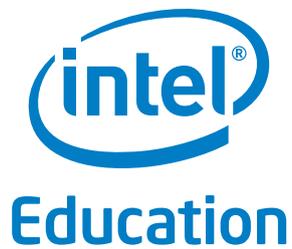


# The European Science Fairs Evaluation Framework - 2014 study

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# EXECUTIVE SUMMARY

**Scope:** In this report we present and analyse the data obtained from the evaluation of ten European science fairs organized in 2014 (Bulgaria, Czech Republic, Estonia, Netherlands, Hungary, Northern Ireland, Norway, Poland, Portugal and Sweden). These fairs, affiliated to Intel ISEF, were selected from among those which had the final events taking place between March and June 2014. The evaluation tool is the same one used for 2013 (see Gras-Velazquez, A., Price, J. K., Velek, P., Dzoga, M. & Pastuszynska, I. K. (2013): The European Science Fairs Evaluation Framework – pilot study). The evaluation tool provides useful data for analysis, ensuring cross-country and cross-year comparability.

**Data infographs and sections:** In this report, the students' and teachers' data from the ten fairs are combined and are provided in table or graph format in separate sections for students and teachers, with short descriptions and highlights for each graph or table. Furthermore, basic comparisons are provided between the 2013 and the 2014 data. We highlight the main differences between both years and briefly discuss the apparent trends that are emerging. A detailed comparison of yearly reported data provides a wider perspective of the impact and sustainability of the fairs, a perspective that will become more detailed when the data from more years are incorporated in the future.

Furthermore, a section with sample detailed investigations is included in this report, both in terms of students' gender and of students' age. These comparisons attest to the richness of detailed studies that the data affords.

As a simple helping tool, average statistical profiles of participating students and teachers are provided at the end of the corresponding section. These statistical profiles can be as comprehensive as needed.

Finally, at the end of the report, a more general analysis of the students' and teachers' data is presented followed by a short section with some conclusions and reactions from the authors. The specific data for each fair can be provided in individual reports should the fairs request it.

**Demographic data:** In the current report we have increased the number of fairs to be evaluated from four in 2013 to ten in 2014. The total numbers of student questionnaires analysed has increased by a factor of 2.5 with respect to the previous year, up to 845, and the number of teachers' questionnaires is 240, 86% higher than in 2013. The ratio of students per teacher participating in the evaluation is similar in both years, at about 3.5.

**Short overview of the conclusions:** The main results in this report are the following:

- **Demographics:**
  - A school coordinator exists in 2/3 of the schools. There is practically gender parity among student participants.
  - Overall the students carried out the science projects on a voluntary basis.
  - Teachers observed less difficulties of getting student involvement in the 2014 fairs compared to 2013.
- **Support:**
  - Great support is received from colleagues, parents and experts. Less from local authorities, local media, or even the National Ministry of Education.
- **Impact:**
  - The project is linked with the national STEM in almost half of the cases.
  - Teachers' use of Inquiry-based methodology increases following the fairs.
  - Teachers consider that they themselves and their students learnt a lot from participating, and that the students know more afterwards about the scientific method.
  - Teachers find science fairs an effective way of obtaining professional development.
  - Collaboration, scientific literacy and work ethic are considered less than other skills like creativity and communication. The capacity of leadership was almost not considered.
  - Females and males differently rate personal traits and skills.
  - The main reason for teachers' involvement is the commitment to their students.
  - As a consequence of developing the project, many students are more likely to consider a STEM career. There is a significant age-group effect in this impact.
- **Sustainability:**
  - Most teachers are satisfied and would repeat tutoring.
  - Most students would repeat the experience and recommend it.

The schools support the fair (a coordinator exists in many schools), as well as colleagues and parents, but more support might come from local authorities, local media or even the National Ministry of Education. The Science Fair initiative achieves the goal of improving school education as regards the necessary transformation and updating of teachers' methodologies, so that the students' education

is improved in terms of transferable knowledge, skills and competences, and, in particular, their attitude towards STEM is improved. Furthermore, both for teachers and students, participating in the science fairs is an enjoyable and positive educational experience.

**Average statistical profile:** For ease of reference, the main findings from the two target groups' (students and teachers) data is shown in the following Table 1, separated in the three main aspects assessed in the questionnaires: impact, support and sustainability. Demographic and project data are shown also for completeness. A further section in the table incorporates the results of the sample detailed data comparisons mentioned above.

**Future evaluation goals:** The 2013 data column in the following data is provided for future reference without detailed comments. As mentioned above, some comparisons between the data of both years are provided in the body of the report. We expect in the future to provide a reasonably complete picture of the fairs eventually after a third evaluation exercise. Furthermore, a series of questionnaire revisions and improvements have been detected which should lead to richer content and analysis of the data. These suggestions have been noted throughout the 2013 and 2014 reports and will be summarised and formalised in the possible report to a third year of the fairs.

**TABLE 1: MAIN FINDINGS FROM STUDENTS' AND TEACHERS' DATA ANALYSIS IN 2014.**

FACTOR	%	REMARKS	IN 2013 (%)
<b>Students</b>			
Age	92	Between 14-19 yrs. old. (Average: 17yrs old).	15-19 yrs. (Av.: 17 yrs old)
Gender	51/49	F/M: almost equal.	F/M = 42 / 58
Newcomers	76	1st time participants in fairs.	72
<b>Projects</b>			
Project areas	60	Science (43%) & Technology (17%). (22%: Combined).	80. No combined data
In teams	58	(Individual projects: 42%).	50/50 F/M distribution
Project time	72	Several months of work.	80
Materials	44	Difficulties in getting hold of materials and equipment.	49
Applying scientific method	43-47	Difficulties in carrying out the different steps in the scientific method. (In drawing conclusions: 35%).	40-50. (In drawing conclusions: 39%)
<b>Impact</b>			
Show work	70	Impact of fair on diffusion of work.	78
Own project	66	Advantage of participating in a science fair.	64.
Skills for success	...	Creativity (60%), communication skills (43%) & intelligence (34%). Last: leadership (4%).	Major differences in ratings: 60, 58, 42, 7.
Scientific method	80-90	More confidence in identifying problems, finding solutions... and even had fun in the fair.	78-85
Communication skill	78	Improved skills - students find values in participation.	85
Team work	65	Improved capability..	63
STEM degree	63	More attracted to, and likely to study, STEM.	68
<b>Support</b>			
Extra work	48	Attend after-school activities. (Agrees with teachers).	54
Internet	80	The most successful resource.	85
The teacher	78	(And help from mentors / experts rated 72%).	77. (Mentors: 75%)
Internships	13	Extra school support to students.	21
<b>Sustainability</b>			
Participation	76	Voluntary student participation.	83
Loyalty	24	Repeat participation in fairs (in the future).	28
Teacher influence	78	The teacher is the major factor for student participation.	78
Satisfaction	88	(And participants would recommend it to friends: 91%).	89. (91).

FACTOR	%	REMARKS	IN 2013 (%)
<b>Teachers</b>			
<b>Demographics</b>			
Gender	57/43	Female predominance.	54/46
Newcomers	33	1st time participants in fairs. Good renew rate.	23
Few yrs. teaching	10	Less than 5 yrs. of experience. (40% more than 20 yrs.)	5%. (40%: > 20 yrs.)
Teachers' areas	42	In science. (7%: Technol., 10%: Engn., 8%: Maths)	38% (12, 19, 6)
Schools repeat	79	Schools participate in fairs more than once.	81
<b>Projects</b>			
Project area	40	Predominant in Science. (Techn.+ Engn. + Maths: 25%)	38. (37).
Students / teacher	50	Ratio 1 to 4 students.	48
<b>Impact</b>			
Learning	84	Teachers learn through participation in the fair.	81
Learning (students)	90	Teachers: students learn thanks to the fair.	94
Students motivated	66	Students are more motivated. (Interact more: 63%).	69 (74%).
IBSME use	48 to 55	Sizable changes in pre-event to post-event use of Inquiry-based Science and Maths Education methodologies.	28 to 35
Project & curriculum	44	Project linked with the national STEM curriculum.	42
Students' creativity	57	Students' most important trait for success. (Communication skills: 44%. Intelligence: 33%).	58 (53%, 48%)
<b>Support</b>			
Funding not easy	51	Difficulty in finding funding for the project.	56
School coordinator	62	Schools support fair participating teachers.	58
Useful support	45	From school colleagues.	30
Local support	< 27	Less support from local authorities, media, etc.	< 32
<b>Sustainability</b>			
Satisfaction	91	Teachers are satisfied and would repeat tutoring.	86
Voluntary tutoring	78	In most schools teacher participation is optional.	99
Why tutoring	91	"My students": main reason for teachers' commitment.	94
<b>Gender comparisons: F (%) / M (%)</b>			
Science projects	54/32	Females focus on science. (Less in Technology: 8/24)	F: even more focused
Working with out-of-school people	54/46	Females are more appreciative.	---
Team projects	56/60	Males a bit more in favour of team work.	50/50 distribution
Intelligence	32/37	As a personal trait for success (students' opinion).	32/50
Mistakes allowed	46/54	Males see it more as advantages of doing projects.	---
<b>Age-range effect: 17-19 yrs. (%) vs 14-16 yrs. olds (%)</b>			
Age and impact on Science	70/30	Significant effect: (70%) 17-19 yrs. old and (30%) 14-16 yrs. old students feel more positively about science.	---



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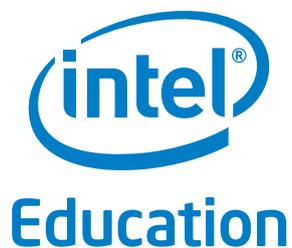
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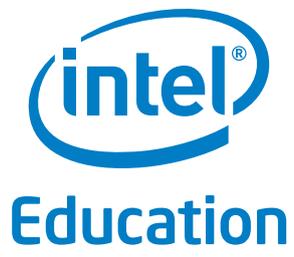
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# Introduction



# Introduction

In this report we present and analyse the data obtained from the evaluation of ten European science fairs organized in 2014 (Bulgaria, Czech Republic, Estonia, Netherlands, Hungary, Northern Ireland, Norway, Poland, Portugal and Sweden). The fairs were selected from among those affiliated to Intel ISEF, which had the final events taking place between March and June 2014.

The basic ideas behind the valuation methodology and strategy for its widespread in fairs across Europe are discussed in Gras-Velázquez, À., Price, J. K., Velek, P., Dzoga, M. & Pastuszynska, I. K. (2013): *Designing a Science Fair Evaluation Strategy: The European Model*. Here we just provide the minimum methodological information required to be able to follow the rest of the report. The specific data for each fair may be provided eventually in separate individualised reports to the fair organizers that request it.

The structure and the general outline of this report follows closely the pilot evaluation exercise of four Science Fairs that was developed in 2013, which showed the value of the data that can be obtained from the evaluation tool developed. The evaluation tool is based on comprehensive and mutually interlaced students' and teachers' questionnaires and provides plenty of useful data for analysis, ensuring cross-country and cross-year comparability. The full contents of the students' and teachers' questionnaires are given in an appendix in the 2013 report, and will not be reproduced here.

The bulk of this report is provided by the data extracted from the students' and teachers' questionnaires listed in this report in two separate sections in graph or tabular form, with comments about the major findings in each questionnaire question. For ease of reference, the main findings from the evaluation are given in infographs for each one of the three main aspects

discriminated in the questionnaires: impact, support and sustainability. Demographic and project data are also shown for completeness.

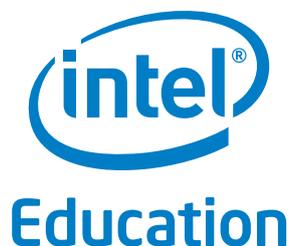
As an example of the cross-year potential of the data we have provided in this report, at the end of each data set (table or figure), short comments comparing the data analysis of 2013 and 2014. We also outline the major observations and conclusions (including similarities and differences) that can be extracted from this detailed comparison of the two years of the scientific fairs. We highlight the trends that are apparently being consolidated across the different years. This provides a wider perspective on the impact and sustainability of the fairs, a perspective that will become much richer when the data from more years are incorporated in the future.

In order to extract additional conclusions for this second fair evaluation exercise we have included some sample detailed investigations in this report, both in terms of students' gender and of students' age groups. These comparisons attest to the potential depth of the detailed studies that the data affords.

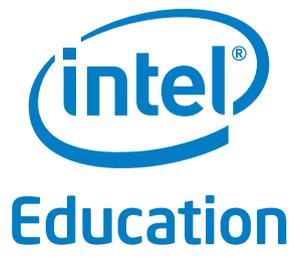
At the end of the report, a more general analysis of the students' and teachers' data is followed by the main conclusions from the evaluation. As a complementary analysis, some conclusions and reactions are presented by the authors in a short final section.

Eventually, the fairs evaluation goals can be enlarged. In the future we would expect to provide a reasonably complete picture of the fairs after a third evaluation exercise. A series of questionnaire revisions and improvements have been identified which can lead to more detailed content and analysis of the data. These suggestions have been noted throughout along the 2013 and 2014 reports and will be summarised and formalised in the report to the third year of the fairs.





# Evaluation methodology



# Evaluation methodology

The evaluation of the science fairs focuses on three aspects in relation to two target groups: students and science teachers. The three main aspects of the fairs that are evaluated are impact, support and sustainability. The aims of this analysis are the following:

**Demographics** – Type of participants in terms of gender, age, experience, etc.

**Impact** – The effect of participating in science fairs on students and teachers.

**Support** – The help received for participating in science fairs (students) or for tutoring students' science projects (teachers).

**Sustainability** – The motivation of students and teachers to participate in science fairs related to their interest in pursuing STEM careers.

We explore these three aspects by means of two questionnaires (one for teachers and a separate one for students) to be filled in by the participants at the selected science fairs.

## Questionnaires

The items in both questionnaires (for students and teachers) are divided into separate sections in order to obtain information about the various items of interest, as shown in Table 2.

The questionnaire items mentioned in **Section 1 (Demographics)** provide the usual demographic data that serve the purpose of characterizing the sample of students and teachers who participate in the science fairs that are evaluated.

