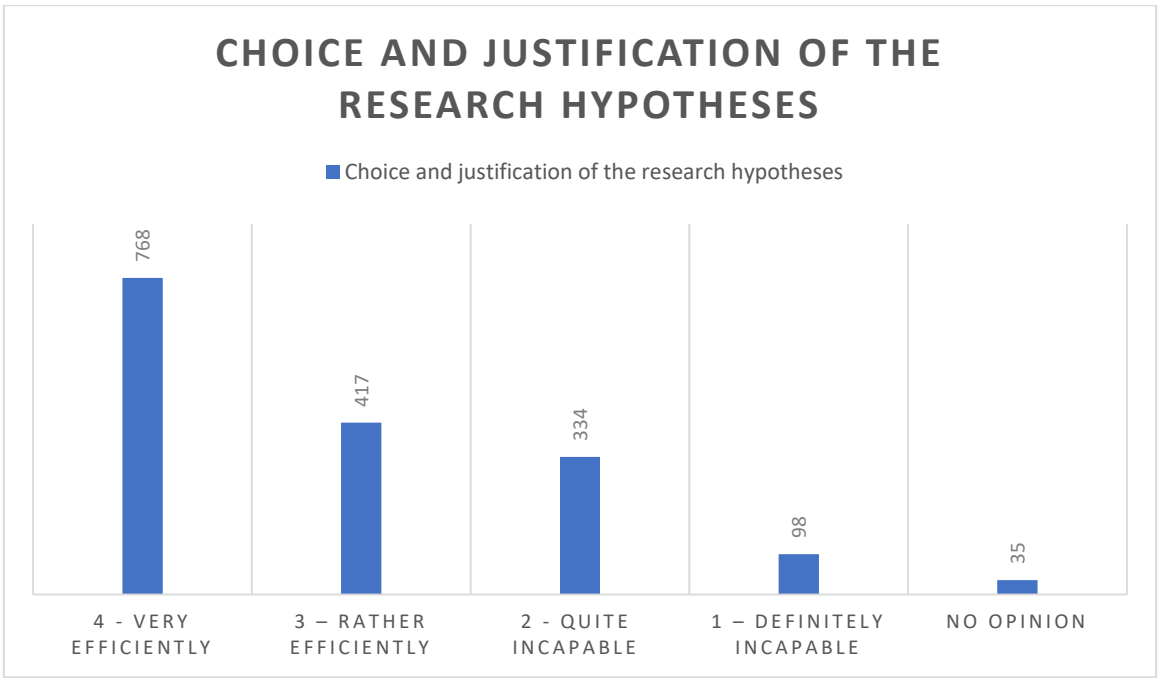
SCHOOLBOYS

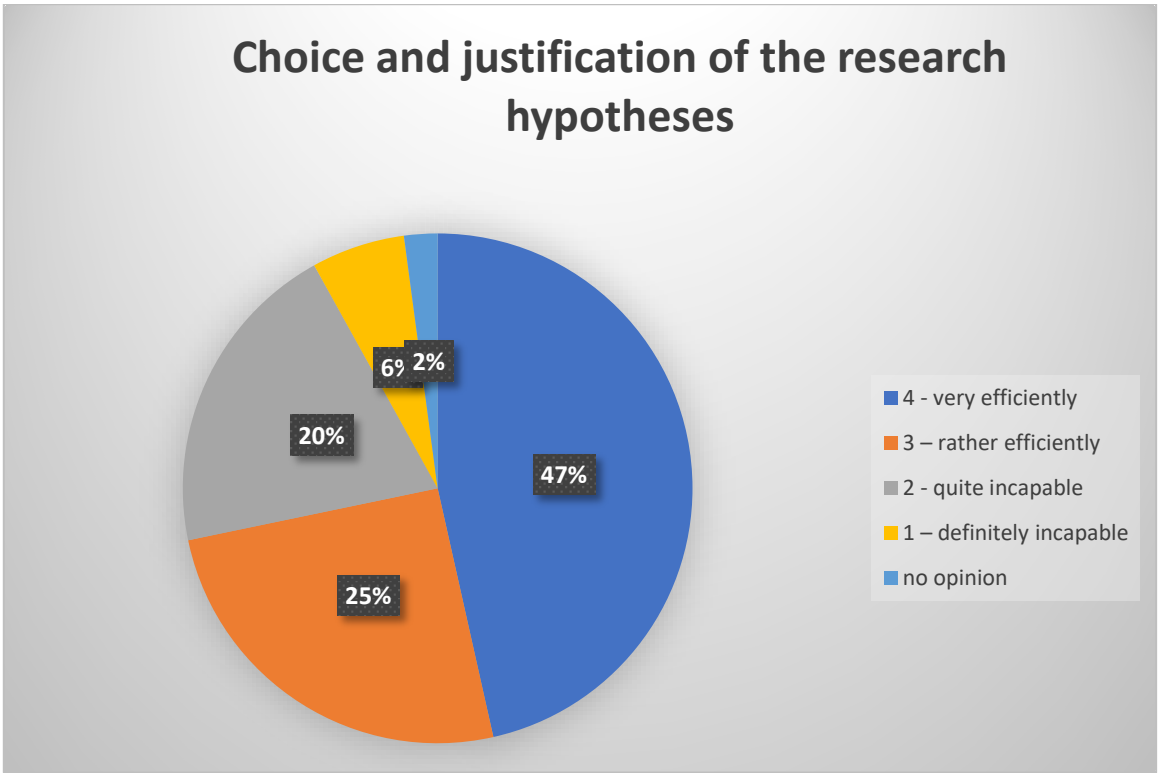
	Formulating research questions	Choice and justification of the research hypotheses	Execution of research
4 - very efficiently	814	768	792
3 – rather efficiently	387	417	374
2 - quite incapable	320	334	340
1 – definitely incapable	97	98	106
I have no opinion	34	35	40

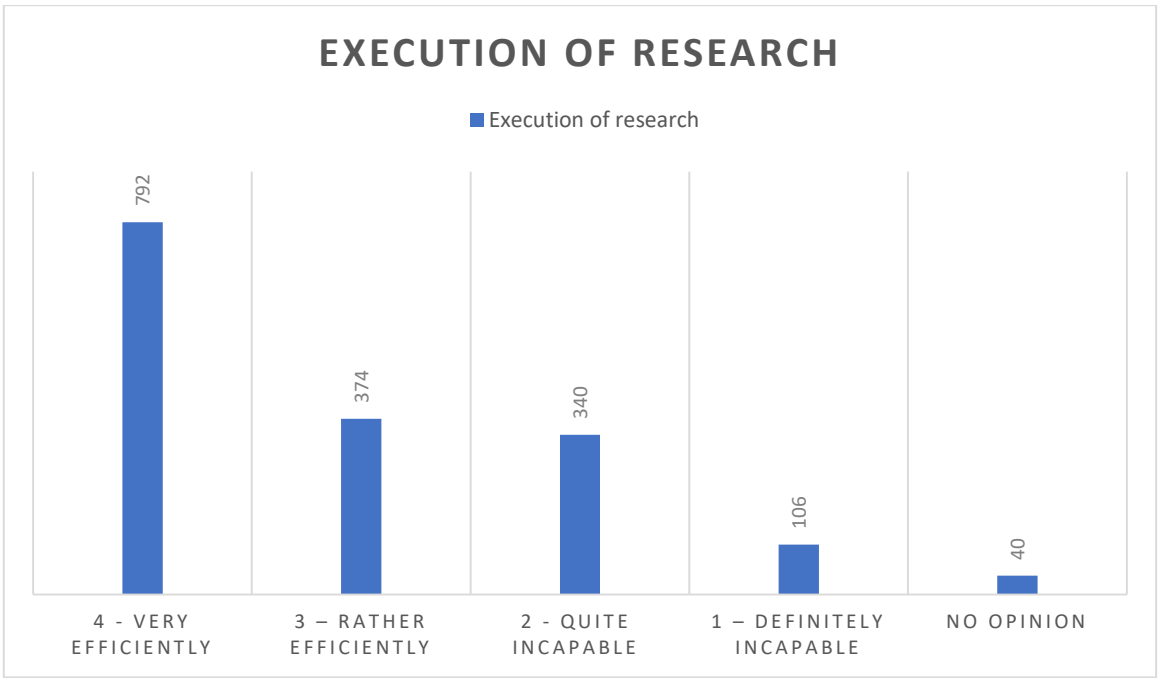


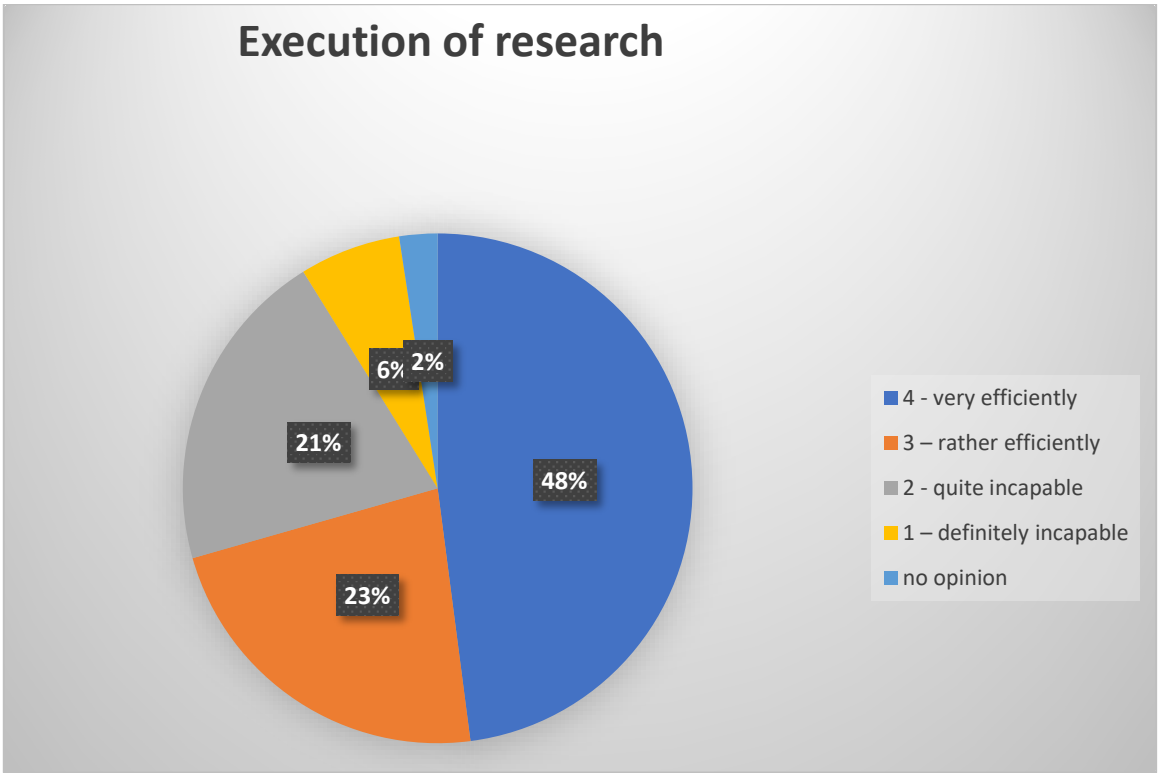

FORMULATING RESEARCH QUESTIONS
Formulating research questions
814
387
320
97
34
4 - VERY EFFICIENTLY
3 – RATHER EFFICIENTLY
2 - QUITE INCAPABLE
1 – DEFINITELY INCAPABLE
NO OPINION


Formulating research questions
49%
24%
19%
6%
2%
4 - very efficiently
3 – rather efficiently
2 - quite incapable
1 – definitely incapable
no opinion

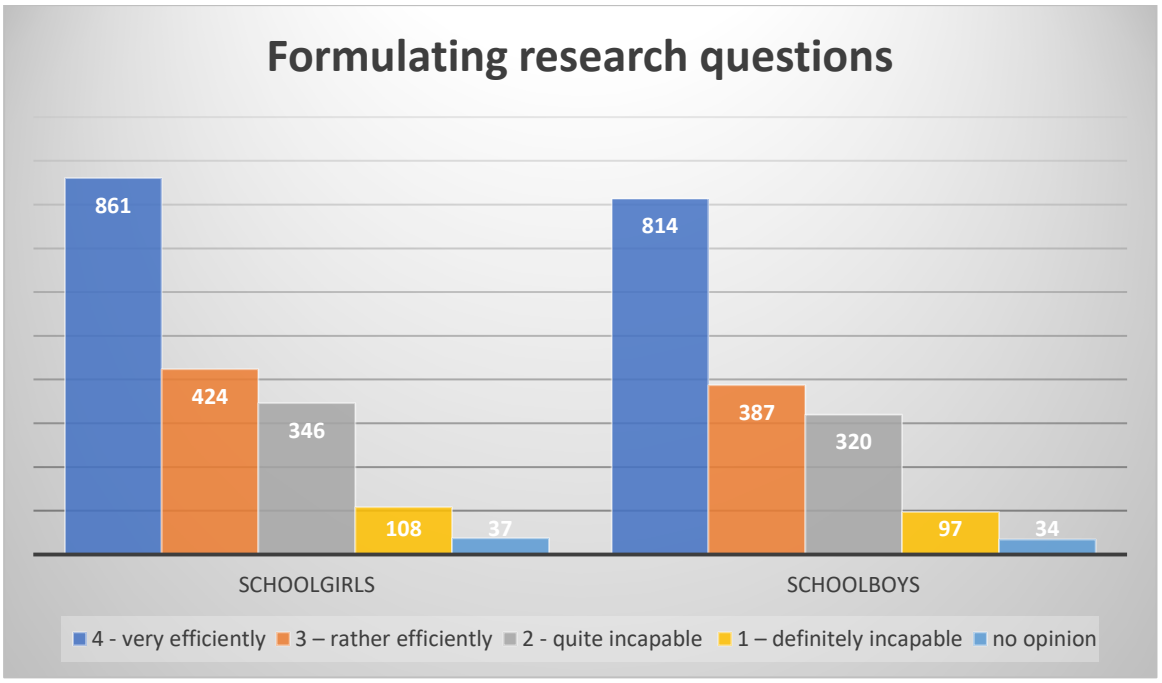

CHOICE AND JUSTIFICATION OF THE RESEARCH HYPOTHESES
Choice and justification of the research hypotheses
768
417
334
98
35
4 - VERY EFFICIENTLY
3 – RATHER EFFICIENTLY
2 - QUITE INCAPABLE
1 – DEFINITELY INCAPABLE
NO OPINION

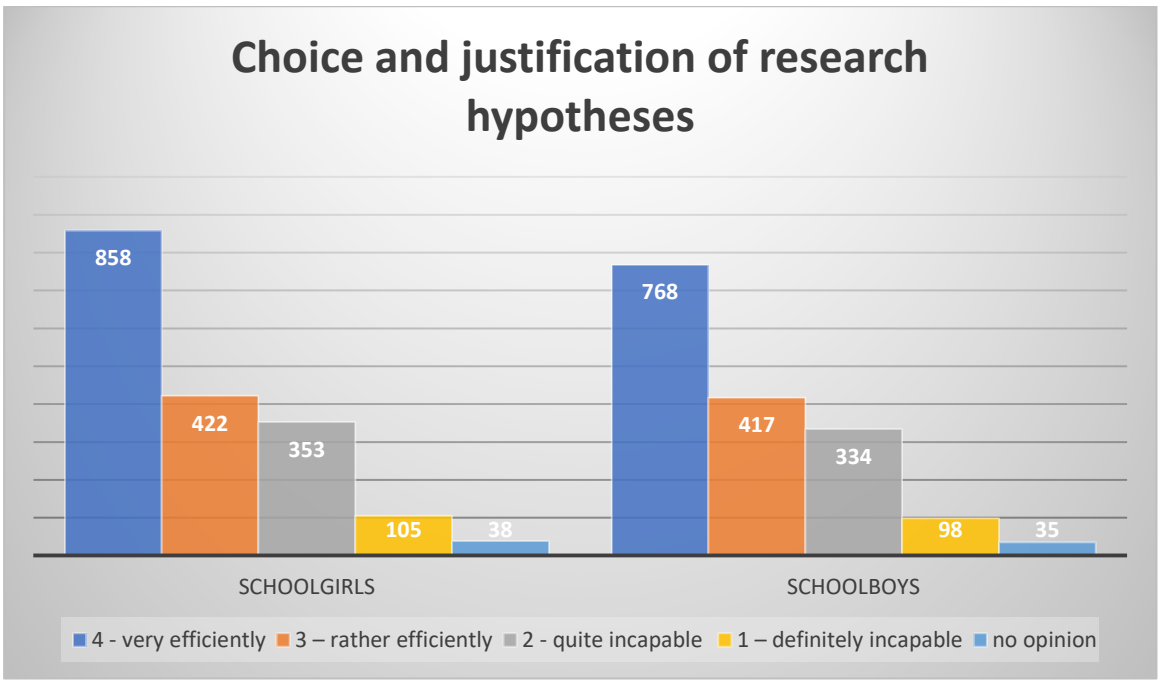

Choice and justification of the research hypotheses
47%
25%
20%
6%
2%
4 - very efficiently
3 – rather efficiently
2 - quite incapable
1 – definitely incapable
no opinion

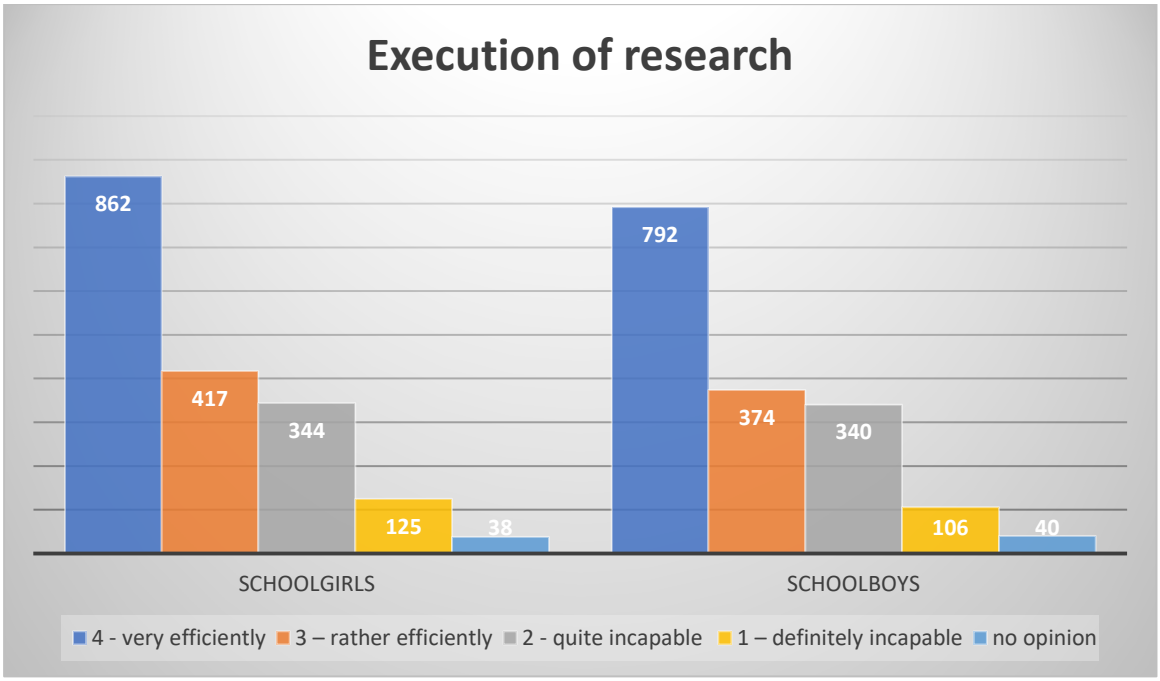




Comparison schoolgirls and schoolboys


Formulating research questions
861
424
346
108
37
814
387
320
97
34
SCHOOLGIRLS
SCHOOLBOYS
4 - very efficiently
3 – rather efficiently
2 - quite incapable
1 – definitely incapable
no opinion


Choice and justification of research hypotheses
858
422
353
105
38
768
417
334
98
35
SCHOOLGIRLS
SCHOOLBOYS
4 - very efficiently
3 – rather efficiently
2 - quite incapable
1 – definitely incapable
no opinion



Remark: Teachers esteemed that more boys than girls are able to formulate research questions "very efficiently": 1) girls: 861 (48% of all girls), 2) boys: 814 (49% of all boys). If one takes the total of girls and boys teachers expressed opinions about, 861 girls represent 25% of the total of pupils and 814 boys 24%.

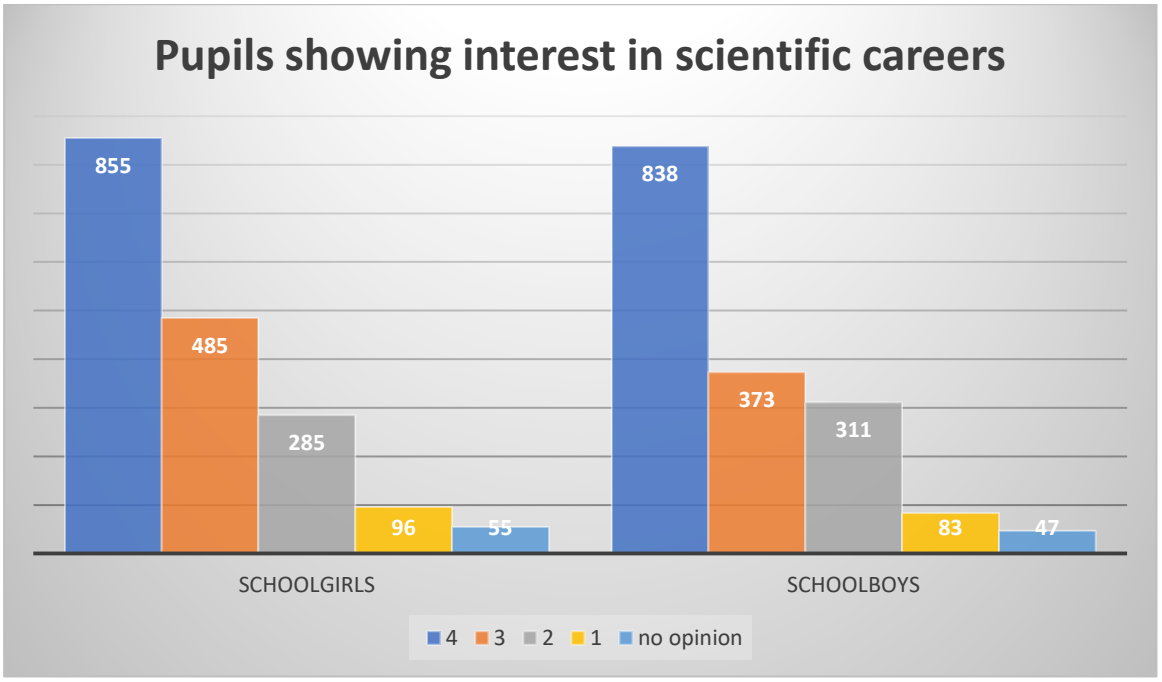
As to the choice and justification of research hypotheses, 858 girls (48% of all girls) can do so very efficiently, and 768 boys (47% of all boys). If one takes the total of girls and boys teachers expressed opinions about, 858 girls represent 25% of the total of pupils and 768 boys 22%.

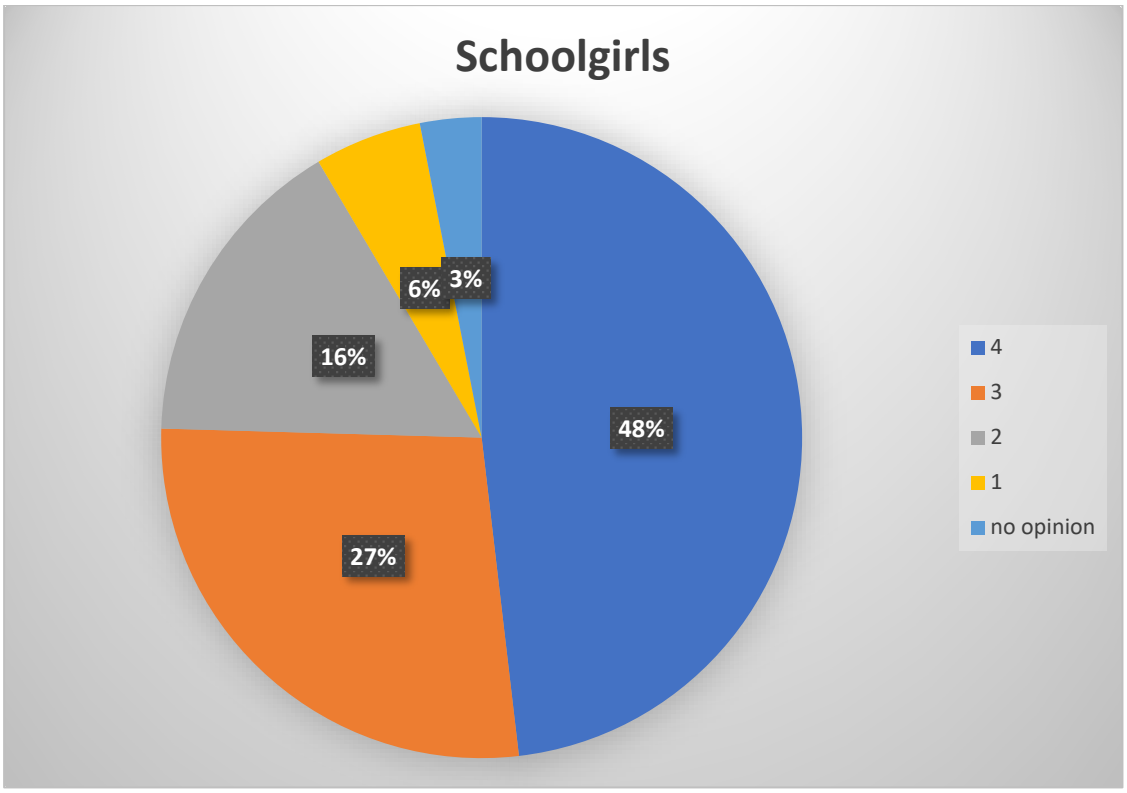
Concerning the „very efficient" execution of research, the percentage is identical for girls and boys: 862 girls (48% of all girls) – 792 boys (48% of all boys). If one takes the total of girls and boys teachers expressed opinions about, 862 girls represent 25% of the total of pupils and 792 boys 23%.

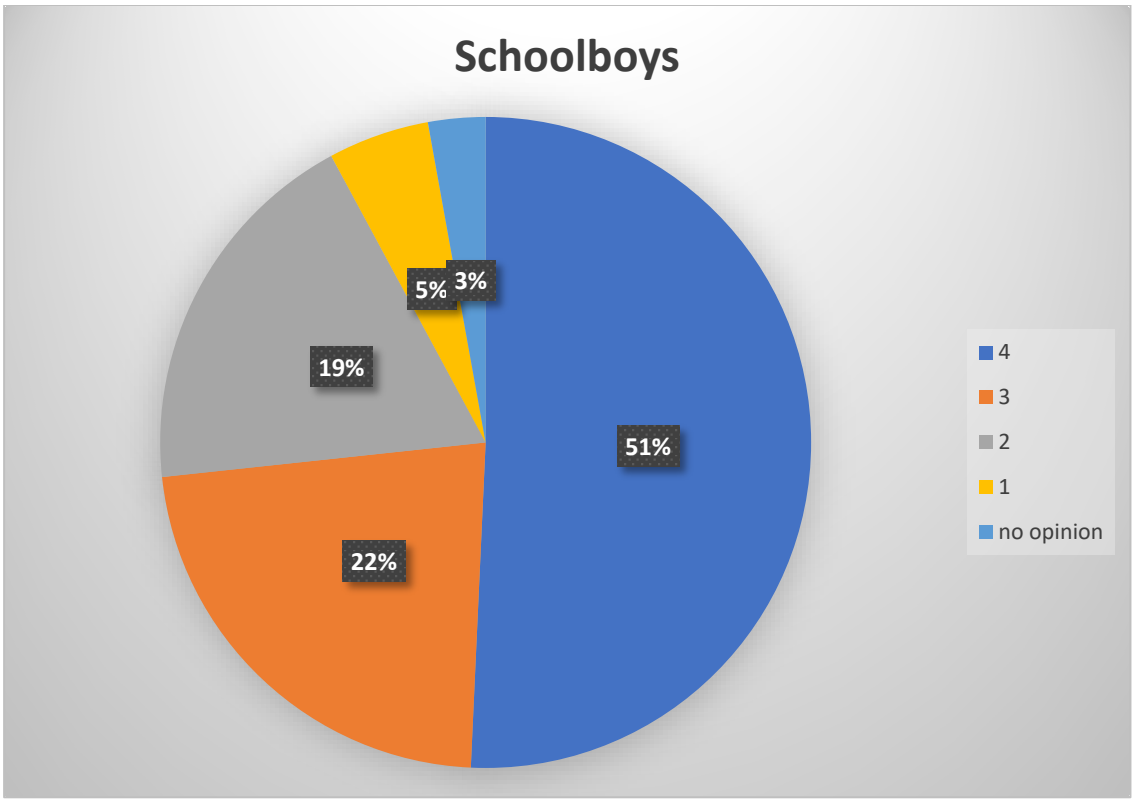
2. Are your pupils showing interest in scientific careers? Please put the proper number of schoolgirls and schoolboys that match to the given answers.

	Schoolgirls	Schoolboys
4 – Definitely are showing	855	838

3 – Rather are showing	485	373
2 – Rather are not showing	285	311
1 – Definitely are not showing	96	83
I have no opinion	55	47





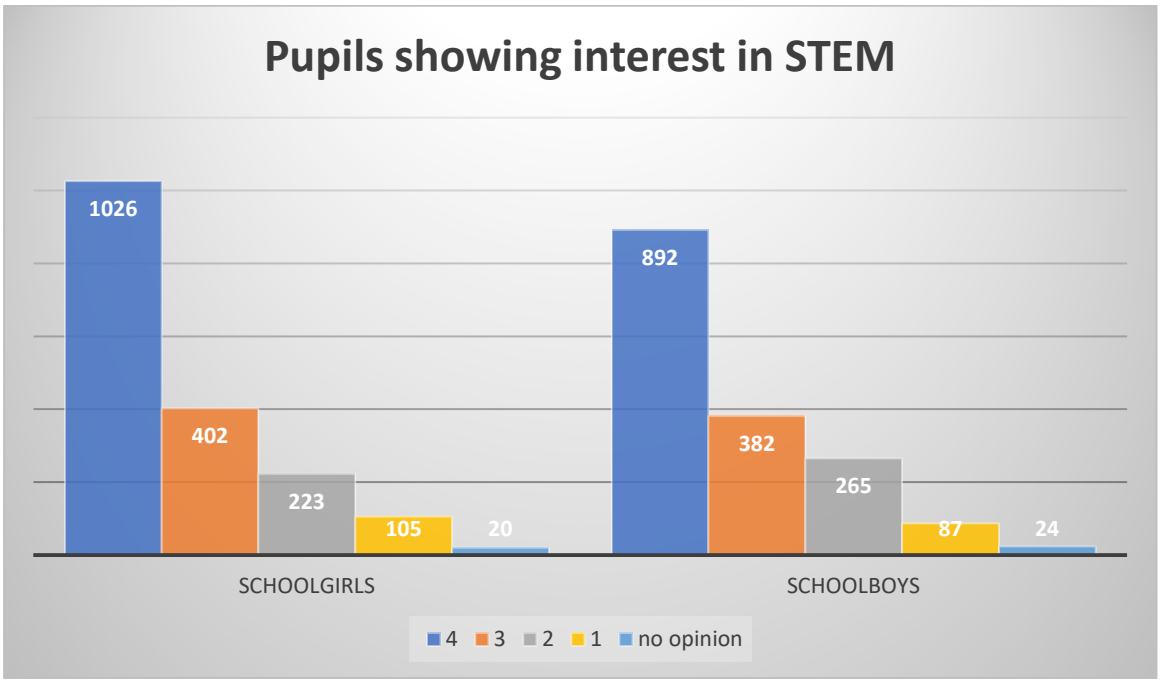


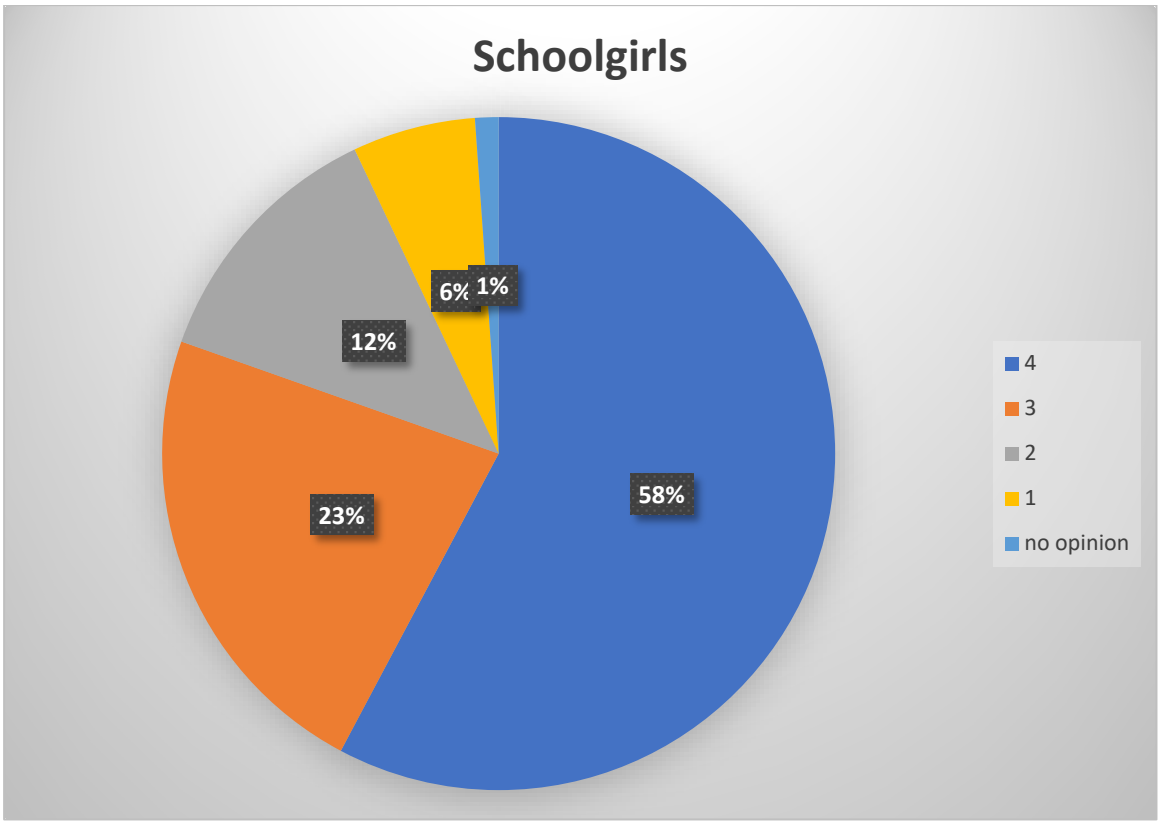
Remark: Teachers esteemed that more boys than girls “are definitely showing“ more interest in scientific careers: 1) girls: 855 (48% of all girls), 2) boys: 838 (51% of all boys). If one takes

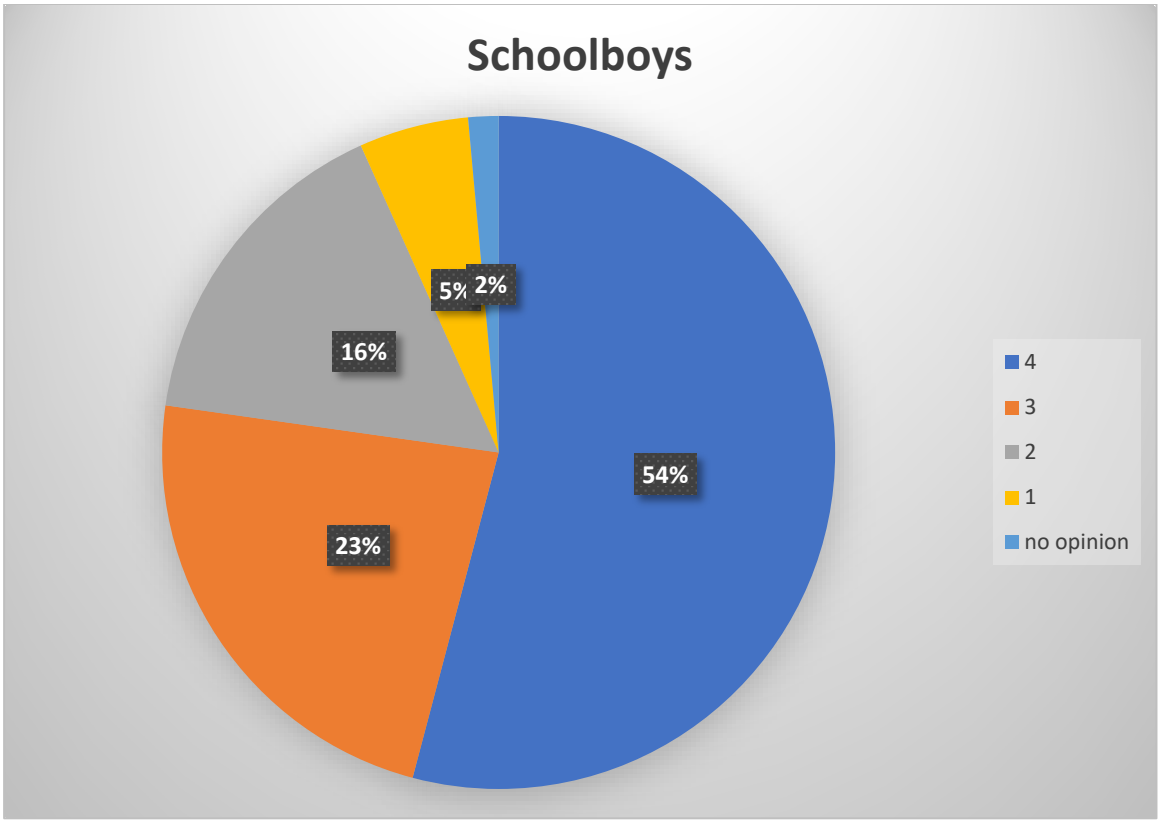
the total of girls and boys teachers expressed opinions about, 855 girls represent 25% of the total of pupils and 838 boys 24%.

3. Are your pupils showing interest in STEM? Please put the proper number of schoolgirls and schoolboys that match to the given answers.