The particular components investigated in **Section 2 (Impact)** of the student questionnaire include students' (self-assessed) knowledge, skills and attitude towards science, their learning experience, and their motivation to study science and choose a career in science. Section 2 in the teachers' questionnaire additionally contains questions regarding the educational value of their student's participation, and the impact that the science fair has on their school and on their teaching practice.

**Section 3 (Support)** aims to identify problematic or challenging aspects (e.g. funding, access to materials and equipment) of those participating in science fairs from the point of view of both students and teachers; and how and by whom they were supported to overcome them.

**Section 4 (Sustainability)** focuses on the motivating and discouraging (intrinsic and extrinsic) factors for students and teachers to participate in science fairs. The teachers' questionnaire also contains items on inquiry-based teaching and the possible role that science fairs may play in promoting active teaching and learning methodologies.

The questions contained in the teachers' and students' questionnaires are presented in unambiguous, jargon-free statements with a Flesch-Kincaid readability. Grade level is 7.3 for the students' questionnaire, suitable for Grades 7 – 8 (i.e. 12 – 14 years old), and 8.4 for the teachers' questionnaire. Additionally, except in the case of the few open-ended questions included, all the questions had a limited range of answers, either in the form of a Likert-type scale, as a multiple-choice or as a single-choice question. We shall give a few more details about the Likert scales and their analysis in the following section. In some items, respondents could add additional comments or explanatory remarks to their answers.

TABLE 2: ASPECTS EVALUATED IN EACH SECTION OF THE STUDENTS' (SQ) & TEACHERS' (TQ) QUESTIONNAIRES.

SECTION	ITEMS IN...		TO OBTAIN DATA ON THE...
	SQ	TQ	
1	1-7	1-10	<b>Demographic data</b> and other basic characteristics of participants.
2	8-9	11-12	<b>Impact</b> of science fairs on the participants.
	16-20	22-27	
3	10-13	13-17	<b>Support</b> received by the participants.
4	14-15	18-21	<b>Sustainability</b> and motivation of the participants in the science fair.

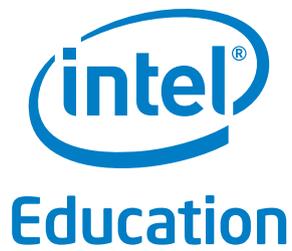
### Likert scales and statistical analysis

As mentioned above we have used various 4-level Likert scales to rate the options provided in some answers, see column 1 in Table 3. However, the difference between respondents saying “completely agree” or just “agree” is highly influenced by personality traits and the differences have little statistical significance. Therefore for the analysis of data the levels 1+2 and 3+4 have been combined and redefined as Low and High degree of fulfilment, respectively (see Table 3, column 2, Redefined scale A), or, whenever more appropriate, as No and Yes, respectively (see Table 3 column 3, Redefined scale B).

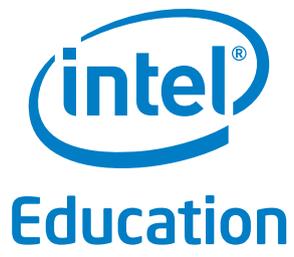
**TABLE 3: LIKERT SCALE & REDEFINED SCALES FOR ANALYSIS.**

LIKERT SCALE	REDEFINED SCALE	
	A	B
1 – Not at all / Very difficult	Low	No
2 -		
3 -	High	Yes
4 – Completely agree		

We have rounded off percentages, so in some cases the total sum may be slightly over or under 100%.



# Data analysis



# Data analysis

We shall first present and discuss the results of the questionnaires separately in the following sections:

- Overall data from the fairs
- Students' questionnaires data
- Teachers' questionnaires data
- Sample data comparisons

The report will then conclude with two sections where the general conclusions and remarks will be outlined:

- Analysis and conclusions
- Open discussion and future work

## Overall data from the fairs

The general data on the fairs and the participants will be presented first. The respondents of the questionnaires were participants – students and their teachers (tutors) – at ten randomly selected science fairs. In total, 240 teachers and 845 students completed the questionnaires.

The breakdown per science fair is indicated in Table 4. The number of student questionnaires in each fair fluctuates from a minimum of 21 to a maximum of 211. The number of student questionnaires per teacher questionnaire is in the range 2-4, except for the larger fairs.

Most of the events in 2014 were of national character. Throughout the remaining of the report, we will refer to the events by the country where they were hosted, regardless of the nationality of the participants.

In comparing 2013 and 2014 data we observe an increase in the number of fairs that have been analysed by a factor of 2.5. The total number of respondents (both students and teachers) increased by about 85%. The average ratio of students per teacher in the data is similar in both years, a little over 3.5.

The total number of participants in each fair as well as the number of respondents to the questionnaires is shown in Table 5. We see that the response rate fluctuates from over 40% to over 80% (for students) which is within reasonable limits.

We have no detailed data for 2013 on the actual number of participants. The 2014 data will be the basis for future comparisons.

**TABLE 4: NUMBER OF RESPONDENTS TO THE QUESTIONNAIRES PER EVENT.**

NAME OF EVENT	LOCATION	STUDENTS	TEACHERS
Science and Innovation Fair	Bulgaria	55	17
Student´s Professional Activities (SPA)	Czech Republic	203	62
Estonian Contest for Young Scientists	Estonia	61	45
INESPO	Netherlands	161	23
National Scientific and Innovation Contest for Youth	Hungary	27	14
Sentinus Young Innovators	Northern Ireland	21	13
The Norwegian Contest for Young Scientists.	Norway	37	4
E(x)plory	Poland	30	12
Portuguese Contest for Young Scientistus	Portugal	211	36
Utställningen Unga Forskare	Sweden	39	14
	<b>Totals</b>	<b>845</b>	<b>240</b>
	(Totals 2013)	(464)	(129)

TABLE 5: NUMBER OF PARTICIPANTS AND QUESTIONNAIRE RESPONDENTS, AND RESPONSE RATE PER EVENT.

LOCATION	STUDENTS	TEACHERS	STUDENTS	TEACHERS	STUDENTS	TEACHERS
	QUESTIONNAIRES		PARTICIPANTS <sup>1</sup>		RESPONSE RATE <sup>2</sup>	
Bulgaria	55	17	106	28	52%	61%
Czech Republic	203	62	~300	n/a	68%	n/a
Estonia	61	45	172	104	35%	43%
Hungary	27	14	~50	n/a	54%	n/a
Netherlands	161	23	205	27	79%	85%
Northern Ireland	21	13	~500	n/a	4%	n/a
Norway	37	4	84	-	44%	n/a
Poland	30	12	44	21	68%	57%
Portugal	211	36	246	53	86%	68%
Sweden	39	14	79	41	49%	34%
<b>Totals</b>	<b>845</b>	<b>240</b>	<b>1786</b>	<b>274</b>	<b>47%</b>	<b>88%</b>

## Students' questionnaires

We start by providing some **demographic data**: age and gender of students participating in the fairs. The 845 students who filled in the science fairs student's questionnaire were mostly between 14 and 19 years of age, with an average age of over 17 years (see Figure 1). A split of ~51% women versus 49% men is also observed (see Figure 2), i.e., there is practically gender parity among participants.

When comparing 2013 and 2014 data we observe a similar average age of 17 years and a similar age distribution but there is a shift toward younger participants in 2014, particularly in the 13-14 age

range. The gender split among participants has come closer to 50% in 2014 (with even a female dominance by two percent-points), whereas in 2013 there was a 16 percent-points dominance of male students. This gender balance is an important achievement in science fairs that will, hopefully, occur also in the future!

The **sustainability of the fairs** depends on the students' participation and their eventual renewed commitment with the fairs. Although most students were newcomers to the fairs (76% of the participants were participating in the respective fair for the first time), 15% were participating for the second time. Even a significant 9% had been to three or more of these fairs (Figure 3).

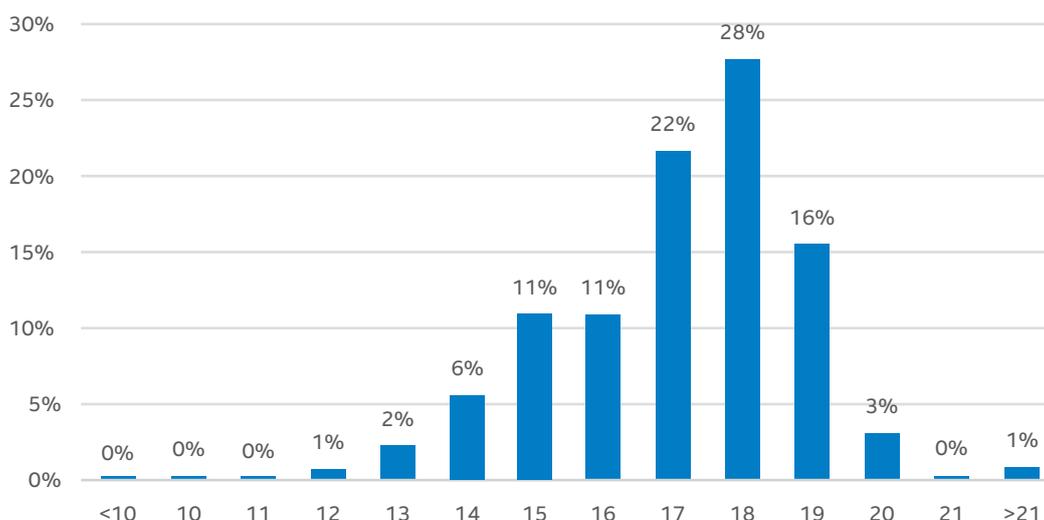


Figure 1: Age of respondents (students).

<sup>1</sup> Values with the approximate symbol (~) are averages values taken from <http://isef.intel.eu/>

<sup>2</sup> Values in italics are estimates based on the data available.

In comparing 2013 and 2014 data we observe an increase in the number of first-time participants (from 72% to 76%) and a similar distribution for the other groups. The dominance 4 to 1 of new to repeat students is a guarantee of continuity of the fairs: a relatively small fraction of repeat students provides the link to engage new students. One would expect this participation figures to be rather stable across the years: an assumption to be checked in future analysis. It may be interesting to check whether repeat participation occurs in consecutive years.

It is interesting to note the distribution of **subjects that the students' projects deal with**. Science and Technology were the most common topics of the participants' projects (~60% in all, see Figure 4) with Maths about 7%. Engineering topics account for 11%. Still, science topics predominate by a factor of 2.5 over technology projects and by a factor of almost four over engineering projects. A significant group of projects (22%) were not classified in any of the four categories suggested and the open answers included mostly either combinations of the above or the respondents said "Biology" or "Physics" and did

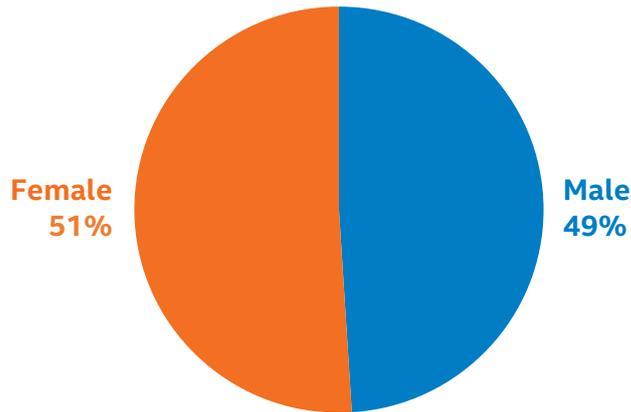


Figure 2: Gender split among the respondents (students).

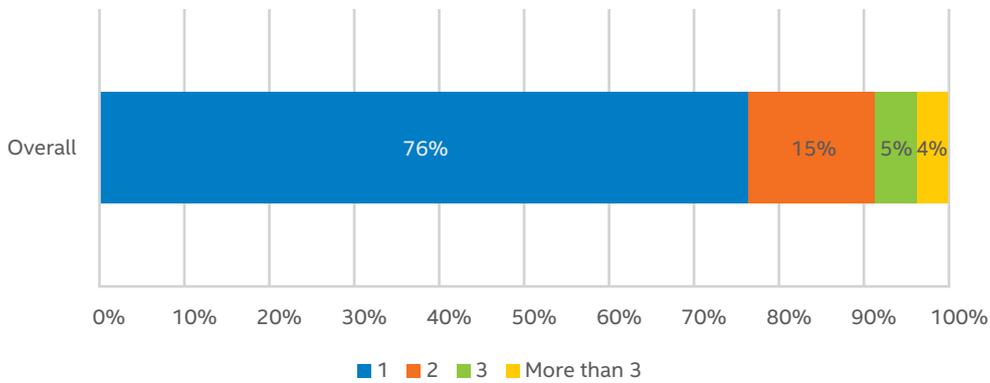


Figure 3: Number of participations in a science fair including the present one (students).

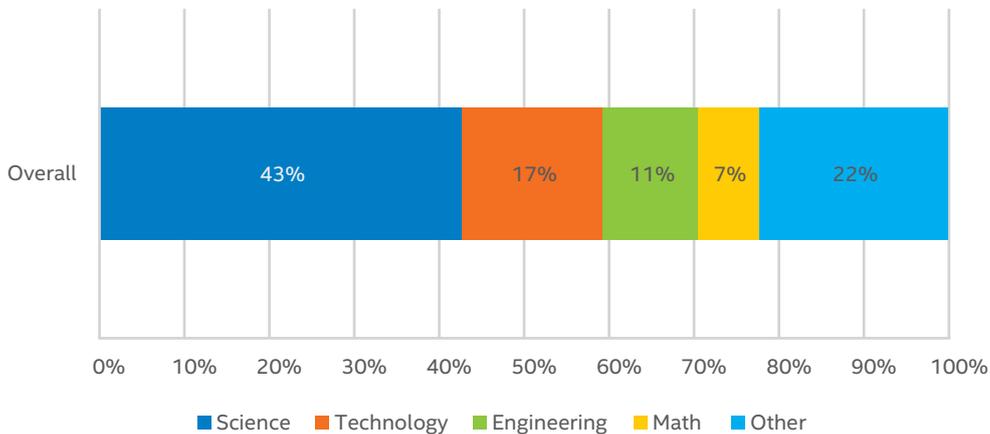


Figure 4: Major focus of the projects (students).

not consider “Science” to include them. A small group mentioned subjects like “psychology” or “pedagogy”, we presume as subtopics in Medicine (also included by some students).

In comparing 2013 and 2014 data we observe a similar dominance of Science and Technology projects, as well as a similar ratio between Science and Technology projects (2.5 in 2014 and about 3 in 2013). The same relatively low presence of Maths projects occurred. However, the large percentage of “Other” types of projects in 2014 was absent in 2013. This may be tentatively attributed to a larger presence of interdisciplinary or not strictly curricular projects in 2014. It would be interesting to check this assumption with a detailed analysis of the projects contents or some other appropriate question added to the questionnaire.

The projects presented to the fairs can be developed **individually or in teams**. It emerged that the participants’ projects are developed in teams, rather than individually, in 58% of the cases, Figure 5.

In comparing 2013 and 2014 data we observe a 7 percent-point increase in the number of projects that have been developed in teams. Last year the distribution of individual versus team work was close to 50-50. This is an interesting trend that has to be checked in future years. It could be interesting to ask about team sizes in the future.

We have registered the **amount of time** devoted in preparing both the project and the presentation of

the project to the fair. The eventual participation of the students in **after-school science programs** is also investigated. Analysing the next three figures below together we see that over 72% of the participants took several months to develop the project (Figure 6), while preparing the presentation part took mainly between a 3-5 hours, for 23%, and a week for 33% (Figure 7). On the other hand, slightly less than half of the participants (48%) attended after-school science activities (Figure 8).

In comparing 2013 and 2014 data we observe a small decrease in the percentage of students that spent several months to develop the project (from 80% in 2013 to 72% in 2014). Conversely, the fraction of students that spent about a month in the project increased from 13% to 18%. The time spent in preparing the presentation of the project is similar in both years, to within a few percent, and on average the time for preparation of the display and the presentation is a little shorter in 2014 than in 2013. Finally, there is a 6-percent points decrease in participation in after-school activities, but still close to 50% of the students do participate in 2014. It would be interesting to question about the average duration and scope of these activities.

The **impact of a science project** may be felt on various levels: schools, teachers and students. First we show the eventual impact of the scientific content on the students. In Figure 9 we show the percentage

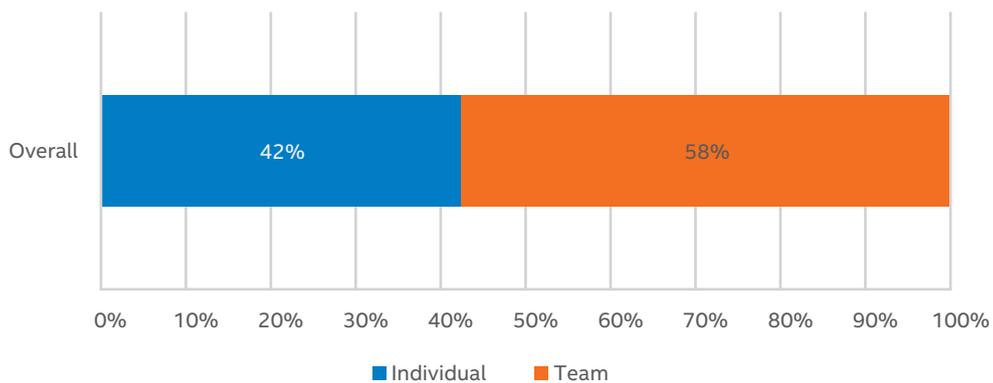


Figure 5: Individual versus team participation in the fair (students).

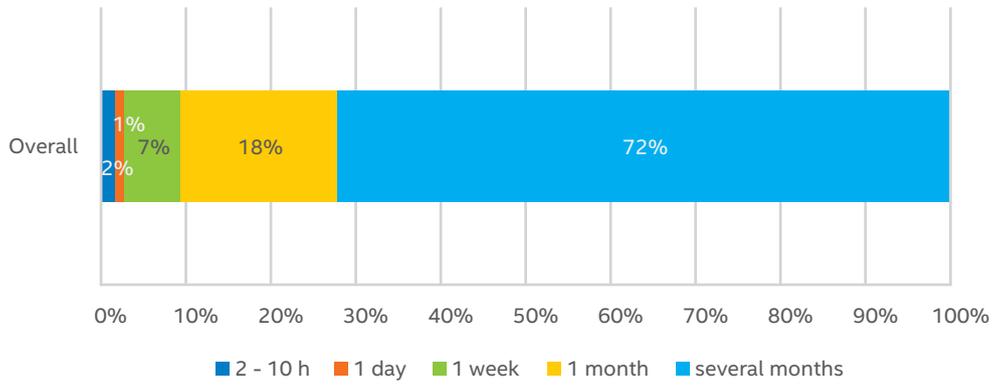


Figure 6: Time spent on developing the project (students).

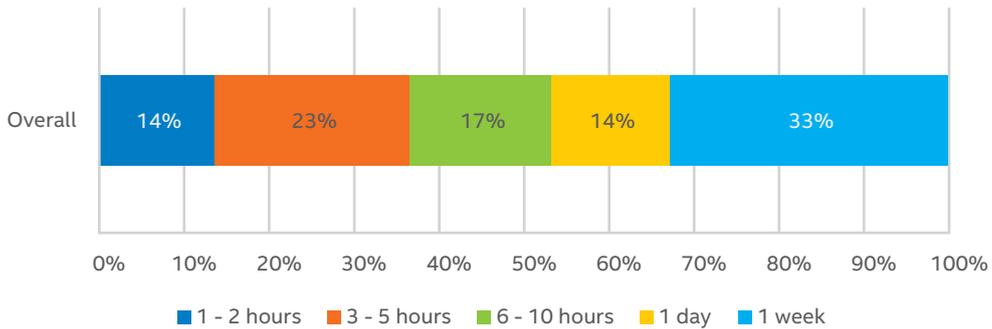


Figure 7: Time preparing the display and the presentation of the project (students).

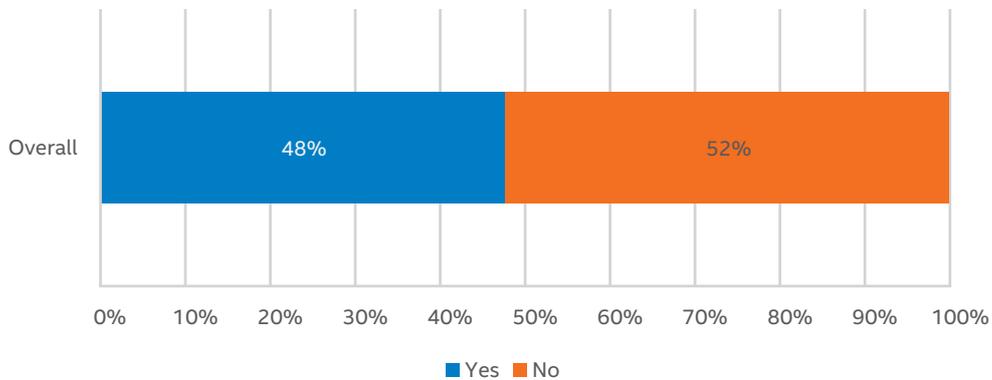


Figure 8: Participation in an after-school science club, programme or activity (students).

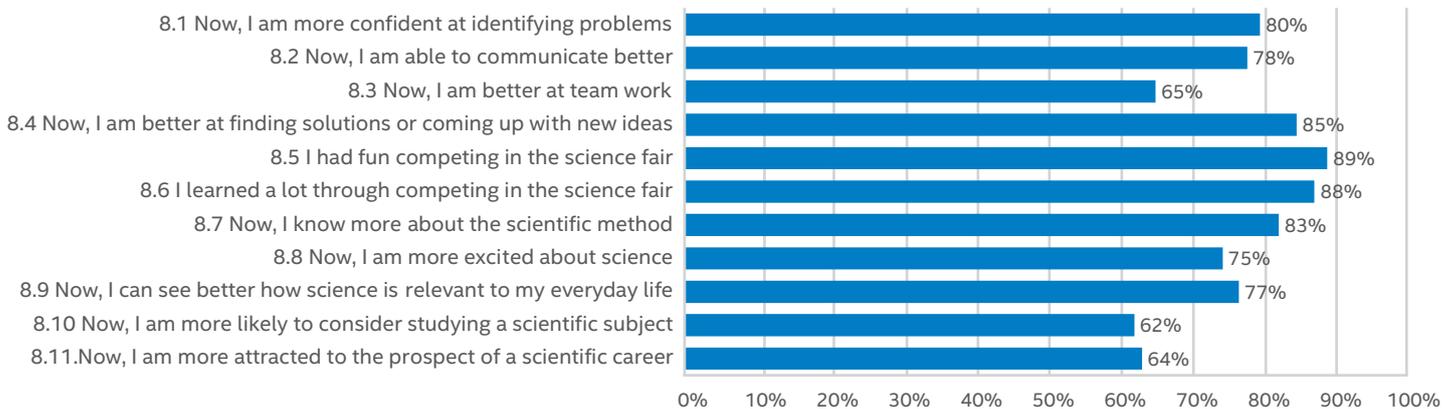


Figure 9: Agreement with different statements on the impact of the fair (students).

of students who agreed with different statements on the effect of the science fairs on themselves. All the items got a larger than 60% rating. A high percentage, 80 to 90%, reported an increase in confidence in identifying problems, in finding solutions and knowing more about how to use the scientific method, or even had fun participating in the fair. A slightly smaller percentage of the students, but still about 65%, have improved in team-working capabilities or felt more likely to study a STEM degree (around 62%).

In comparing 2013 and 2014 data we observe a rather similar distribution. Whereas in 2014 having fun and learning a lot in competing in the fair ranked 1<sup>st</sup> and 2<sup>nd</sup>, respectively, at close to 90%, in 2013 those two items also ranked most but in the reverse order. In both years personal attitudes towards the fair ranked as highly as intellectual achievements related to the scientific work. In future reports it may be interesting to separate in this and related questions the effect of the fair on the attitudinal, axiological, procedural, etc. components of the teaching and learning process.

Moving on to the eventual **impact of the scientific methodology on the students**, in Figure 10 we show the percentage of students who selected each of the statements as advantages of carrying out a science fair project. The main advantages selected (based on more than 50% responses) were having a chance to show their work to society at large (70%), working on a project of their own (66%) and collaborating with people from out-of-school (54%). Feeling like a real scientist was important for almost 45% of the students. On the other end of the scale, the fact that no marks are involved in developing a project is only relevant for a minimum of 13% of the students.

Again, the 2013 and 2014 distributions are strikingly similar. The same three items received the major scoring, and in the same order of relative importance. Items like being the one in charge, working with teachers or students from various subjects or in

mixed groups came in the second group of items at similar rating in both years. The fact that no marks are involved was pointed out by less than 15% of the students in both years also. Thus, the distribution shown in the figure above seems to be consolidated across the two set of fairs.

Usually, in the process of developing a project students encounter various types of **difficulties**. We see in Figure 11 that coming up with a topic and getting hold of the materials and equipment for the project, as well as working with the various components of the scientific method (formulating and testing hypotheses, analysing data, etc.) was problematic for around 45% of the students. Testing the project's hypothesis was a problem for 47% of the students. The relatively least difficult part was drawing conclusions from project data (35%).

Whereas testing the project hypothesis was the highest difficulty in 2014 (47%) in 2013 it was getting hold of the materials and equipment (49%). In comparing further 2013 and 2014 data we observe that current-year students find it more difficult to come up with a topic (44% versus 37% last year) but it is now relatively easier for the students to find the materials and equipment (44% compared to 49% last year). Drawing conclusions from the data received the minimum rating in 2014 (35% versus 39% in 2013).

The students were asked also about the eventual **help they received** in the development of the projects. In Figure 12 we show the percentage of students who found useful the knowledge and experience received from different sources. The data is normalized to the total number of students: since they could mark various options, the total number of responses is quite high. The Internet proves to be the most used resource at 80%, followed by help from the teacher (78%) and mentors/experts in the field (72%). Family members come in 4th place at 55%. About 52% find school classes useful in relation with developing the project. Advice from previous fair participants and after-school science clubs are important for a third of the students.

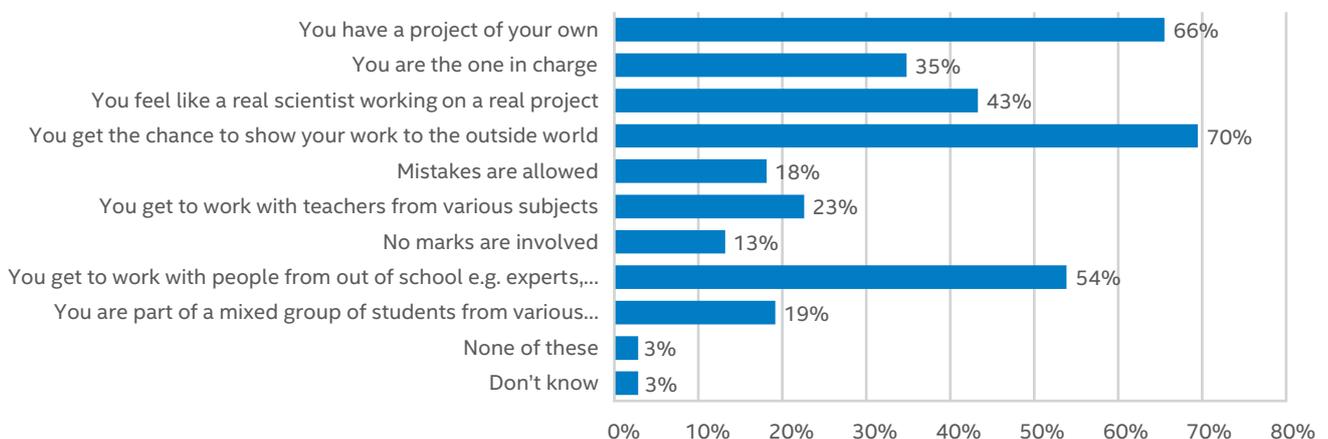


Figure 10: Advantages of doing a science fair project (students).

In comparing 2013 and 2014 data we observe the same dominance of Internet, teachers' and experts' rating (with Internet receiving 85% in 2013). The other items receive almost identical rating in both years.