	Schoolgirls	Schoolboys
4 – Definitely are showing	1026	894
3 – Rather are showing	402	382
2 – Rather are not showing	223	265
1 – Definitely are not showing	105	87
I have no opinion	20	24





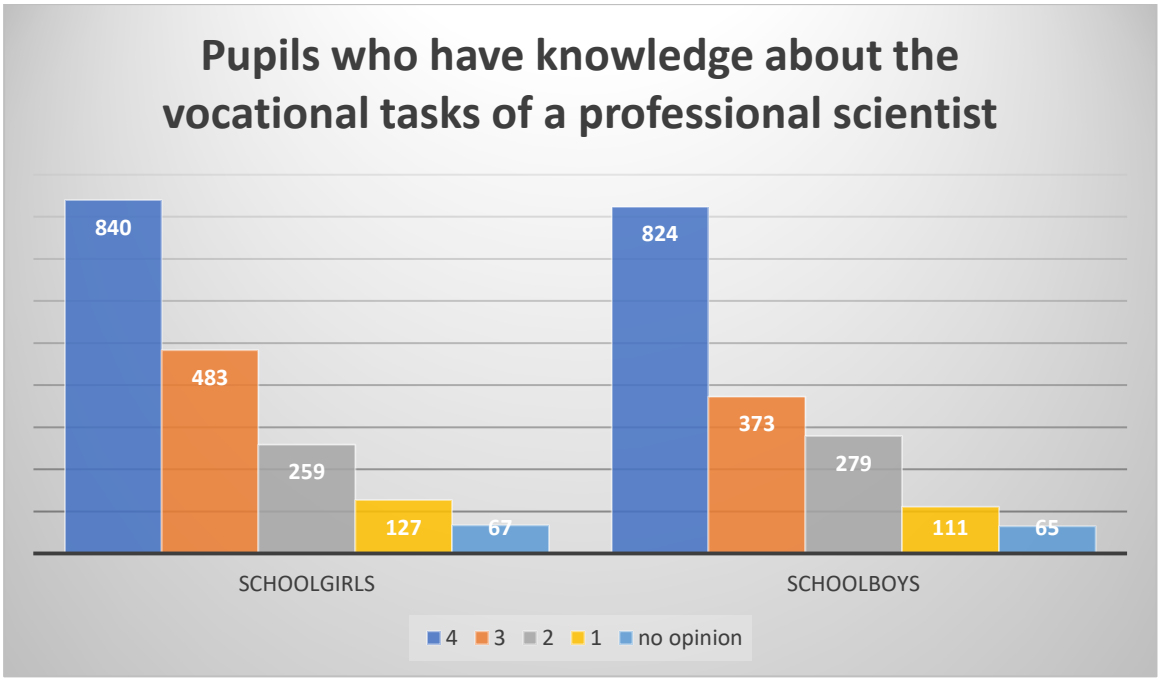


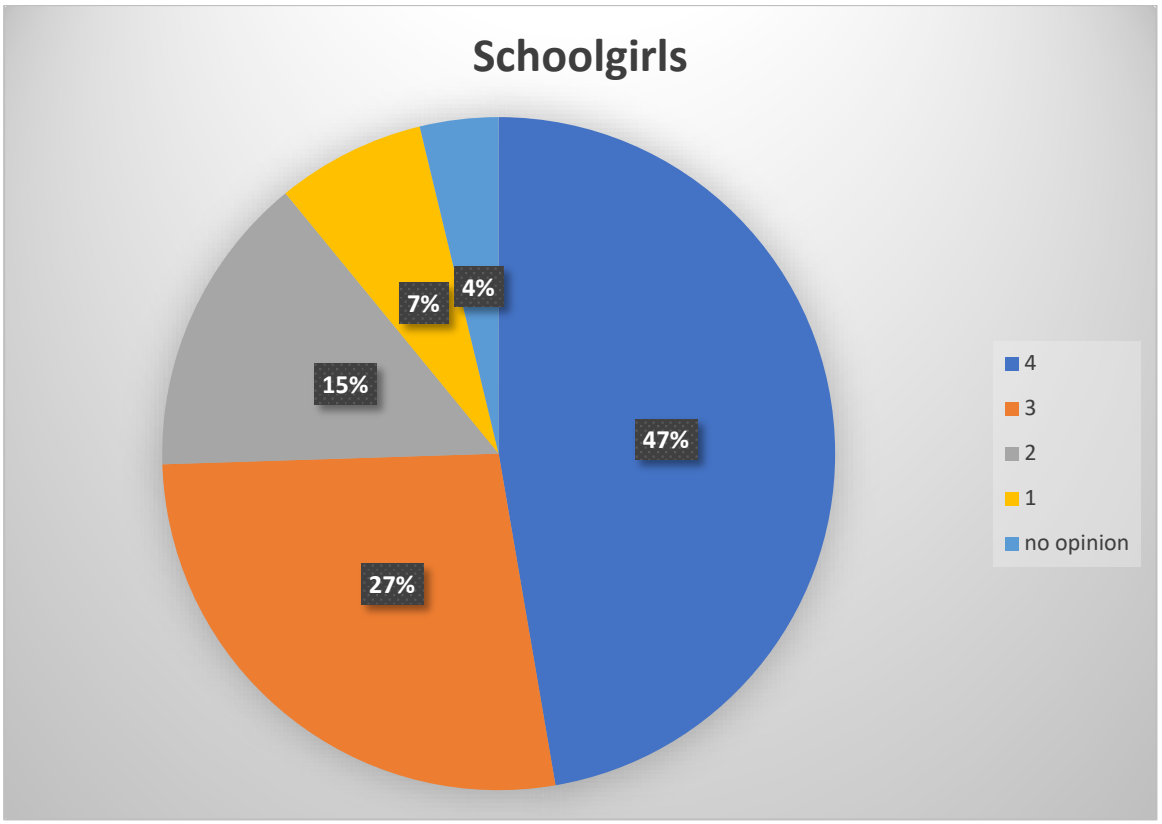
Remark: Teachers esteemed that more girls than boys "are definitely showing" more interest in STEM: 1) girls: 1026 (58% of all girls), 2) boys: 892 (54% of all boys). If one takes

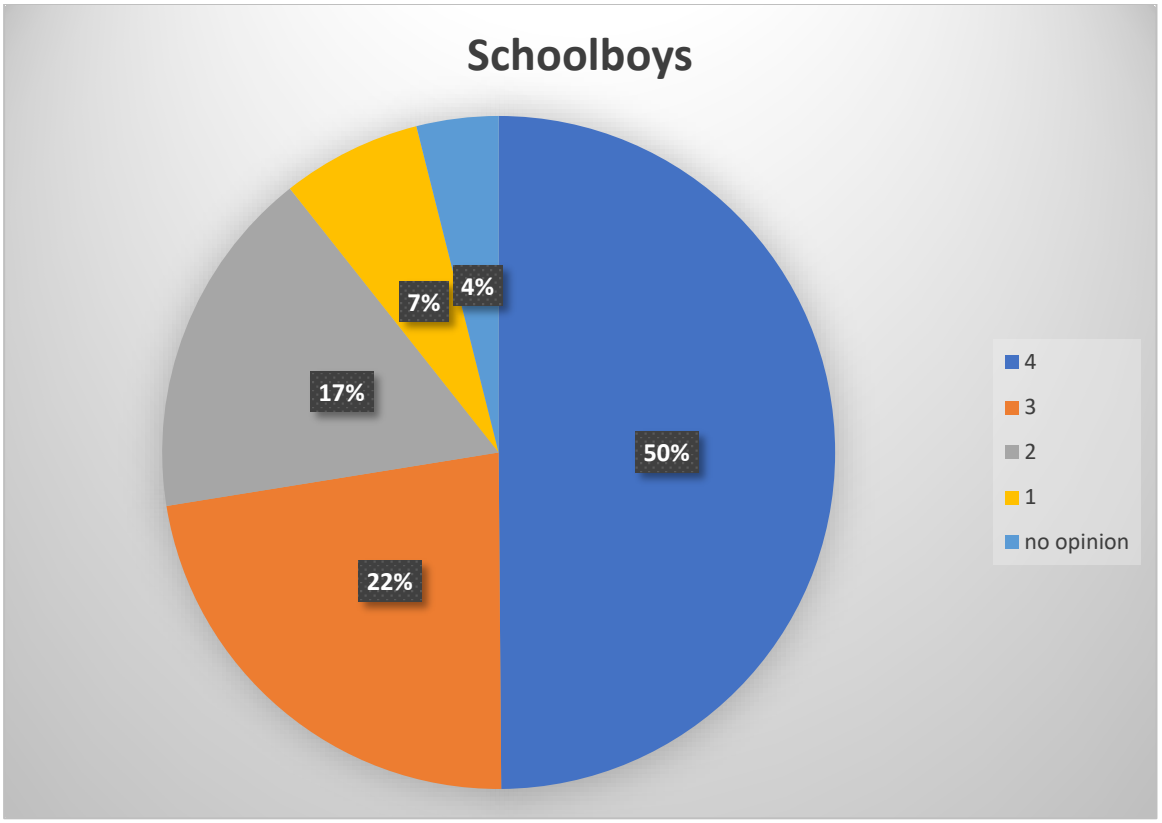
the total of girls and boys teachers expressed opinions about, 1026 girls represent 30% of the total of pupils and 892 boys 26%.

4. Have of your pupils got knowledge about the vocational tasks of a professional scientist? Please put the proper number of schoolgirls and schoolboys that match to the given answers.

	Schoolgirls	Schoolboys
4 – Definitely have	840	824
3 – Rather have	483	373
2 – Rather do not have	259	279
1 – Definitely do not have	127	111
I have no opinion	67	65





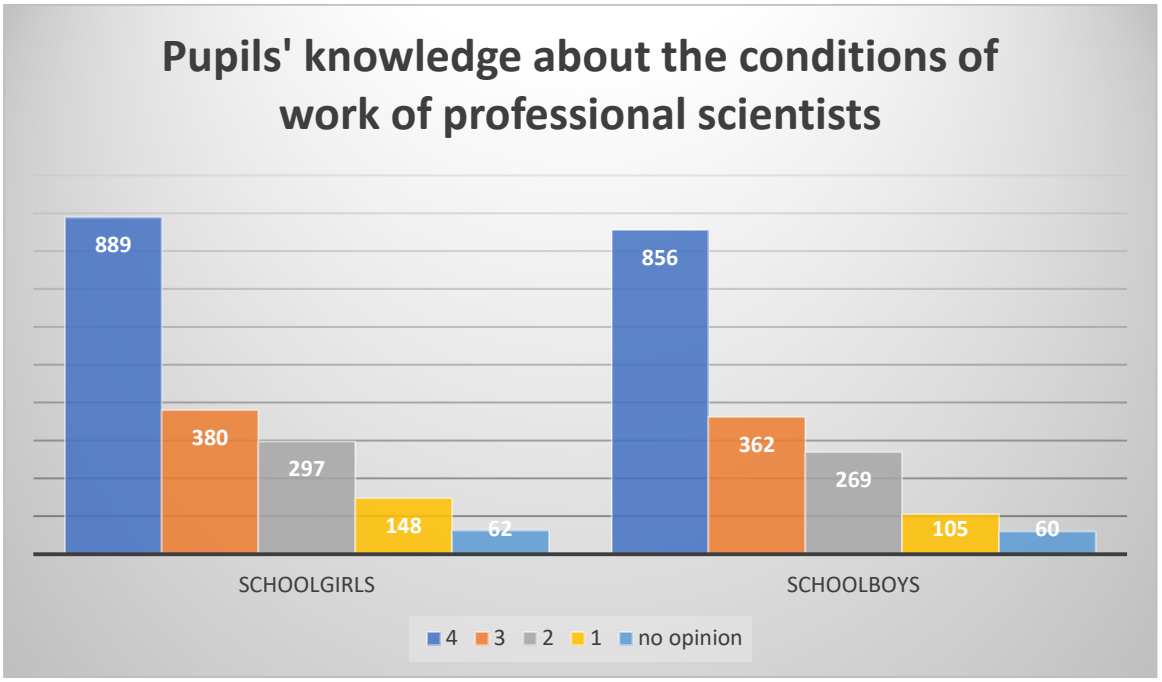


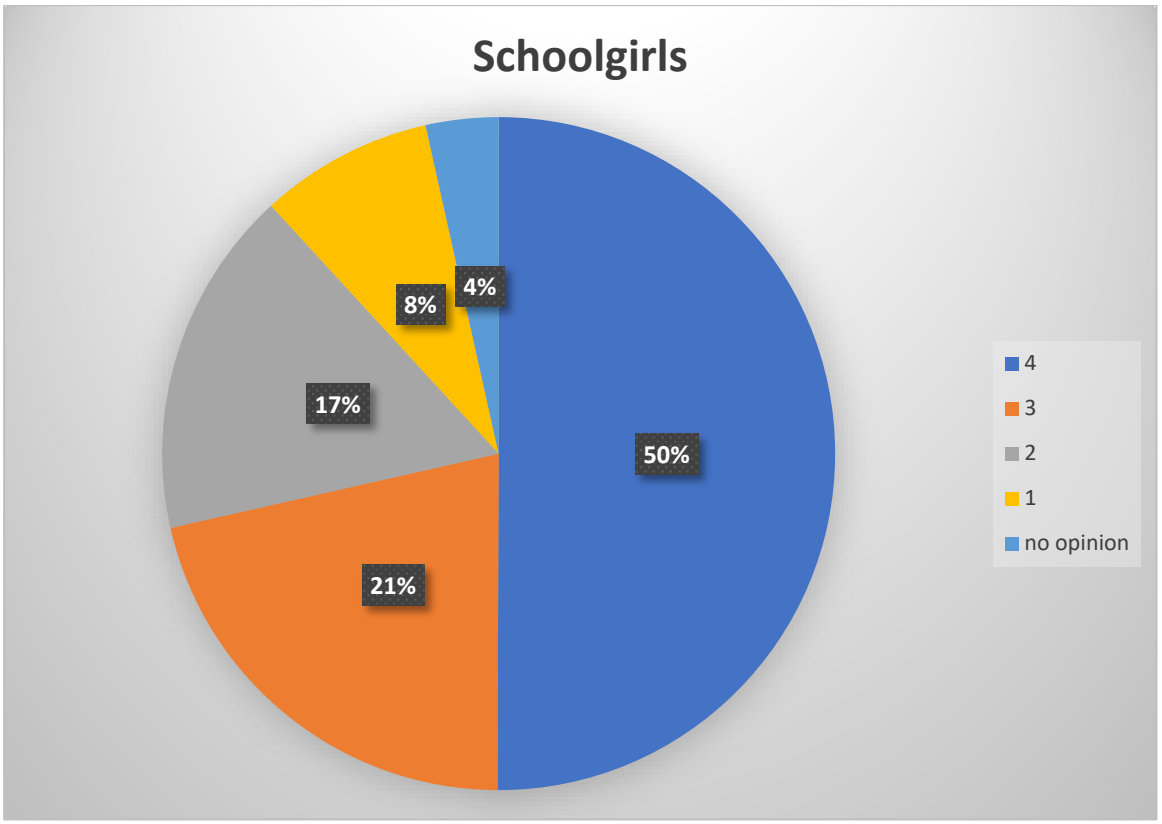
Remark: Teachers esteem that relatively more boys than girls “definitely have“ more knowledge about the vocational tasks of a professional scientist: 1) girls: 840 (47% of

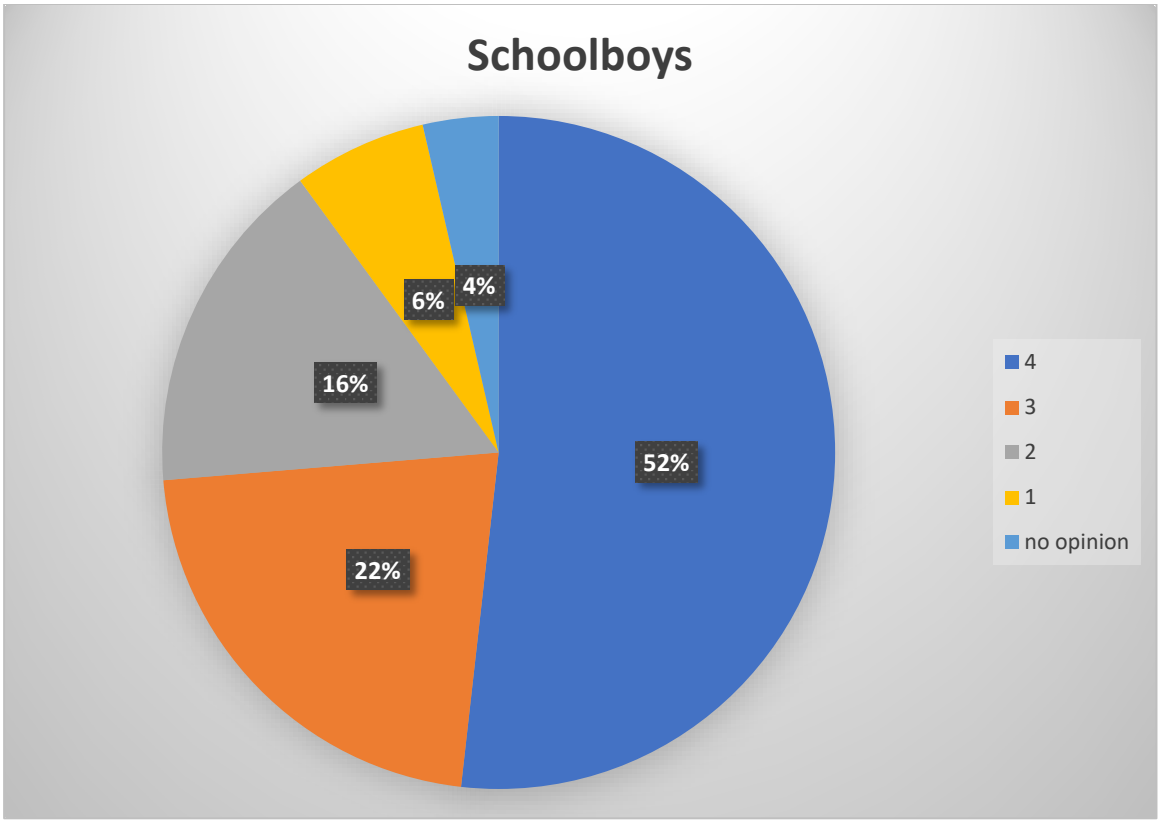
all girls), 2) boys: 824 (50% of all boys). If one takes the total of girls and boys teachers expressed opinions about, 840 girls represent 24% of the total of pupils and 824 boys 24%, i.e. an equal score percentage.

5. Do your pupils know anything about the conditions of work of professional scientists (e.g. possibilities of employment, salary, requirements to obtain a degree)? Please put the proper number of schoolgirls and schoolboys that match to the given answers.

	Schoolgirls	**Schoolboys**
4 – They definitely do	889	856
3 – Some	380	362
2 – Not very much	297	269
1 – Nothing at all	148	105
I have no opinion	62	60




Schoolgirls
50%
21%
17%
8%
4%
4
3
2
1
no opinion


Schoolboys
52%
22%
16%
6%
4%
4
3
2
1
no opinion

Remark: Teachers esteem that more boys than girls “definitely“ know more about the conditions of work of a professional scientist: 1) girls: 889 (50% of all girls), 2) boys: 856 (52% of all boys). If one takes the total of girls and boys teachers expressed opinions about, 889 girls represent 26% of the total of pupils and 856 boys 25%.

CATEGORY 3: KNOWLEDGE ABOUT NATURE, GEOGRAPHY, NATURAL RESOURCES, HISTORY, SOCIAL AND POLITICAL SPECIFICITIES CONCERNING THE ARCTIC AND INCREASE OF SENSITIVITY TO ENVIRONMENTAL ISSUES AND CLIMATE CHANGE.

1. Please find below a list of specific issues and concepts related to the Arctic. Please rate the level of knowledge of your pupils for each item.

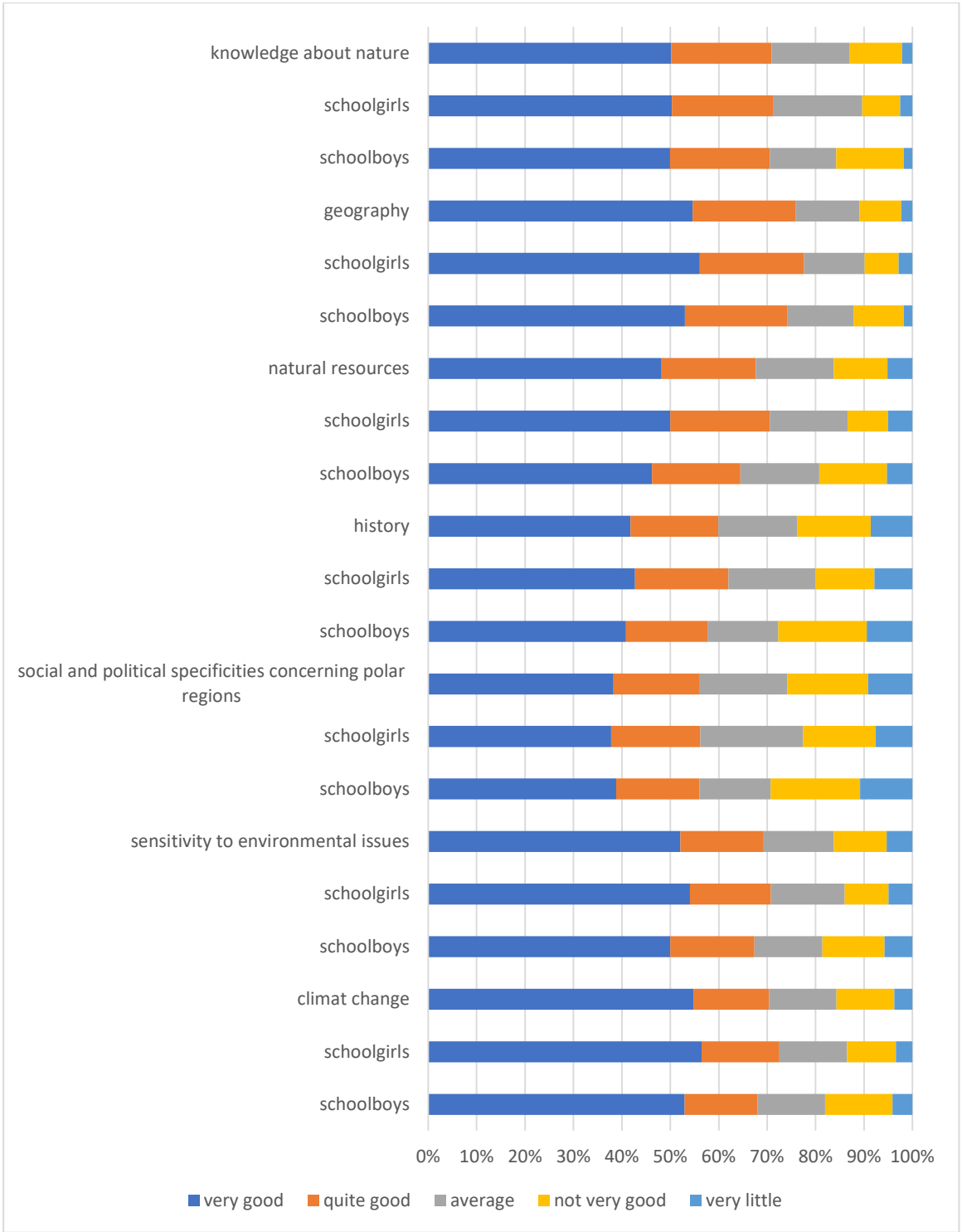
   Scroll down list for a single choice with marks ranging from 1 to 5 and separate for schoolgirls and schoolboys. Please put the proper number of schoolgirls and schoolboys that match to the given answers.

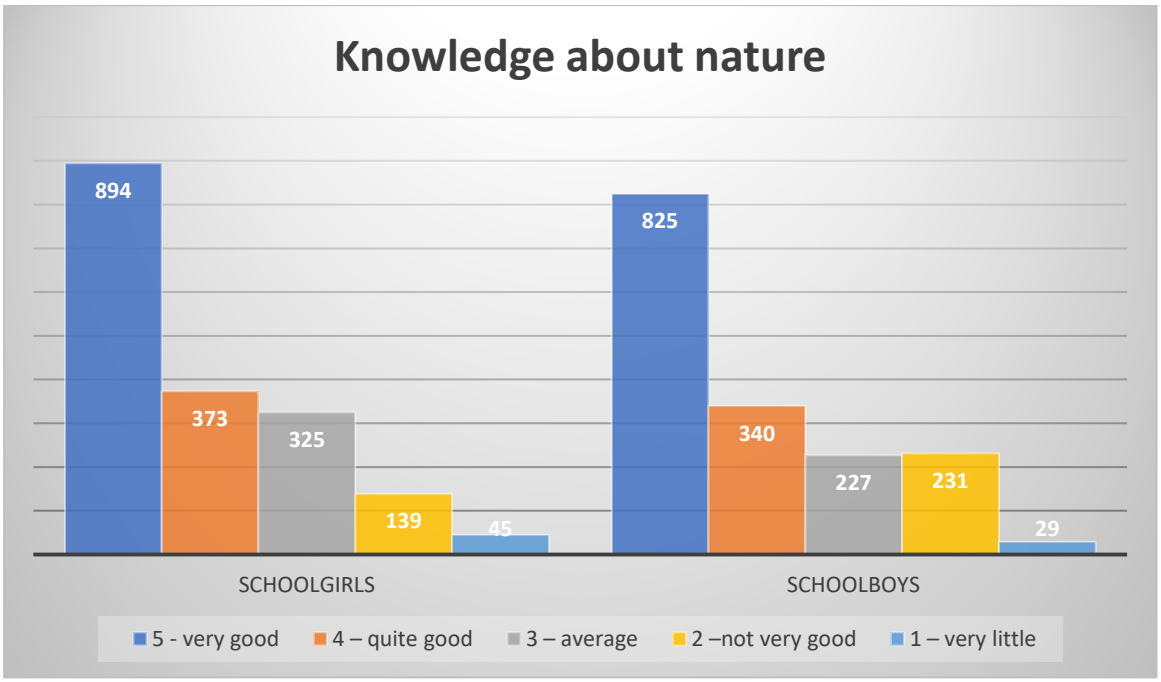
SCHOOLGIRLS

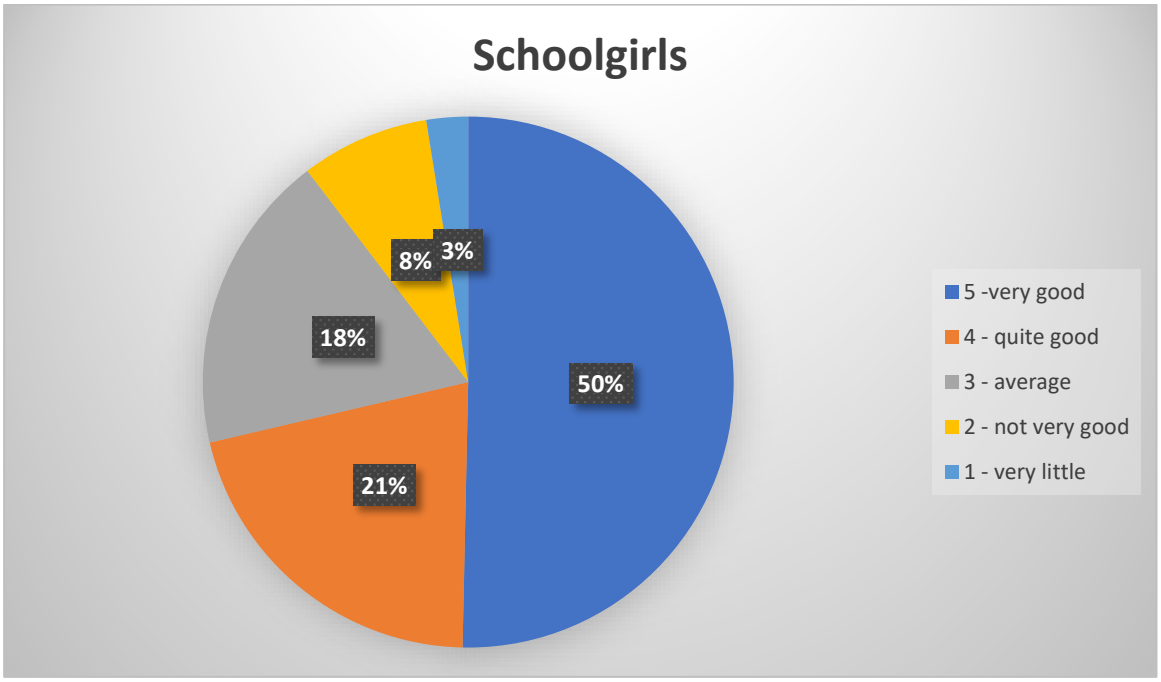
	Knowledge about nature	Geography	Natural resources	History	social and political specificities concerning polar regions	sensitivity to environmental issues	climate change
5 - very good	894	991	888	758	671	960	1005
4 – quite good	373	381	365	343	327	297	286
3 – average	325	221	285	319	377	270	249
2 –not very good	139	124	148	216	266	161	179
1 – very little	45	51	90	140	135	88	61

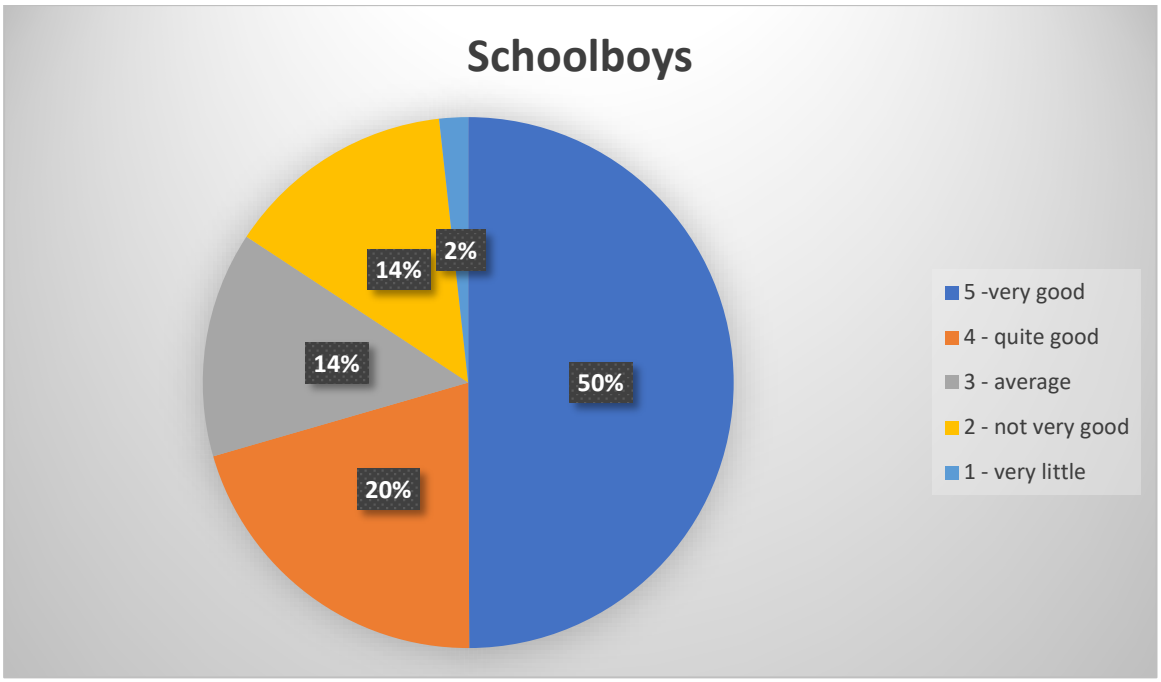
SCHOOLBOYS

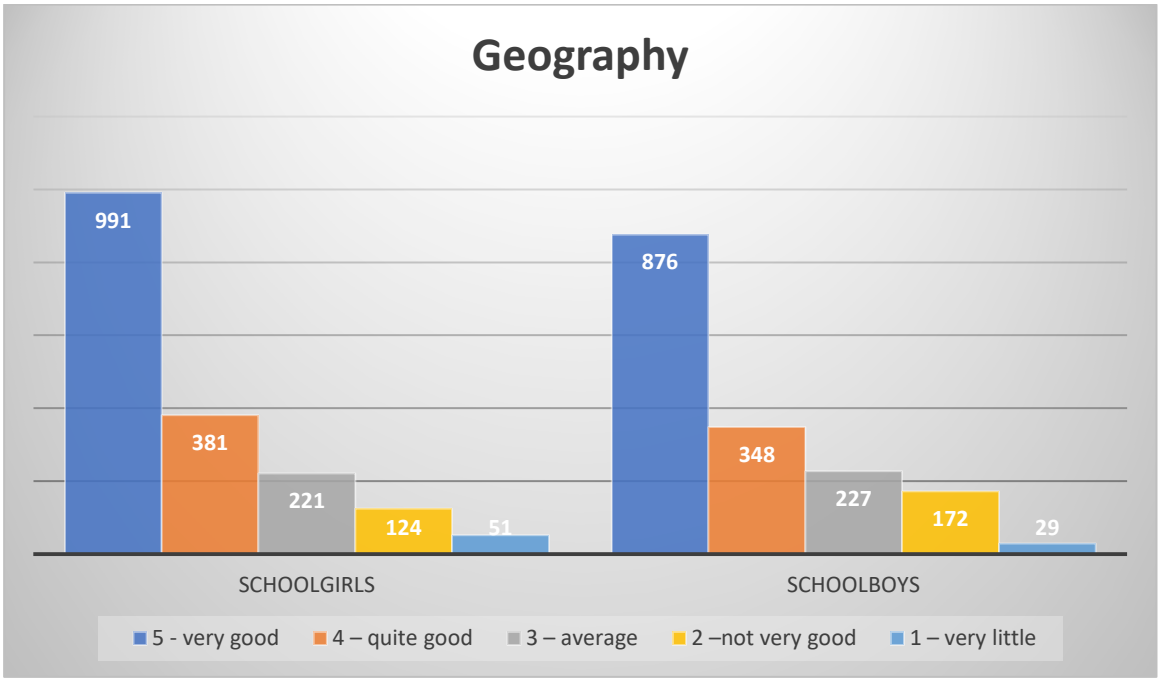
	Knowledge about nature	Geography	Natural resources	History	social and political specificities concerning polar regions	sensitivity to environmental issues	climate change
5 - very good	825	876	763	678	641	826	875
4 – quite good	340	348	302	280	284	287	249
3 – average	227	227	269	234	243	232	230
2 –not very good	231	172	231	303	305	212	230
1 – very little	29	29	87	157	179	95	68

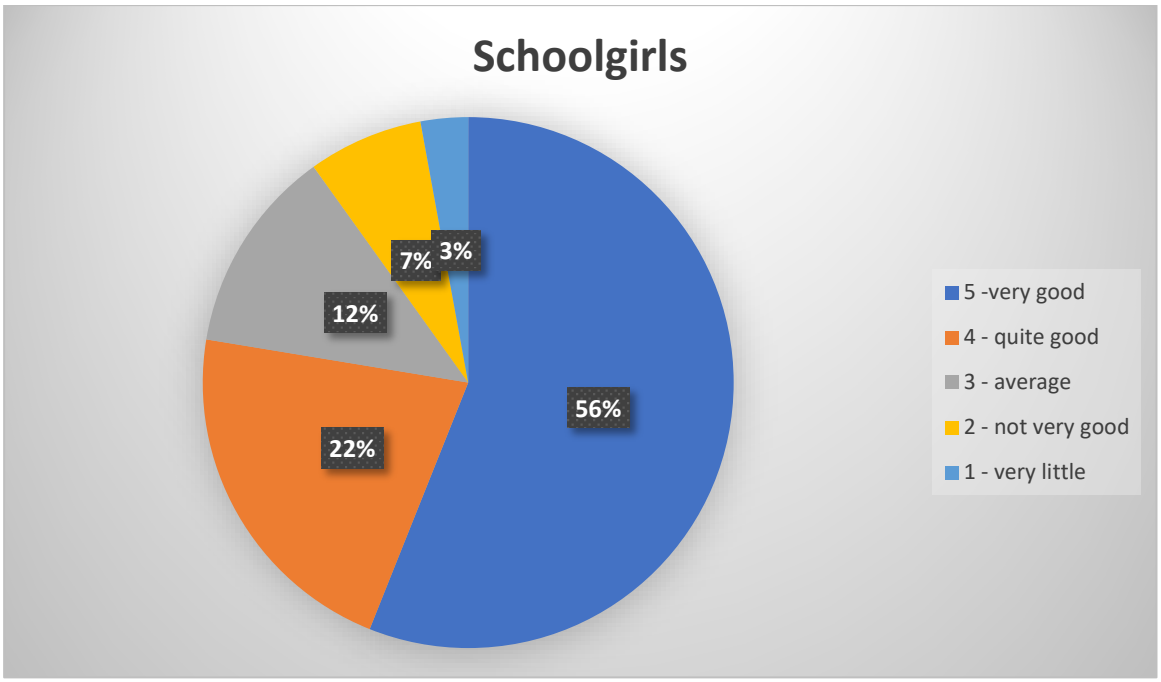

knowledge about nature
schoolgirls
schoolboys
geography
schoolgirls
schoolboys
natural resources
schoolgirls
schoolboys
history
schoolgirls
schoolboys
social and political specificities concerning polar regions
schoolgirls
schoolboys
sensitivity to environmental issues
schoolgirls
schoolboys
climat change
schoolgirls
schoolboys
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
very good
quite good
average
not very good
very little

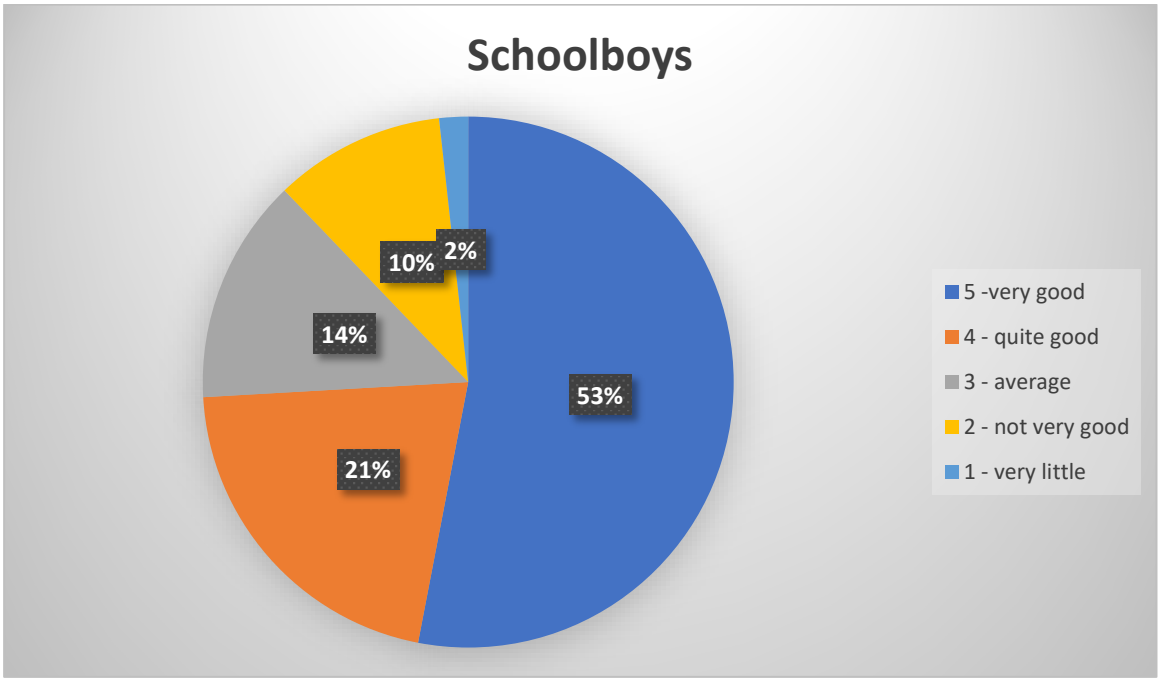

Knowledge about nature
894
373
325
139
45
825
340
227
231
29
SCHOOLGIRLS
SCHOOLBOYS
5 - very good
4 – quite good
3 – average
2 –not very good
1 – very little

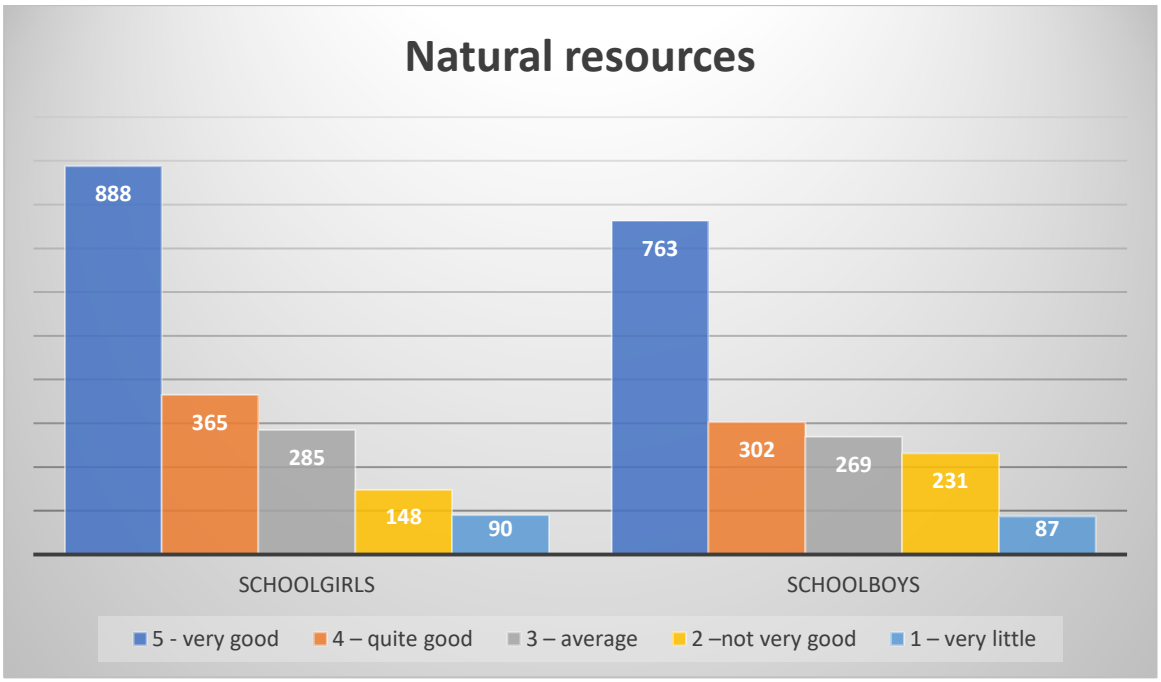

Schoolgirls
50%
21%
18%
8%
3%
5 -very good
4 - quite good
3 - average
2 - not very good
1 - very little

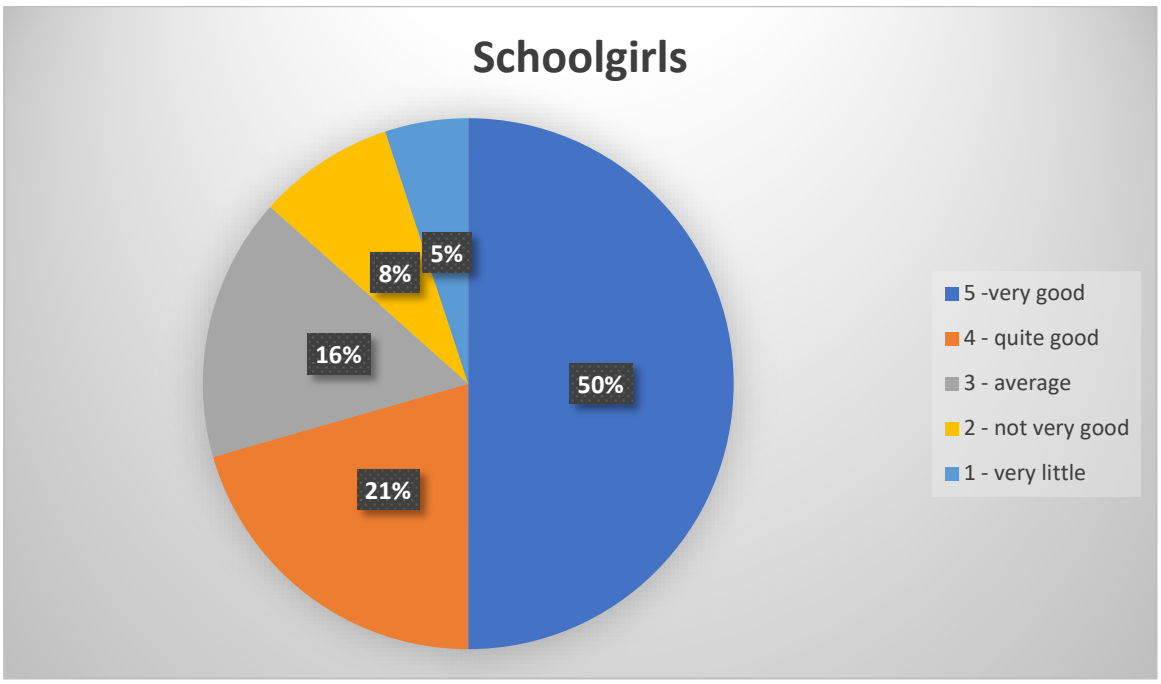

Schoolboys
50%
20%
14%
14%
2%
5 -very good
4 - quite good
3 - average
2 - not very good
1 - very little

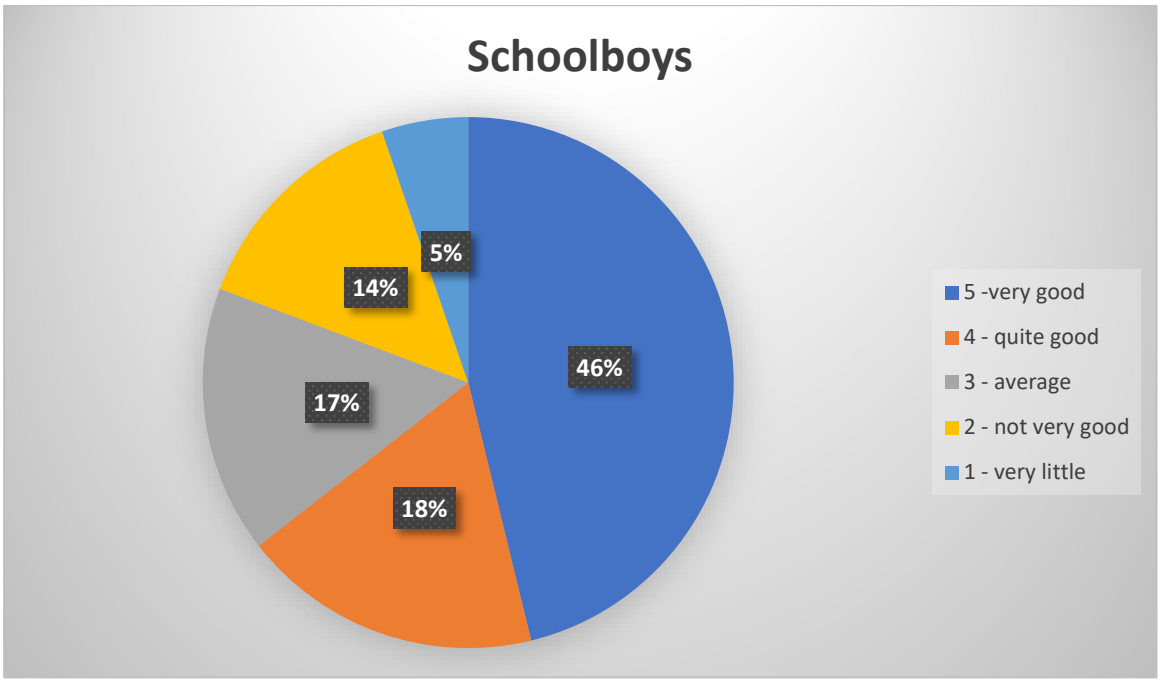

Geography
991
381
221
124
51
876
348
227
172
29
SCHOOLGIRLS
SCHOOLBOYS
5 - very good
4 – quite good
3 – average
2 –not very good
1 – very little

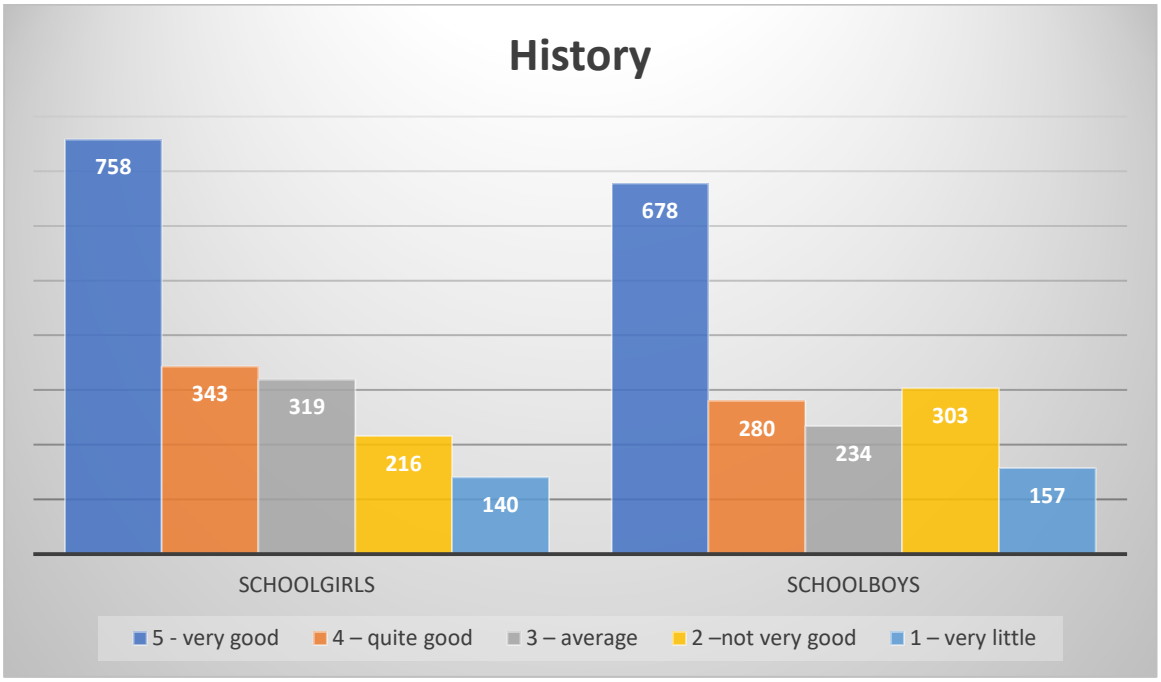

Schoolgirls
56%
22%
12%
7%
3%
5 -very good
4 - quite good
3 - average
2 - not very good
1 - very little

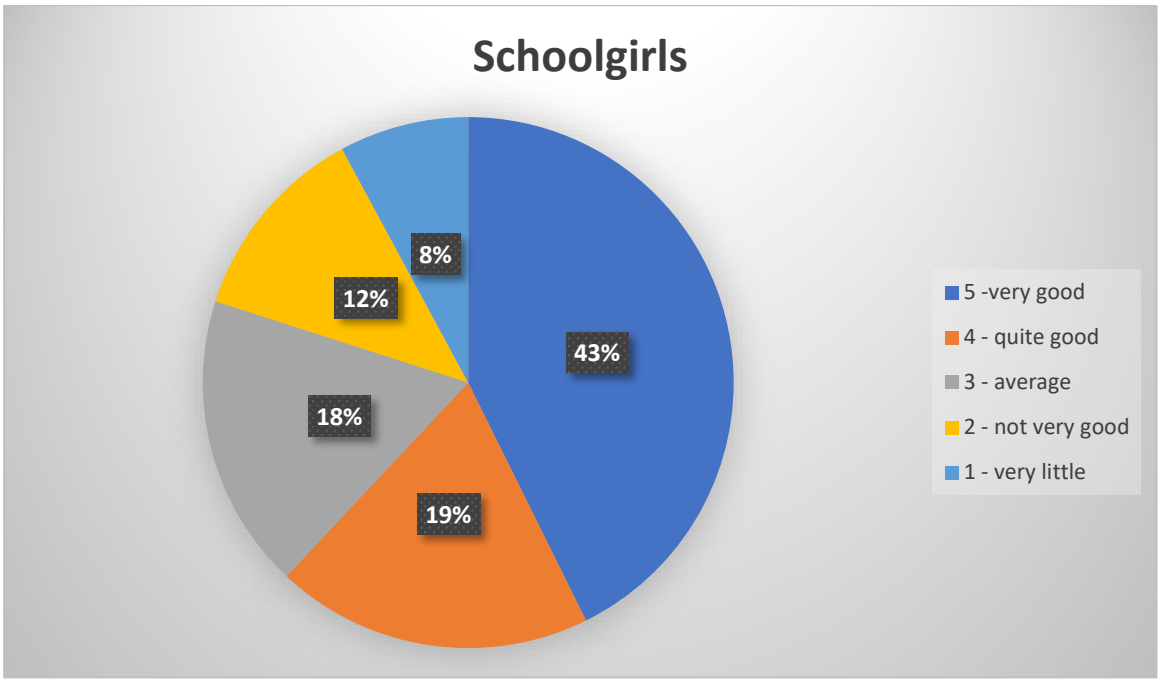

Schoolboys
53%
21%
14%
10%
2%
5 -very good
4 - quite good
3 - average
2 - not very good
1 - very little

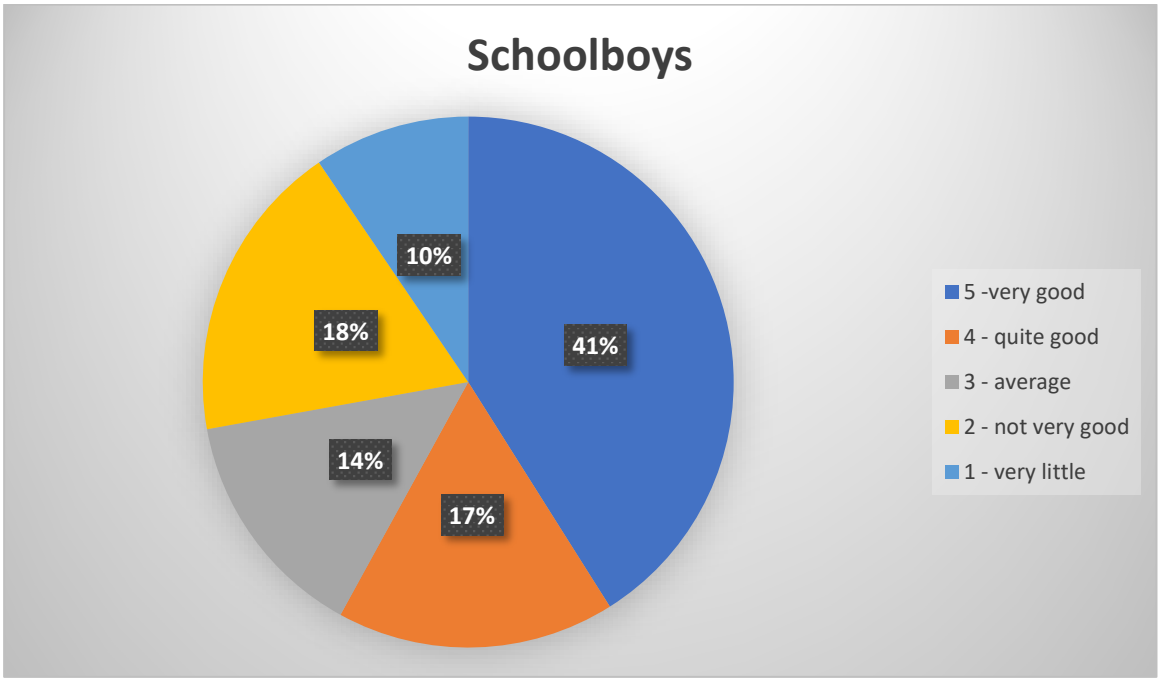

Natural resources
888
365
285
148
90
763
302
269
231
87
SCHOOLGIRLS
SCHOOLBOYS
5 - very good
4 – quite good
3 – average
2 –not very good
1 – very little

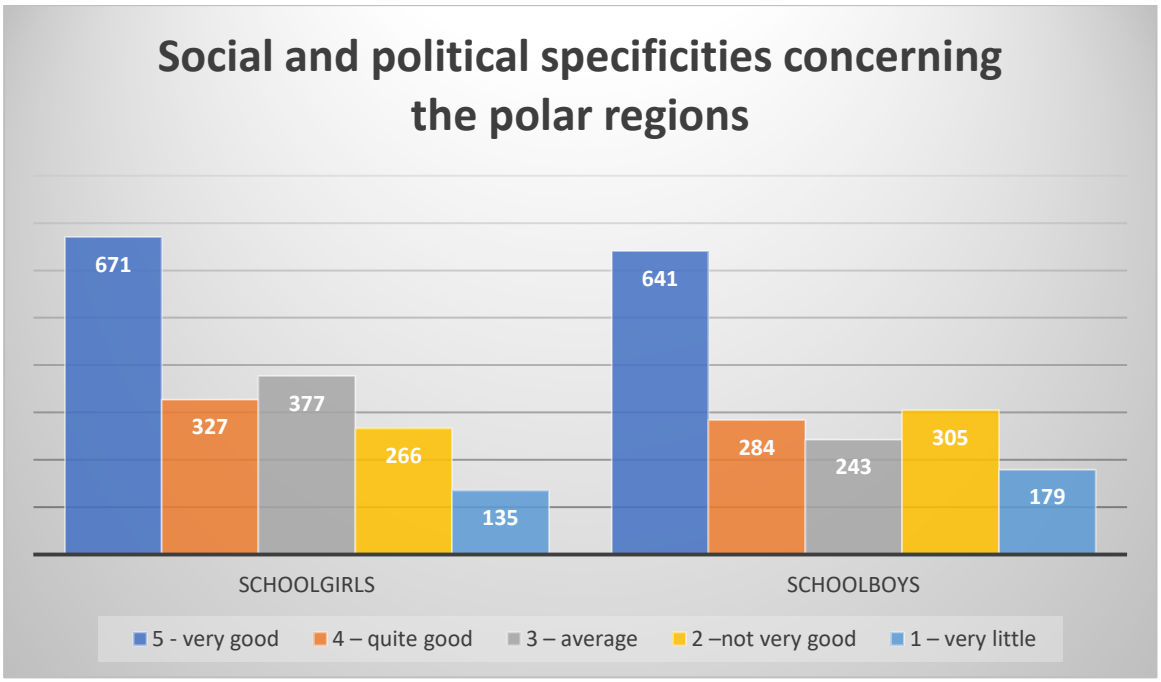

Schoolgirls
50%
21%
16%
8%
5%
5 -very good
4 - quite good
3 - average
2 - not very good
1 - very little

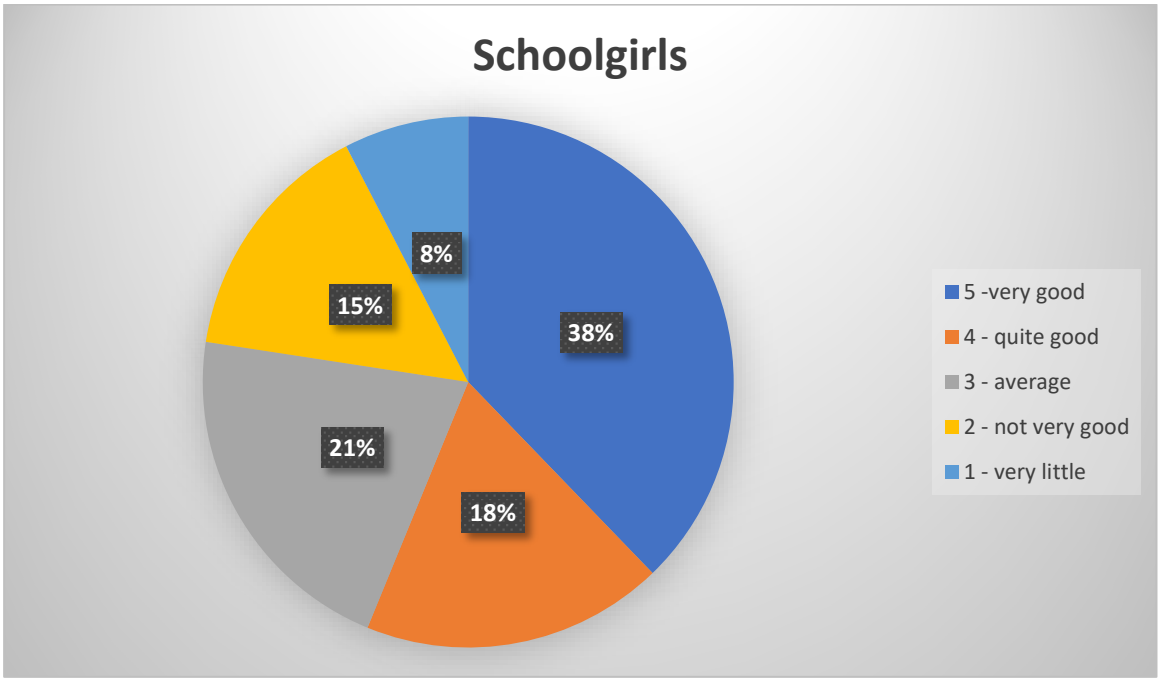

Schoolboys
46%
18%
17%
14%
5%
5 -very good
4 - quite good
3 - average
2 - not very good
1 - very little

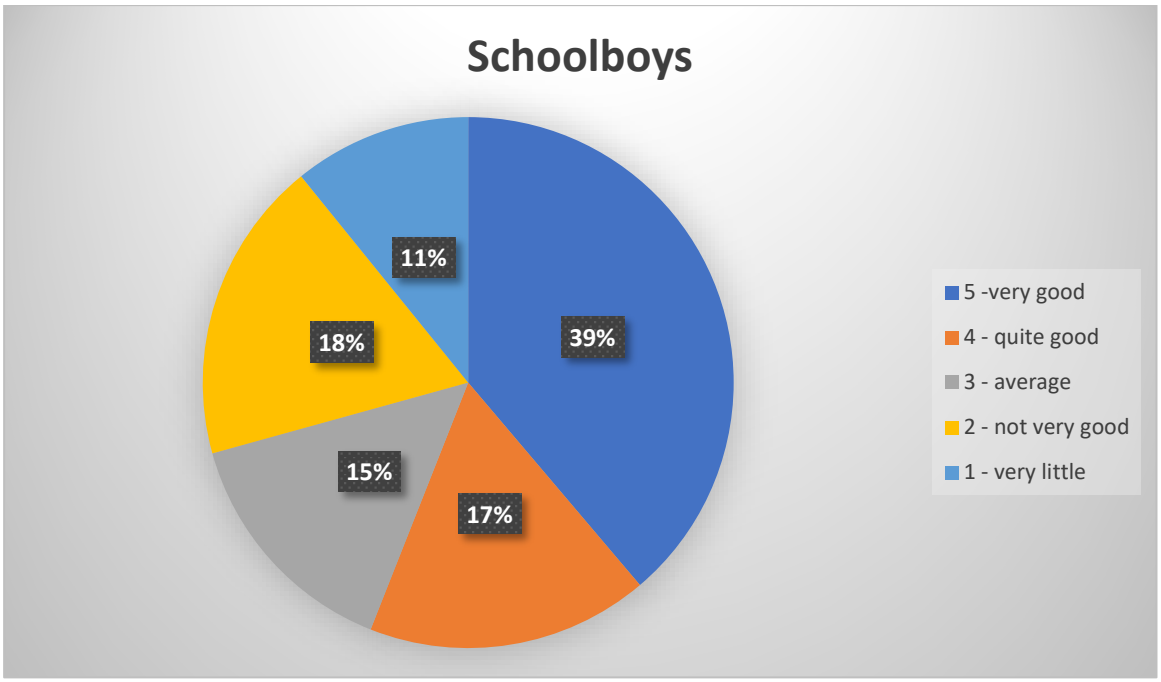

History
758
343
319
216
140
678
280
234
303
157
SCHOOLGIRLS
SCHOOLBOYS
5 - very good
4 – quite good
3 – average
2 –not very good
1 – very little

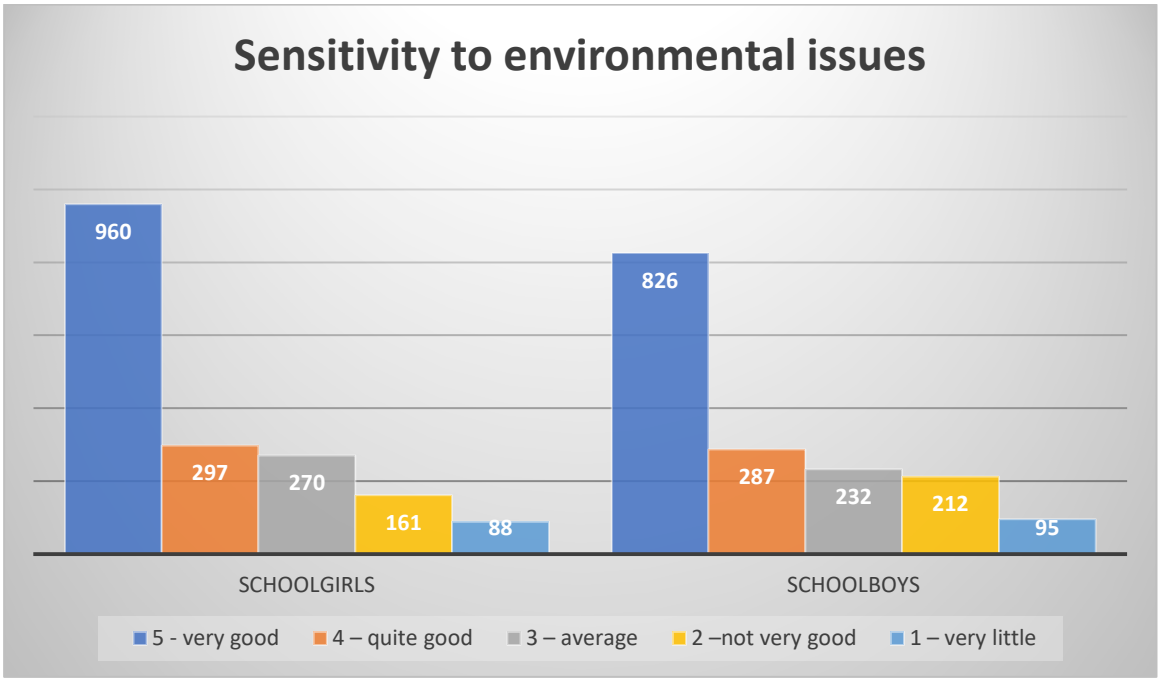

Schoolgirls
43%
19%
18%
12%
8%
5 -very good
4 - quite good
3 - average
2 - not very good
1 - very little

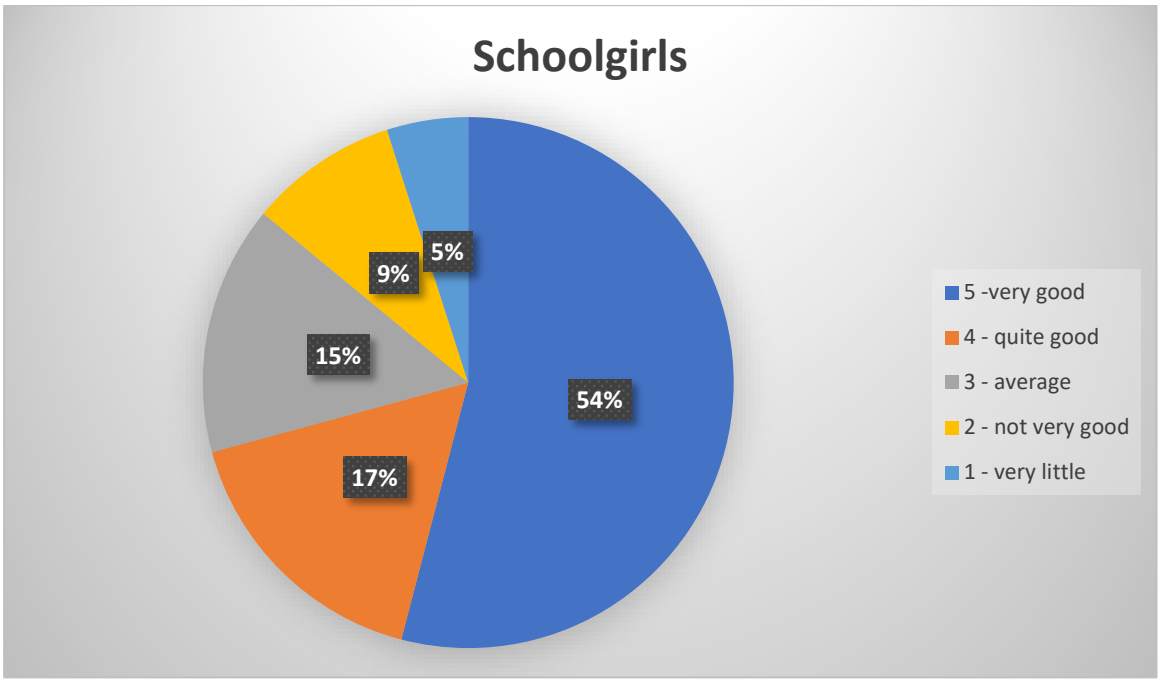

Schoolboys
41%
17%
14%
18%
10%
5 -very good
4 - quite good
3 - average
2 - not very good
1 - very little

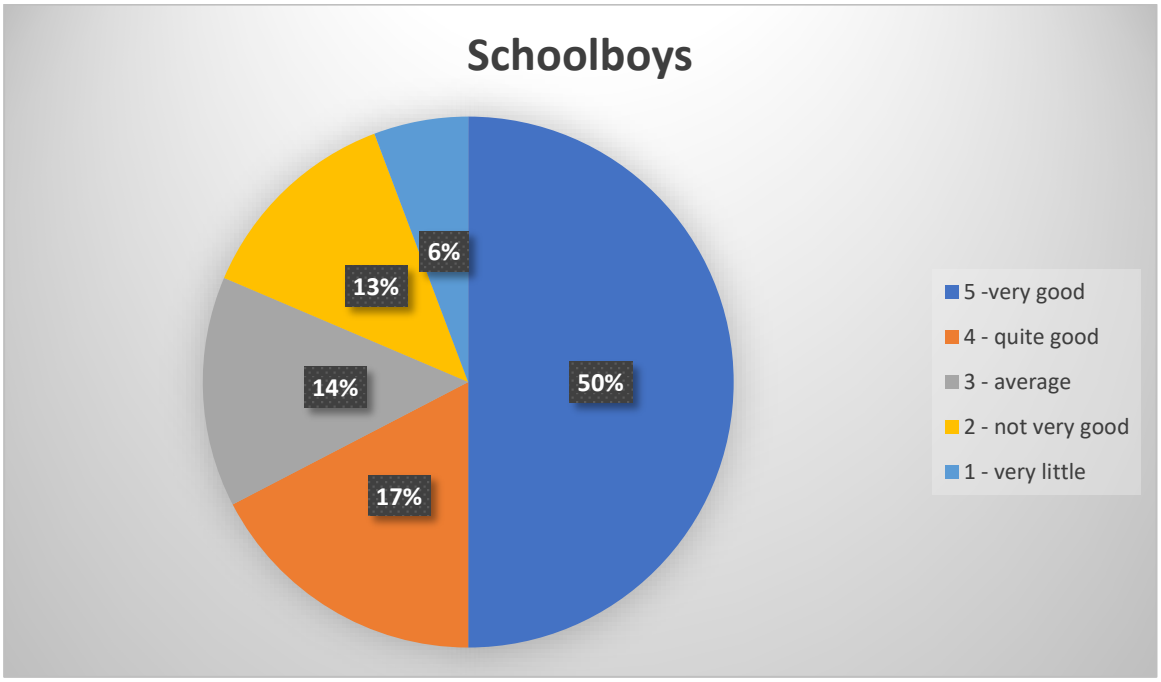

Social and political specificities concerning the polar regions
671
327
377
266
135
641
284
243
305
179
SCHOOLGIRLS
SCHOOLBOYS
5 - very good
4 – quite good
3 – average
2 –not very good
1 – very little

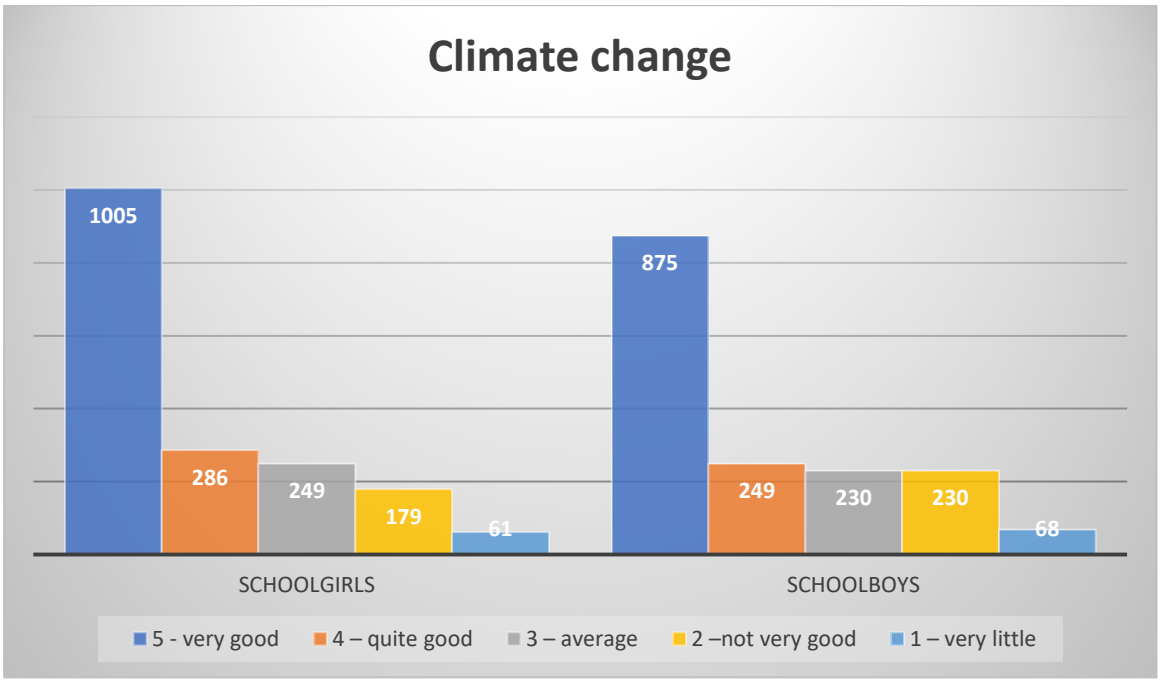

Schoolgirls
38%
18%
21%
15%
8%
5 -very good
4 - quite good
3 - average
2 - not very good
1 - very little

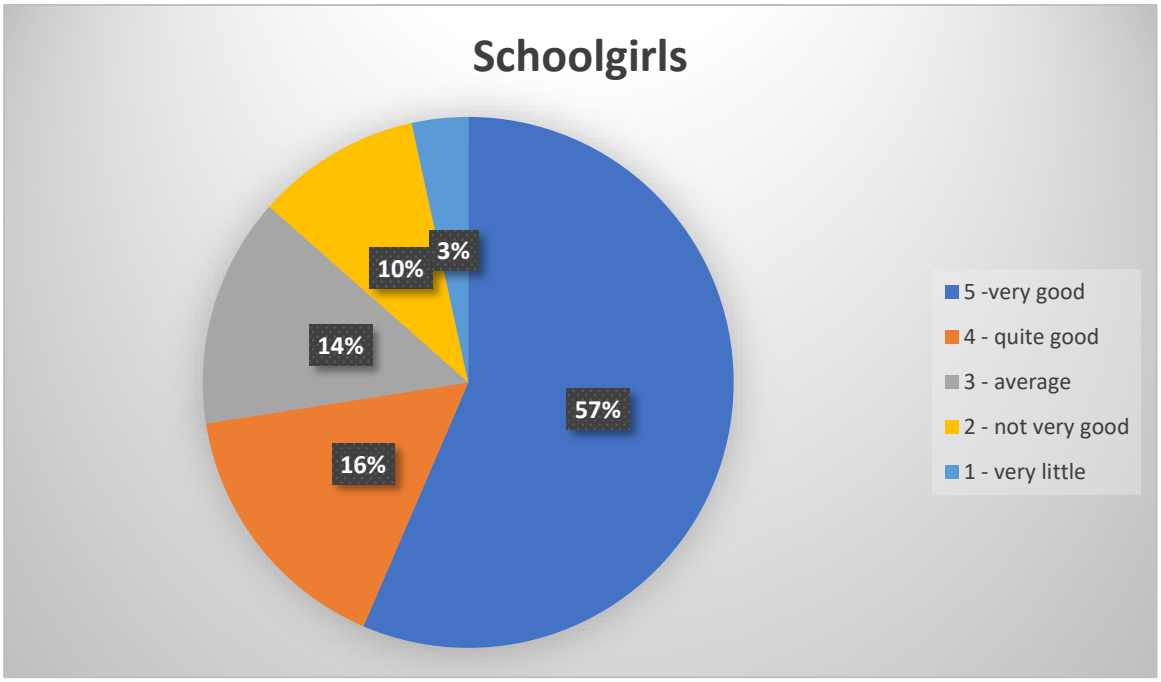

Schoolboys
11%
18%
39%
15%
17%
5 -very good
4 - quite good
3 - average
2 - not very good
1 - very little

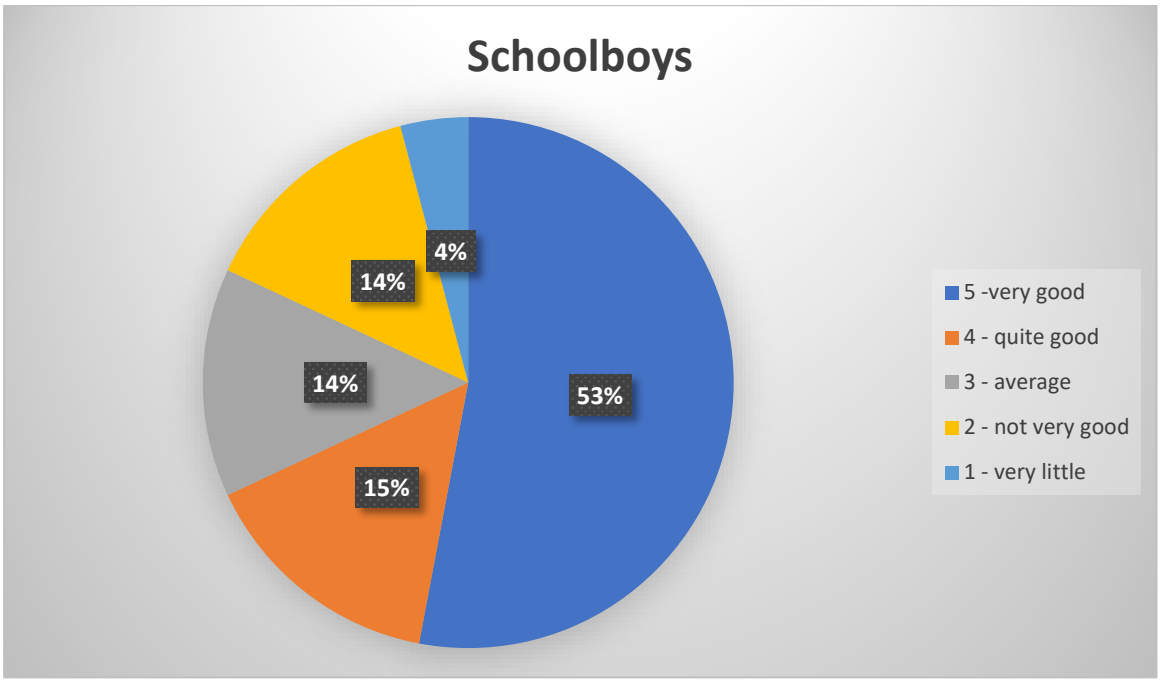

Sensitivity to environmental issues
960
297
270
161
88
826
287
232
212
95
SCHOOLGIRLS
SCHOOLBOYS
5 - very good
4 – quite good
3 – average
2 –not very good
1 – very little


Schoolgirls
54%
17%
15%
9%
5%
5 -very good
4 - quite good
3 - average
2 - not very good
1 - very little


Schoolboys
50%
17%
14%
13%
6%
5 -very good
4 - quite good
3 - average
2 - not very good
1 - very little


Climate change
1005
286
249
179
61
875
249
230
230
68
SCHOOLGIRLS
SCHOOLBOYS
5 - very good
4 – quite good
3 – average
2 –not very good
1 – very little


Schoolgirls
57%
16%
14%
10%
3%
5 -very good
4 - quite good
3 - average
2 - not very good
1 - very little



Remark: Teachers esteemed in relation to all subjects (except Nature – equal percentage – and Social and political specificities concerning polar regions – more boys than girls) that more girls than boys have "very good" knowledge about

1) Nature: a) girls: 894 (50% of all girls), b) boys: 825 (50% of all boys). If one takes the total of girls and boys teachers expressed opinions about, 894 girls represent 26% of the total of pupils and 825 boys 24%.
2) Geography: a) girls: 991 (56% of all girls), b) boys: 876 (53% of all boys). If one takes the total of girls and boys teachers expressed opinions about, 991 girls represent 29% of the total of pupils and 876 boys 25%.
3) Natural resources: a) girls: 888 (50% of all girls), b) boys: 763 (46% of all boys). If one takes the total of girls and boys teachers expressed opinions about, 888 girls represent 26% of the total of pupils and 763 boys 22%.
4) History: a) girls: 758 (43% of all girls), b) boys: 678 (41% of all boys). If one takes the total of girls and boys teachers expressed opinions about, 758 girls represent 22% of the total of pupils and 678 boys 20%.
5) Social and political specificities concerning polar regions: a) girls: 671 (38% of all girls), b) boys: 641 (39% of all boys). If one takes the total of girls and boys teachers

expressed opinions about, 671 girls represent 19% of the total of pupils and 691 boys 20%.