In some cases students can get extra support from the school, for instance via internships. This year about

13% of the students participated on average in an internship related to the project (see Figure 13).

This figure of participation in an internship related to the project (13%) is well below the 2013 data, when about 21% of the students had one. Given the much larger sample of 2014 one would expect this year's data to be closer to future results.

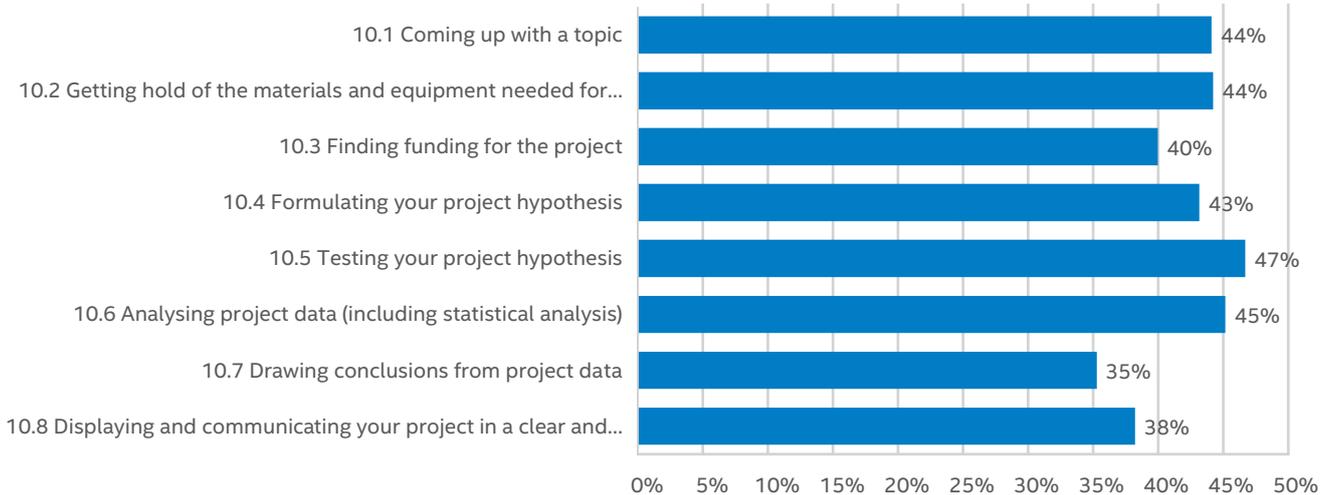


Figure 11: Difficulties encountered (students).

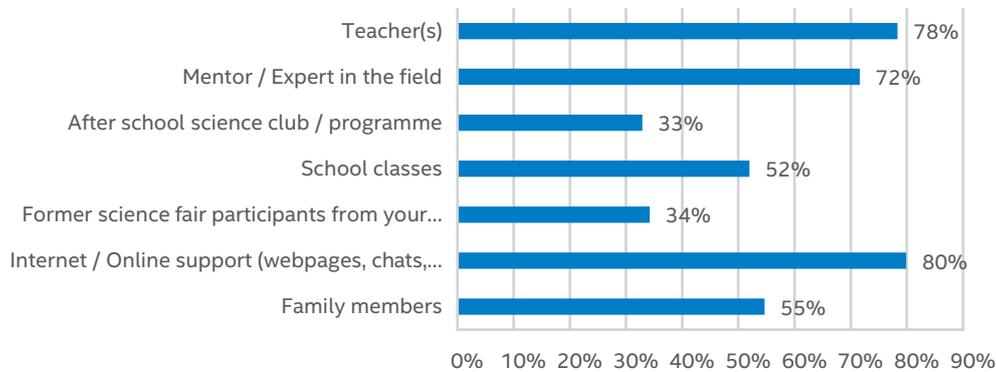


Figure 12: Usefulness of various sources of project support (students).

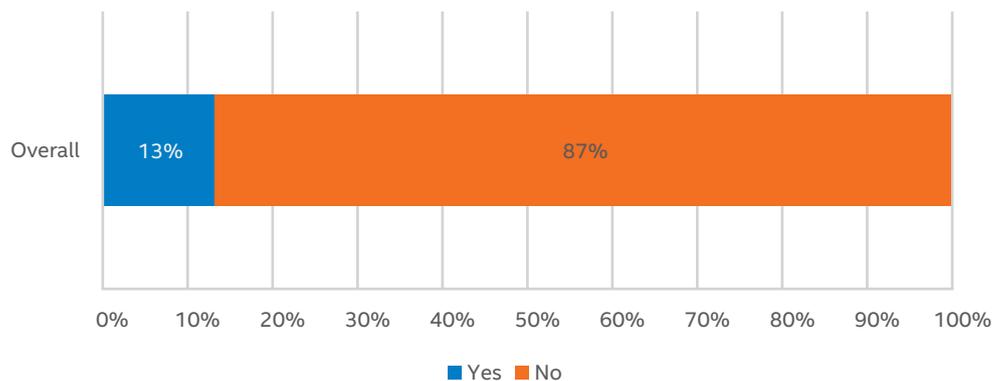


Figure 13: Participation in internships related to the project (students).

It is interesting to assess what do students consider to be the **major factors that contribute to the success** of a project. The data is normalized to the total number of students: since they could mark various options, the total number of responses is quite high. As seen in Figure 14, about 60% of the students felt creativity was the most essential factor, followed by communication skills (43%). The third group of skills would be creative thinking and curiosity (at about 38%), intelligence (34%) and then work ethic (29%). Scientific literacy was placed at the same level (about 23%) as collaboration (25%). Leadership (4%) came in last.

The previous question about essential students' traits and skills that lead to a good project is the one with big differences between the 2013 and 2014 data. Students in both years agree on the major importance of creativity (both at about 60%) and the next in importance: communication skills. But whereas in 2014 this item "communication skills" receives 43%, it was much higher (58%) in 2013. Intelligence came third in 2013 (at 42%) but only in fifth place in 2014 at 34%. On the lower end of the scale, leadership receives even less rating in 2014 (4%)

than in 2013 (7%). Other details in the different rating of the students in both years are also worth further investigation, especially when data from more years becomes available in the future. On a technical note, in the future, it would be interesting to reconsider the effect of limiting the maximum number of answers to three in the question above, but leave them unlimited for other parts of the questionnaires.

Mandatory participation in a science project is in some instances an institutional policy. Overall 76% of the students carried out the science projects on a voluntary basis (Figure 15) and as we shall immediately see, they were mostly influenced by the teacher(s).

In comparing 2013 and 2014 data we observe a 7 percent-point increase this year in the number of students that participate in the fairs at school's request. The teacher's influence on this participation (see next paragraph) is curiously the same in both years, at 78%.

A series of factors may determine the **student participation in a fair**. Let us see which ones are

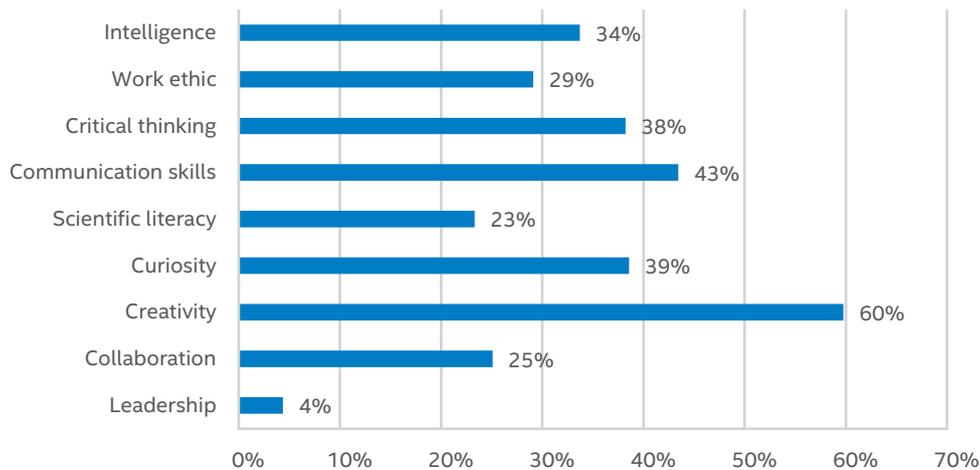


Figure 14: Most essential contributions to the project's success (students).

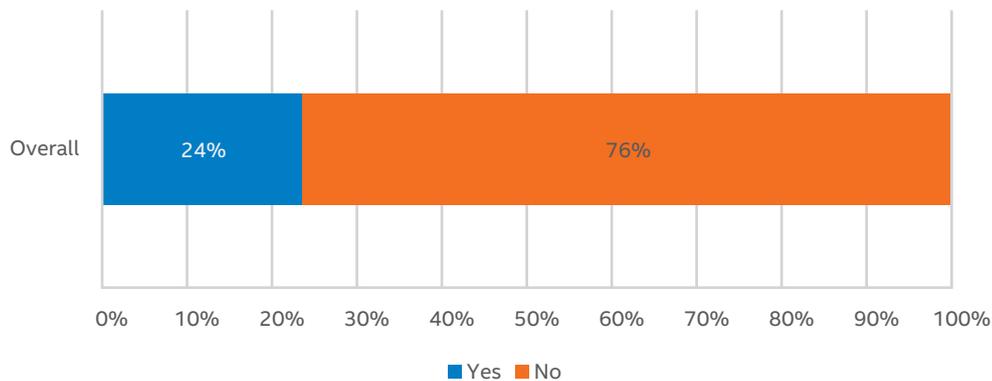


Figure 15: Is it compulsory in the school to do a science fair project (students)?

most significant. According to Figure 16, in addition to the influence of the teacher (which dominates at 78%), other factors that influence the participation of students in these projects are the opportunity to do something science-related that is different from what is done in school, and to attend a fair (both at 70%). A similar rating is given to the prestige or recognition from competing in the fair (73%), as well as the opportunity to support one's application to university (63%). The influence of friends participating in the fair ranks at about 36%. It is followed by parents' influence, which is indicated in 43% of the cases.

In comparing 2013 and 2014 data on the factors that influence students on the decision to compete in the science fair we observe a very similar rating and relative influence in both instances. But while the influence of the teachers is just the same, all other factors receive a few (or even several) percent-points lower rating in 2014, except for

the opportunity to participate in a national science fair, which increases slightly in 2014.

Regarding the **sustainability of the fairs** it is essential that the students feel satisfied with their participation. This was measured via two questions. Firstly, over 90% of the participants would recommend the experience of participating in a fair to a friend (Figure 17). Secondly, around 88% would certainly participate in a science fair event again in the future.

In spite of the large size differences between the two samples of participating students, the data for both items in the previous figure are almost identical for 2013 and 2014. This indicates a consistent and quite positive response by the students to the organization of the fairs. It might be interesting to analyse in the future the distribution of responses to the two previous items as a function of age and participation in more than one fair.

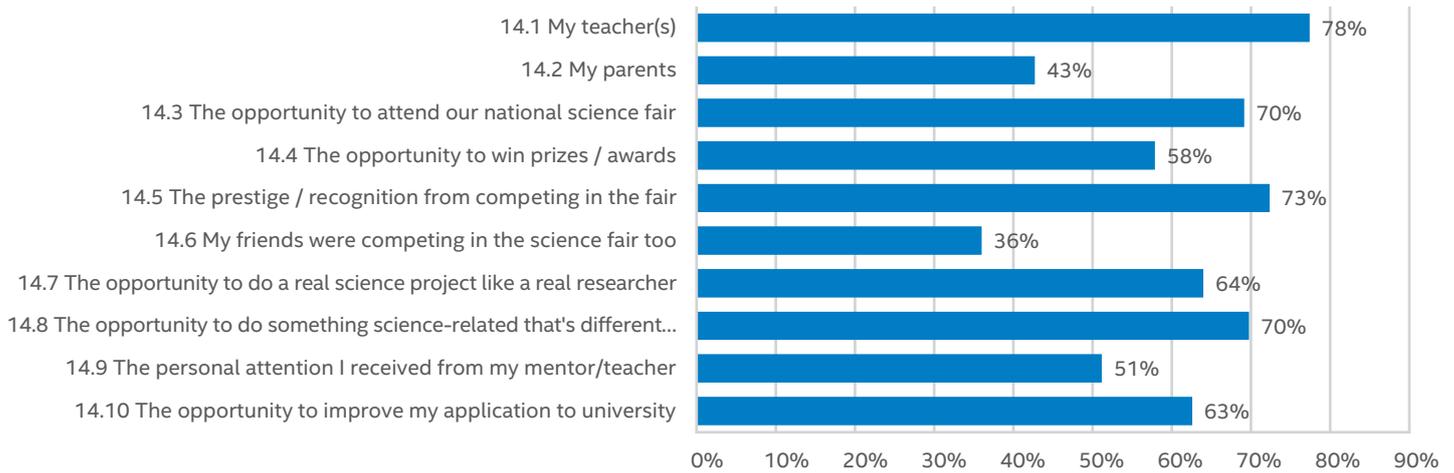


Figure 16: Factors influencing the decision to compete in the science fair (students).

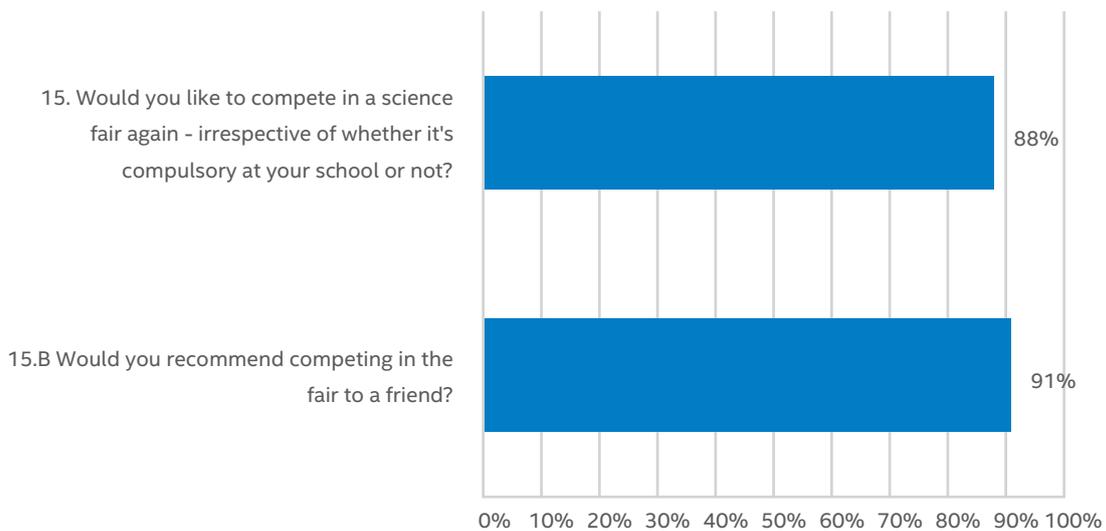


Figure 17: Willingness to repeat a science fair and recommend the experience (students).