6) Sensitivity to environmental issues: a) girls: 960 (54% of all girls), b) boys: 826 (50% of all boys). If one takes the total of girls and boys teachers expressed opinions about, 960 girls represent 28% of the total of pupils and 826 boys 24%.
7) Climate change: a) girls: 1005 (57% of all girls), b) boys: 875 (53% of all boys). If one takes the total of girls and boys teachers expressed opinions about, 1005 girls represent 29% of the total of pupils and 875 boys 25%.

6. General evaluation

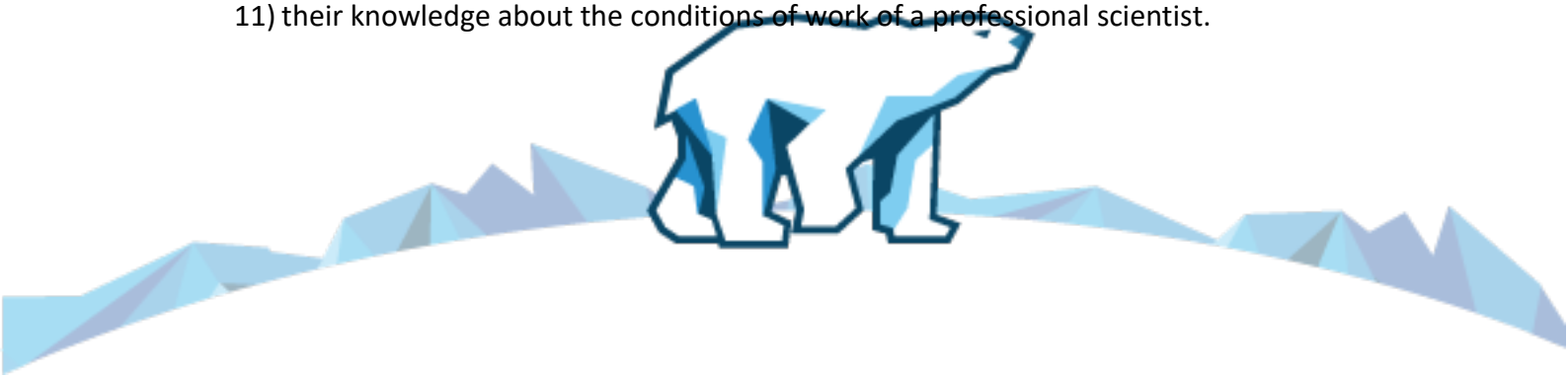
The survey permits remarks about the subjective opinion of anonymous teachers from 21 European countries, as well as Colombia, on pupils' use of the acquired knowledge and practice, pupils' interest in issues related to the Arctic, pupils' capacity

1) to integrate knowledge from various fields of mathematics and natural science,
2) to explain external phenomena,
3) to correctly interpret the results of experiments and research,
2) to use scientific language,
3) pupils' enthusiasm in getting involved in research or experimental processes,
4) their capacity to independently design the experimental research process, to conclude,
5) to realize tasks within a group,
6) to engage willingly in various tasks of the group,
7) to use willingly modern technology,

Finally, teachers were asked about their opinion on whether modern technology has an impact on raising the effectiveness of learning processes among their pupils.

The second category covers the following aspects:

8) pupils' interest in scientific careers
9) their interest in STEM
10) their knowledge about the vocational tasks of a professional scientist
11) their knowledge about the conditions of work of a professional scientist.



The third category covers the knowledge of pupils about the Arctic in a certain number of subjects (nature, geography, natural resources, history, social and political specificities, sensitivity to environmental issues and climate change).

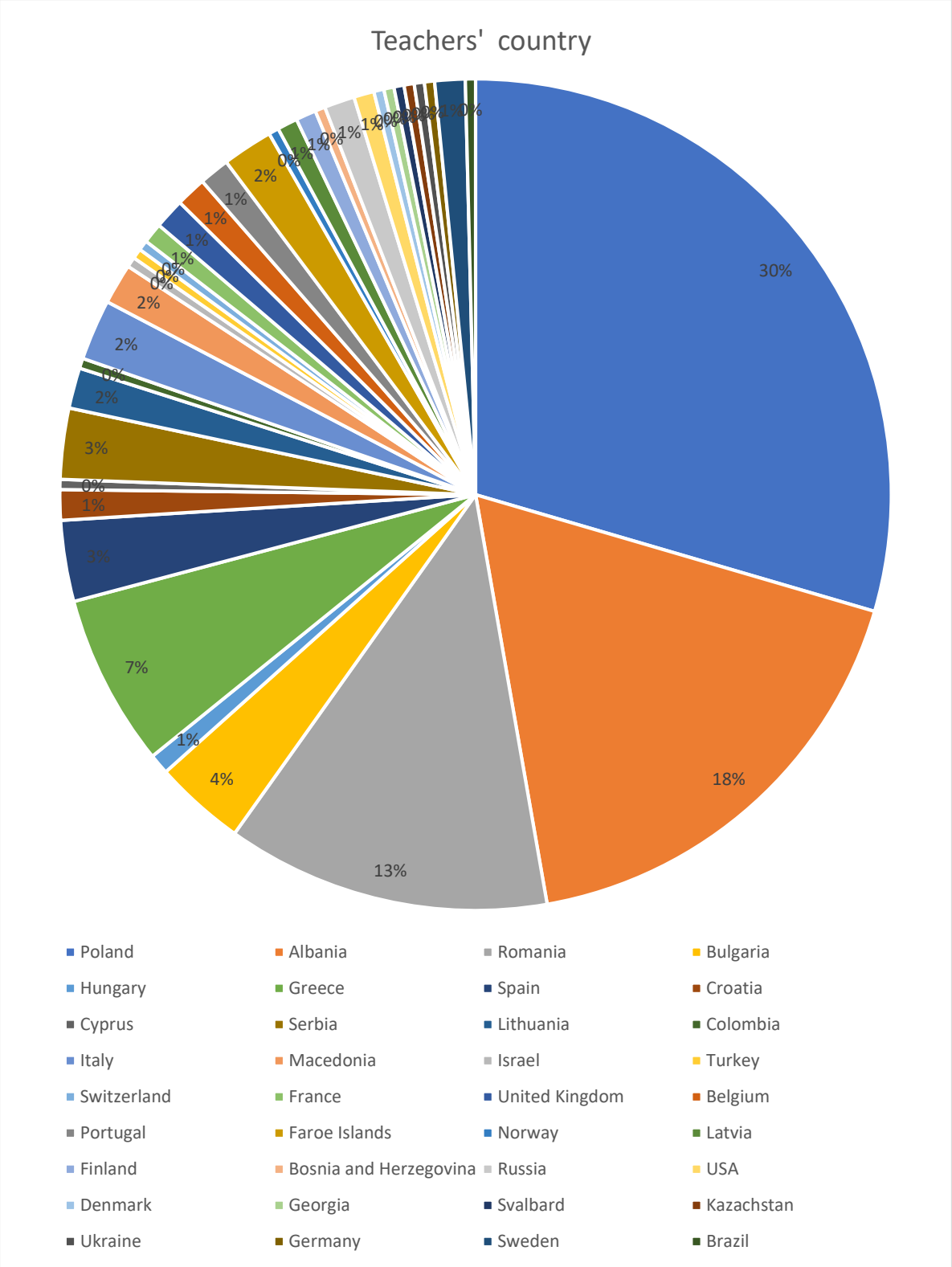
The analysis of the figures easily indicates that for each question, the largest number of pupils concerned corresponded to the top category, that-is-to-say the most active, the most willing, the most interested etc. It is striking to see that this observation is valid for both girls and boys, indicating an improvement of skills.

As to the comparison between girls and boys, the former systematically outnumber the latter as to the number of pupils in the respective top categories. It is to be noted however, that the number of female and male pupils covered by the survey are not identical (1776 girls and 1652 boys).

7. Evaluation in relation to the objectives

As part of the project´s direct results, the after-skills have to be measured as far as the enhancement of knowledge about science and scientific research is concerned, as well as their place in the modern world, enhancement of knowledge about nature, geography, natural resources, history, social and political specificities concerning polar regions and increase of sensitivity to environmental issues and climate change and establishing strong links between the worlds of research and young people/society to increase their ability to understand scientific messages and scientific language. The largest group of teachers esteemed that the EDU-ARCTIC project has had a significant impact on the increase of the level of pupils' knowledge about issues related to the Arctic, on the level of understanding of scientific issues and scientific language among pupils and level of interest in STEM and scientific careers among pupils.

8. Comparisons between the “entry-skills assessment” and “after-skills assessment” surveys

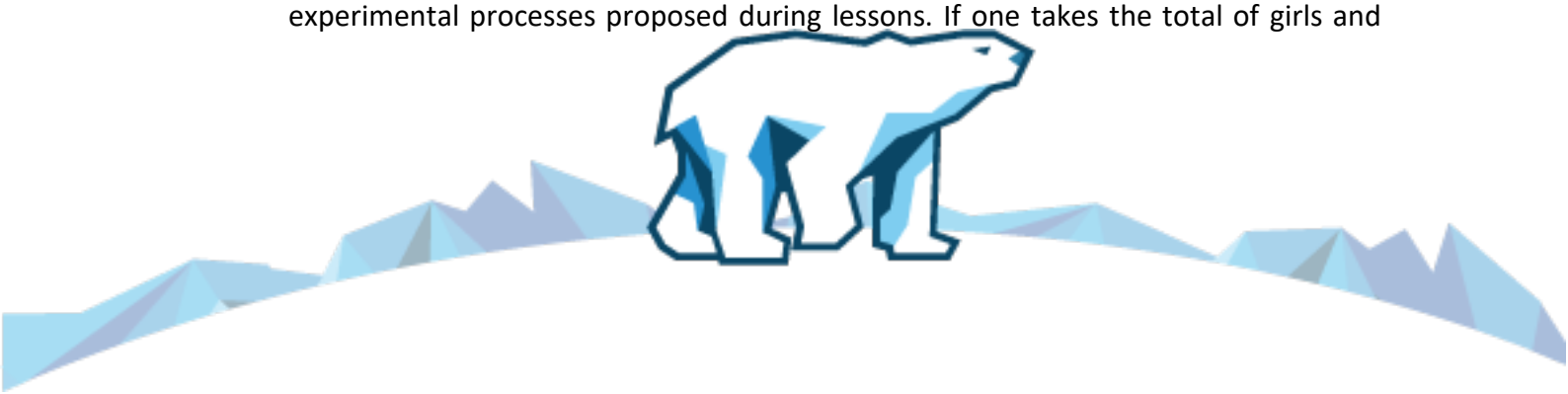


The “Entry-skills assessment” survey was filled in by 254 teachers, representing 37 countries from all over Europe. The 194 female and 60 male teachers indicated that they taught a total of 12469 schoolgirls and 12929 schoolboys, ie 25 398 pupils in total. The surveys were submitted in the period 12.01.2017-9.04.2018. Each new participant of the EDU-ARCTIC program, who registered before 28.03.2018., was encouraged to fill in this survey within 60 days after registration.

Results of the “Entry-skills assessment” survey show

in CATEGORY 1

- that 42% of girls and 44% of boys definitely use acquired knowledge in practice. If one takes the total of girls and boys teachers expressed opinions about, 5295 girls represent 21% of the total of pupils and 5704 boys 22%.
- 47% of girls and 44% are definitely interested in issues related to the Arctic. If one takes the total of girls and boys teachers expressed opinions about, 5814 girls represent 23% of the total of pupils and 5687 boys 22%.
- 48% of girls and 47% of boys definitely integrate knowledge from various fields of mathematics and natural science. If one takes the total of girls and boys teachers expressed opinions about, 6032 girls represent 24% of the total of pupils and 6001 boys 24%.
- 41% of girls and 42% of boys definitely explain external phenomena acquired during the act of learning. If one takes the total of girls and boys teachers expressed opinions about, 5066 girls represent 20% of the total of pupils and 5379 boys 21%.
- 42% of girls and 42% of boys definitely correctly interpret the results of experiments and research results. If one takes the total of girls and boys teachers expressed opinions about, 5210 girls represent 20% of the total of pupils and 5487 boys 22%.
- 42% of girls and 42% of boys are definitely able to use scientific language used in class. If one takes the total of girls and boys teachers expressed opinions about, 5218 girls represent 20% of the total of pupils and 5424 boys 21%.
- 55% of girls and 55% of boys are definitely enthusiastically involved in research or experimental processes proposed during lessons. If one takes the total of girls and



boys teachers expressed opinions about, 6887 girls represent 27% of the total of pupils and 7035 boys 28%.

- 39% of girls and 39% of boys definitely independently design the experimental research process. If one takes the total of girls and boys teachers expressed opinions about, 4786 girls represent 19% of the total of pupils and 5031 boys 20%.
- 48% of girls and 47% of boys definitely can conclude logically. If one takes the total of girls and boys teachers expressed opinions about, 6052 girls represent 24% of the total of pupils and 6137 boys 24%.
- 61% of girls and 57% of boys definitely can realize tasks within a group. . If one takes the total of girls and boys teachers expressed opinions about, 7597 girls represent 30% of the total of pupils and 7348 boys 29%.
- 54% of girls and 53% of boys are definitely willingly engaged in various tasks within a group. . If one takes the total of girls and boys teachers expressed opinions about, 6798 girls represent 27% of the total of pupils and 6786 boys 27%.
- 63% of girls and 62% of boys definitely willingly use modern technology in order to learn. If one takes the total of girls and boys teachers expressed opinions about, 7842 girls represent 31% of the total of pupils and 8047 boys 32%.
- 75% of girls and 71% of boys definitely think modern technologies have an impact on raising the effectiveness of learning processes among pupils. If one takes the total of girls and boys teachers expressed opinions about, 9310 girls represent 37% of the total of pupils and 9260 boys 36%.
- as to subjects taught in class

in CATEGORY 2:

- that 41% of girls and 41% of boys can formulate research questions very efficiently. If one takes the total of girls and boys teachers expressed opinions about, 5061 girls represent 20% of the total of pupils and 5286 boys 21%.
- 39% of girls and 39% of boys definitely can choose and justify research hypotheses very efficiently. If one takes the total of girls and boys teachers expressed opinions about, 4879 girls represent 19% of the total of pupils and 5025 boys 20%.

- 39% of girls and 39% of boys can verify the quality of research results very efficiently. If one takes the total of girls and boys teachers expressed opinions about, 4908 girls represent 19% of the total of pupils and 5052 boys 20%.
- 42% of girls and 44% of boys are definitely showing interest in scientific careers. If one takes the total of girls and boys teachers expressed opinions about, 5285 girls represent 21% of the total of pupils and 5684 boys 22%.
- 47% of girls and 50% of boys are definitely showing interest in STEM. If one takes the total of girls and boys teachers expressed opinions about, 5883 girls represent 23% of the total of pupils and 6454 boys 25%.
- 37% of girls and 39% of boys definitely have knowledge about the vocational tasks of a professional scientist. If one takes the total of girls and boys teachers expressed opinions about, 4558 girls represent 18% of the total of pupils and 5070 boys 20%.
- 36% of girls and 37% of boys definitely know about the conditions of work of professional scientists. If one takes the total of girls and boys teachers expressed opinions about, 4434 girls represent 17% of the total of pupils and 4854 boys 19%.

in CATEGORY 3:

as far as subjects taught in school are concerned

- 38% of girls and 37% of boys have very good knowledge about *nature*. If one takes the total of girls and boys teachers expressed opinions about, 4778 girls represent 19% of the total of pupils and 4824 boys 19%.
- 39% of girls and 38% of boys have very good knowledge about *geography*. If one takes the total of girls and boys teachers expressed opinions about, 4913 girls represent 19% of the total of pupils and 4959 boys 19%.
- 36% of girls and 35% of boys have very good knowledge about *natural resources*. If one takes the total of girls and boys teachers expressed opinions about, 4480 girls represent 18% of the total of pupils and 4578 boys 18%.
- 31% of girls and 29% of boys have very good knowledge about *history*. If one takes the total of girls and boys teachers expressed opinions about, 3820 girls represent 15% of the total of pupils and 3800 boys 15%.

- 29% of girls and 28% of boys have very good knowledge about *social and political specificities of the Arctic*. If one takes the total of girls and boys teachers expressed opinions about, 3662 girls represent 14% of the total of pupils and 3641 boys 14%.
- 36% of girls and 34% of boys have very good *sensitivity to environmental issues*. If one takes the total of girls and boys teachers expressed opinions about, 4501 girls represent 18% of the total of pupils and 4387 boys 17%.
- 40% of girls and 40% of boys have very good knowledge about *climate change*. If one takes the total of girls and boys teachers expressed opinions about, 5038 girls represent 20% of the total of pupils and 5152 boys 20%.

Remarks:

The difference between girls and boys is not particularly significant (highest score 4%). One will note the generally high proportion of top score replies (the lowest being 28% in relation to knowledge about social and political specificities of the Arctic which non-Arctic European pupils are indeed not likely to know very much about, 75% being the top score, also not surprisingly in relation to the impact of modern technologies in lessons). The answers about school subjects indicate lower scores to begin with (esp. not surprisingly in Arctic history, social and political specificities of the Arctic, but again almost on level of category one about climate change, much more present in the media in a global sense). If one takes the total of girls and boys teachers expressed opinions about, the difference between girls and boys does not exceed 2% more boys per question.

Comparisons between the "Entre-skills assessment" and "After-skills assessment" surveys

Remark about general statistics

Far more surveys were submitted for the "entry-skills assessment" survey than for the "after-skills assessment" survey (254 versus 73, i.e. a difference of 174 surveys). In terms of pupils' representation:

"entry-skills assessment" survey – replies from teachers concern 12469 schoolgirls and 12929 schoolboys taught by particular teachers;

"after-skills assessment" survey - replies from teachers concern 1776 girls and boys 1652 involved in the EDU-ARCTIC program on a regular basis.

The very significant difference in numbers of schoolchildren represented in the "entry-skills assessment" and the "after-skills assessment" means that the two surveys are not comparable at the same level because the total number of surveys filled in by teachers for the "entry-skills assessment" and "after-skills assessment" are not identical. The results can only be used for indicative purposes.

Comparing evaluation results question by question

Remark: the following comparisons draw on the percentages of girls and boys out of the total number of pupils.

in CATEGORY 1

the difference/progression between the "entry-skills-" and "after-skills-assessment" surveys in relation to the question

- "definitely use acquired knowledge in practice" is: entry-skills/girls 21% and entry-skills/boys 22% - after-skills/girls 21% and after-skills/boys 20%; difference: girls 0%, boys -2%
- "are definitely interested in issues related to the Arctic": entry-skills/girls 23% and entry-skills/boys 20% - after-skills/girls 26% and after-skills/boys 25%; difference: girls +3%, boys +5%
- "definitely integrate knowledge from various fields of mathematics and natural science": entry-skills/girls 24% and entry-skills/boys 24% - after-skills/girls 26 and after-skills/boys 23; difference: girls +2%, boys -1%
- "definitely explain external phenomena acquired during the act of learning": entry-skills/girls 20% and entry-skills/boys 21% - after-skills/girls 23 and after-skills/boys 22; difference: girls +3%, boys +1%
- "definitely correctly interpret the results of experiments and research results": entry-skills/girls 20% and entry-skills/boys 22% - after-skills/girls 28 and after-skills/boys 26; difference: girls +8%, boys +4%
- "definitely able to use scientific language used in class": entry-skills/girls 20% and entry-skills/boys 21% - after-skills/girls 25 and after-skills/boys 22; difference: girls +5%, boys +1%

- “are definitely enthusiastically involved in research or experimental processes proposed during lessons”: entry-skills/girls 27% and entry-skills/boys 28% - after-skills/girls 29 and after-skills/boys 27; difference: girls +2%, boys -1%
- “definitely independently design the experimental research process”: entry-skills/girls 19% and entry-skills/boys 20% - after-skills/girls 20 and after-skills/boys 19; difference: girls +1%, boys -1%
- “definitely can conclude logically”: entry-skills/girls 24% and entry-skills/boys 24% - after-skills/girls 30 and after-skills/boys 28; difference: girls +6%, boys +2%
- “definitely can realize tasks within a group”: entry-skills/girls 30% and entry-skills/boys 29% - after-skills/girls 35 and after-skills/boys 30; difference: girls +5%, boys +1%
- “definitely willingly engaged in various tasks within a group”: entry-skills/girls 27% and entry-skills/boys 27% - after-skills/girls 33 and after-skills/boys 29; difference: girls +6%, boys +2%
- “definitely willingly use modern technology in order to learn”: entry-skills/girls 31% and entry-skills/boys 32% - after-skills/girls 34 and after-skills/boys 30; difference: girls +3%, boys -2%
- “definitely think modern technologies have an impact on raising the effectiveness of learning processes among pupils”: entry-skills/girls 37% and entry-skills/boys 36% - after-skills/girls 35 and after-skills/boys 33; difference: girls -2%, boys -3%

in CATEGORY 2:

- “can formulate research questions very efficiently”: entry-skills/girls 20% and entry-skills/boys 21% - after-skills/girls 25 and after-skills/boys 24; difference: girls +5%, boys +3%
- “can choose and justify research hypotheses very efficiently”: entry-skills/girls 19% and entry-skills/boys 20% - after-skills/girls 25 and after-skills/boys 23; difference: girls +6%, boys +3%
- “can verify the quality of research results very efficiently”: entry-skills/girls 19% and entry-skills/boys 20% - after-skills/girls 25 and after-skills/boys 22; difference: girls +6%, boys +2%

- "are definitely showing interest in scientific careers": entry-skills/girls 21% and entry-skills/boys 22% - after-skills/girls 25 and after-skills/boys 24; difference: girls +4%, boys +2%
- "are definitely showing interest in STEM ": entry-skills/girls 23% and entry-skills/boys 25% - after-skills/girls 30 and after-skills/boys 26; difference: girls +7%, boys +1%
- "definitely have knowledge about the vocational tasks of a professional scientist": entry-skills/girls 18% and entry-skills/boys 20% - after-skills/girls 24 and after-skills/boys 24; difference: girls +6%, boys +4%
- "definitely know about the conditions of work of professional scientists" entry-skills/girls 17% and entry-skills/boys 19% - after-skills/girls 26 and after-skills/boys 25; difference: girls +9%, boys +6%

in CATEGORY 3:

as far as subjects taught in school are concerned

- "have very good knowledge about *nature*": entry-skills/girls 19% and entry-skills/boys 19% - after-skills/girls 26 and after-skills/boys 24 ; difference : girls +7%, boys +5%
- "have very good knowledge about *geography*": entry-skills/girls 19% and entry-skills/boys 19% - after-skills/girls 24 and after-skills/boys 25 ; difference : girls +5%, boys +6%
- "have very good knowledge about *natural resources*": entry-skills/girls 18% and entry-skills/boys 18% - after-skills/girls 26 and after-skills/boys 22 ; difference : girls +8%, boys +4%
- "have very good knowledge about *history*": entry-skills/girls 15% and entry-skills/boys 15% - after-skills/girls 22 and after-skills/boys 20 ; difference : girls +7%, boys +5%
- "have very good knowledge about *social and political specificities of the Arctic*": entry-skills/girls 11% and entry-skills/boys 14% - after-skills/girls 19 and after-skills/boys 20 ; difference : girls +8%, boys +6%
- "have very good *sensitivity to environmental issues*": entry-skills/girls 18% and entry-skills/boys 17% - after-skills/girls 28 and after-skills/boys 24 ; difference : girls +10%, boys +7%

- "have very good knowledge about *climate change*": entry-skills/girls 20% and entry-skills/boys 20% - after-skills/girls 29 and after-skills/boys 25; difference : girls +9%, boys +5%

Remarks:

In category 1, the percentages are in progress for girls in response to 11 out of 13 questions and for boys in 7 out of 13. In categories 2, all figures indicate a progression (lowest score +1%, highest score +9%). The research-related questions show a progression between 2 and 6%. The question about pupils' interest in science shows a relatively small progression (girls +4% and boys +2%), the one about interest in STEM reveals a striking result: 7% progression among girls and 1% among boys, suggesting that the project's objectives in terms of furthering interest in STEM among girls had a certain impact – the contact of pupils with scientists and especially female scientist presumably playing an important role in this respect. The increased interest in science and STEM can also partly be explained by the figures concerning knowledge about the profession of the scientist and the conditions of work (respectively +6 /+4 and +9/+6%).

As to category 3, all percentages indicate a progression, the lowest score being +4% and the highest 10%. It is perhaps not surprising that the vast majority of school children represented did not have particularly specific knowledge about the Arctic other than the best-known phenomena, but more importantly for the project results, the online lessons, terms from Polarpedia and Arctic competitions clearly had an impact on the enhancement of knowledge about the Arctic, environmental issues and climate change.

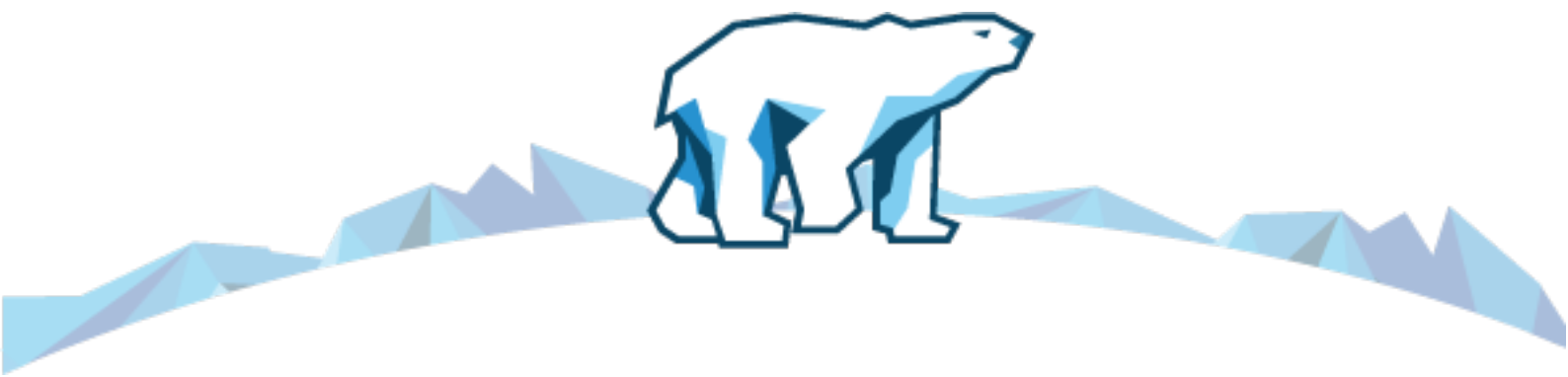
In conclusion, the figures demonstrate that the repeated contact with scientists has had a positive impact on the development of STEM-related knowledge and skills among the pupils, with higher progression figures among girls possibly being related to the repeated contact with female scientists in the project. As to the questions concerning the Arctic, environmental issues and climate change, the progression is naturally positive and significant since the children were exposed to these subjects on a regular basis, but it could be added that such progression figures indicate at the same time the high potential of the project's educational tools when it comes to sensitizing young people (and the general public beyond them – their

parents notably) about such burning issues as climate change and its particularly strong impact in the Arctic.

9. General Conclusion of Report on STEM skills assessment

As far as the interest of young people in STEM and scientific careers is concerned, the after-skills assessment reveals the opinion of teachers about the differences in the growth of knowledge, interest and understanding of scientific issues between schoolgirls and schoolboys. Generally speaking, there are no significant differences between girls and boys in the achieved level of knowledge about issues related to the Arctic, the level of understanding of scientific issues and scientific language among pupils and the level of interest in STEM and scientific careers after the participation in the EDU-ARCTIC project. However, the clear progression of girls' interest in STEM and careers as a scientist are a significant result of the project, just like the marked increase in knowledge about the Arctic, environmental issues and climate change. Regarding the interest of young people in STEM and their skills in related subjects, as well as knowledge about the Arctic, the project's objectives have been achieved. The logical conclusion from this remark is to suggest that such initiatives as EDU-ARCTIC do make a difference and that positive action may lead to clearly improved results. Hopefully, more opportunities will be offered at national, European and international level to pursue in this very promising vein.

The final conclusions and remarks concerning the project's impact and fulfilment of particular objectives of the action will be presented in details in the deliverable D5.4 *Impact Assessment*, due in July 2019.

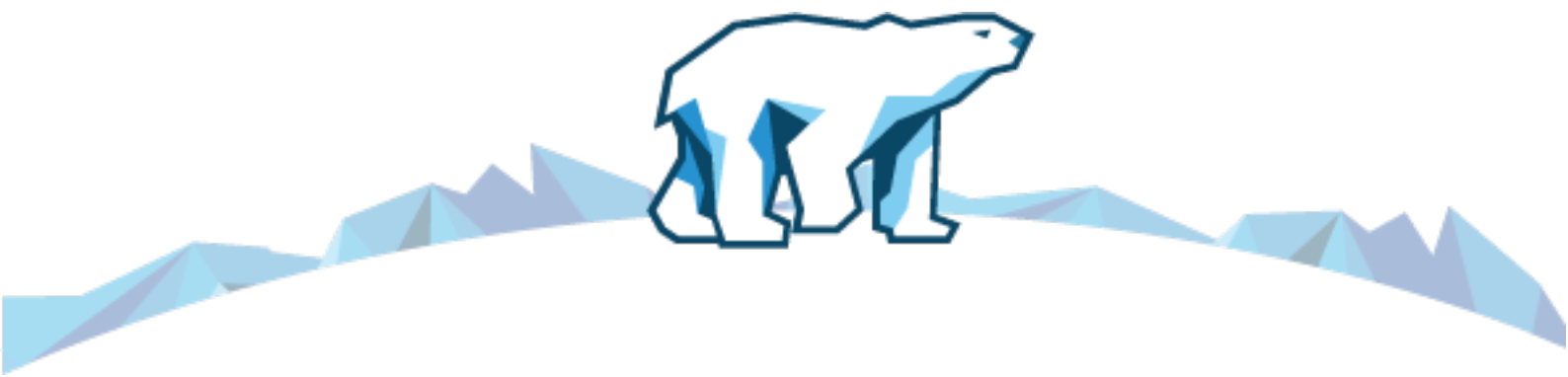


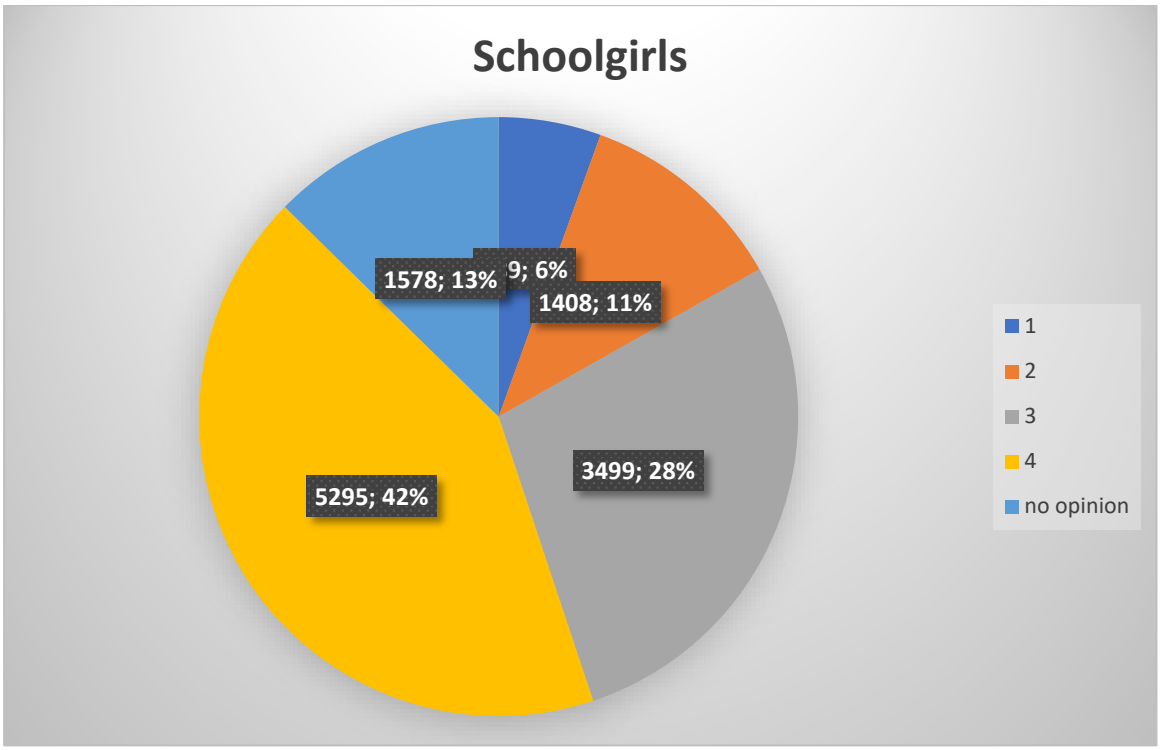
APPENDIX: Evaluation of the "entry-skills assessment" survey question by question

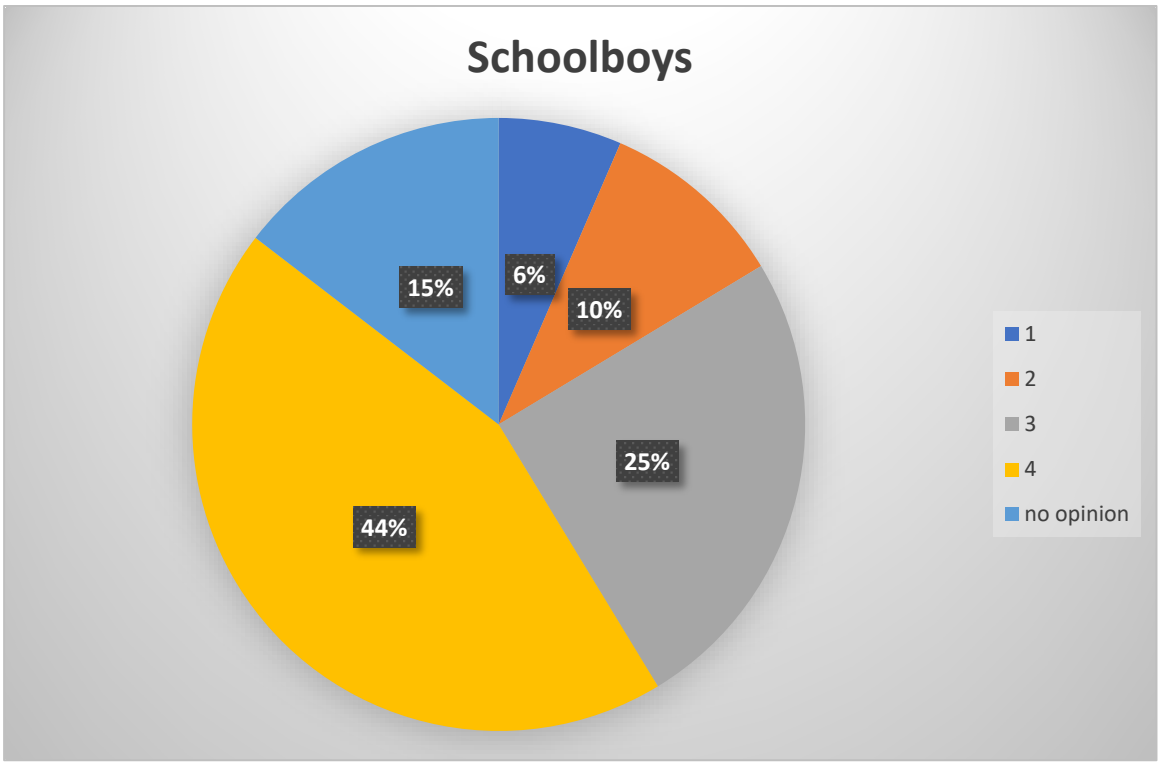
CATEGORY 1: STEM SKILLS
LEARN AND APPLY CONTENT

3. Do your pupils use the acquired knowledge in practice? Please put the proper number of schoolgirls and schoolboys that match to the given answers.

	Schoolgirls	Schoolboys
4 – Definitely use it	5295	5704
3 – Tend to use it	3499	3225
2 – Tend not use it	1408	1274
1 – Definitely do not use it	689	841
I have no opinion	1578	1885

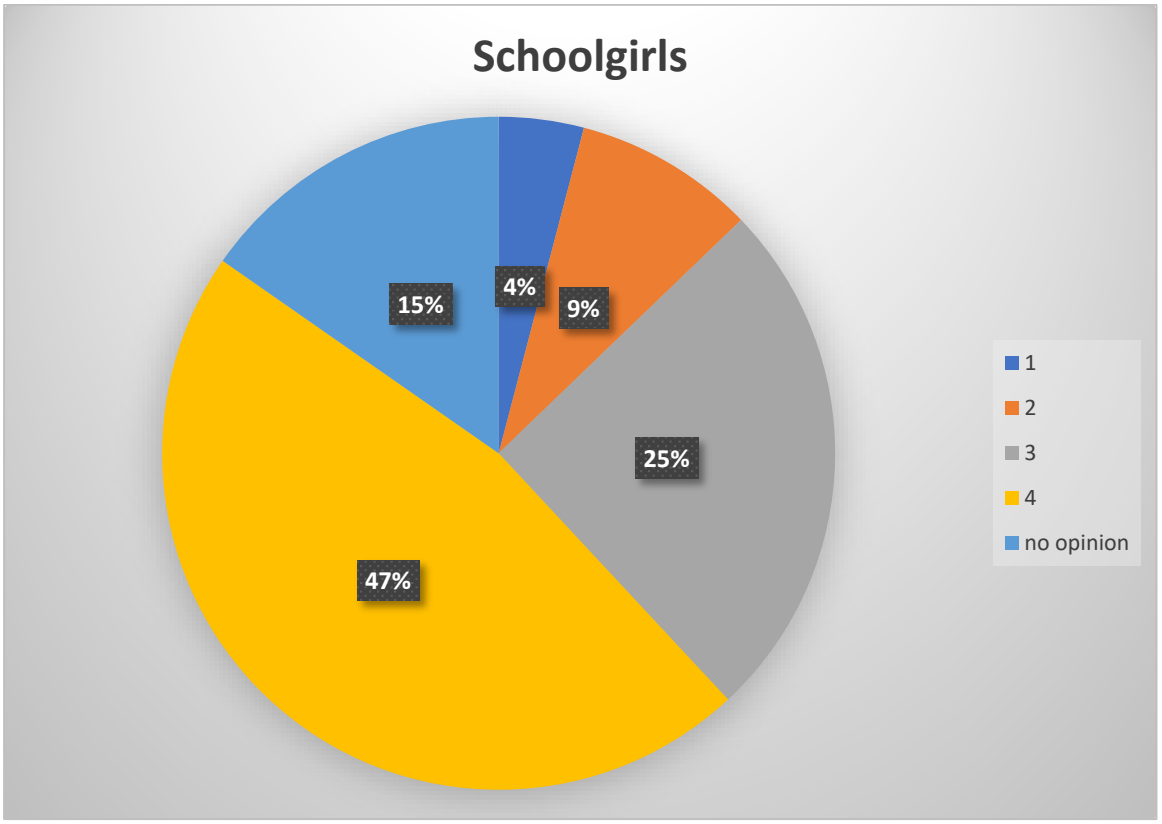


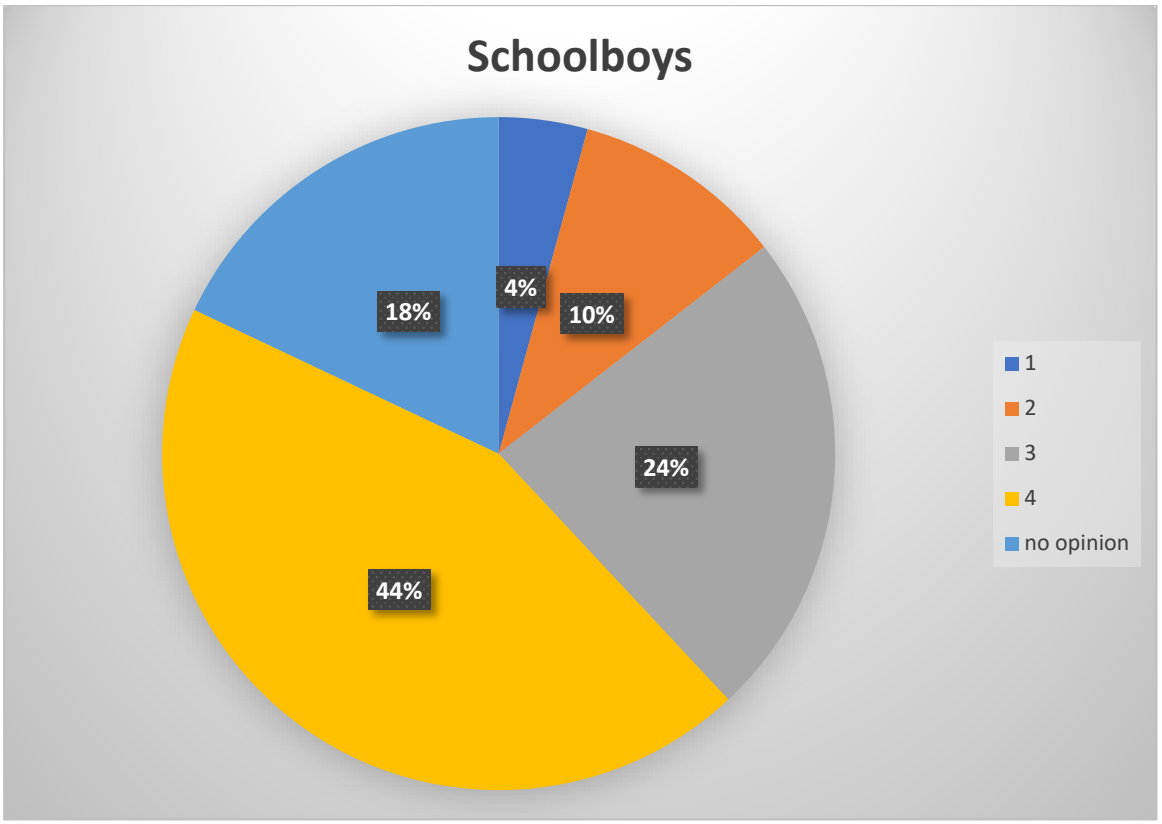




4. Are your pupils interested in issues related to the Arctic? Please put the proper number of schoolgirls and schoolboys that match to the given answers.

	Schoolgirls	Schoolboys
4 – Definitely interested	5814	5687
3 – Quite interested	3149	3046
2 – Not very interested	1088	1321
1 – Definitely not interested	509	551
I have no opinion	1909	2324

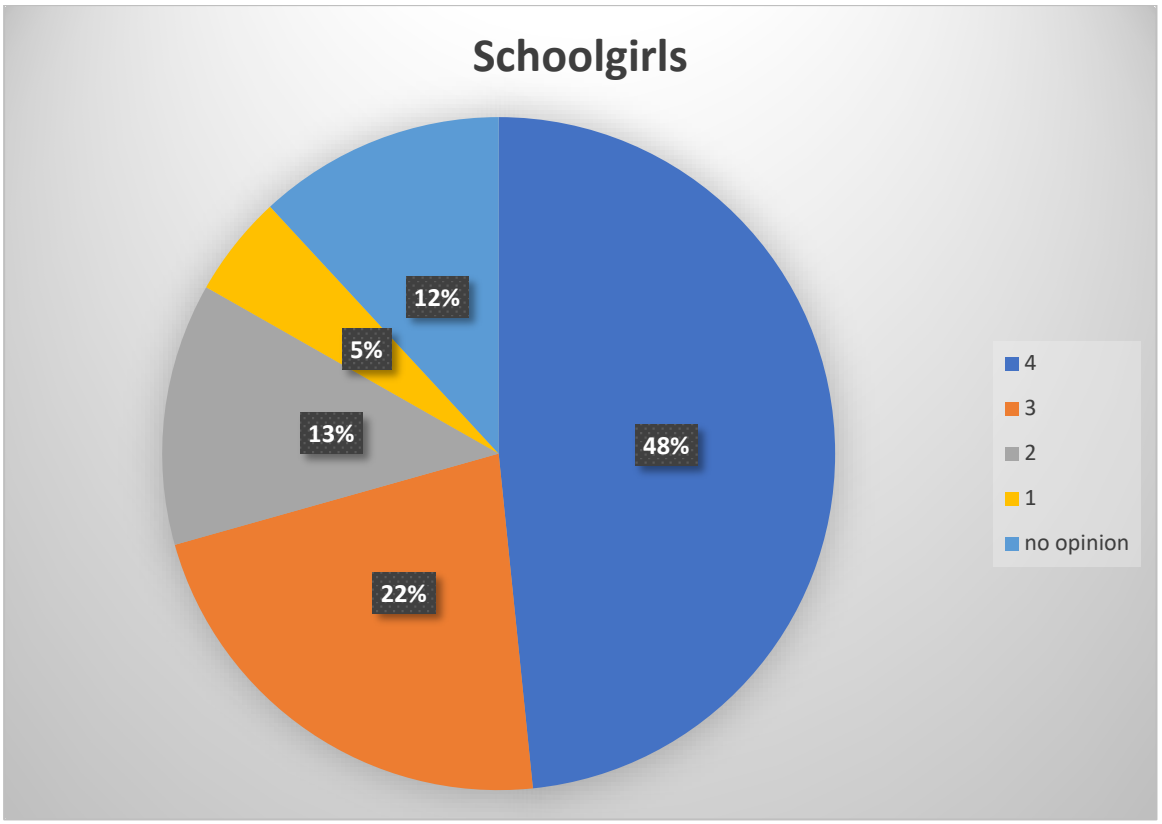


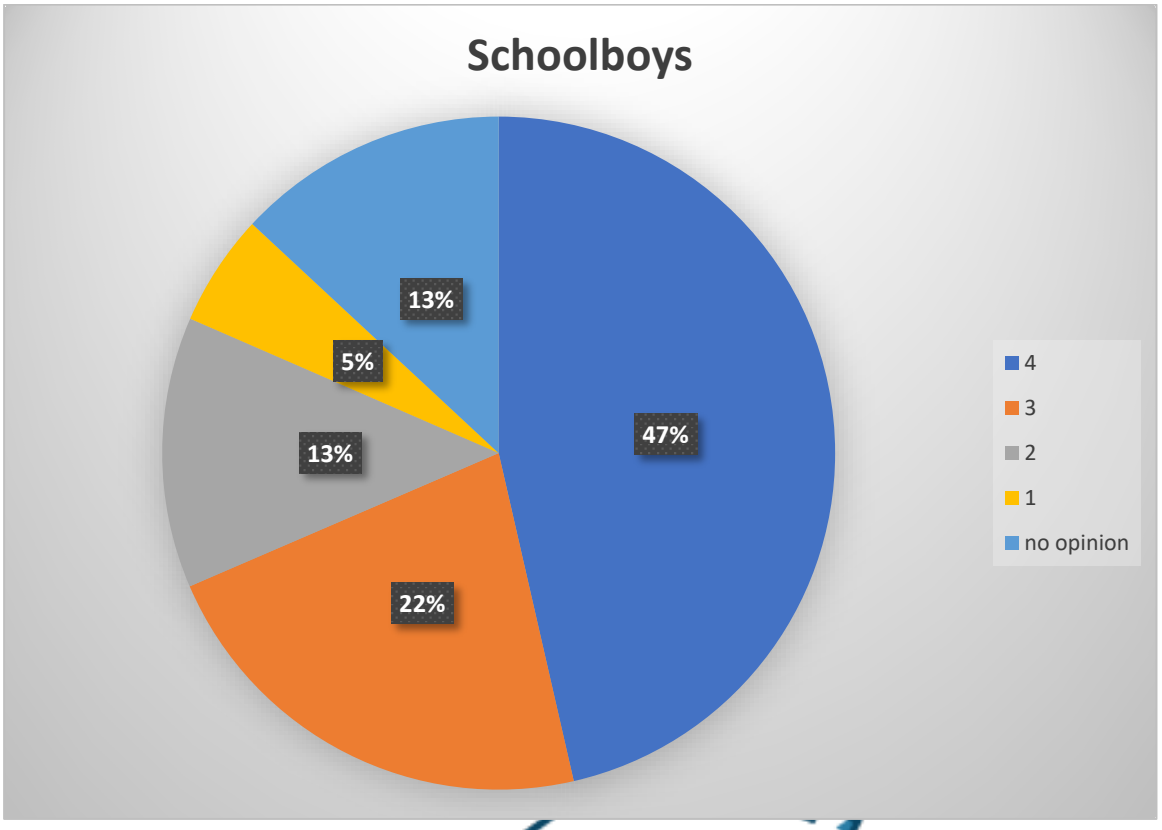


INTEGRATE CONTENT

3. Do your pupils integrate knowledge from various fields of mathematics and natural sciences (e.g. they use information obtained on other subjects while participating in your lesson)? Please put the proper number of schoolgirls and schoolboys that match to the given answers.

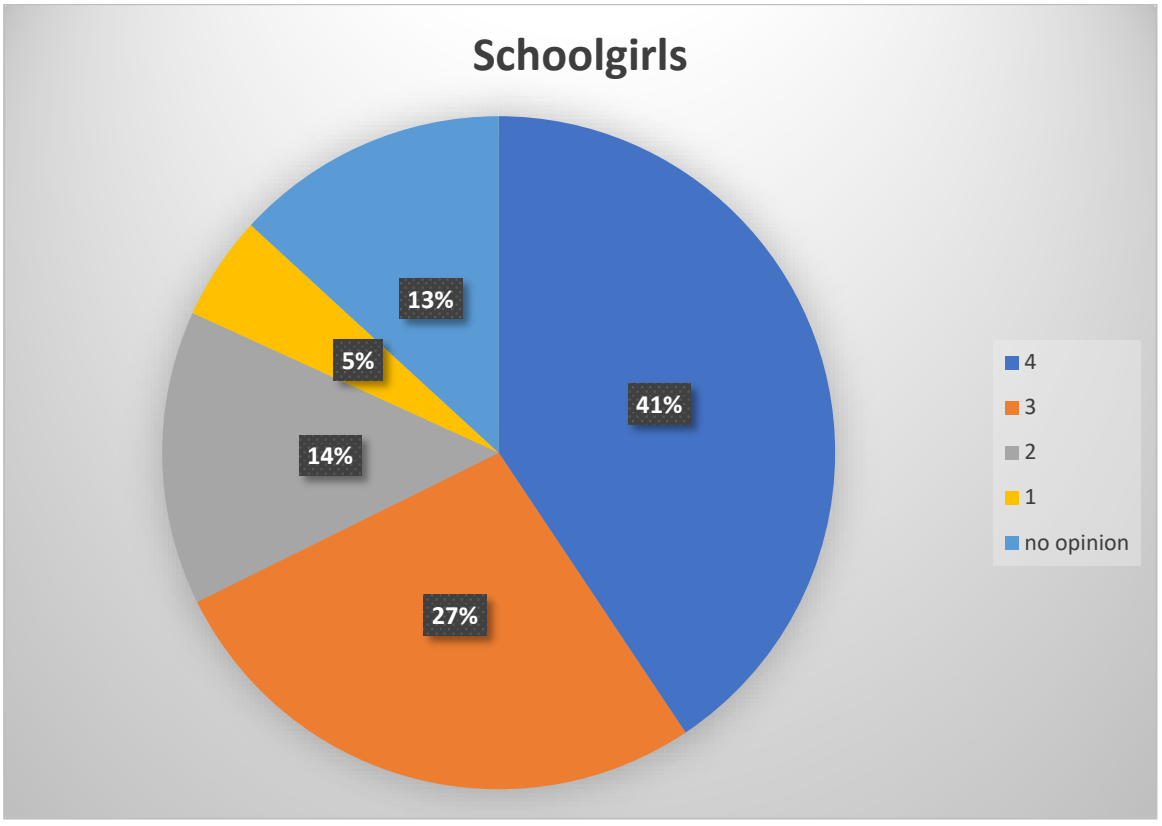
	Schoolgirls	Schoolboys
4 – Definitely integrate	6032	6001
3 – Often integrate	2775	2858
2 – Rarely integrate	1571	1683
1 – Definitely do not integrate	609	696
I have no opinion	1482	1691

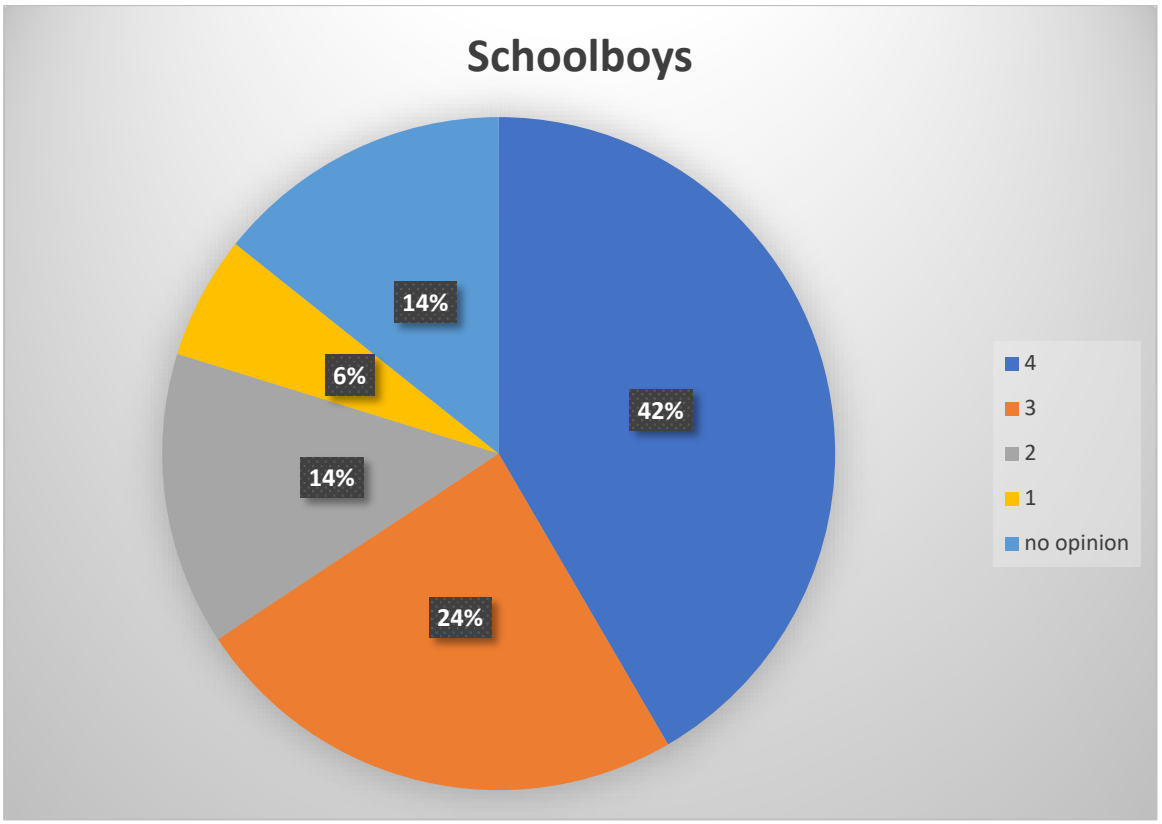

Schoolgirls
12%
5%
13%
48%
22%
4
3
2
1
no opinion


Schoolboys
13%
5%
13%
47%
22%
4
3
2
1
no opinion

4. Do your pupils explain external phenomena (e.g. natural, social, etc.) using the concepts acquired during the act of learning? Please put the proper number of schoolgirls and schoolboys that match to the given answers.

	Schoolgirls	Schoolboys
4 – Definitely explain	5066	5379
3 – Often explain	3374	3115
2 – Rarely explain	1761	1822
1 – Definitely do not explain	625	765
I have no opinion	1643	1848

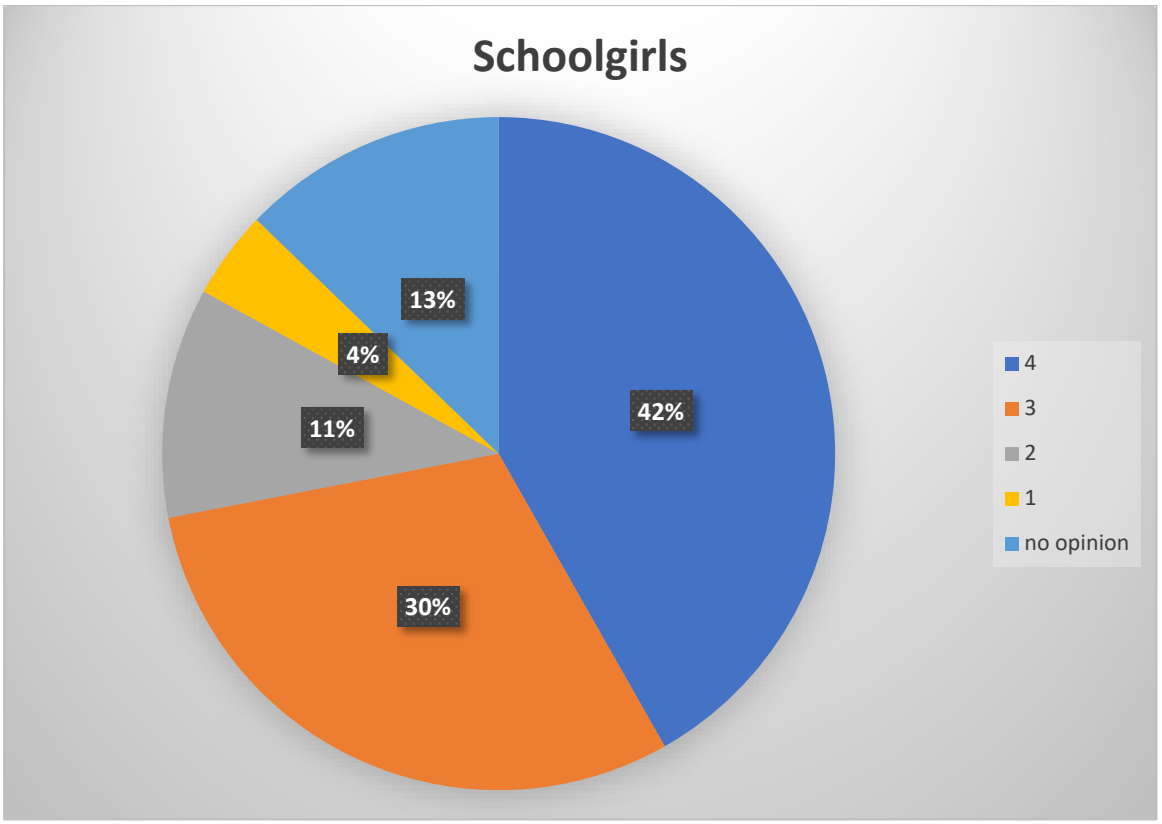


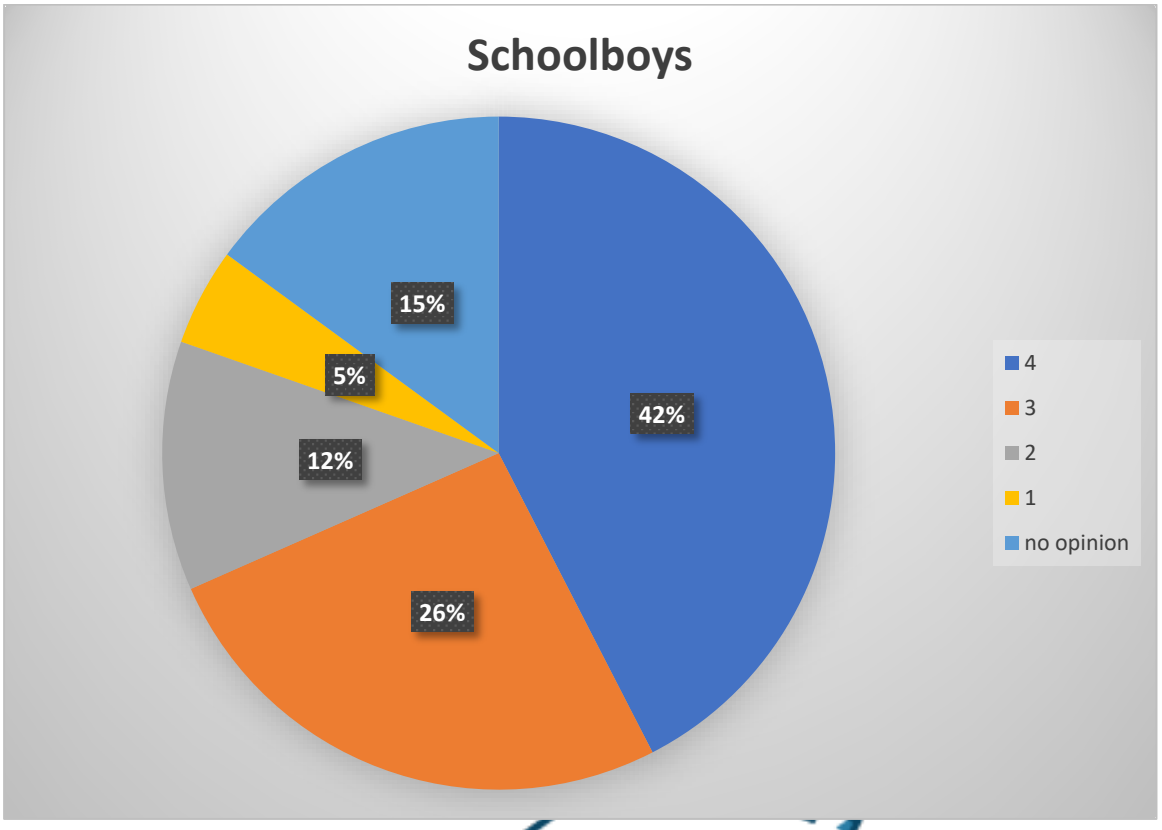


INTERPRETATION AND COMMUNICATION OF INFORMATION

2. Do your pupils correctly interpret the results of experiments, results of research? Please put the proper number of schoolgirls and schoolboys that match to the given answers.

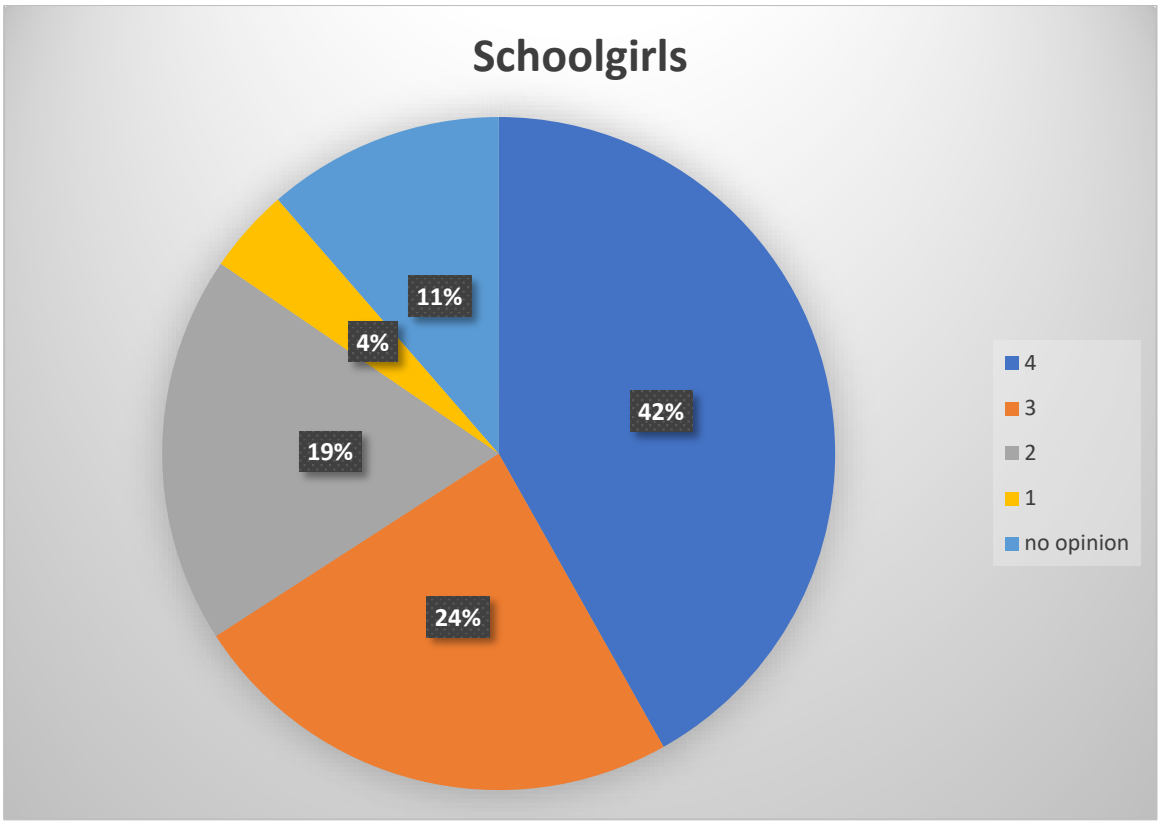
	Schoolgirls	Schoolboys
4 – Definitely yes	5210	5487
3 – Rather yes	3760	3355
2 – Rather no	1379	1549
1 – Definitely no	527	605
I have no opinion	1593	1933

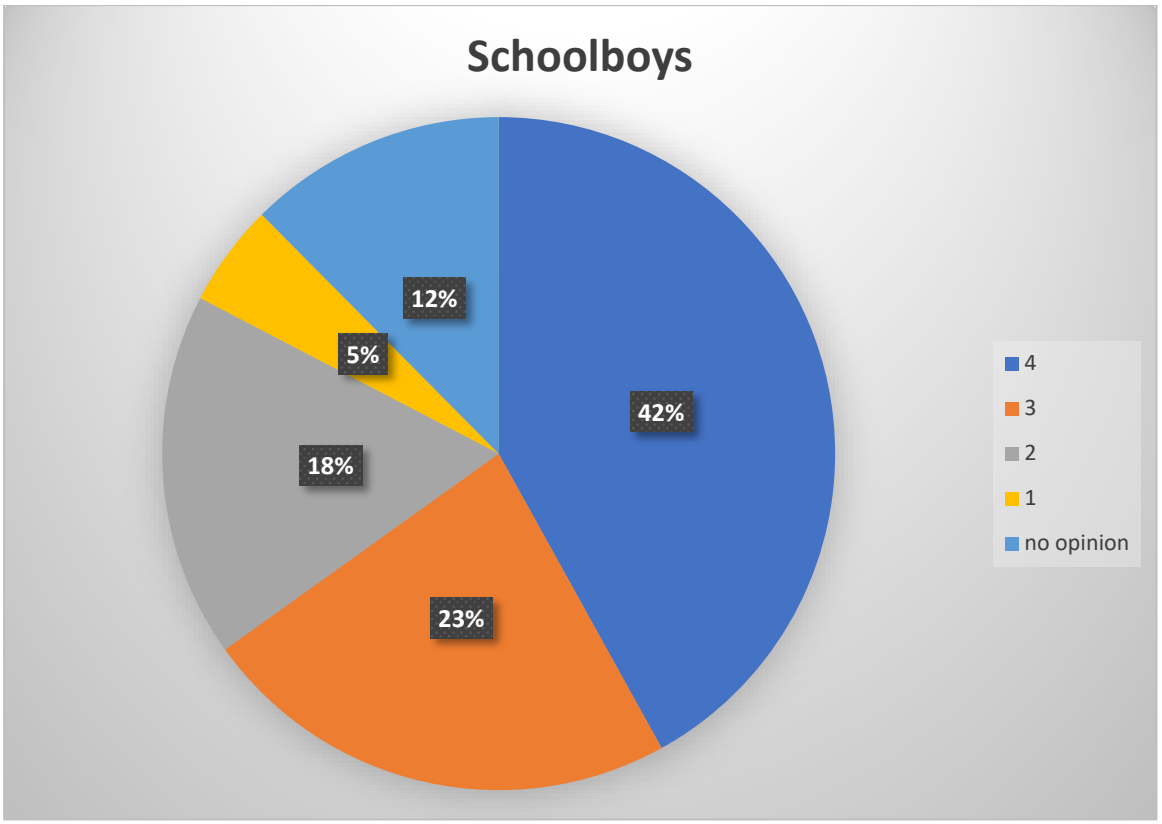

Schoolgirls
13%
4%
11%
42%
30%
4
3
2
1
no opinion


Schoolboys
15%
5%
12%
42%
26%
4
3
2
1
no opinion

2. Are your pupils able to use scientific language, which you use in a class (e.g. use the same terminology)? Please put the proper number of schoolgirls and schoolboys that match to the given answers.

	Schoolgirls	Schoolboys
4 – Definitely are able	5218	5424
3 – Rather are able	2996	2994
2 – Rather are not able	2327	2267
1 – Definitely not able	508	637
I have no opinion	1420	1607

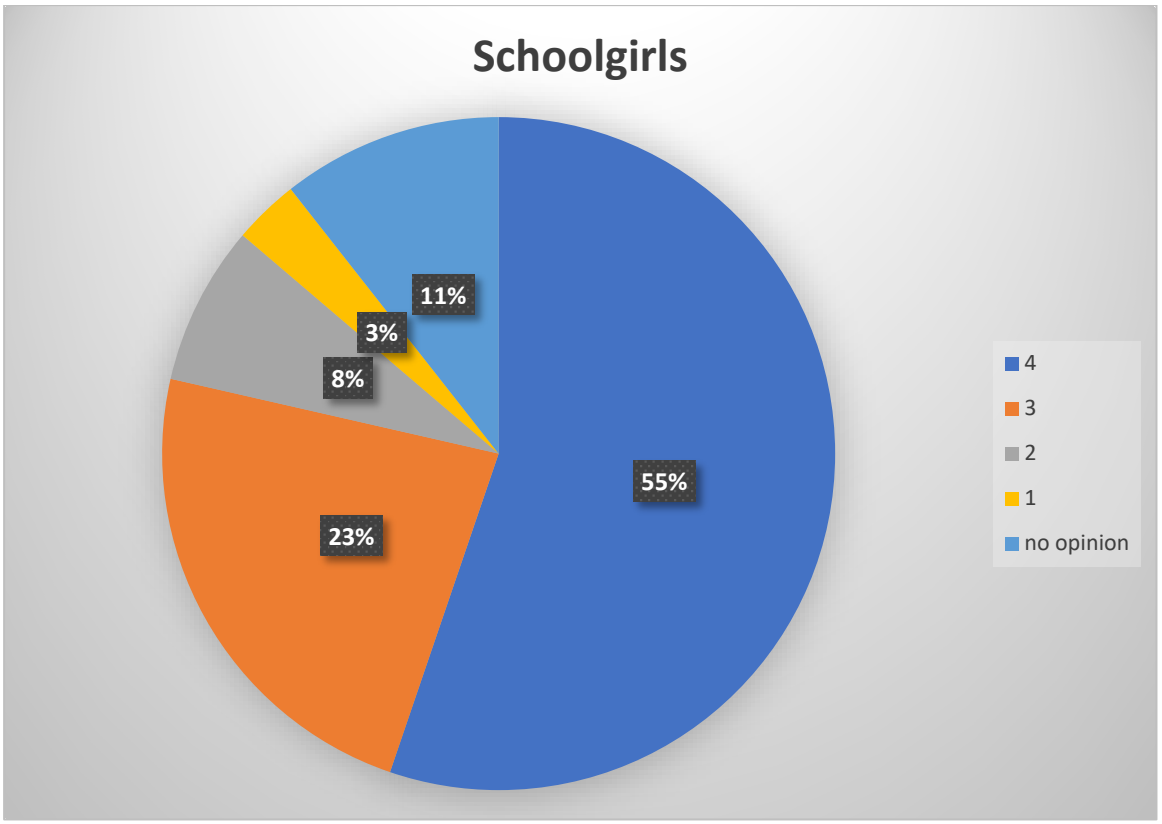


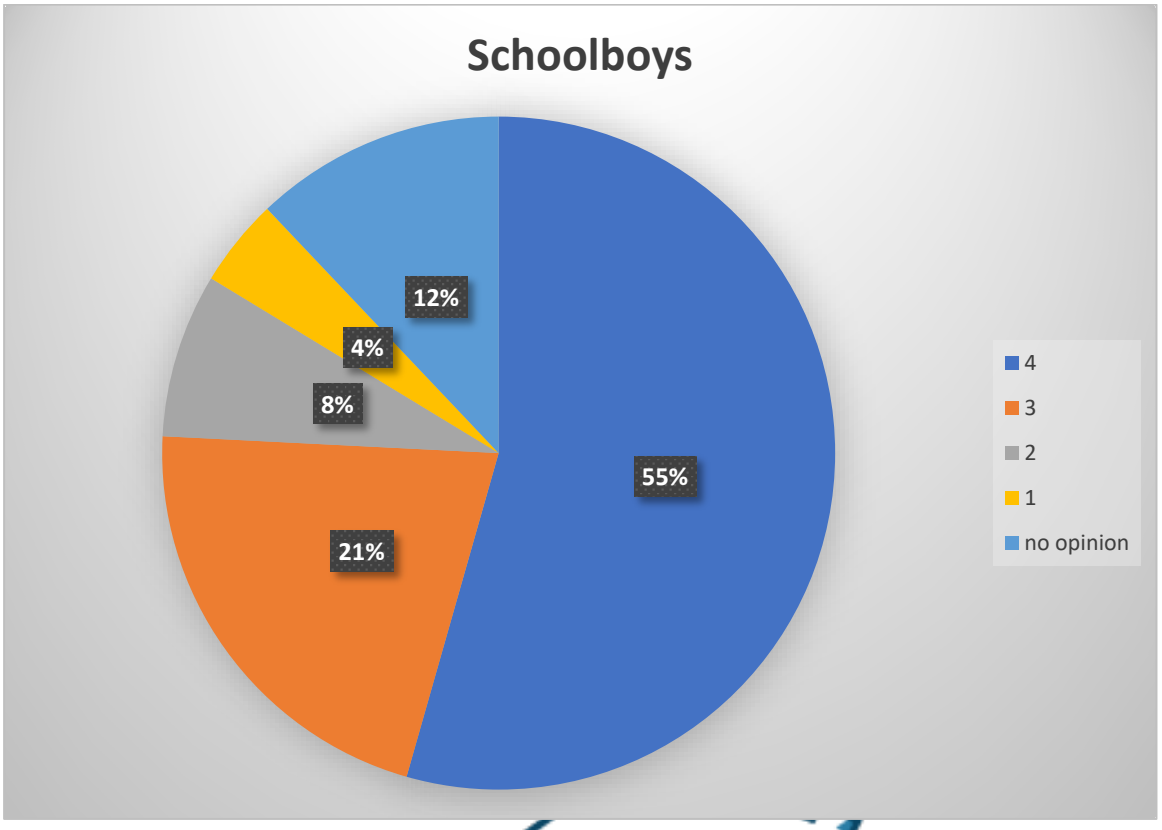


ENGAGE IN INQUIRY

3. Are your pupils enthusiastically involved in research processes or experimental processes which you propose during your lesson? Please put the proper number of schoolgirls and schoolboys that match to the given answers.

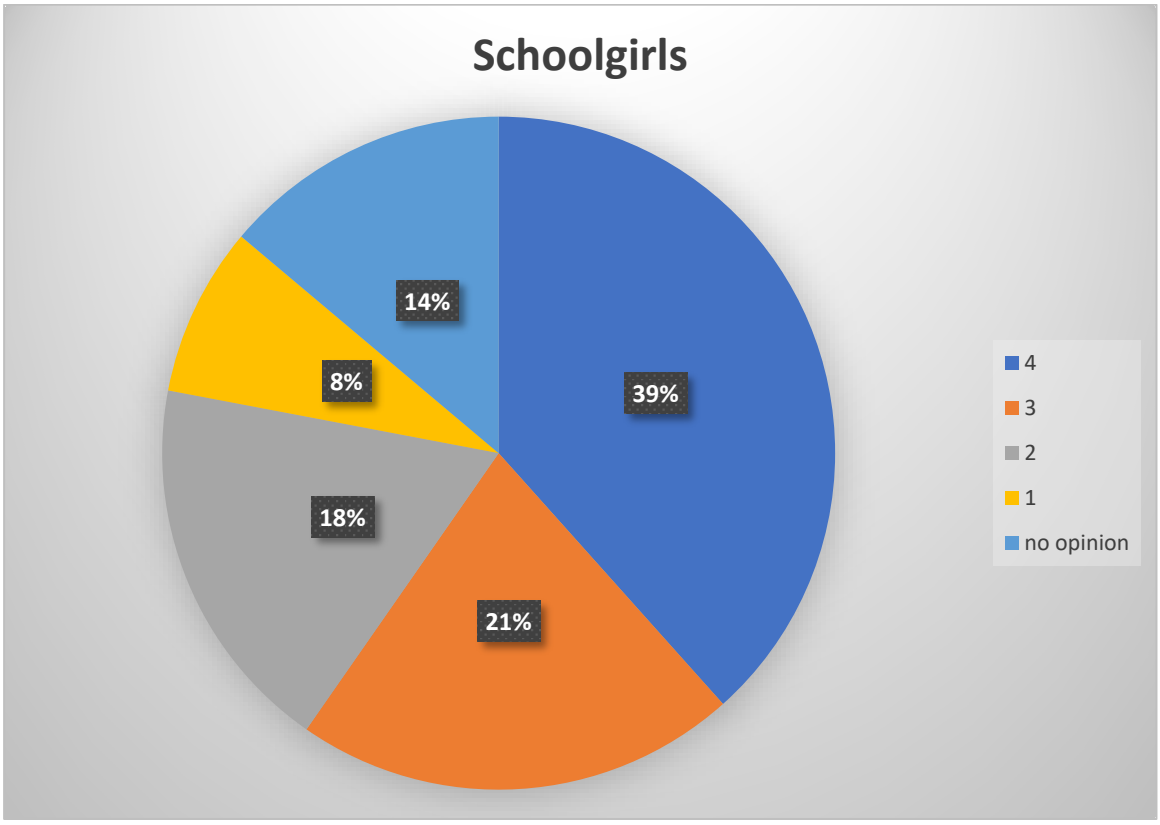
	Schoolgirls	Schoolboys
4 – Definitely are involved	6887	7035
3 – Rather are involved	2910	2765
2 – Rather are not involved	956	1020
1 – Definitely not involved	394	548
I have no opinion	1322	1561

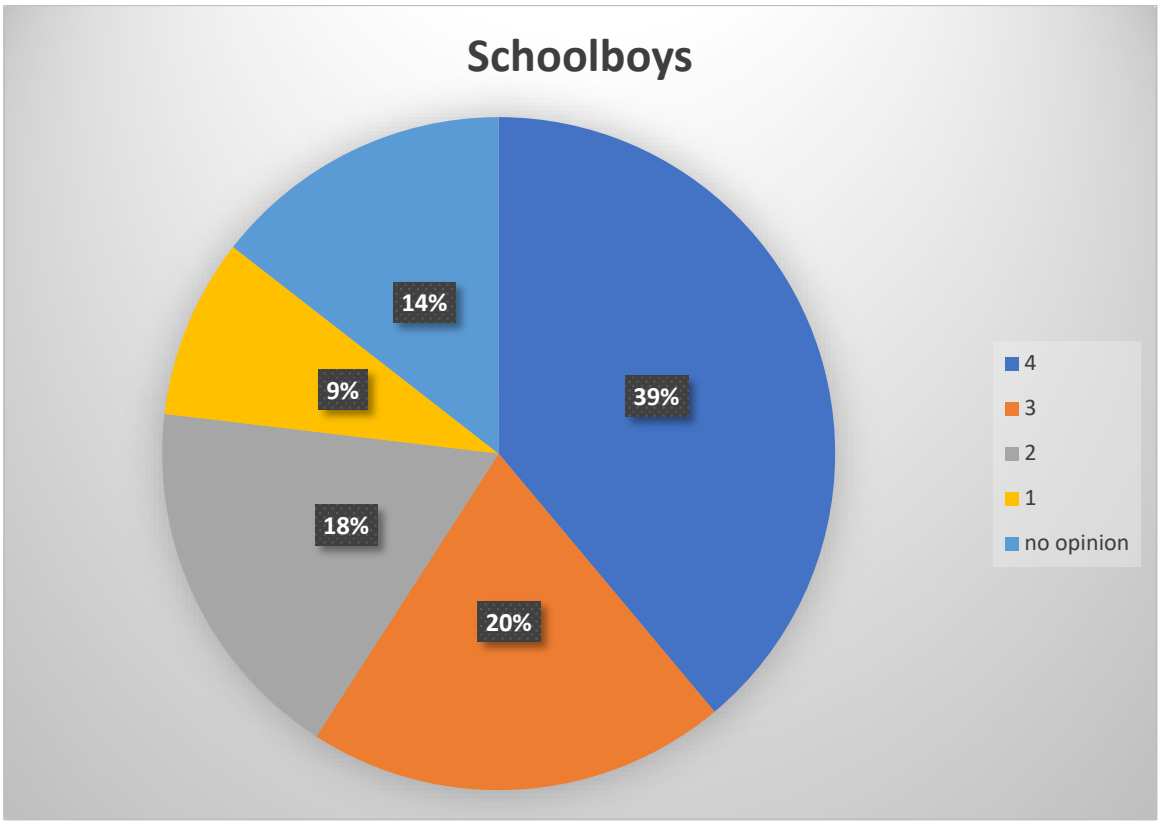

Schoolgirls
11%
3%
8%
55%
23%
4
3
2
1
no opinion


Schoolboys
12%
4%
8%
55%
21%
4
3
2
1
no opinion

4. Do your pupils independently design the experimental, research process? Please put the proper number of schoolgirls and schoolboys that match to the given answers.