**Conclusion: Average students' profile**

Taking into account the major characteristics indicated in the students' replies to the questionnaires, one finds the average picture depicted in Figure 18. This provides a simple visual tool which contains the average statistical profiles of participating students.

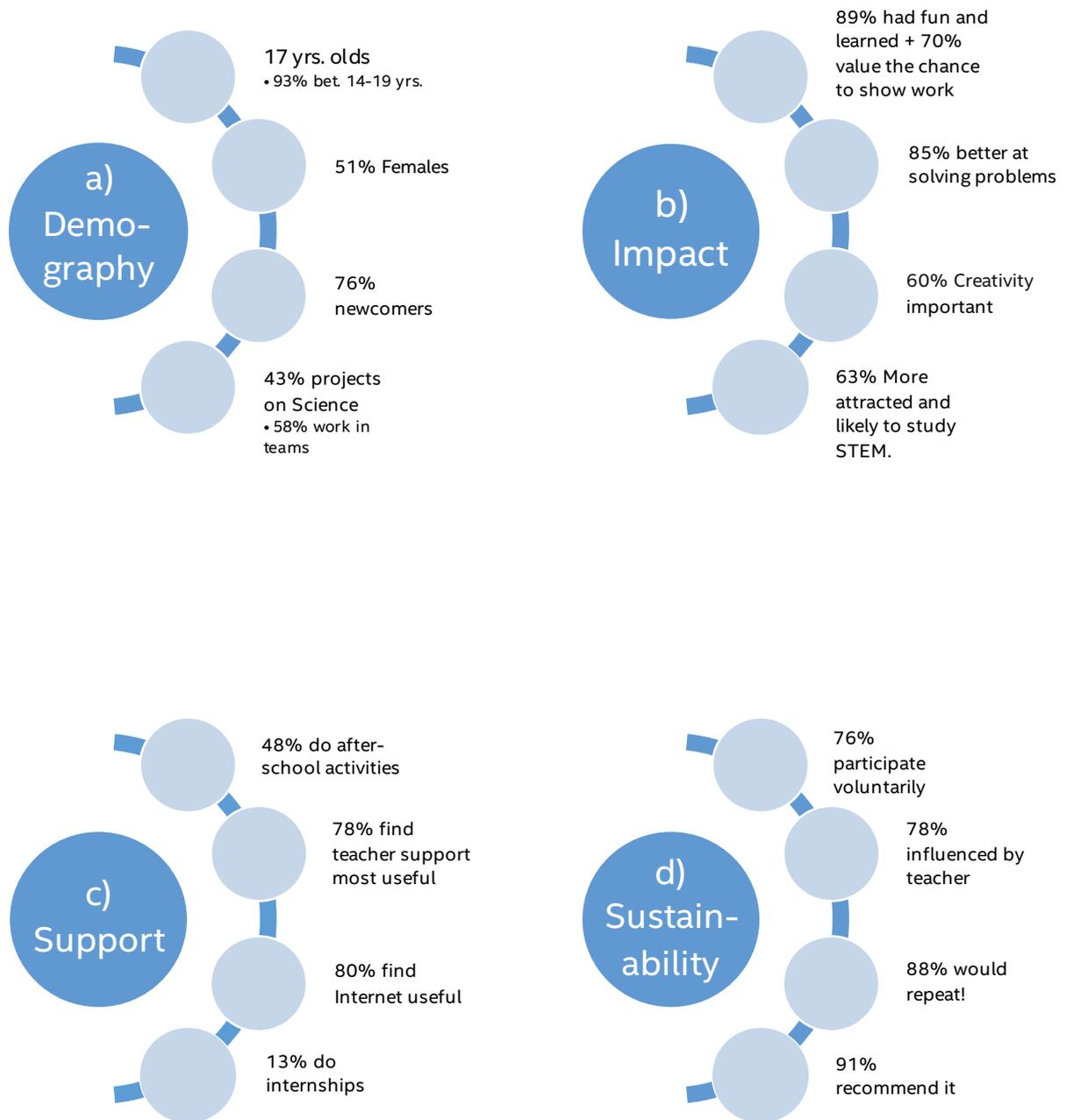


Figure 18: Average participant profile in terms of demography, impact, support and sustainability (students).

## Teachers' questionnaires

The analysis of the questionnaires filled in by the teachers participating in the ten science fairs that are reported on here shows the following results.

Starting with **demographic data**, female teachers predominate in the fairs (57% versus 43%), Figure 19. The teachers involved, in general have a long teaching experience, 11-20 years for 34% of them (Figure 20) and more than 20 years for 40%. About 10% have less than 5 years' teaching experience.

In comparing 2013 and 2014 data we observe an increase in the predominance of female teachers, from 8 percent-points in 2013 to 14 percent-points in 2014, and a small shift towards fewer years of experience as teachers. The percentage of teachers with less than 5 years of experience doubled from 2013 to 2014, but are still a minority at 10%. This increase is a good sign for the vitality of the fairs.

The next question informs about the **teachers' academic background**. The teachers hold the usual master's degree in about 73% of the cases, Figure 21. There is even a significant 10% of PhD holders.

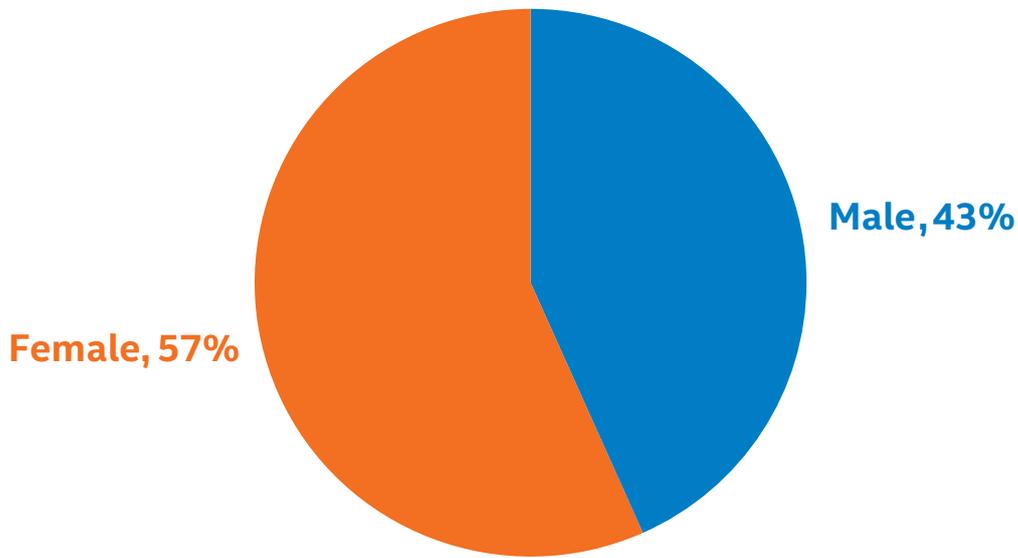


Figure 19: Gender split among participants (teachers).

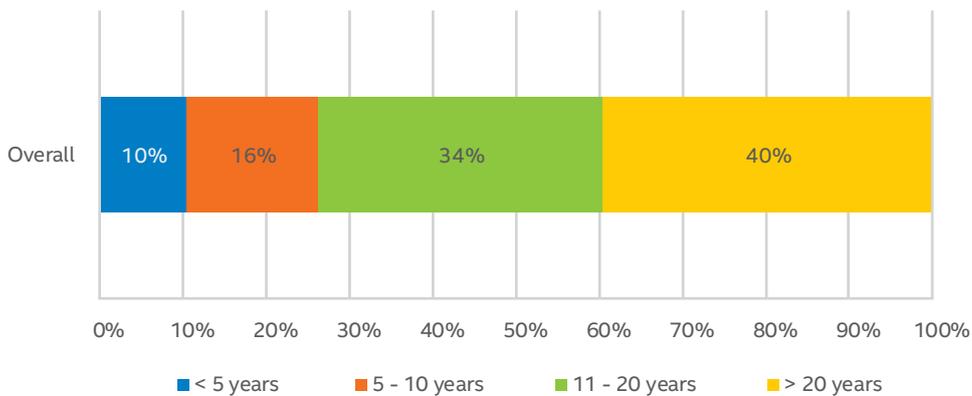


Figure 20: Years of teaching experience (teachers).

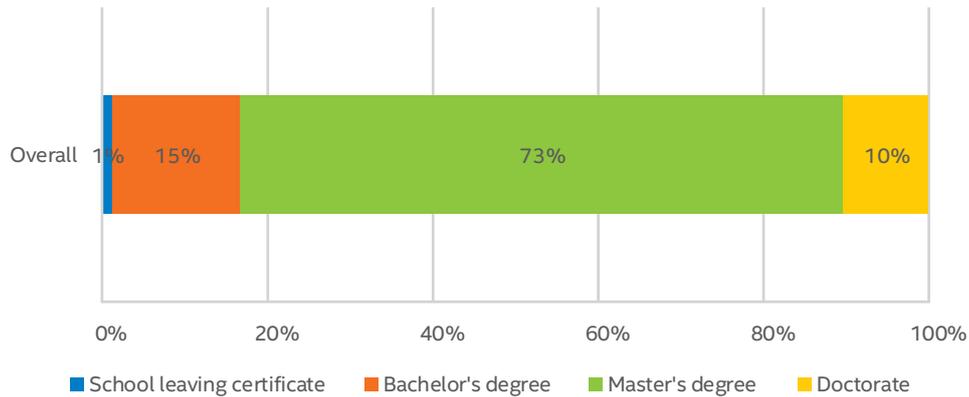


Figure 21: Highest degree held (teachers).

In comparing 2013 and 2014 data we observe similar numbers in all categories and a small increase over time of 2% in the number of PhD holders. This increase is a positive trend which should be checked again in the future, since teachers highly qualified in research will lead to an improvement in the quality of the fair projects.

Just 50% of the teachers are accompanying between 1 and 4 students, Figure 23, while a total of 75% bring between 1 and 10. A fifth of the teachers are bringing in more than 50 students. This last data seems like a large number, but the questionnaire does not allow us to discriminate how many teachers were accompanying the same students from a given school. On the other hand, as we saw in relation to Table 4 (and Table 5), the number of student and teachers respondents (and participants) for each fair fluctuates widely.

In the following three figures we shall see the **relation of the school and the accompanying teachers with the present and past fairs**. More than half of the participating teachers work in schools that have participated in more than three science fairs, Figure 22, and for about 21% of the schools this is their first fair.

In comparing 2013 and 2014 data we observe a small increase in the number of teachers accompanying between 1 and 4 students and, correspondingly, a small reduction of those accompanying between 11 and 50.

In comparing 2013 and 2014 data we observe in 2014 a 15 percent-point decrease in the number of schools that have participated more than 3 times in a fair and an increase of participating schools for the 1<sup>st</sup>, 2<sup>nd</sup> or 3<sup>rd</sup> time. This trend also reinforces the foundation of the fair program.

We see in Figure 24 that for more than 2/3 of the teachers this was not their first experience with a science fair.

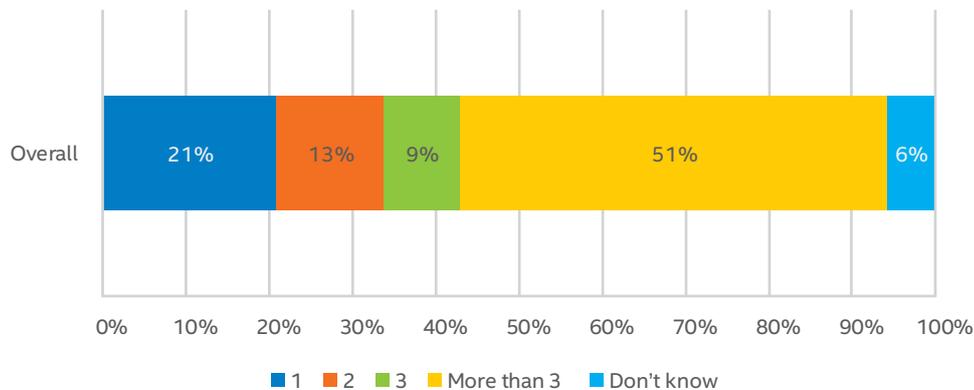


Figure 22: Number of school participations in the fair (teachers).

In comparing 2013 and 2014 data we observe a 10 percent-points increase in the number of teachers that participate for the first time in a fair, totalling about 1/3 of the whole sample this year. In 2013 first comers were less than 1/4 of the sample. This, again, is a promising trend.

if there is any connection to the teachers' regular classes. According to Figure 25 the largest group teach Science, at 42%, and there are similar numbers of teachers of Engineering (10%), Maths (8%) and Technology (7%). About a third of the teachers teach other areas, including computer science, social sciences and languages.