	Schoolgirls	Schoolboys
4 – Definitely designed	4786	5031
3 – Rather designed	2655	2612
2 – Rather do not designed	2283	2297
1 – Definitely do not designed	1016	1117
I have no opinion	1729	1872

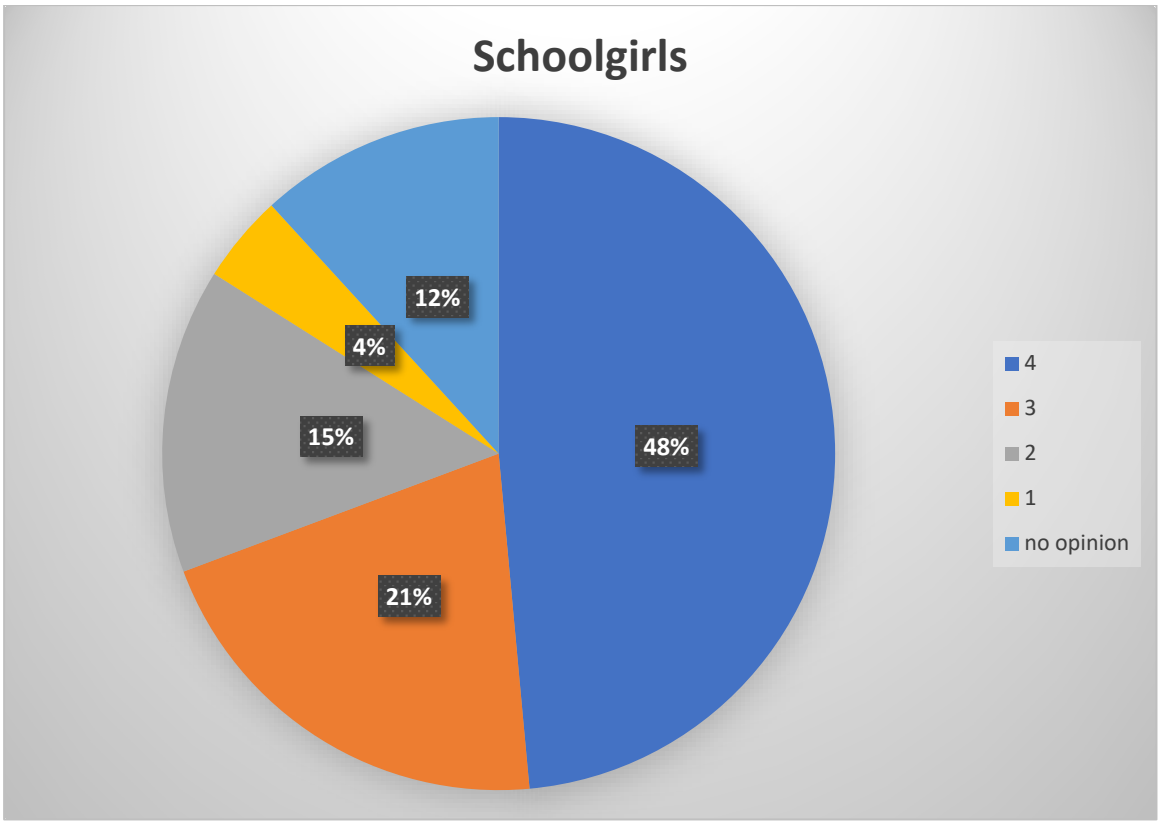


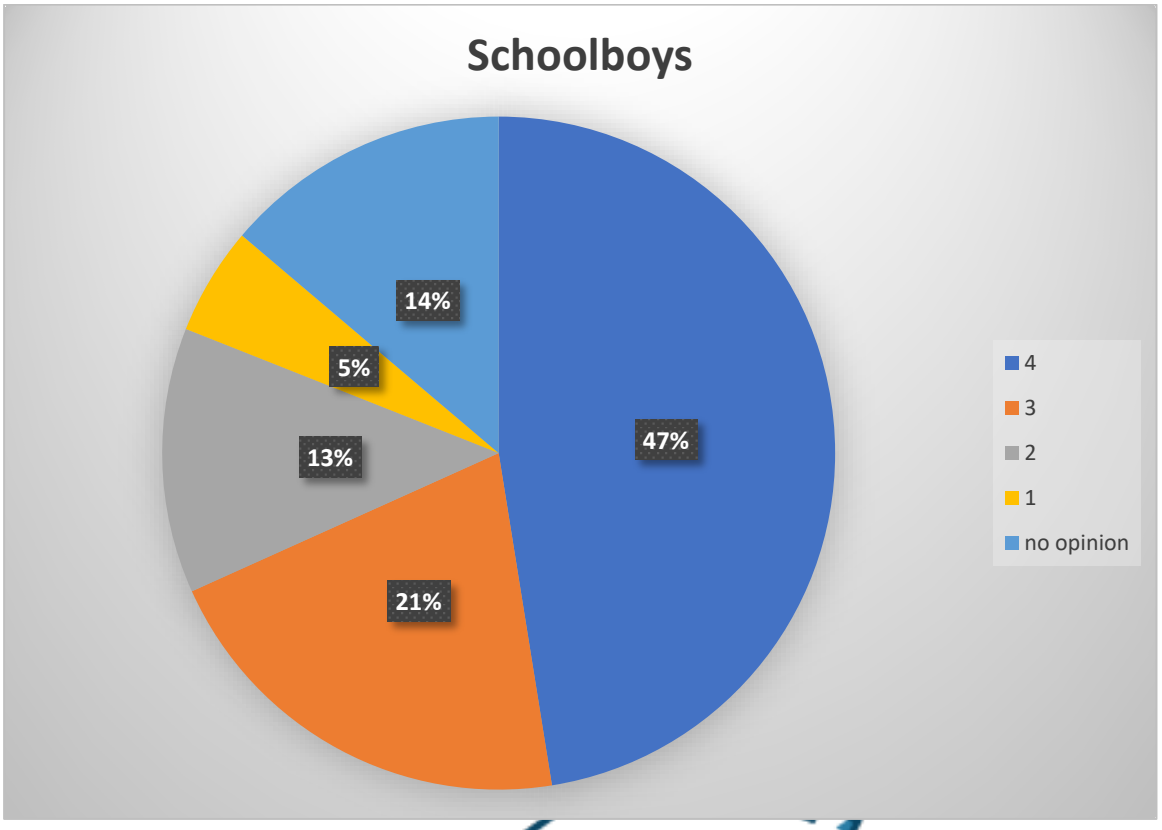


ENGAGE IN LOGICAL REASONING

2. Can your pupils logically conclude? Please put the proper number of schoolgirls and schoolboys that match to the given answers.

	Schoolgirls	Schoolboys
4 – Definitely can	6052	6137
3 – Rather can	2589	2689
2 – Rather cannot	1829	1648
1 – Definitely cannot	528	670
I have no opinion	1471	1785

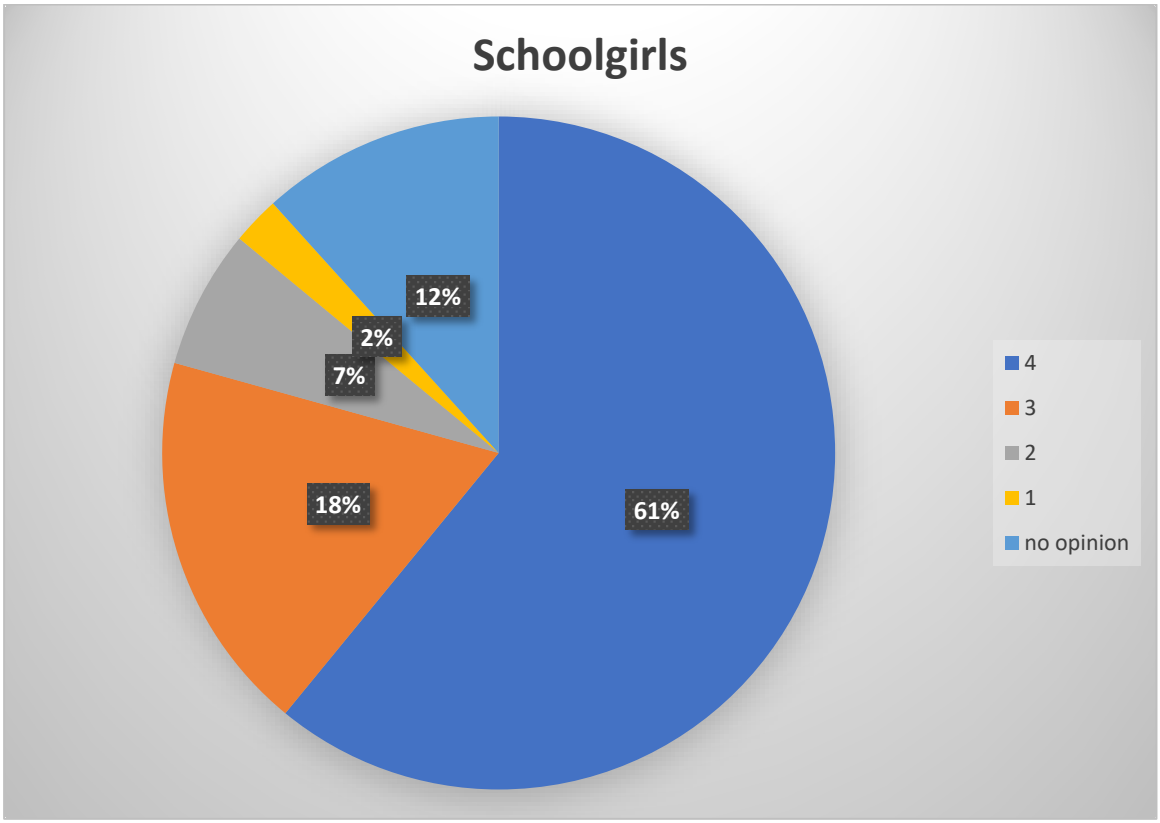

Schoolgirls
12%
4%
15%
48%
21%
4
3
2
1
no opinion

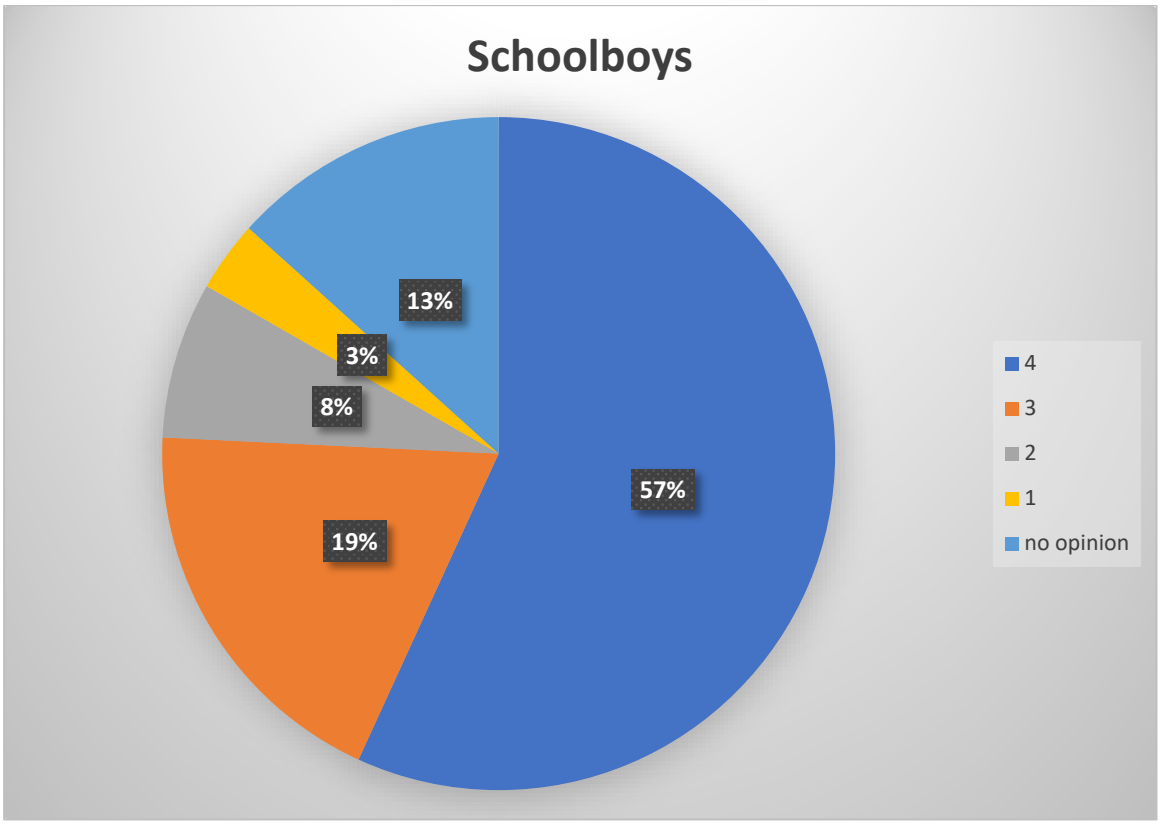

Schoolboys
14%
5%
13%
47%
21%
4
3
2
1
no opinion

COLLABORATE AS A TEAM

3. Can your pupils realize tasks within group? Please put the proper number of schoolgirls and schoolboys that match to the given answers.

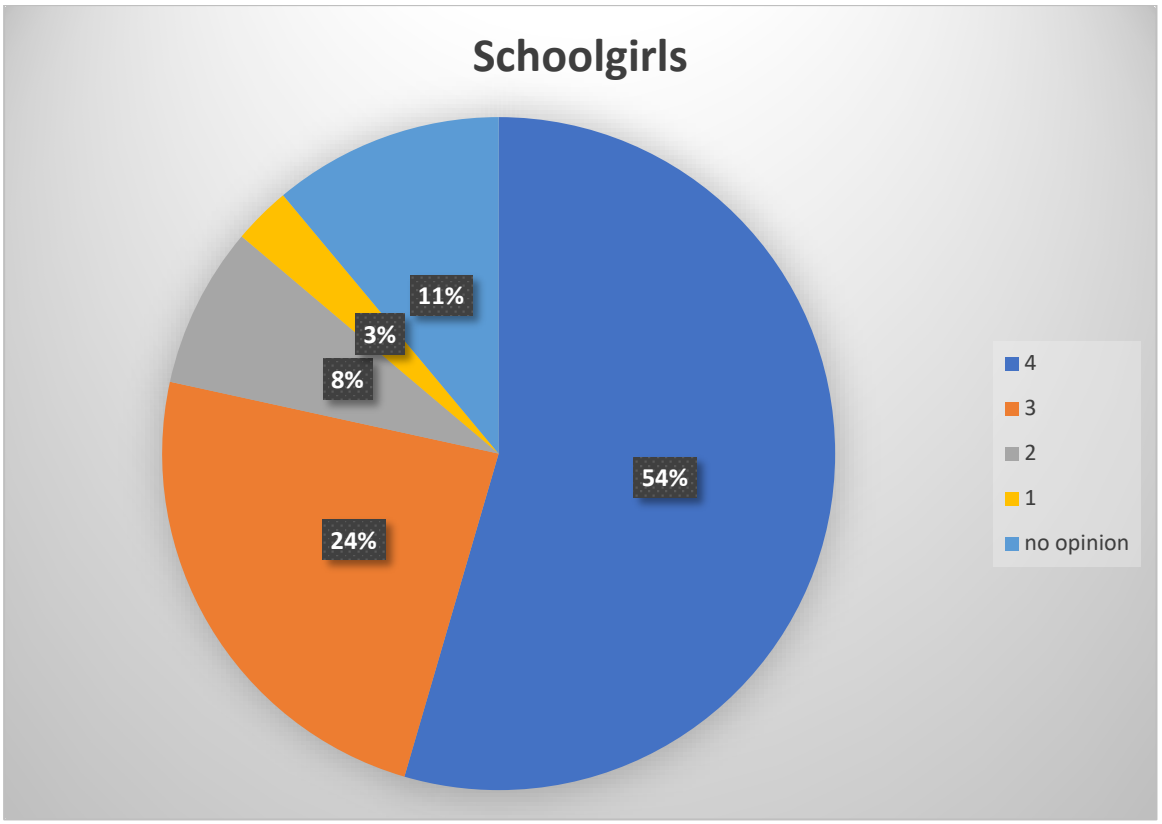
	Schoolgirls	Schoolboys
4 – Definitely can	7597	7348
3 – Tend to be able	2293	2448
2 – Tend not to be able	833	972
1 – Definitely cannot	287	439
I have no opinion	1459	1722

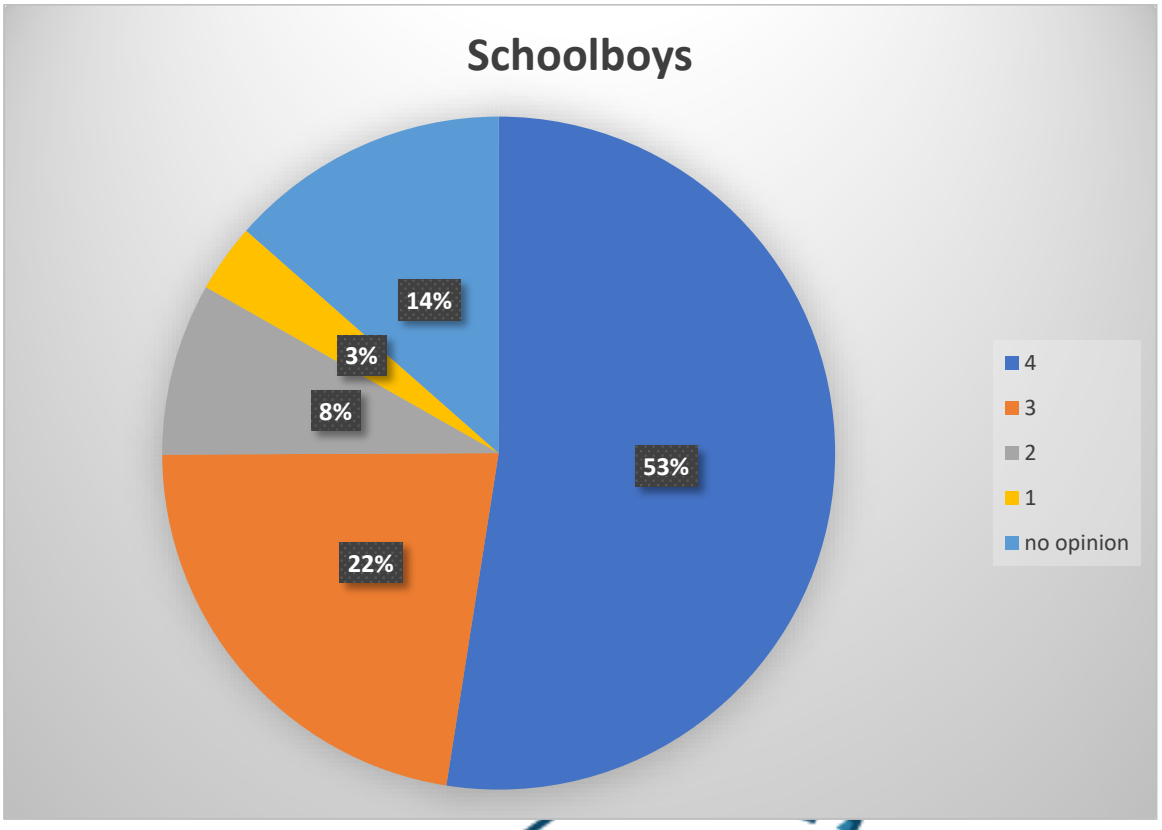




4. Are your pupils willingly engaged in various of tasks within group? Please put the proper number of schoolgirls and schoolboys that match to the given answers

	Schoolgirls	**Schoolboys**
4 – Definitely engaged	6798	6786
3 – Tend to be engaged	2981	2901
2 – Tend not to engaged	965	1071
1 – Definitely are not engaged	345	425
I have no opinion	1380	1746

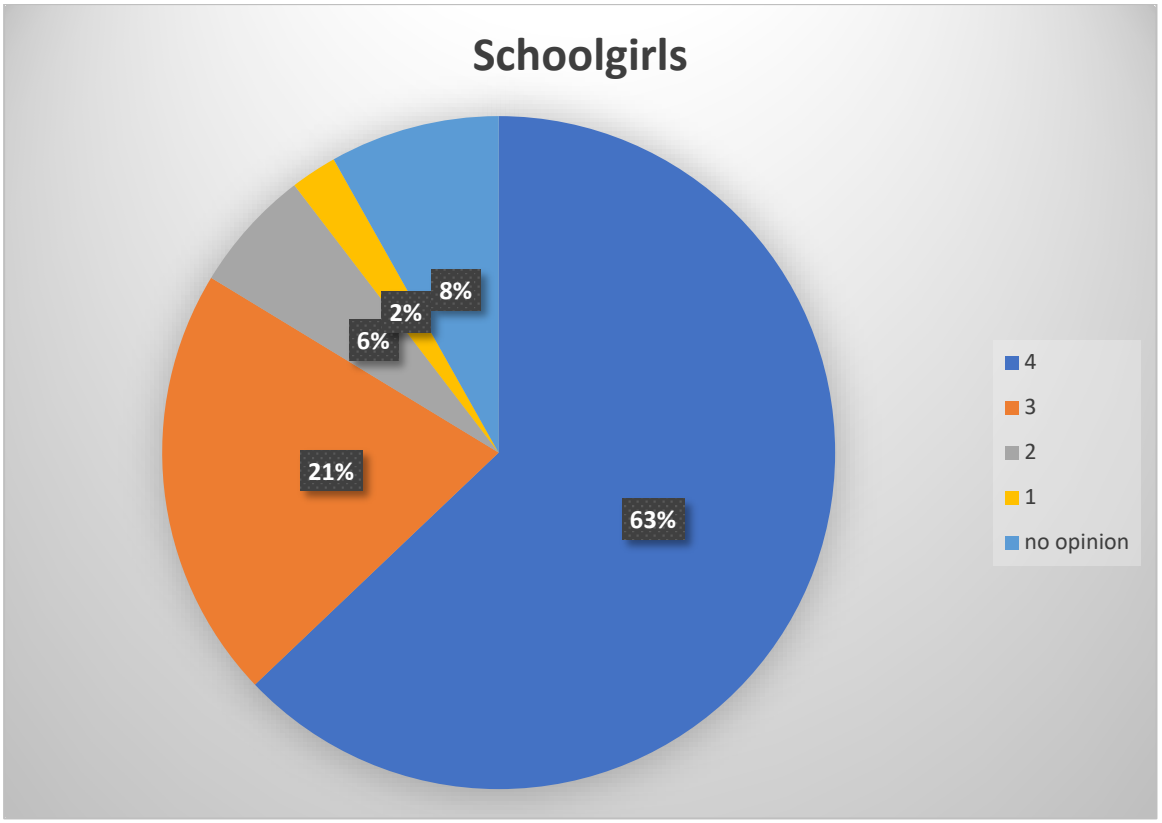

Schoolgirls
11%
3%
8%
54%
24%
4
3
2
1
no opinion

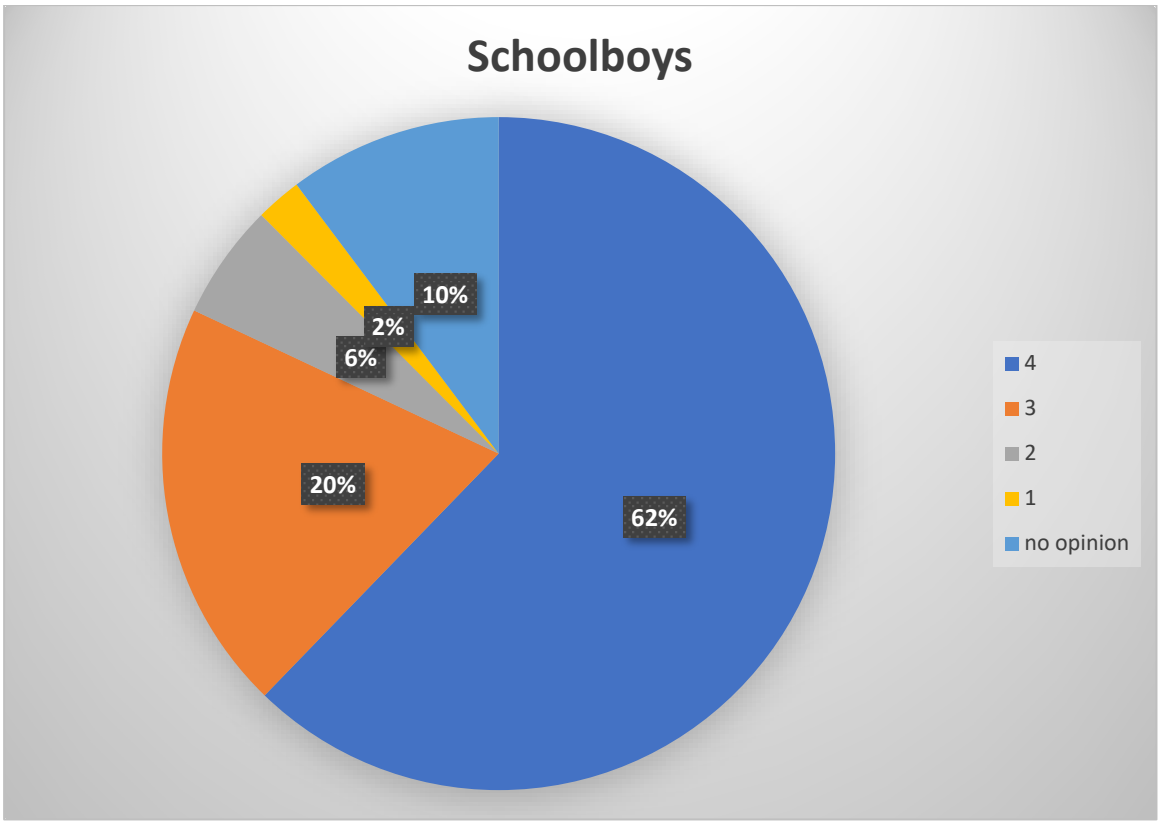

Schoolboys
14%
3%
8%
53%
22%
4
3
2
1
no opinion

APPLY TECHNOLOGY APPROPRIATELY

3. Do your pupils willingly use modern technologies in order to learn? Please put the proper number of schoolgirls and schoolboys that match to the given answers.

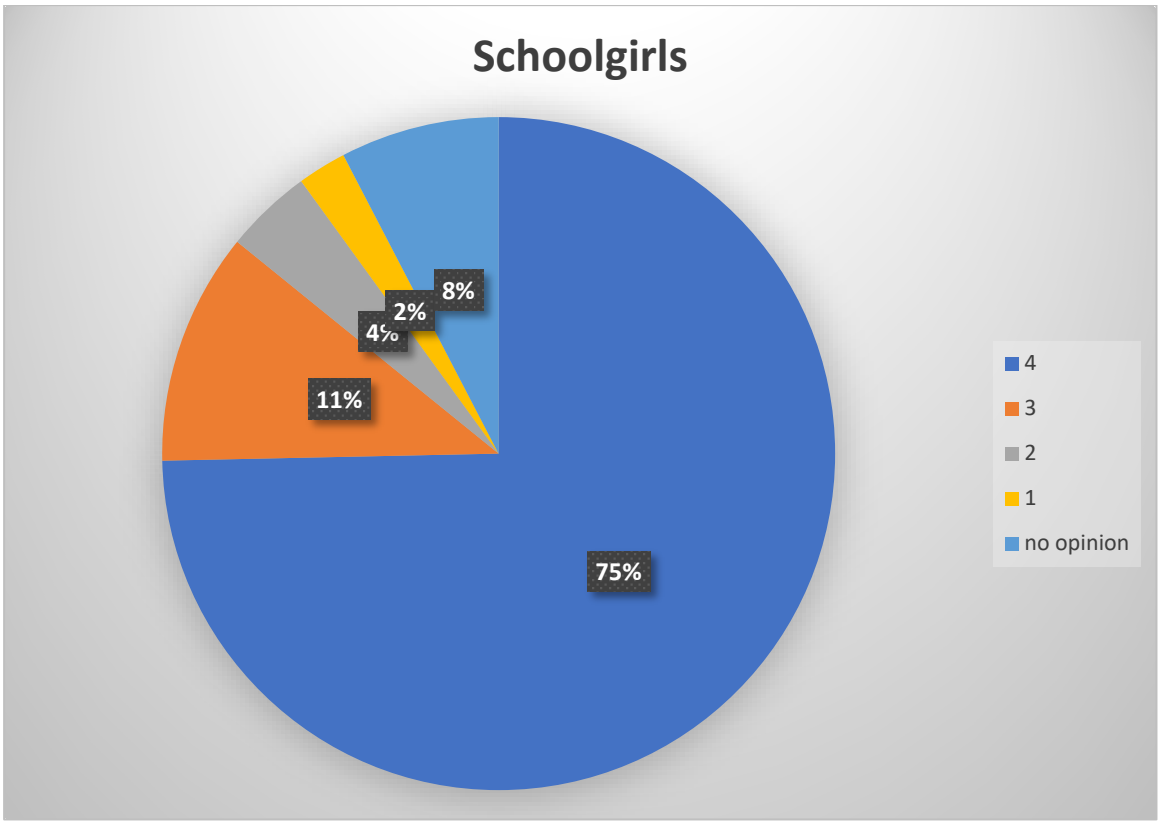
	Schoolgirls	Schoolboys
4 – Definitely do so	7842	8047
3 – Tend to	2594	2554
2 – Tend not to	738	717
1 – Definitely are not use	278	285
I have no opinion	1017	1326

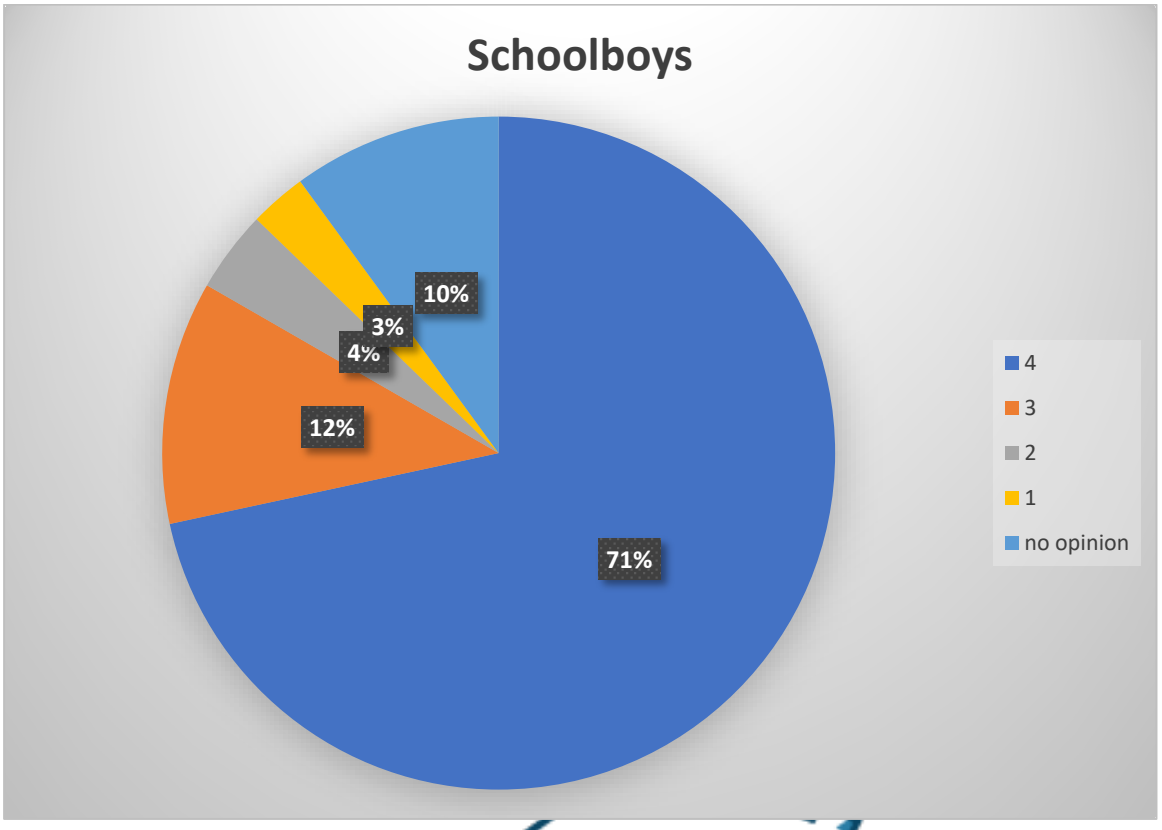




4. Do you think modern technologies have an impact on raising the effectiveness of learning process among your pupils? Please select the most appropriate.

	Schoolgirls	Schoolboys
4 – Yes, definitely	9310	9260
3 – Quite	1393	1511
2 – Not very much	521	506
1 – Definitely no	293	354
I have no opinion	952	1298


Schoolgirls
8%
2%
4%
11%
75%
4
3
2
1
no opinion


Schoolboys
10%
3%
4%
12%
71%
4
3
2
1
no opinion

CATEGORY 2: KNOWLEDGE ABOUT SCIENCE AND SCIENTIFIC RESEARCH, AS WELL AS THEIR PLACE IN THE MODERN WORLD

9. Please find below specified elements of the research process. Please rate how well your pupils are able to realize each one of these.

Scroll down list with a single choice with marks from 1 to 4 and separate for schoolgirls and schoolboys. Please put the proper number of schoolgirls and schoolboys that match to the given answers.

Formulating research questions

Question:

Knowledge about formulating research questions and hypothesis (Can your pupils formulate questions? Can your pupils formulate objectives of research? Can your pupils justify formulated objectives of research?)

Choice and justification of the research hypotheses

Question:

Knowledge about applying adequate tools and methods to test the hypothesis (Are your pupils familiar with the scientific method of verification in the area of STEM? Do your pupils know examples of research in the area of STEM? Do your pupils have knowledge about searching for reliable sources of information about scientific method and tools? Can they use these scientific method and tools effectively?)

Execution of research

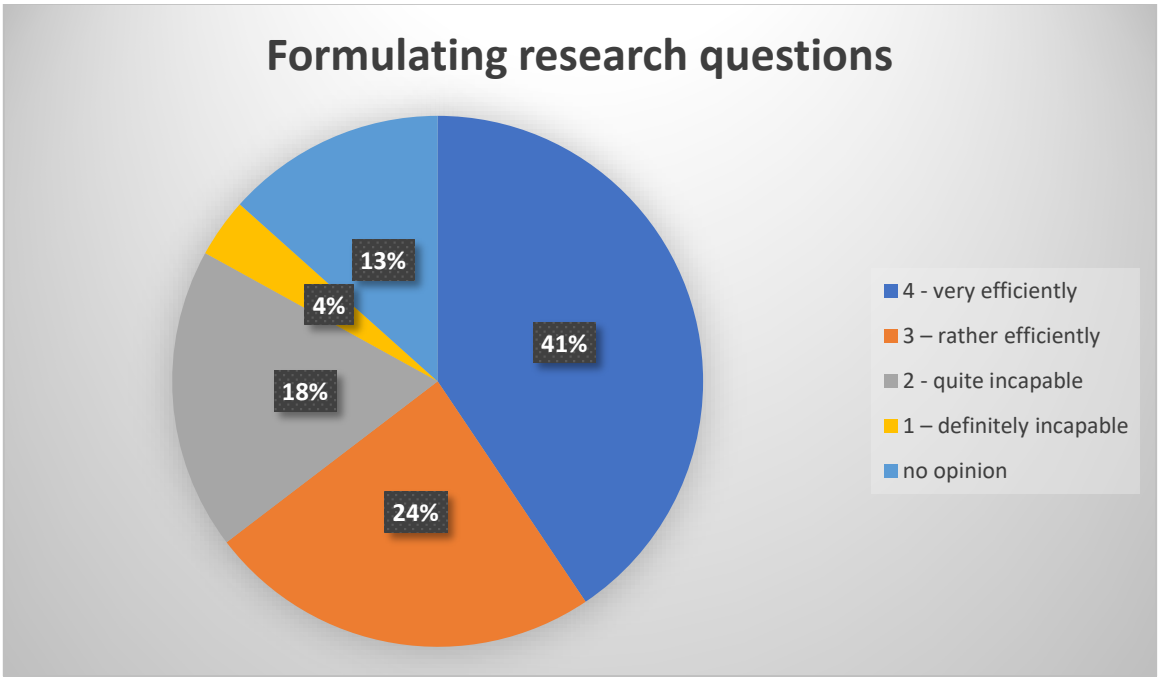
Question:

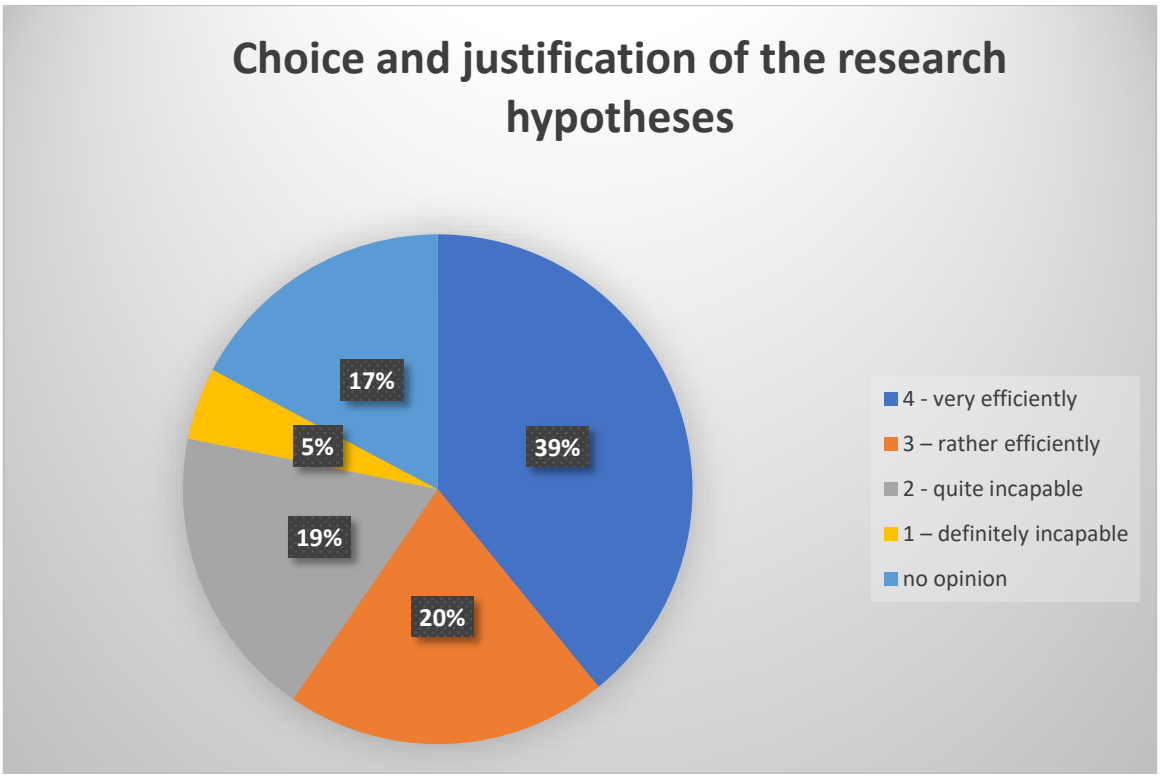
Can your pupils verify the quality of research results? (Whether the purpose, objective of the research was achieved, whether there is a need to another attempt, whether the resulting data are inconclusive or ambiguous?)

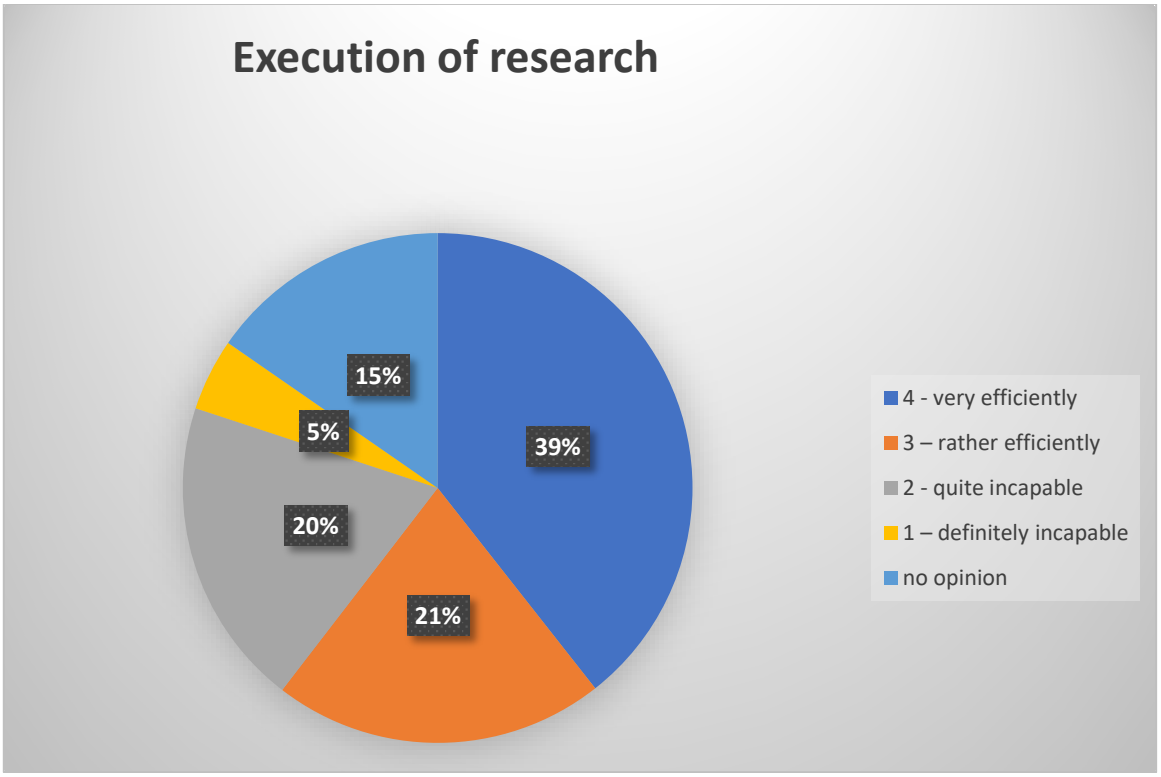
SCHOOLGIRLS

	Formulating research questions	**Choice and justification of the research hypotheses**	**Execution of research**

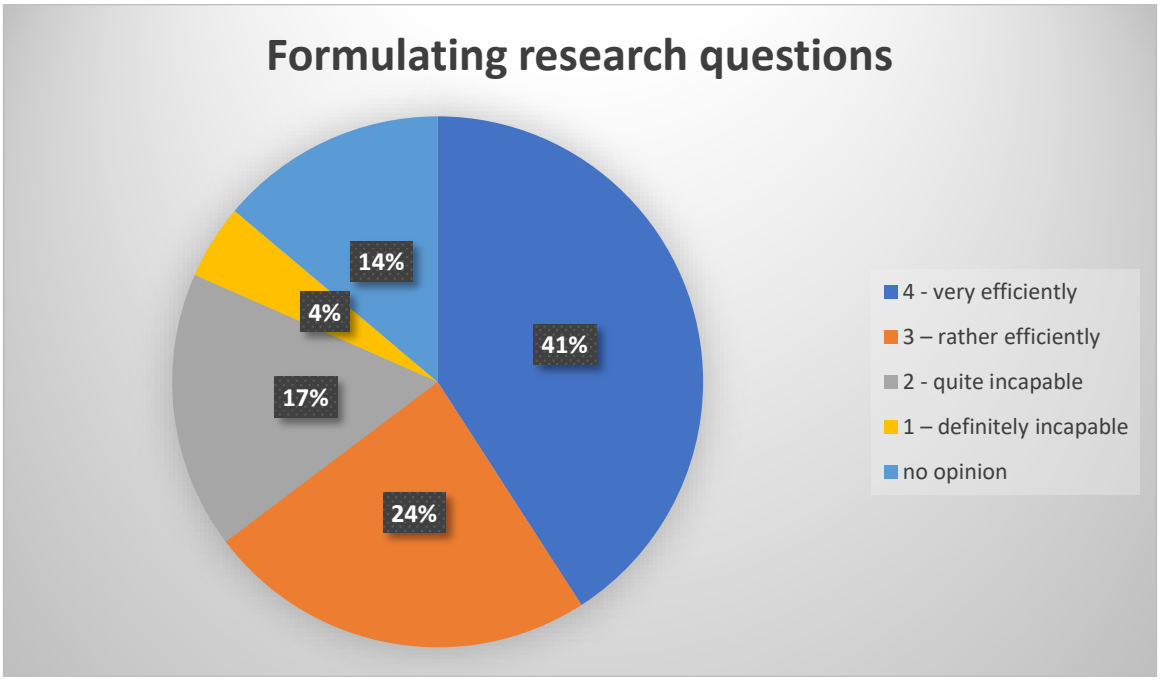
2 - very efficiently	5061	4879	4908
3 – rather efficiently	2998	2554	2623
2 - quite incapable	2293	2316	2454
1 – definitely incapable	448	571	570
I have no opinion	1669	2149	1914

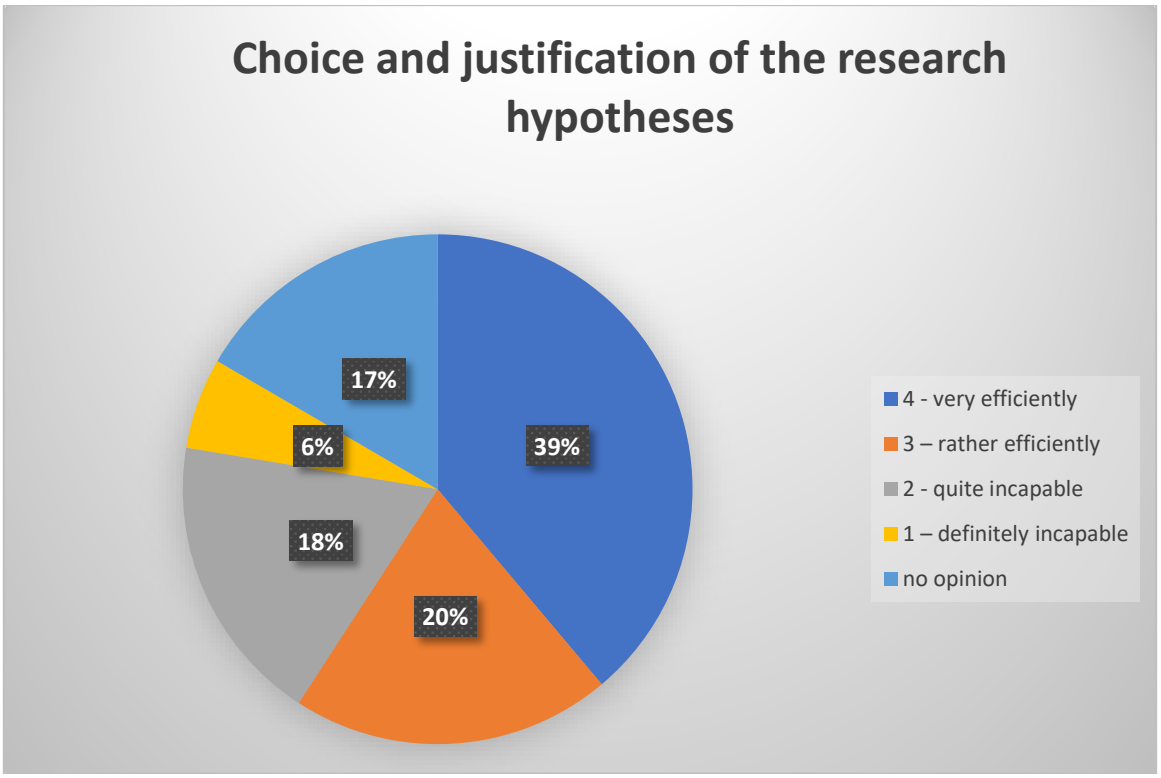


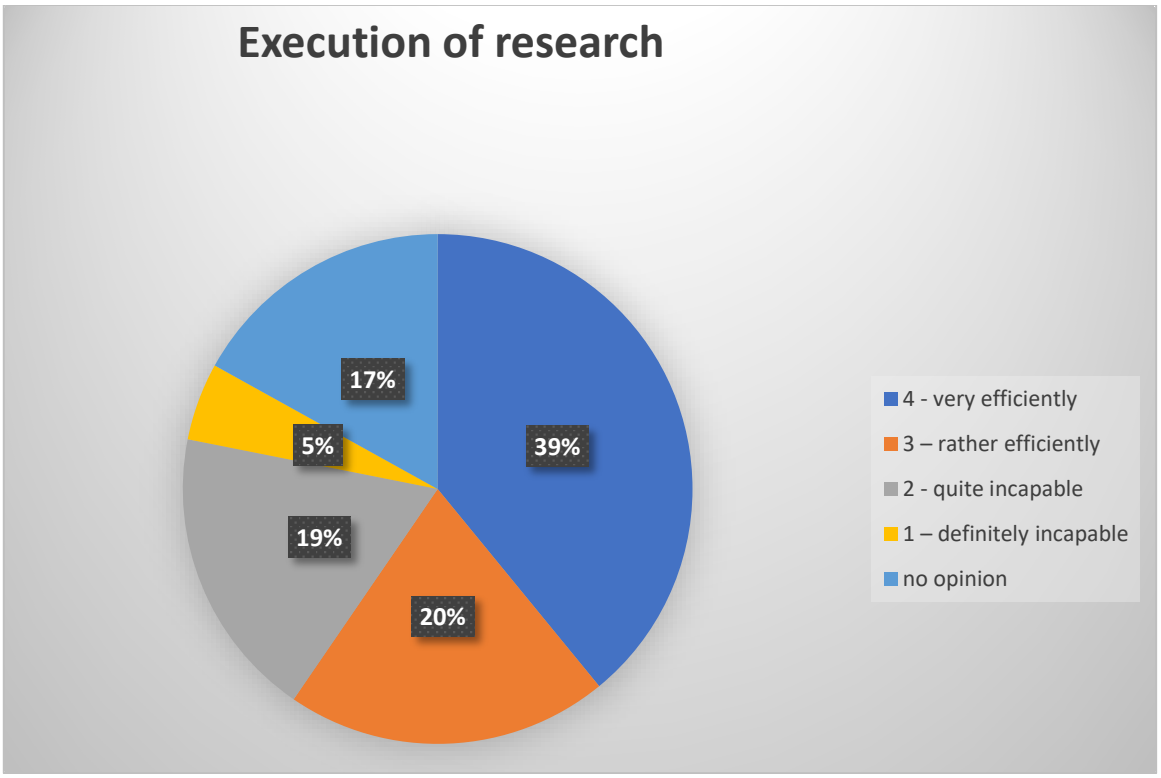

Choice and justification of the research hypotheses
17%
5%
39%
19%
20%
4 - very efficiently
3 – rather efficiently
2 - quite incapable
1 – definitely incapable
no opinion


Execution of research
15%
5%
39%
20%
21%
4 - very efficiently
3 – rather efficiently
2 - quite incapable
1 – definitely incapable
no opinion

	Formulating research questions	Choice and justification of the research hypotheses	Execution of research
4 - very efficiently	5286	5025	5052
3 – rather efficiently	3082	2626	2648
2 - quite incapable	2182	2383	2401
1 – definitely incapable	587	747	637
I have no opinion	1792	2148	2191

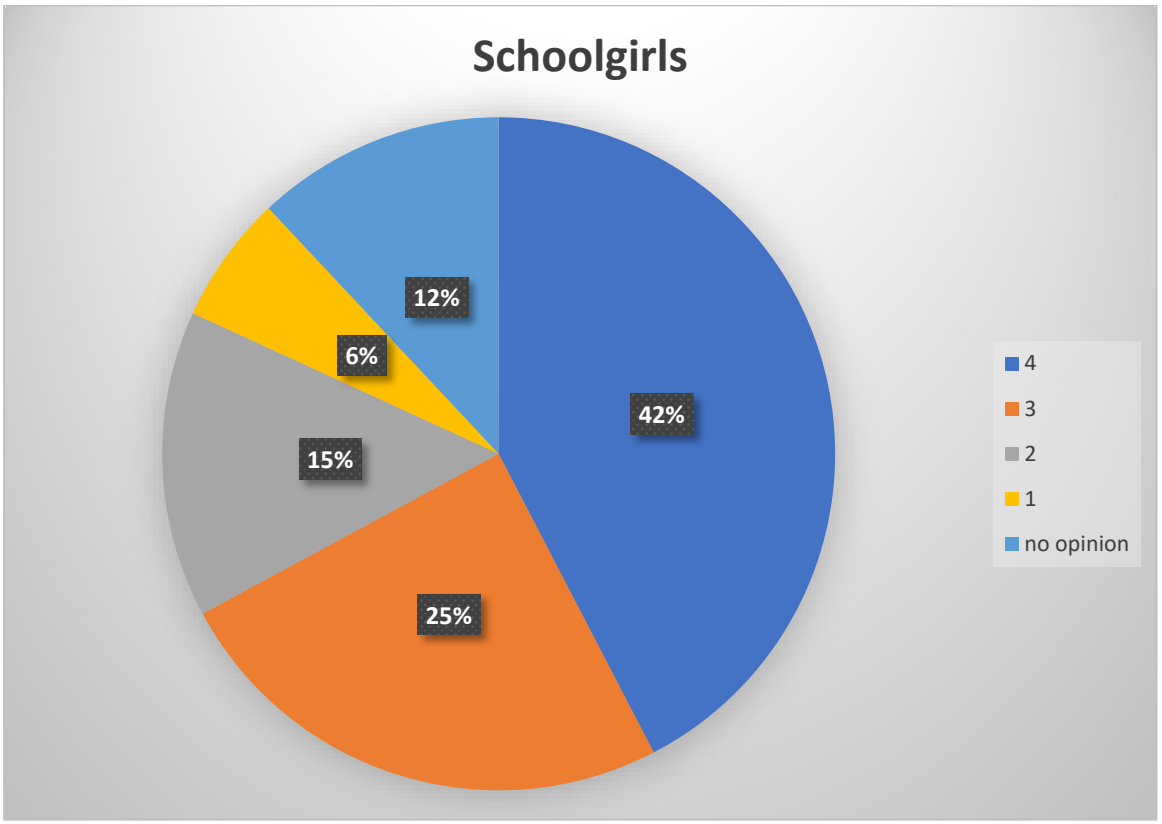


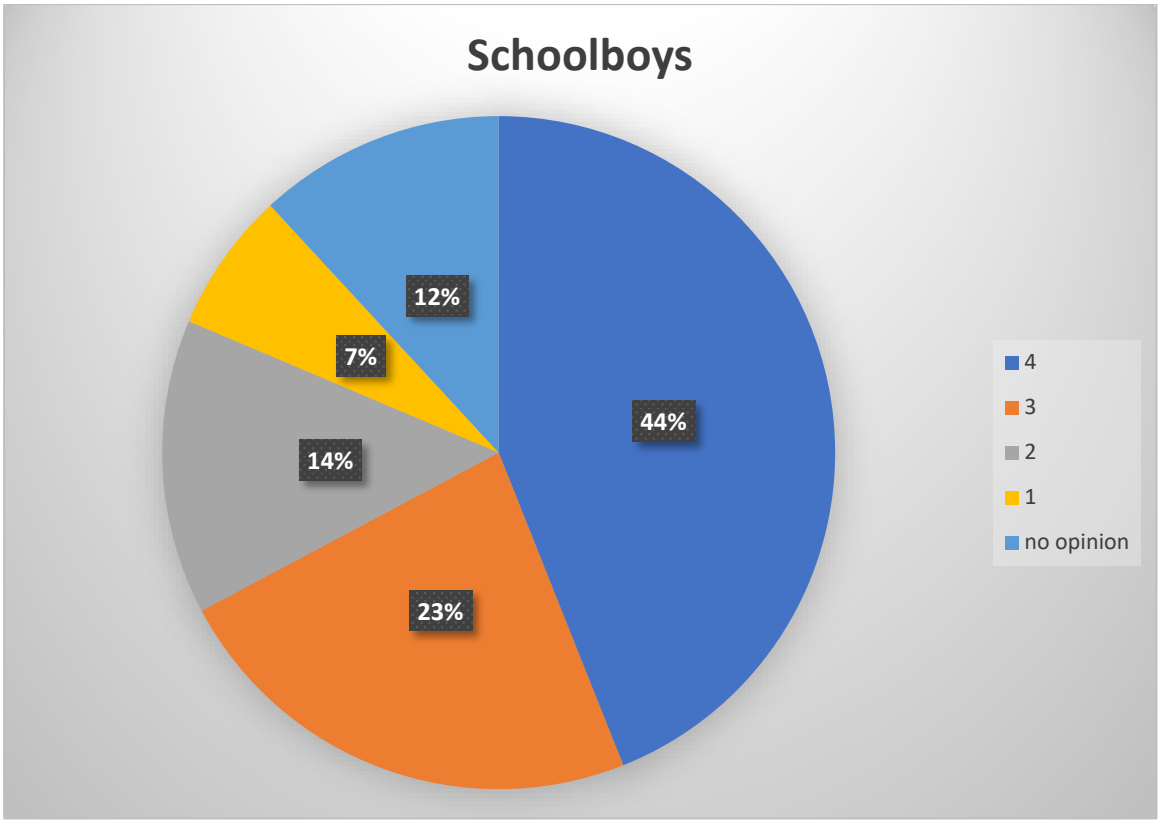

Choice and justification of the research hypotheses
17%
6%
39%
18%
20%
4 - very efficiently
3 – rather efficiently
2 - quite incapable
1 – definitely incapable
no opinion


Execution of research
17%
5%
39%
19%
20%
4 - very efficiently
3 – rather efficiently
2 - quite incapable
1 – definitely incapable
no opinion

10. Are your pupils showing interest in scientific careers? Please put the proper number of schoolgirls and schoolboys that match to the given answers.

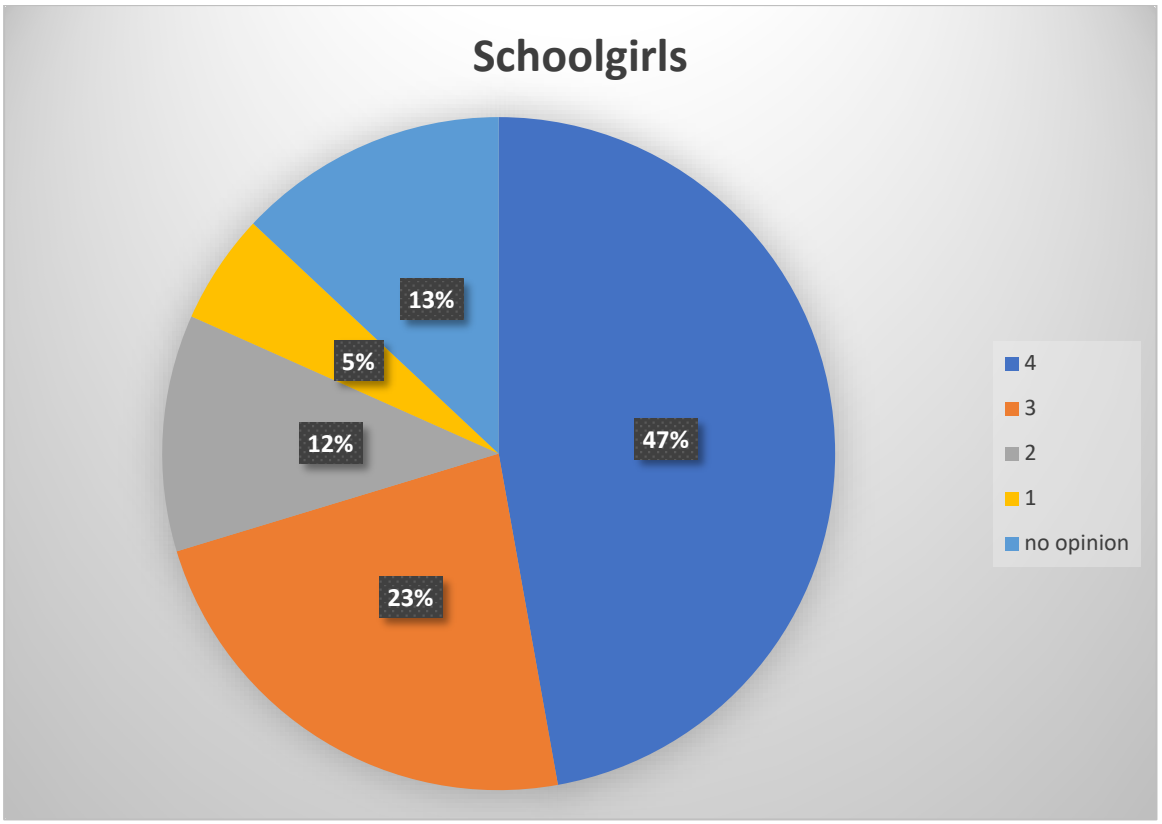
	Schoolgirls	Schoolboys
4 – Definitely are showing	5285	5684
3 – Rather are showing	3085	3006
2 – Rather are not showing	1838	1832
1 – Definitely are not showing	769	872
I have no opinion	1494	1535

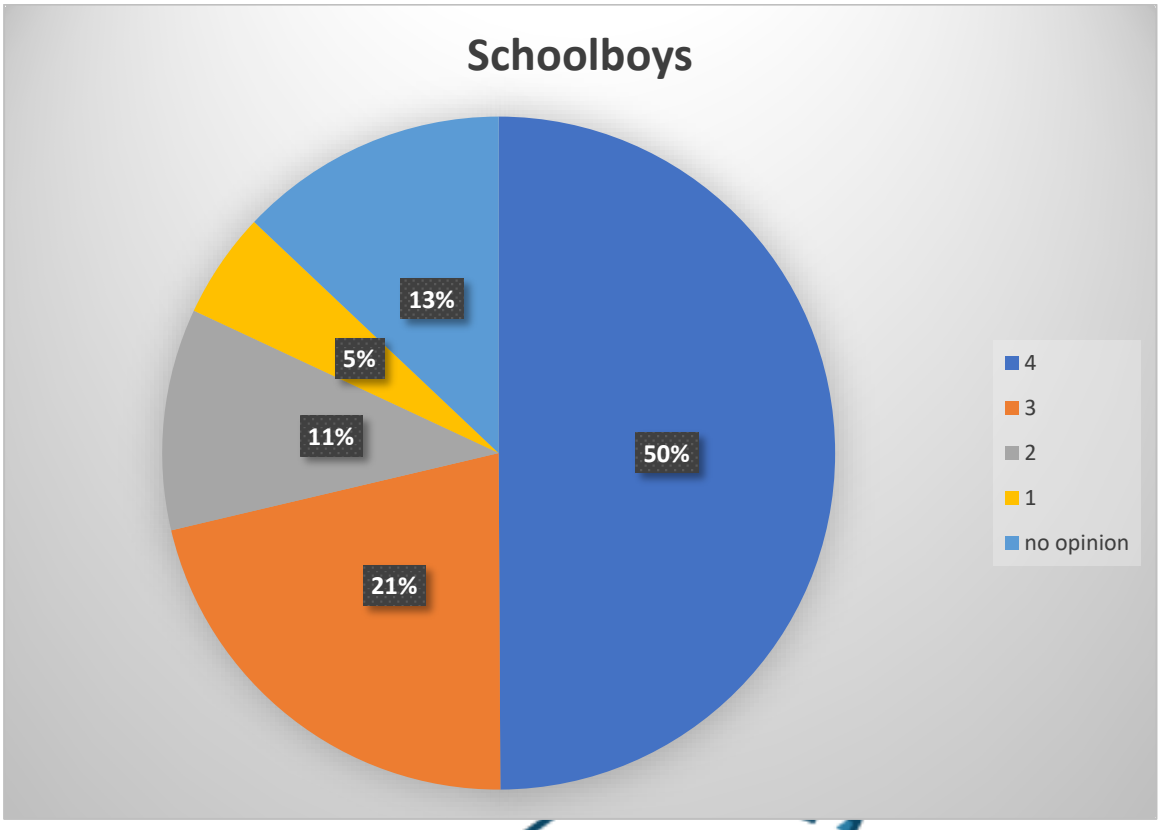




11. Are your pupils showing interest in STEM? Please put the proper number of schoolgirls and schoolboys that match to the given answers.

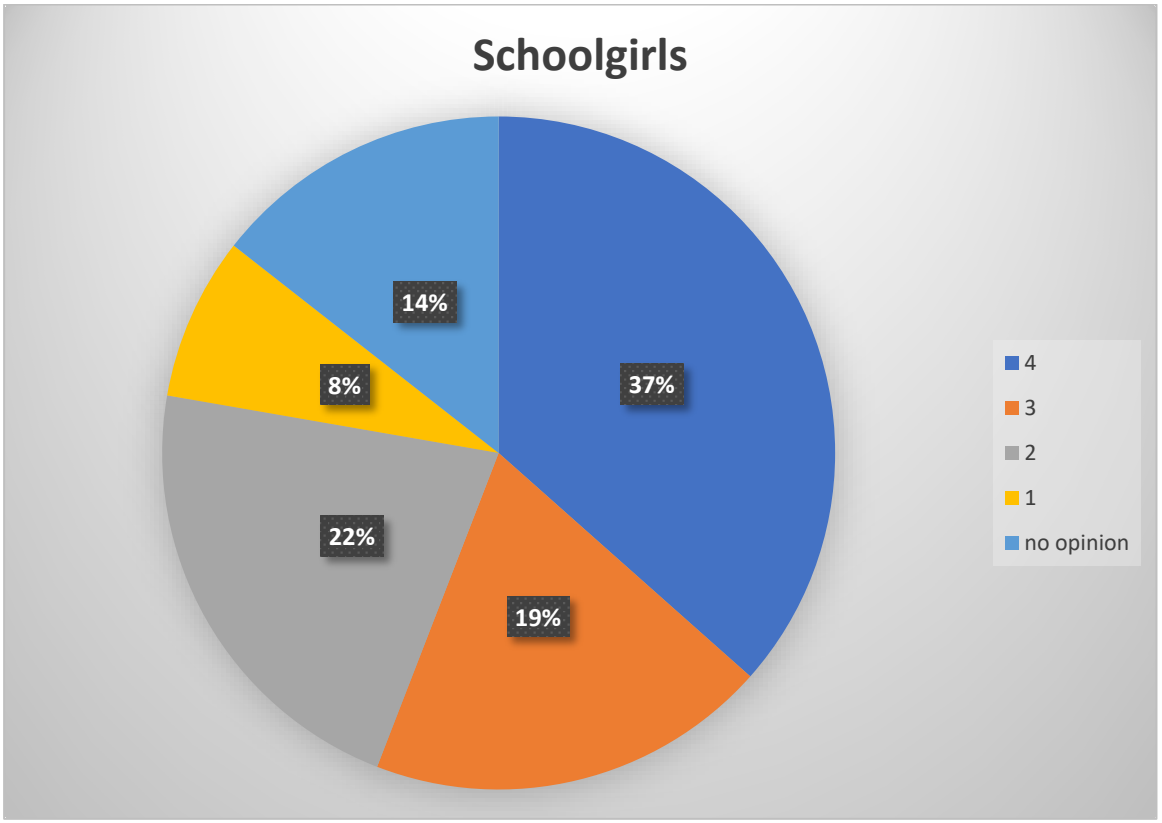
	Schoolgirls	**Schoolboys**
4 – Definitely are showing	5883	6454
3 – Rather are showing	2884	2766
2 – Rather are not showing	1418	1376
1 – Definitely are not showing	661	659
I have no opinion	1623	1674

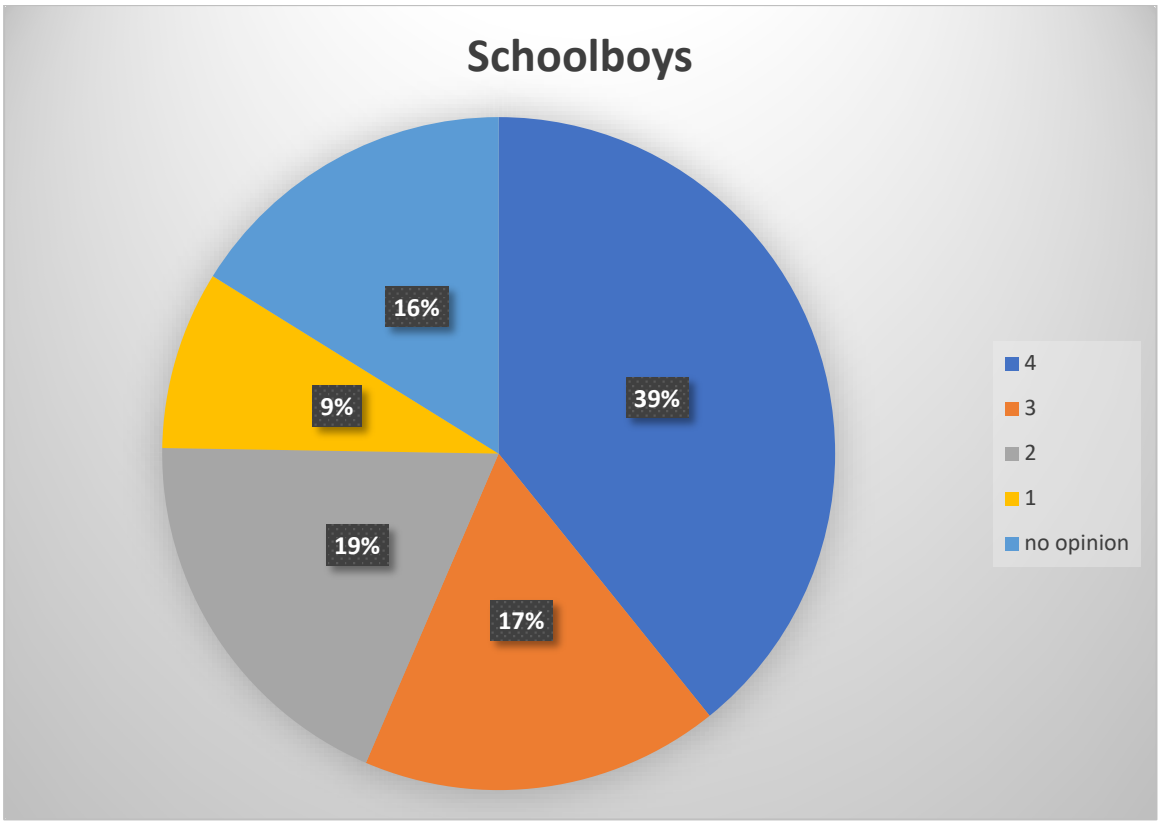

Schoolgirls
13%
5%
12%
47%
23%
4
3
2
1
no opinion


Schoolboys
13%
5%
11%
50%
21%
4
3
2
1
no opinion

12. Have of your pupils got knowledge about the vocational tasks of a professional scientist? Please put the proper number of schoolgirls and schoolboys that match to the given answers.

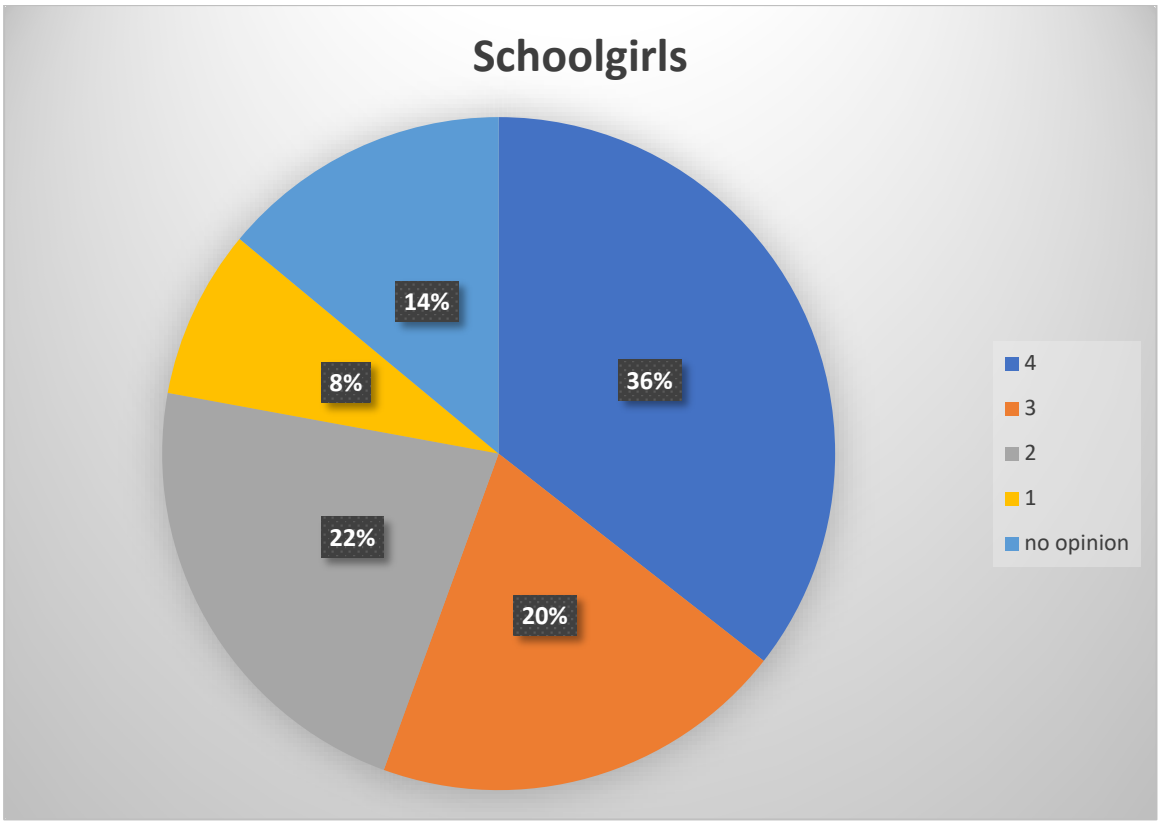
	Schoolgirls	Schoolboys
4 – Definitely have	4558	5070
3 – Rather have	2410	2229
2 – Rather do not have	2725	2432
1 – Definitely do not have	977	1109
I have no opinion	1799	2089

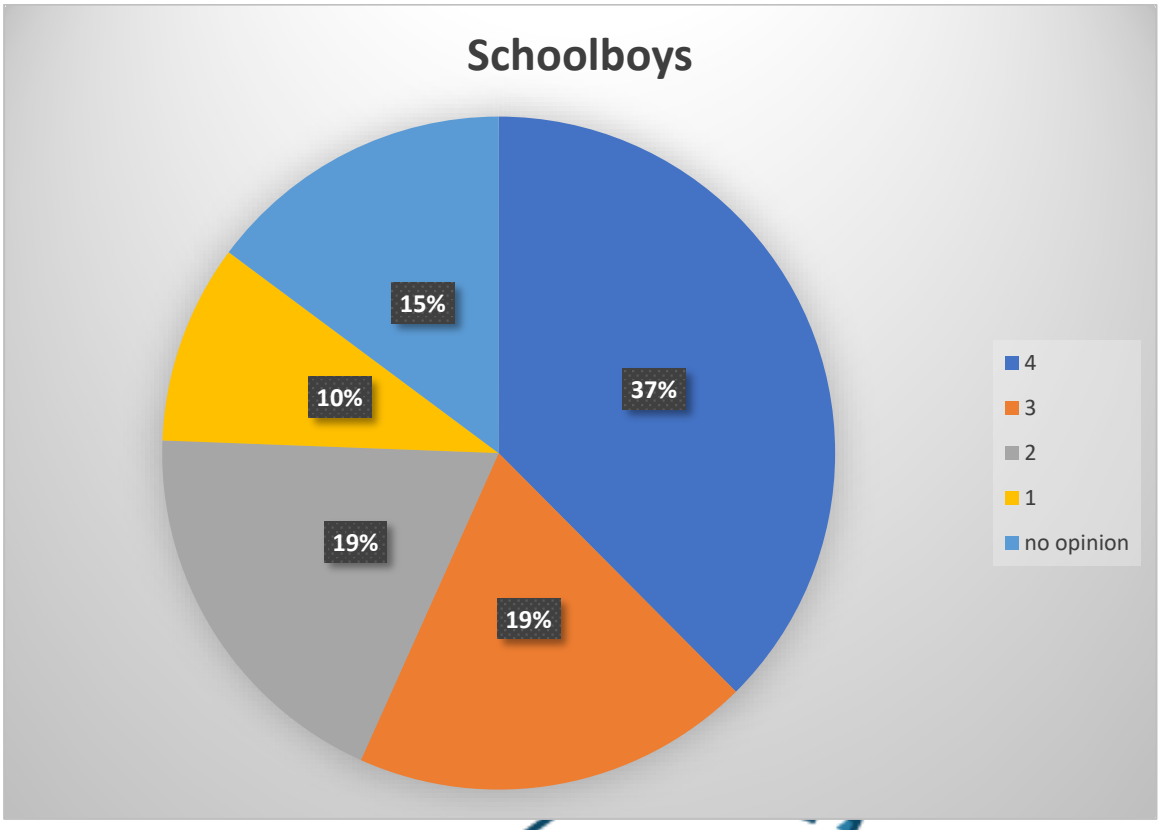




13. Do your pupils know anything about the conditions of work of professional scientists (e.g. possibilities of employment, salary, requirements to obtain a degree)? Please put the proper number of schoolgirls and schoolboys that match to the given answers.