The participation in the Science Fairs can take place with **projects developed in various areas**, like science, technology, etc. Let us see how they are represented and

In comparing 2013 and 2014 data we observe an increase in the number of Science teachers (38 to 42%) and a more even distribution in 2014 among

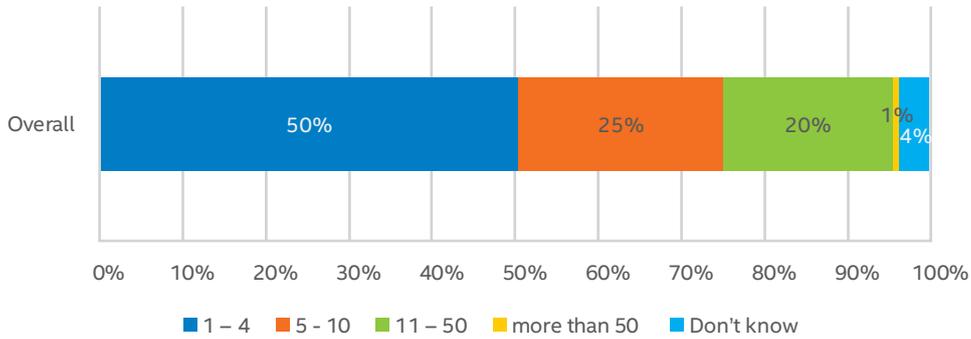


Figure 23: Number of students from their schools who are competing (teachers).

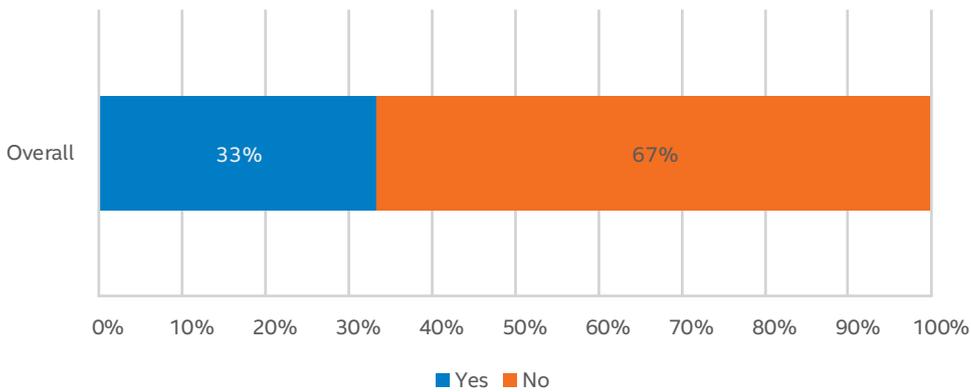


Figure 24: First time participants in fairs (Yes) versus repeat participants (No) (teachers).

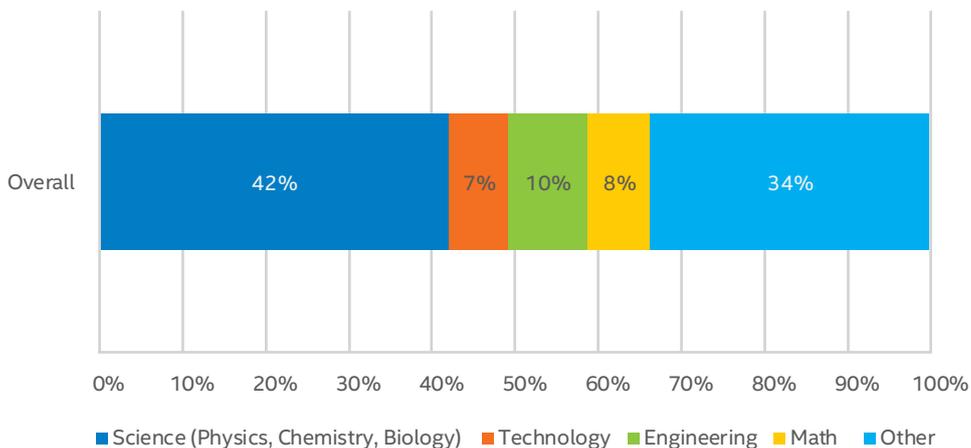


Figure 25: Main subject taught (teachers).

the number of teachers of Engineering, Technology and Maths. The fraction of teachers doing other subjects has also increased by 10 percentage points in 2014.

According to the accompanying teachers the ratio of Science to Technology or Engineering projects presented at the fair is about 4 : 1 (Figure 26) with Science projects accounting for a majority of the ones presented (40%). Maths projects are 4% and are underrepresented in relation to the areas taught (Figure 25). A 13% of the teachers are accompanying projects from a combination of the areas mentioned above and a significant 24% are presenting other kinds of projects, like social sciences and chemistry, computer science, ecology and environment, and even some social sciences.

In comparing 2013 and 2014 data we observe the same dominance of Science projects at about 40%, an increase in 2014 in the number of Maths projects, and larger fraction in 2014 of combined topics as well as "Other" topics. The relatively large presence of combined and other topics is something to look into in future years. It could be of interest to inquire about the cross-topic character of the projects.

In the next two questions the eventual existence of **after school activities** is explored, and also the influence of the school on the participating students. Almost half of the students participated in after-school activities, according to the teachers, Figure 27, while over 18% did not and in 20% of the cases these extracurricular options were not available in their schools.

In the 2014 data there is at least a 4 percent-point increase in the number of students participating in after-school activities in comparison to 2013. The fraction of teachers who could not respond to the question increased from 7% (2013) to 13% (2014). In both years in about the same fraction of cases (20%) there is no such a program available to the students.

Concerning teachers' participation and **direct schools' support**, it is compulsory for teachers in a given school to participate in a fair project in less than 1/4 of the cases and the school designates a coordinator in almost 2/3 of the cases, Figure 28.

In comparing 2013 and 2014 data we observe a significant increase in the number of schools where teachers are asked to participate in the fair: the increase is from 1% to 22%. In the future, it would be interesting to check whether this is a

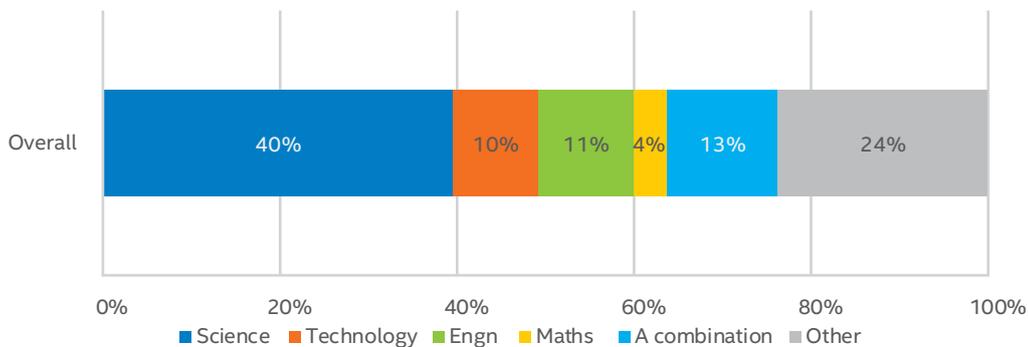


Figure 26: Main focus of the projects supervised (teachers).

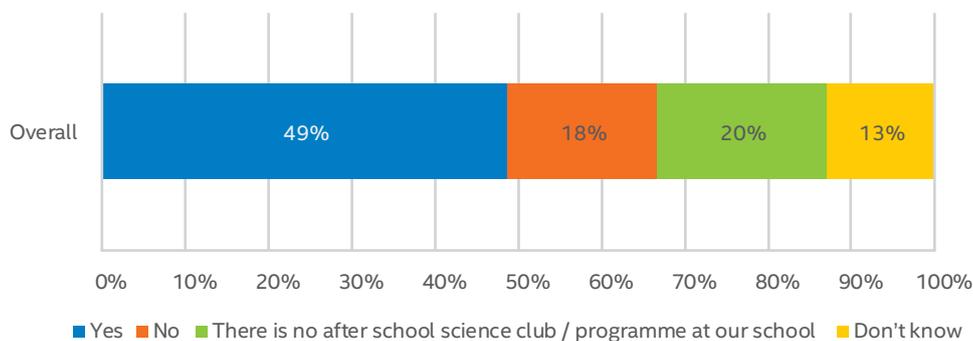


Figure 27: Schools where the students participated in after-school science clubs, etc. (teachers).

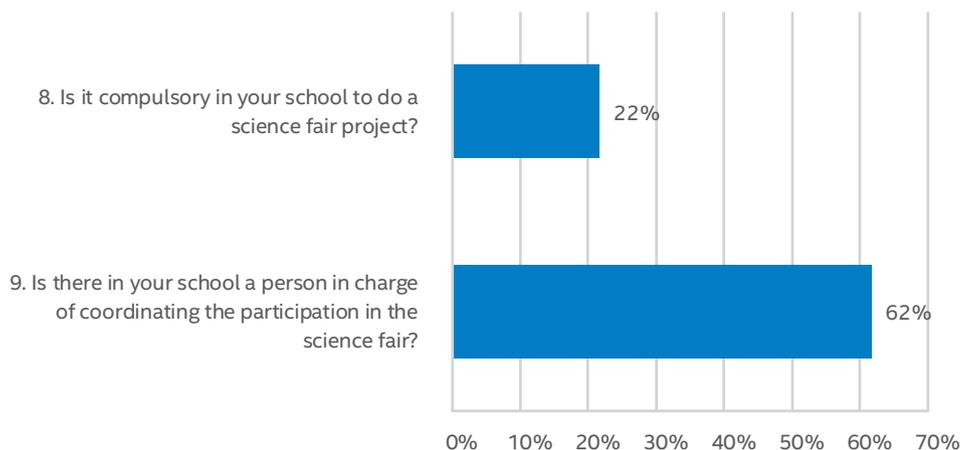


Figure 28: Schools where (top) it is compulsory to participate in science fairs and (bottom) there is a person in charge of the participation (teachers).

circumstantial fact or just a bias in 2014 from a particular population of teachers. On the other hand, there is a 4-percent point increase in the fraction of schools that name a fair coordination teacher (from 58 to 62%). This is a positive trend that reinforces the importance of the fairs for the schools. One might check, of course, if there is any correlation with the size of the students-teachers sample from a given school and the existence of a fair coordinator.

Teachers' extra tasks related to the fairs are somewhat diminished or made more profitable if they can find a connection of their regular teaching with the students' projects. There is a clear link between the national STEM curriculum and the contents of the fair projects in about 44% of the cases, Figure 29.

In comparing 2013 and 2014 data we observe a small increase (42 to 44%) in the number of teachers that find it straight forward to integrate the fair with the curricula. This is an encouraging trend (which has to be confirmed eventually in future evaluations) because, possibly, teachers find

it easier to get involved in extra-academic activities if the curriculum is a part of this additional effort. This assumption would have to be confirmed.

In the next two questions we explore the **teachers' reasons for participating in the fairs** and how this participation may impact them and their students. In Figure 30 we show the teachers' rating to 16 different items related to this eventual impact. All the items were rated at least over 58%, this value being for the impact of the fair on the way they teach.

Specifically, according to Figure 30 for between 85% and 90% of the teachers consider that they themselves and their students learnt a lot from participating, and that the students know more afterwards about the scientific method. On the other hand, for about 74% to 81% of them, participation in the fair has had a big impact on their students' interest in science and improved important skills (like team work and science communication). Participating in the fair has encouraged students to pursue excellence in STEM, and has promoted scientific inquiry in their schools in almost 3/4 of the cases. Moreover, for about 53 to 60%,



Figure 29: It was easy to integrate the competition with the curricula (teachers).

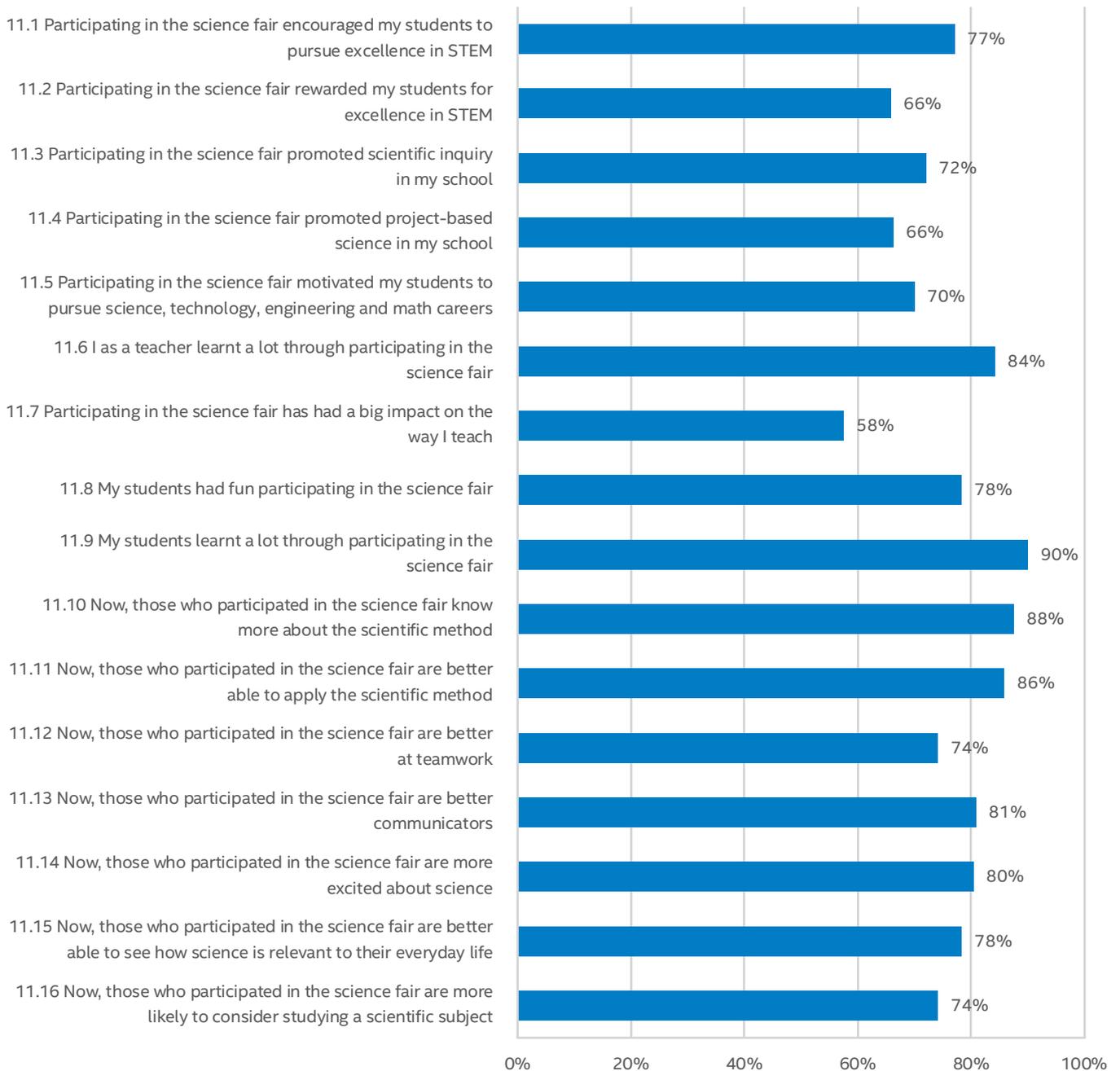


Figure 30: Impact of participating in the science fairs on both teachers and students (teachers).

participation in the fair has had a big impact on the way they teach and rewarded their students for excellence in STEM.

In comparing 2013 and 2014 data we observe a similar importance attributed to all of the points in Figure 30, with some changes in the detailed rating of each item. For the most valued aspects mentioned in the paragraph above (teachers and students learning a lot, students knowing more about the scientific method, a big impact on their students' interest in science and improved important skills) the 2013 teachers rated them greatest also and even with a few percent-point more than 2014 teachers. On

the contrary, 2014 teachers gave higher marks than 2013 teachers to the fact that participating in the fair rewarded the students for Excellency in STEM (53% in 2013 jumps to 66%), and participating in the science fair promoted inquiry in their school (62% in 2013 jumps to 72% in 2014). Together with the overall data, these two last examples are of significance, given the objectives and the character of the fairs. Various other comparative considerations are possible in view of the large amount of data available in the previous figure. Maybe, in the future, the contents of the previous question could be separated according to the actors involved in the analysis.

The **advantages of taking part in a science fair** in comparison with regular science classes are, for the teachers, that they interact with their students differently (63%) and students are more motivated (66%), and it is a good opportunity to engage with the out-of-school world (63%), Figure 31. On the other hand, it is a good opportunity for collaboration across school years for 1/3 of them, and students start behaving like real scientists for 37% of the teachers.

In comparing 2013 and 2014 data we observe a very similar distribution of the ratings among all of the points in Figure 31, but with differences in detail. So, 2013 teachers stress more the opportunity to

interact differently with their students (74% in 2013 versus 63% in 2014), but value less the opportunity for collaboration across school years (23% in 2013 versus 34% in 2014) and the fact that students become the leaders of their own learning (43% in 2013 versus 52% in 2014).

In developing the project both teachers and students may encounter various kinds of **difficulties**. First we ask about the teachers' difficulties in providing assistance to the participating students. The main problems are finding funding (51%) and getting experts and materials (about 45%), Figure 32, but supervising students in projects outside their areas of expertise or getting

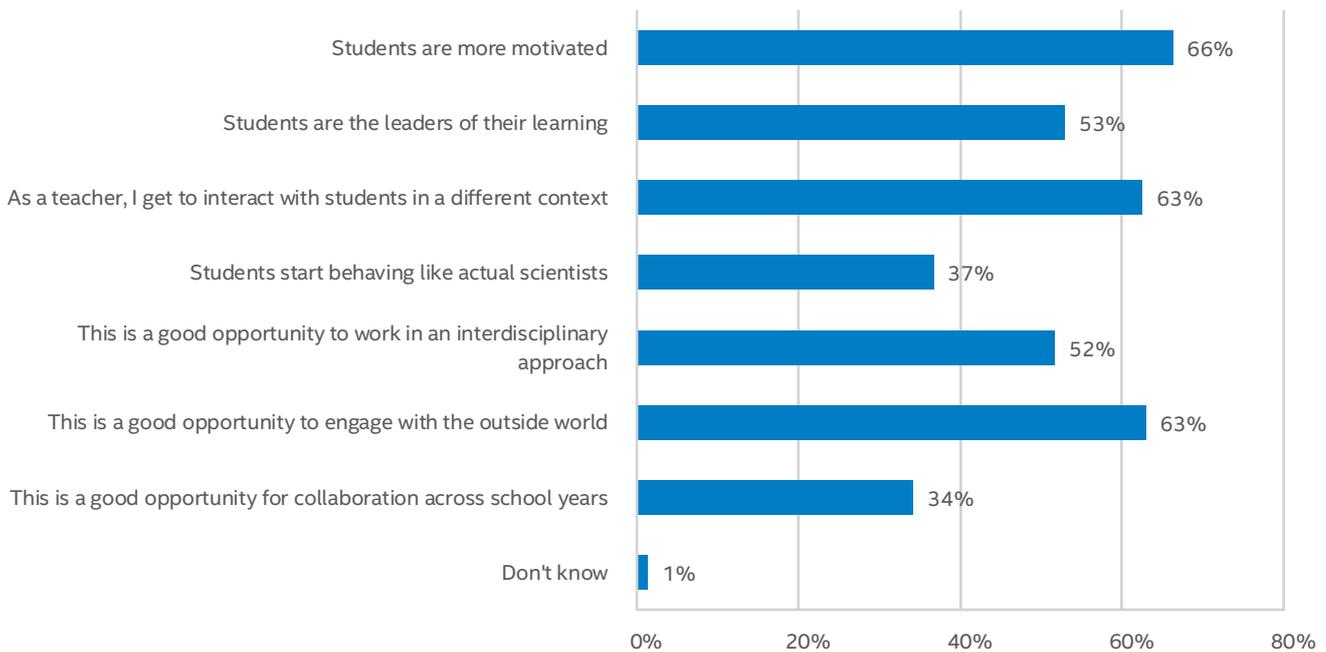


Figure 31: Advantages of doing a science fair project over a regular science class (teachers).

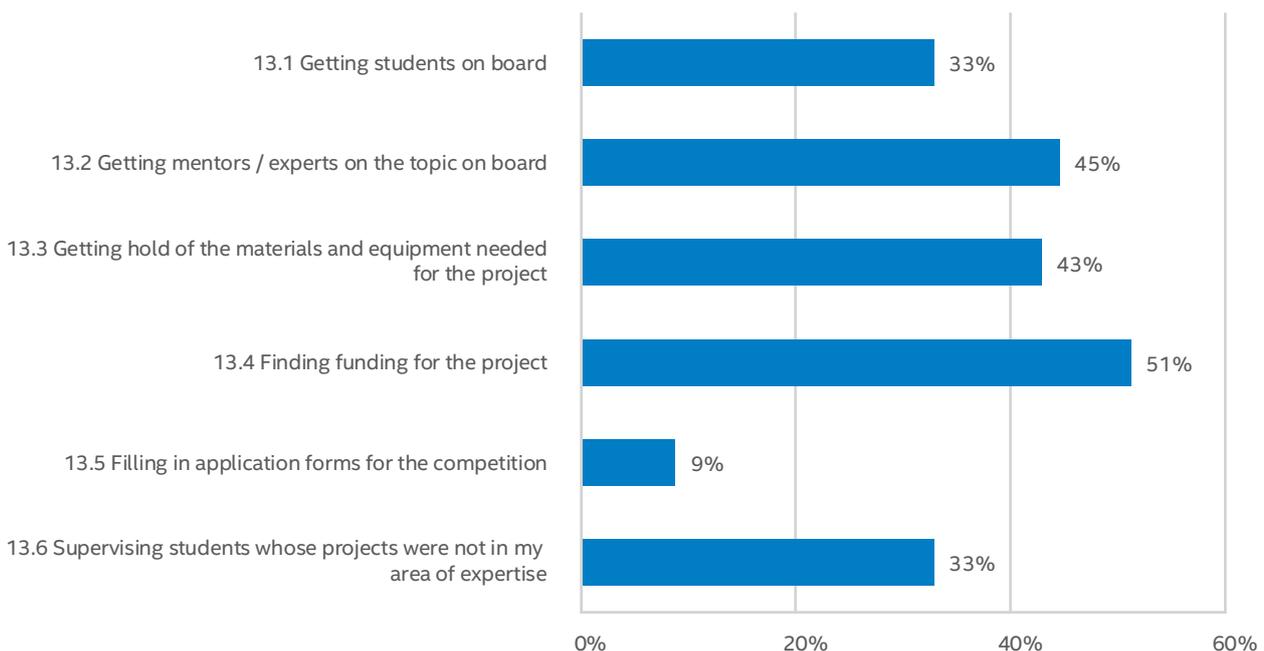


Figure 32: Difficulties encountered in preparing a project and in participating in the fair (teachers).

students on board is a problem for just a third of the teachers. About 9% of the teachers find difficulties in filling in application forms for the competition.

Major shifts in the data occur between 2013 and 2014 concerning project difficulties. Most items are mentioned by 2014 at lower levels than in 2013, except for the difficulty in filling in the competition forms: a jump from 4% to 9% is observed. This may be due to the more varied teaching areas of the accompanying teachers which was apparent in Figure 25. On the other hand, a quite significant reduction of 25 percent-points is observed in the difficulties of getting student on board. 2014 teachers do not find this hard (33%), in comparison to 2013 teachers (58%). This is a good trend, especially when one compares this with the fact that 2014 more students are newcomers or have limited experience in fairs in 2014, in comparison to 2013 (see Figure 3).

The teachers also gave their opinion about what **difficulties the students met** in preparing the projects for the fair. In their opinion, Figure 33, on top of the same two items mentioned in the previous figure (finding funding and the materials for the project, both at about 48%), teachers add the difficulty for students to apply the scientific method and to analyse the data (at about 45%). The least difficulty lays in filling in the form to participate in the event (difficult for about 15%), followed by the difficulty for students to communicate their projects clearly (30%).

In comparing 2013 and 2014 data we observe a significant decrease in the difficulties that students encounter in all items, both practical

(materials and equipment) and methodological (applying the scientific method), according to the teachers (Figure 33). The reduction ranges from 6 to 12 percent-points. A 10 percent-point reduction is observed also in 2014 in the difficulty in displaying and communicating the project. Only the students' difficulty in filling in application forms for the fair sees an increase from 8% (2013) to 15% (in 2014). This last effect is also observed in the teachers, Figure 32, and deserves further investigation.

In developing a project, the teachers and the students receive **support** from various sources, as we shall see in the next two questions. Concerning support for participation in the fair, the school provides support for more than 70% of the teachers, Figure 34, with help from colleagues, parents and experts coming second at about 58 to 66%. Universities rank next at 41%. Least relative support comes from local authorities, local media, the Intel team or even the national Ministry of Education (all of them in the 10-22% range).

In comparing 2013 and 2014 data we observe the same level of support from senior management in their schools (at 71%) and several percent-points increase in support from colleagues, parents and experts. The support from the Intel team is also 3-percent points higher in 2014 but support from the national Ministry of Education is mentioned by 10% of the teachers in 2014, down from 17% in 2013. As we remarked in last year's report in the analysis of the 2013 fairs, the apparent small involvement of Ministries of Education and other local authorities is something to focus on for future fairs.

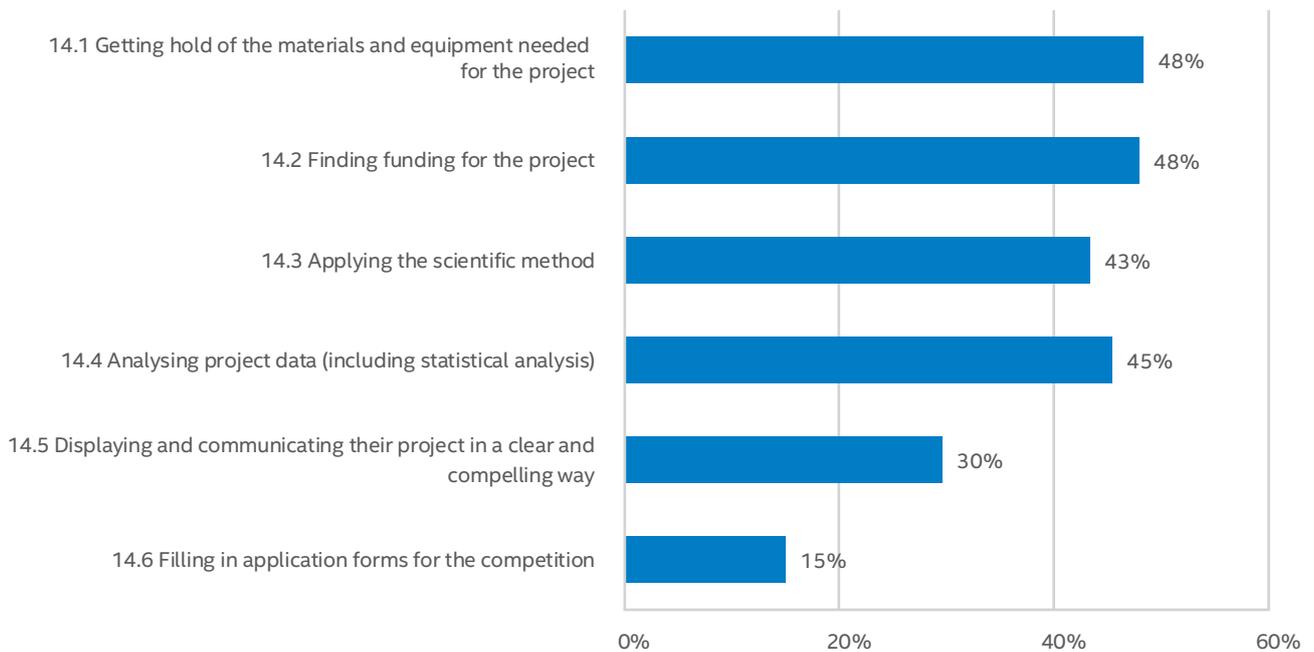


Figure 33: Difficulties students found in activities in carrying out a project and participating in a fair (teachers).

As regards the usefulness of the support, mentors or science experts as well as colleagues and (mainly) the school management were considered to be the most effective, within 43 to 50%, Figure 35. Parents come next, at 29%. The importance of other sources for support of the students' projects is below 5%.