	Schoolgirls	**Schoolboys**
4 – They definitely do	4434	4854
3 – Some	2492	2479
2 – Not very much	2786	2441
1 – Nothing at all	1013	1239
I have no opinion	1744	1916


Schoolgirls
14%
8%
36%
22%
20%
4
3
2
1
no opinion


Schoolboys
15%
10%
37%
19%
19%
4
3
2
1
no opinion

CATEGORY 3: KNOWLEDGE ABOUT NATURE, GEOGRAPHY, NATURAL RESOURCES, HISTORY, SOCIAL AND POLITICAL SPECIFICITIES CONCERNING THE ARCTIC AND INCREASE OF SENSITIVITY TO ENVIRONMENTAL ISSUES AND CLIMATE CHANGE.

2. Please find below a list of specific issues and concepts related to the Arctic. Please rate the level of knowledge of your pupils for each item.

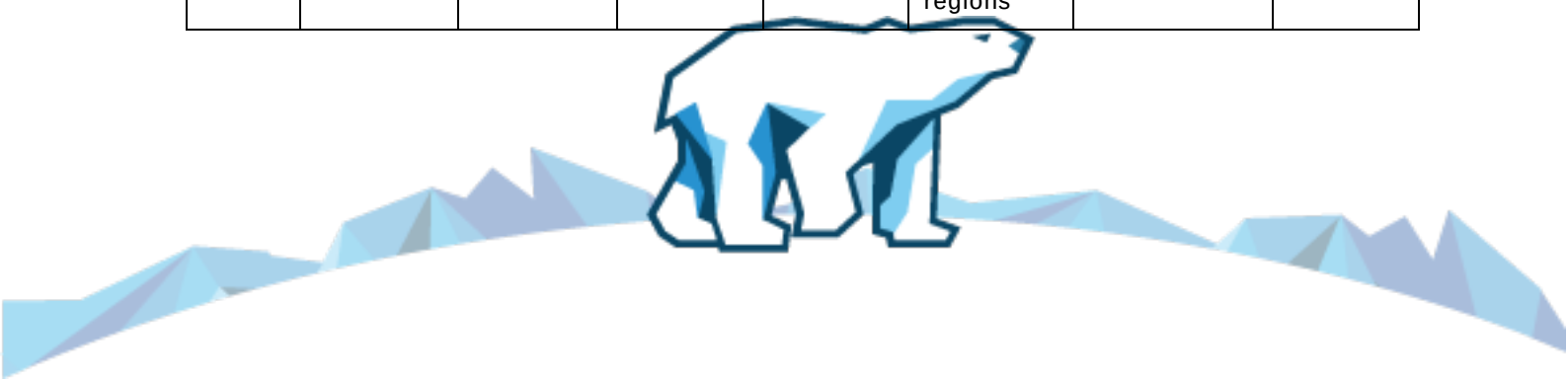
   Scroll down list for a single choice with marks ranging from 1 to 5 and separate for schoolgirls and schoolboys. Please put the proper number of schoolgirls and schoolboys that match to the given answers.

SCHOOLGIRLS

	Knowledge about nature	Geography	Natural resources	History	social and political specificities concerning polar regions	sensitivity to environmental issues	climate change
5 - very good	4778	4913	4480	3820	3662	4501	5038
4 – quite good	1892	2471	1601	977	929	1699	1971
3 – average	3234	2283	2970	2748	1970	2835	2802
2 –not very good	1116	1491	1633	2539	3253	1769	1398
1 – very little	1449	1311	1785	2385	2655	1665	1260

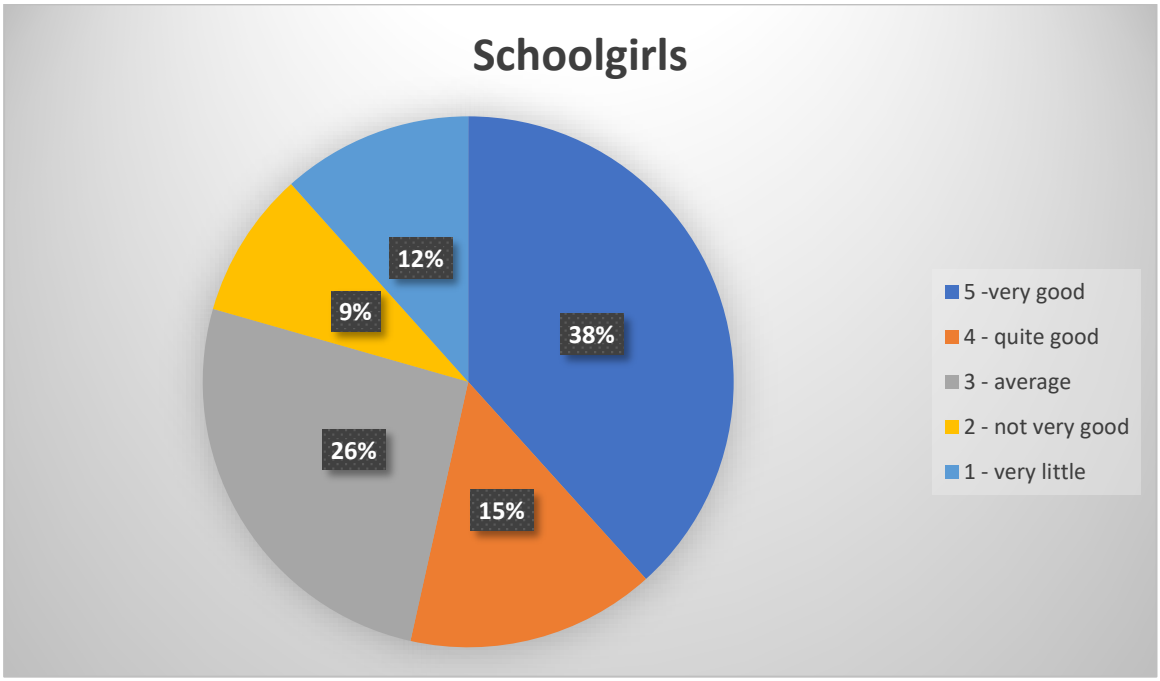
SCHOOLBOYS

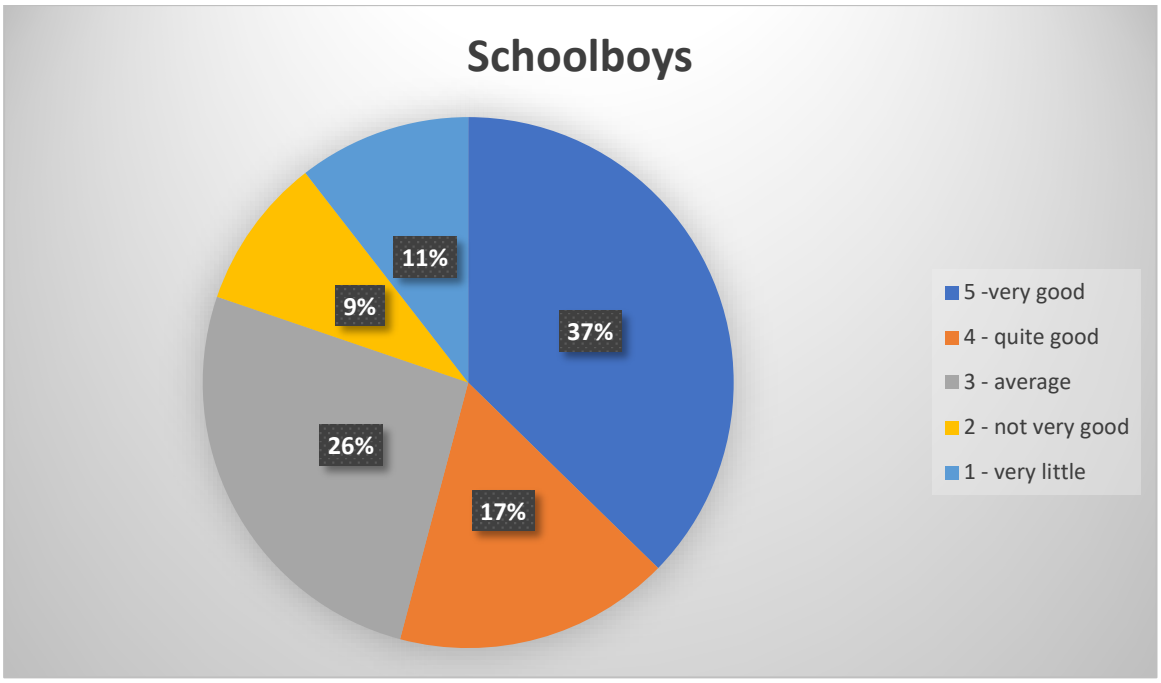
	Knowledge about nature	Geography	Natural resources	History	social and political specificities concerning polar regions	sensitivity to environmental issues	climate change



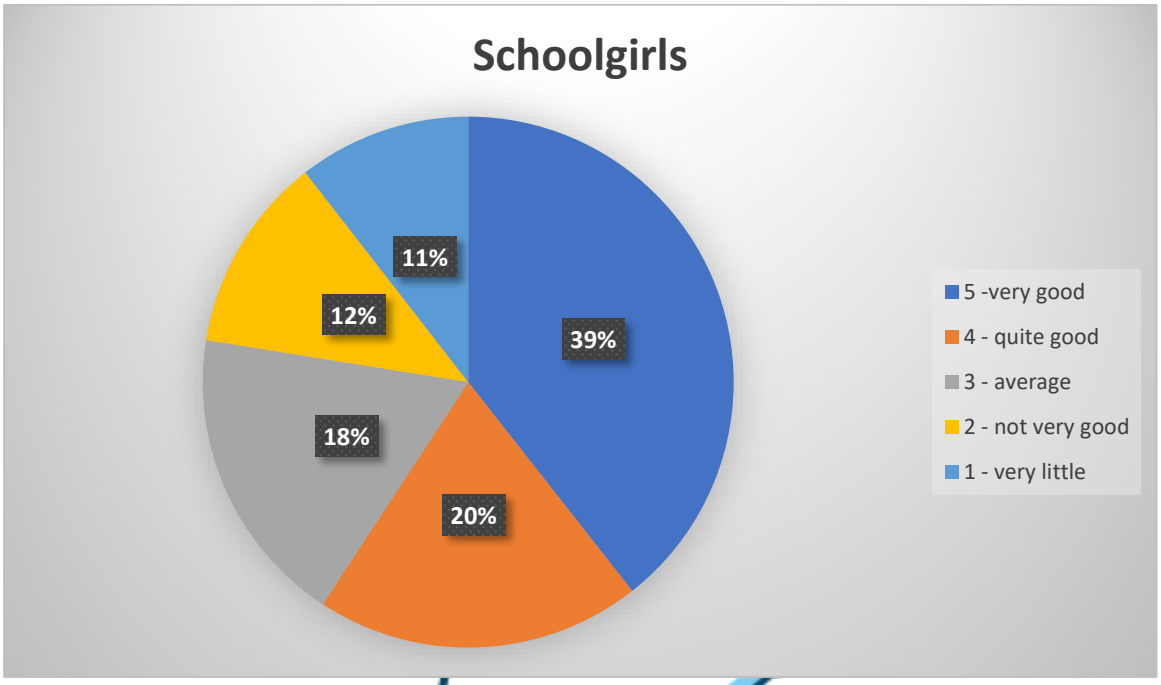
5 - very good	4824	4959	4578	3800	3641	4387	5152
4 – quite good	2175	2412	1638	1249	1114	2050	2284
3 – average	3375	2936	3343	2304	1943	2760	2501
2 –not very good	1196	1420	1616	3046	3415	2141	1713
1 – very little	1359	1202	1754	2440	2816	1591	1279

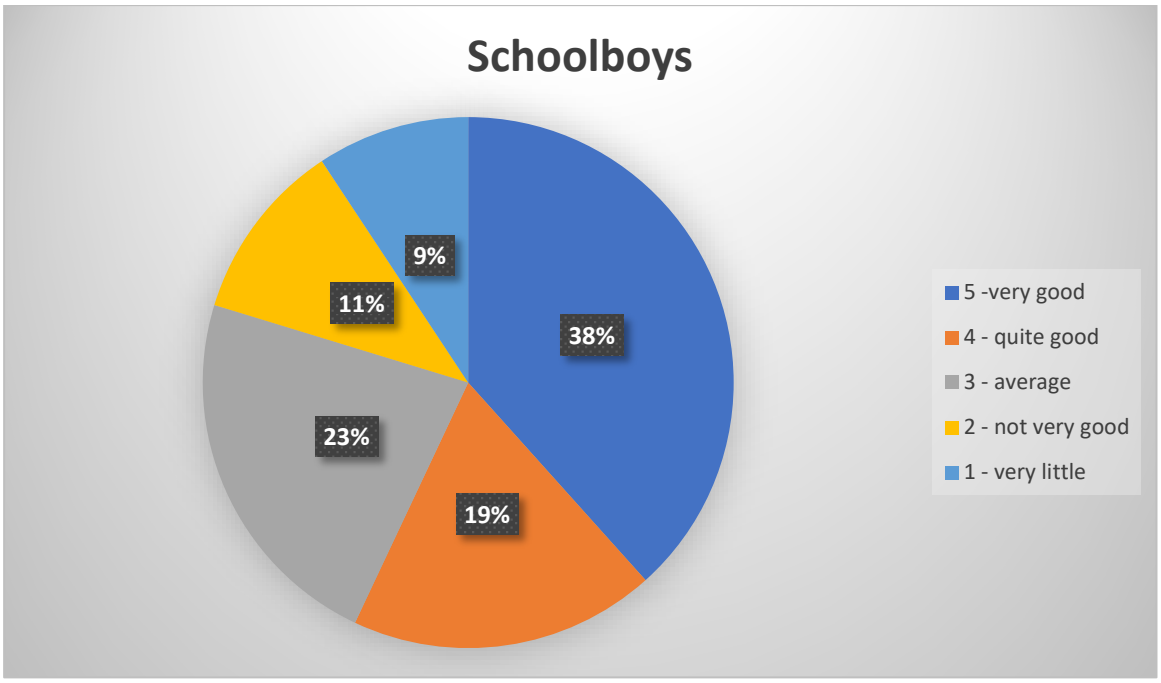
Knowledge about nature:



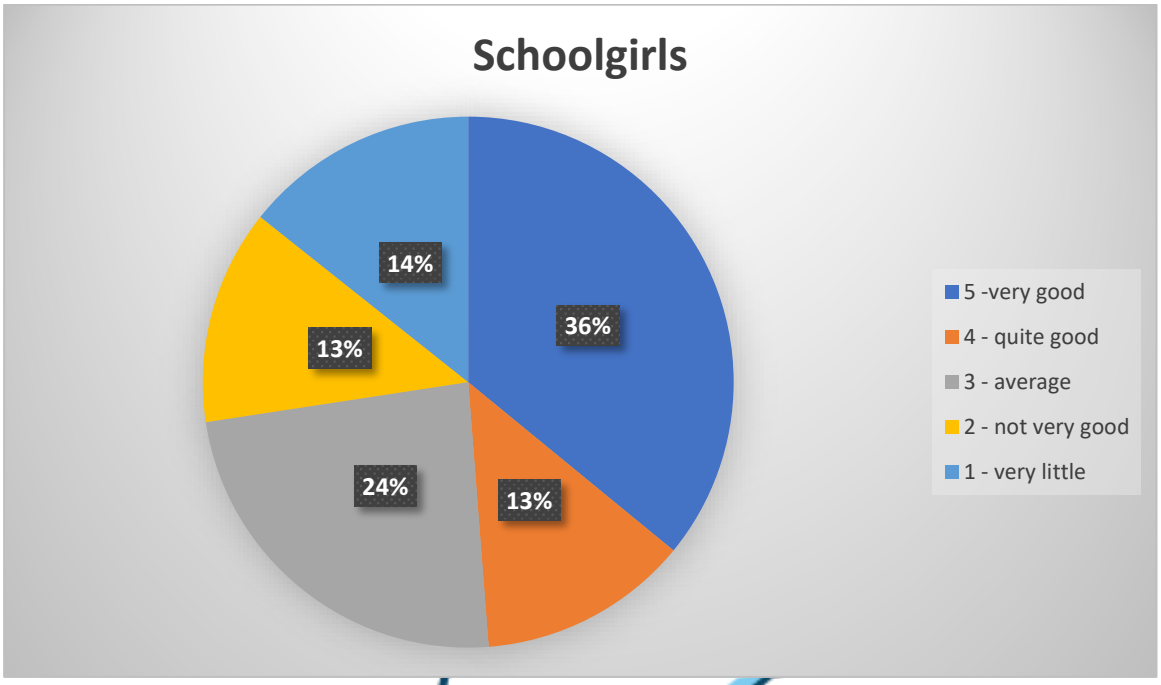

Schoolboys
37%
17%
26%
9%
11%
5 -very good
4 - quite good
3 - average
2 - not very good
1 - very little

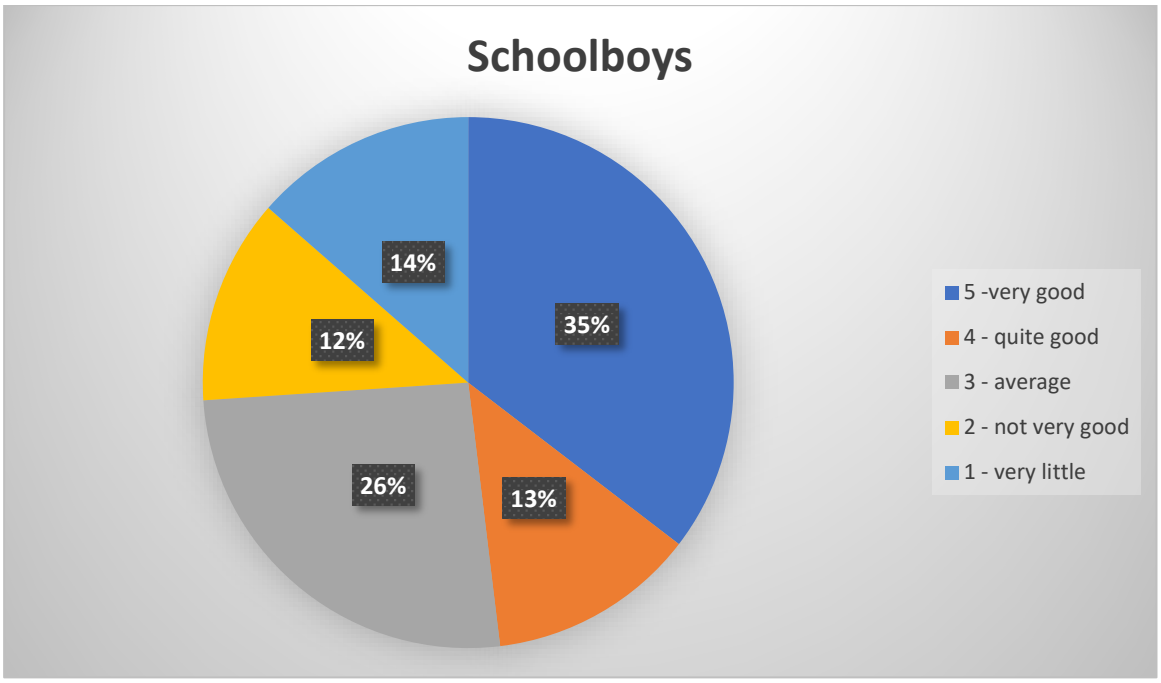
Geography


Schoolgirls
39%
20%
18%
12%
11%
5 -very good
4 - quite good
3 - average
2 - not very good
1 - very little

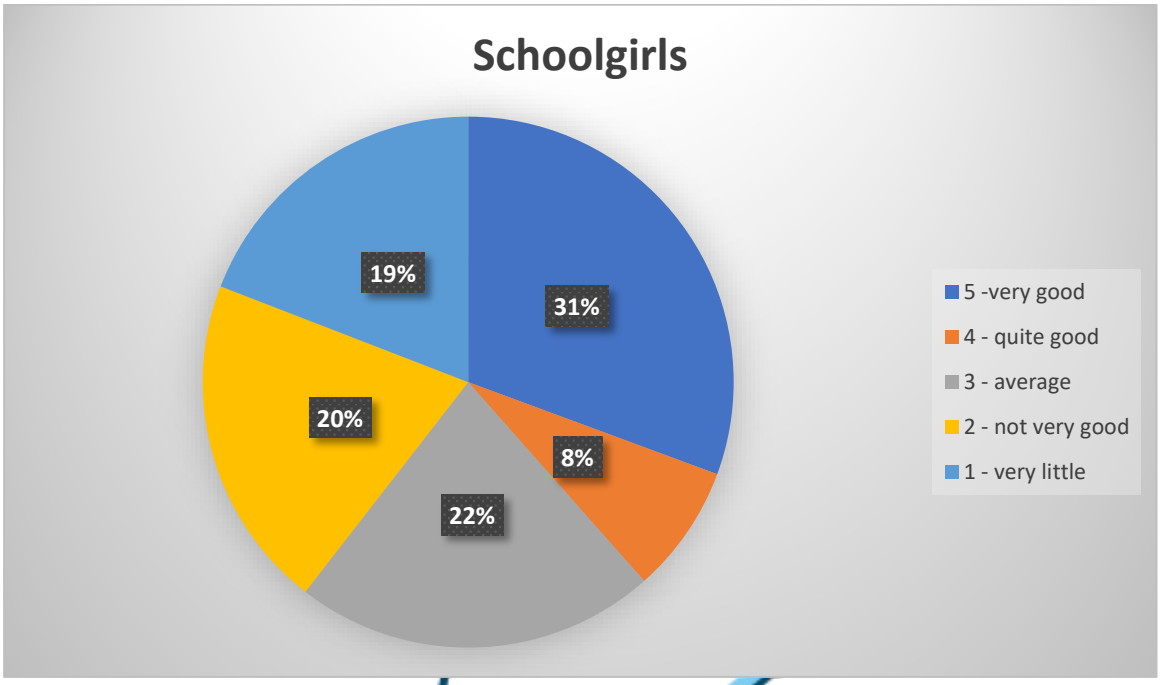


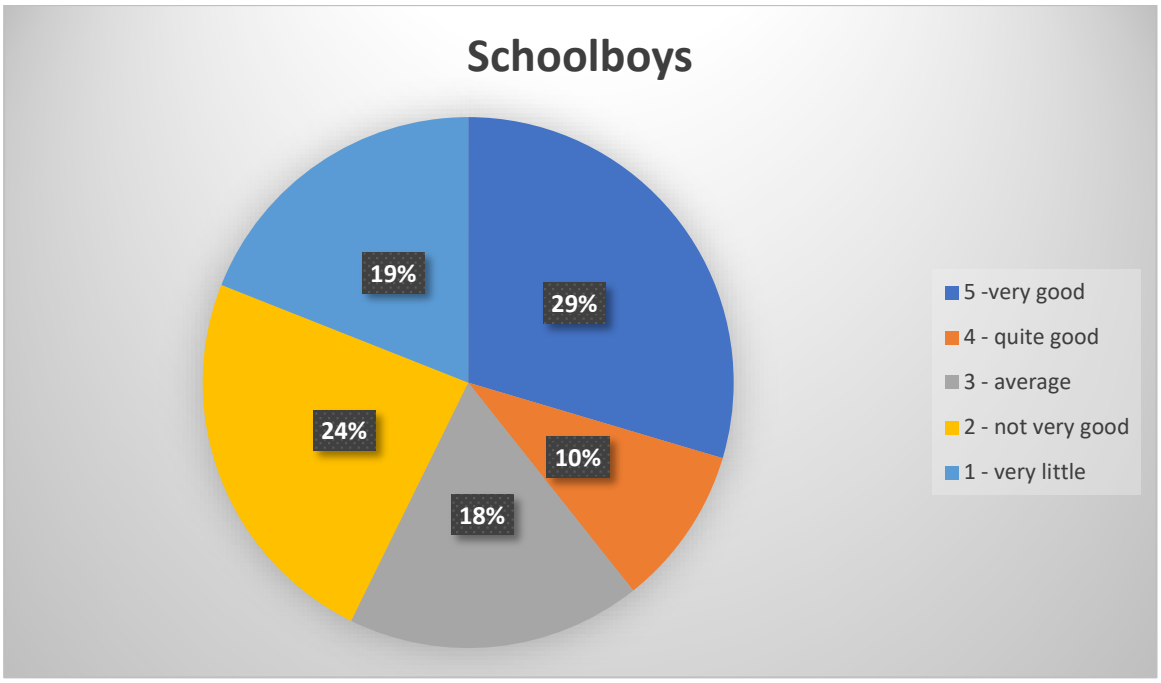
Natural Science



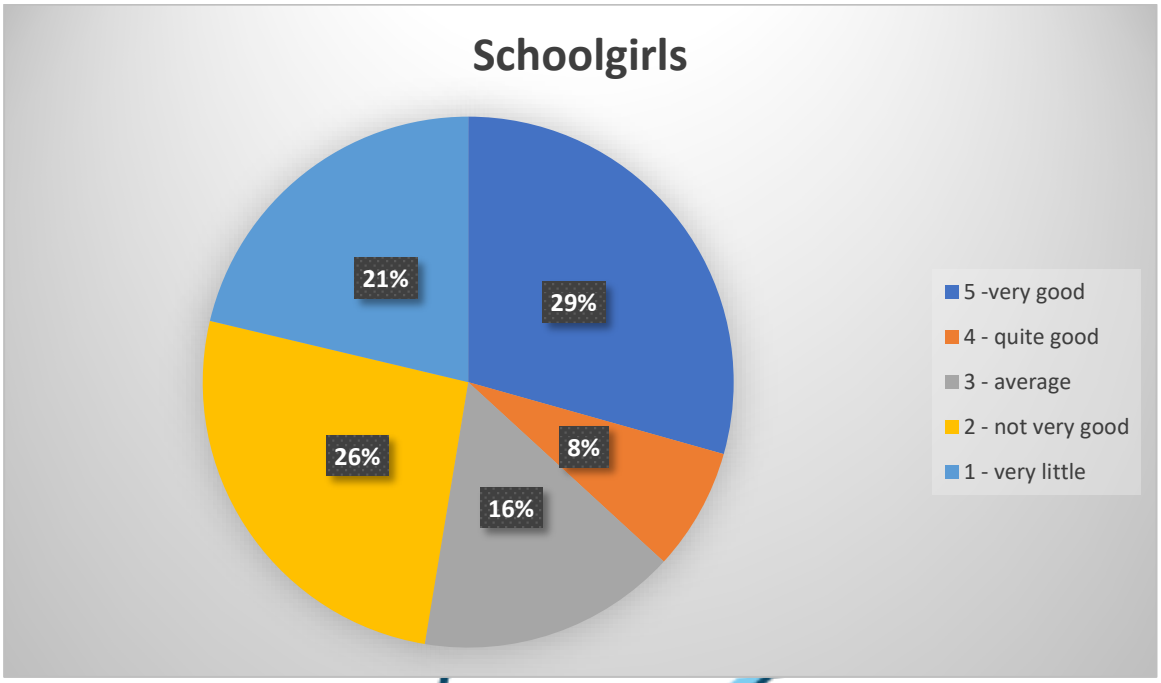

Schoolboys
35%
13%
26%
12%
14%
5 -very good
4 - quite good
3 - average
2 - not very good
1 - very little

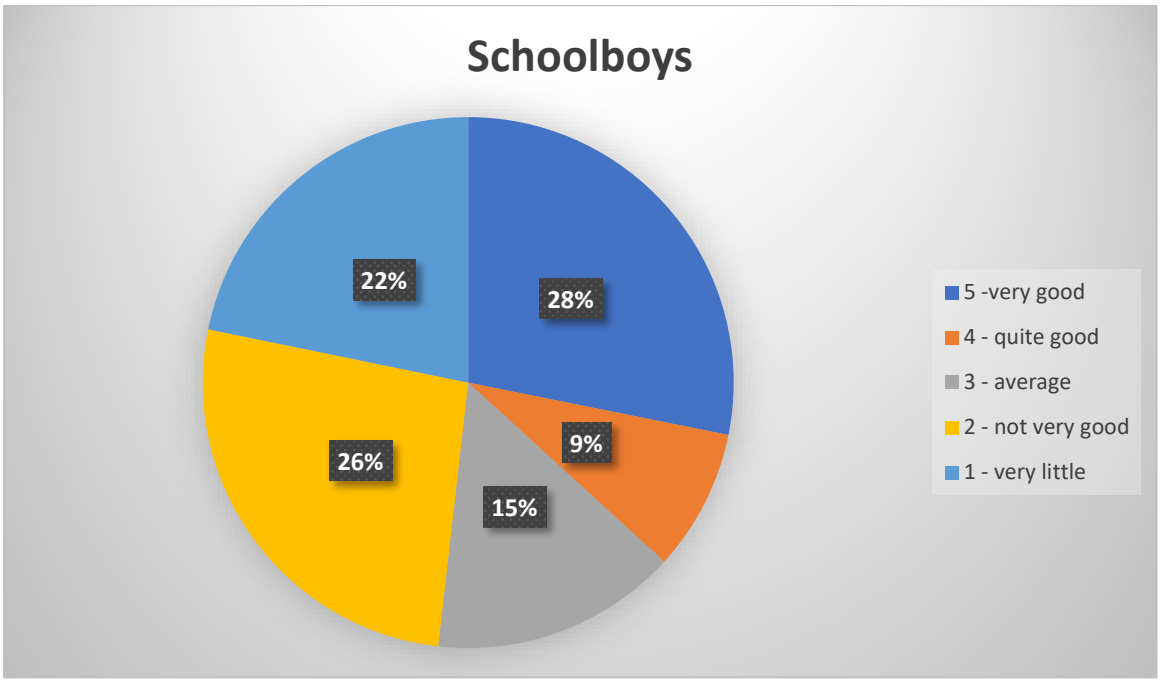
History


Schoolgirls
31%
8%
22%
20%
19%
5 -very good
4 - quite good
3 - average
2 - not very good
1 - very little

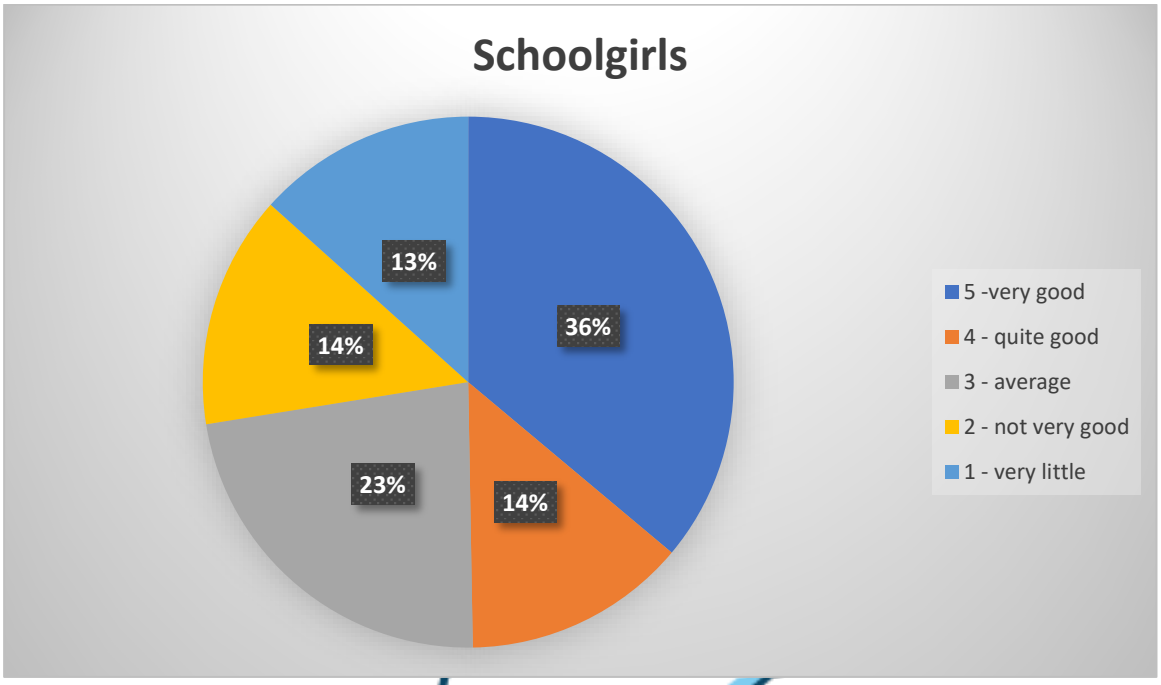


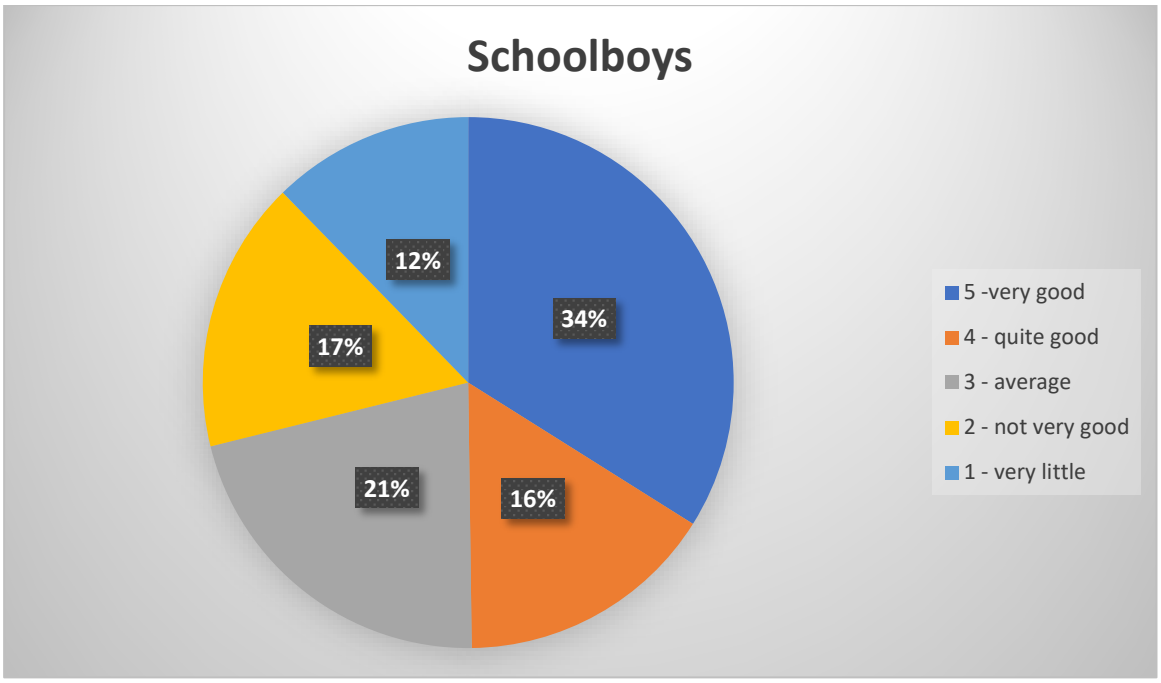
Social and political specificities concerning the polar regions



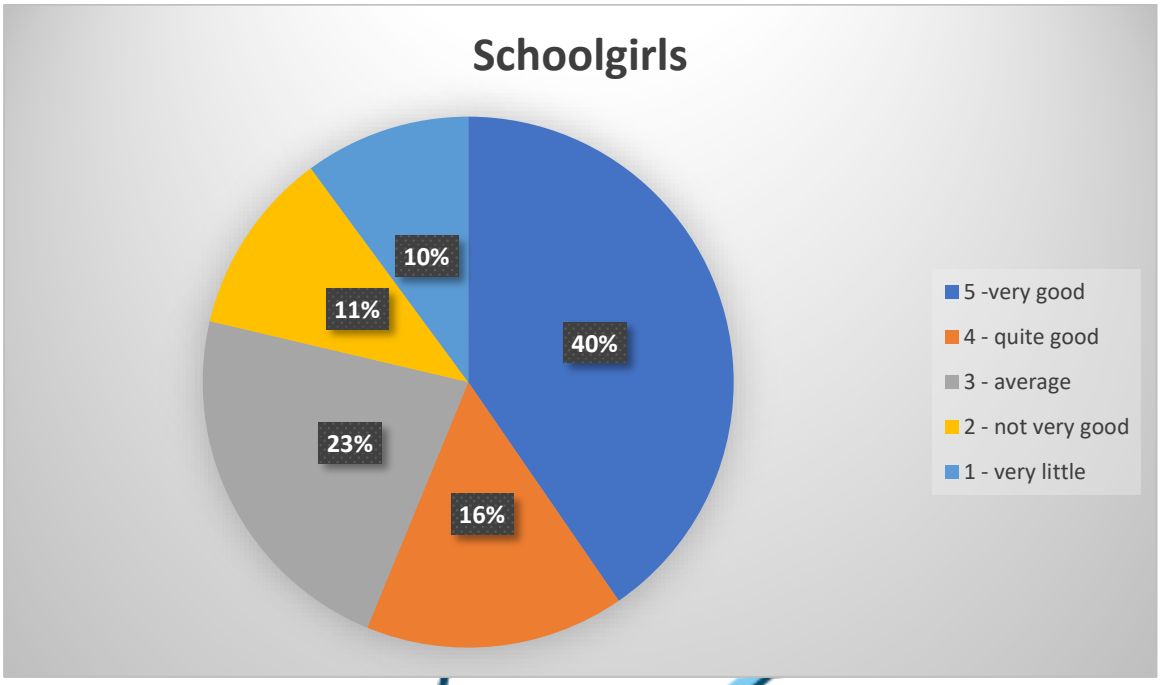


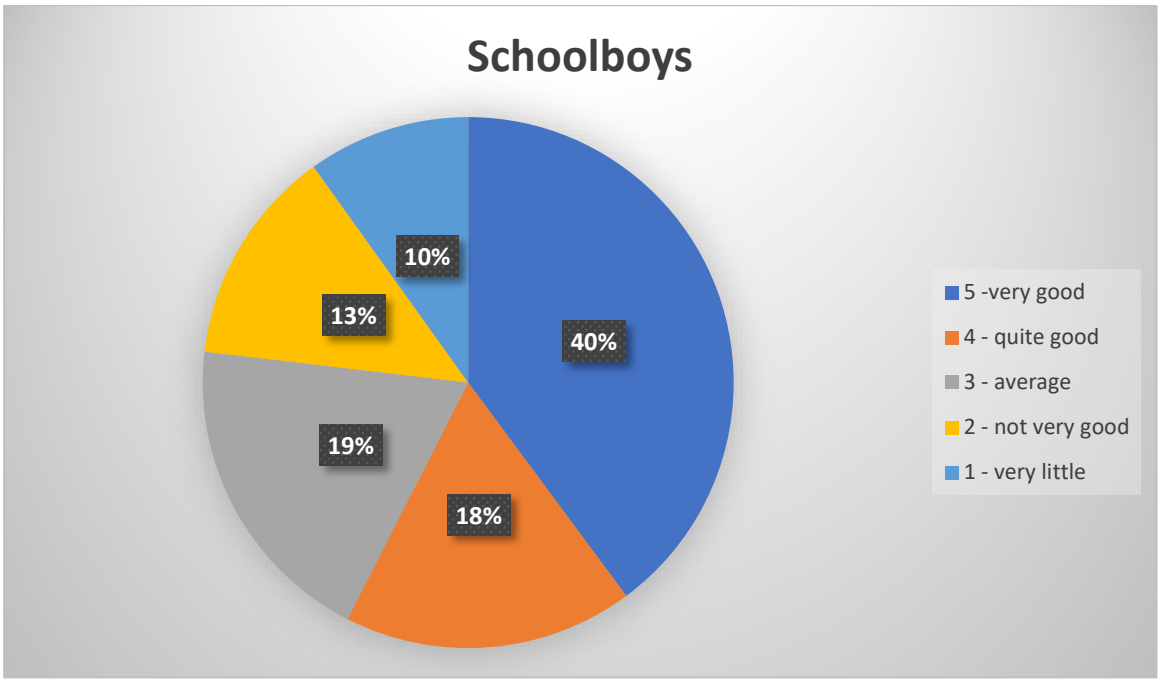
Sensitivity to environmental issues





Climate change




Schoolboys
40%
18%
19%
13%
10%
5 -very good
4 - quite good
3 - average
2 - not very good
1 - very little