The data in 2013 and 2014 show quite similar overall trends. Significant specific differences are the 9 percent-point reduction in the support mentioned from senior school management (59% in 2013 to 50% in 2014) and the 15-percent points increase in support from colleagues (up to 45% in 2014). The

importance of the support from the Intel team also more than doubles in 2014. Interestingly enough, the ratings drop significantly when the teachers compare the support they get with their relevance for the project. All in all, in comparing the last two figures, as well as Figure 12 where students express their views on the usefulness of the support received, one may tentatively conclude that students and teachers do basically work hard and together towards the projects, and the external support they may get is considered by both actors of significant but secondary relevance to the success of the project.

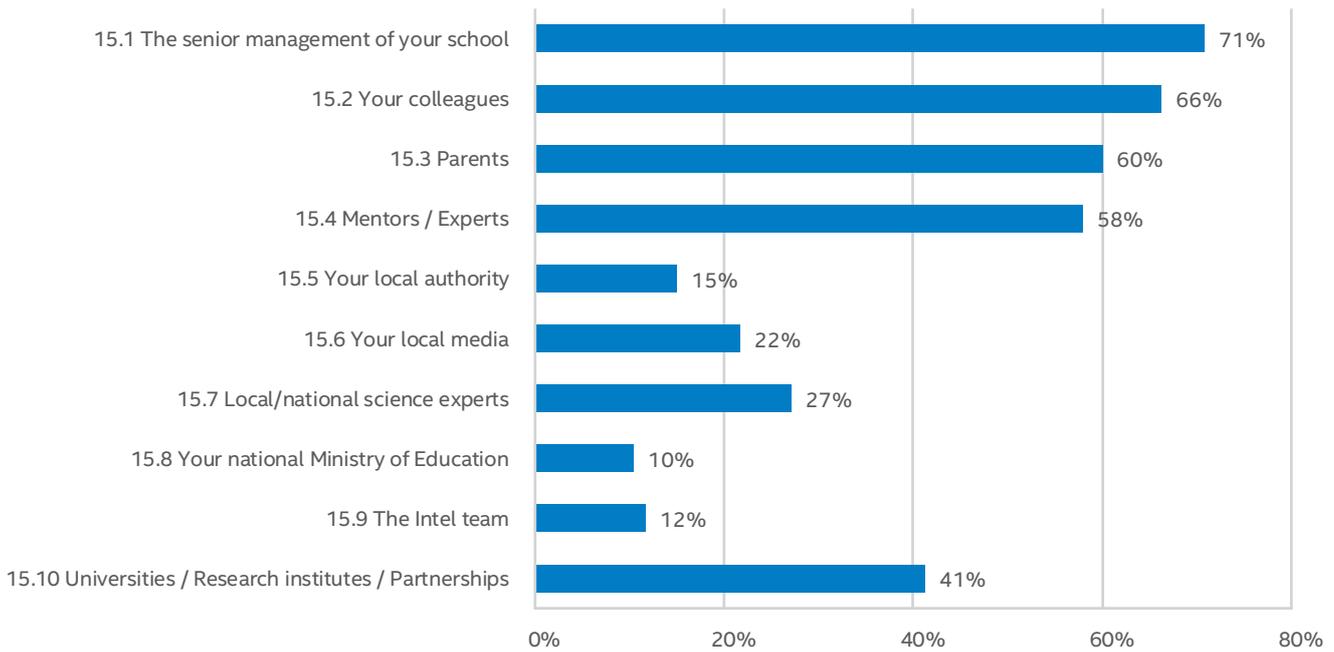


Figure 34: Support obtained from different people or organizations (teachers).

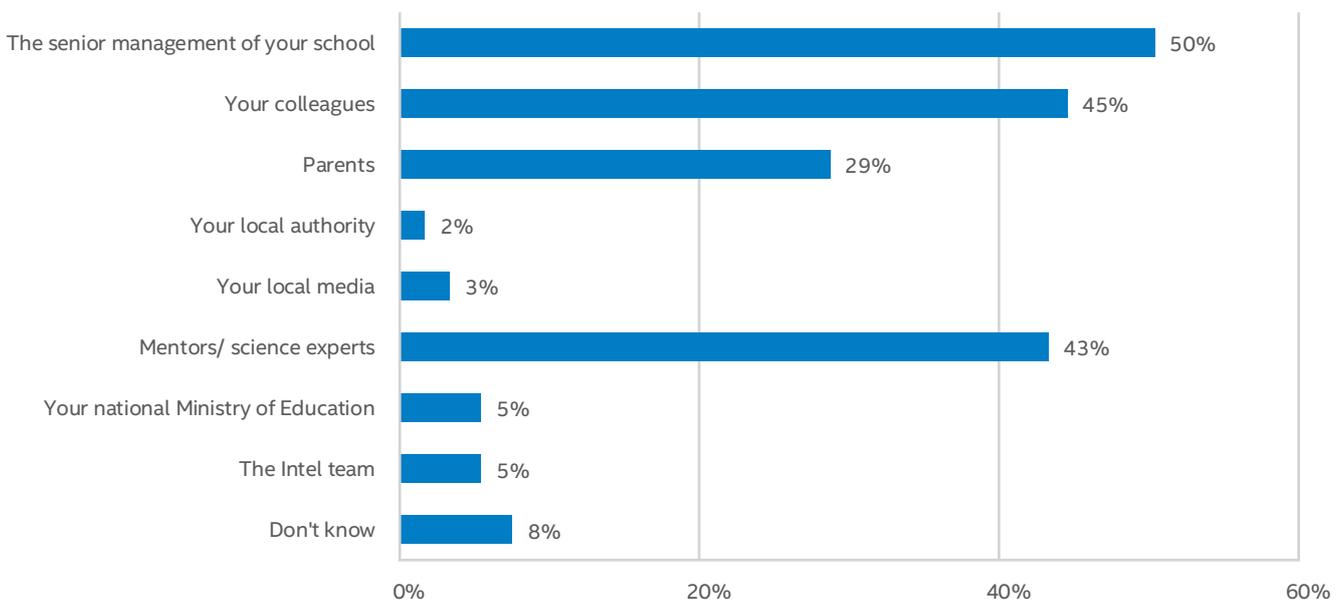


Figure 35: Organizations or people that were instrumental to carrying out the students' projects (teachers).

Similar to the students', the teachers' questionnaire looked into the **personal traits** of the participating students that, in the opinion of the accompanying teachers, contributed most to the success of the project undertaken. Teachers mention outstandingly creativity as the foremost trait (57%), Figure 36, all the other following well below: communication skills, curiosity and critical thinking (42-44%). Intelligence is only mentioned in 33% of the cases, below scientific literacy (35%). Factors like collaboration, and work ethic are considered of less importance, as they are selected in about 1/4 of the answers. Leadership is only considered by 4% of the teachers.

above, with the same winning trait (creativity) at the same percentage level (57 to 58%). However there are significant differences in the details. Communication skills and intelligence fall from 53% and 48%, respectively, in 2013 to 44% and 33% in 2014, i.e., a good 9 to 15 percent-points. On the contrary, curiosity and scientific literacy gain more than 10 percent-points in 2014. Leadership was absent in 2013 and gets a small 4% recognition in 2014.

In comparing 2013 and 2014 data we observe a similar relative importance attributed to the items

It is important to know the **reasons why teachers make the commitment** to orient and even help students to participate in the fair. According to the data in Figure 37 "My students" stands out at 91%, and second and

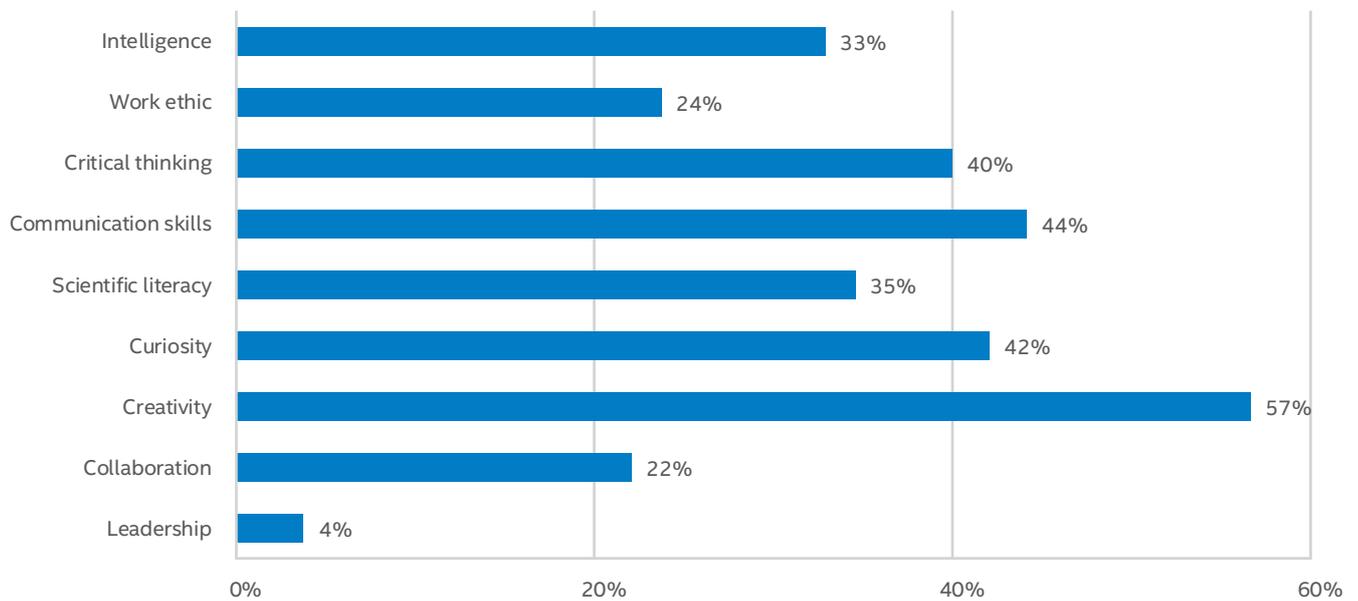


Figure 36: Essential issues contributing to the success of students' science fair projects (teachers).

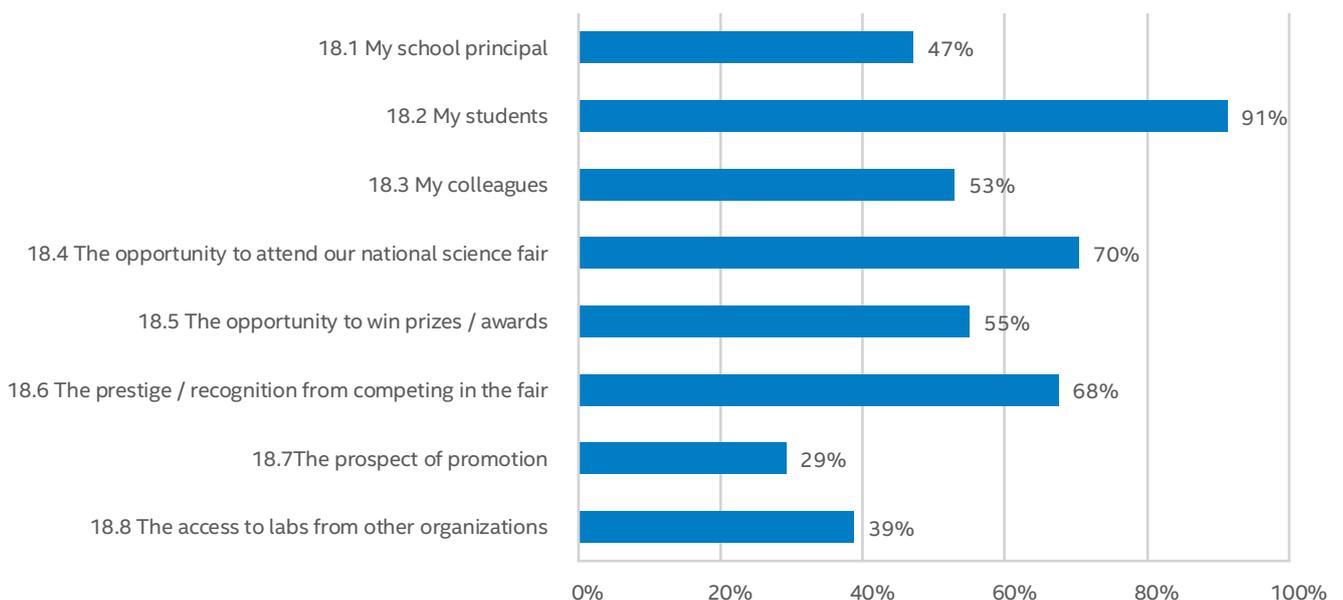


Figure 37: Factors or people that influenced the decision to lead participants in the fair and made the task easier (teachers).

third reasons are the opportunity to attend a fair (70%) and the prestige that comes from the competition (68%). Least importance but still significant at 29% is attributed to the prospect of promotion followed by the access to labs from other organizations (39%).

In comparing 2013 and 2014 data we observe major similarity in the relative importance of various issues that influence the teacher's decision to lead a project. There is agreement in the outstanding reason attributed "the teachers' students" (above 90% in both years), and the same percentage is attributed to the opportunity to participate in a fair (70% in both cases). The associated prestige was rated 74% in 2013 and 68% in 2014. Again, there is coincidence in the low rating associated to the prospect of promotion (29% in both cases).

The following question explores the **use of active teaching methodologies** in the classroom both prior and after the fairs. Regarding the extent to which science fairs contribute towards extending the use of Inquiry-Based Science and Mathematics Education (IBSME), as Figure 38 shows, participation in science fairs results in a 7 percentage-points increase in the use of inquiry-based teaching. A large 48% of the

teachers already use IBSME in their classes before attending the fair.

In comparing 2013 and 2014 data we observe the same 7 percent-points increase in the fraction of teachers that use IBSME in their teaching. But a major difference of 20 percent-points exists in the pre-event use of this methodology. In 2013 only 28% of the teachers did use it before their participation in the Science fairs. Since promoting the use of active teaching and learning methodologies in science education is a major objective of the fairs, it will be interesting to observe in future fairs whether the data on the pre-event use of IBSME is closer to the 2013 or to the 2014 figures.

Long term sustainability of the fair rests in a good part on the shoulders of the teachers. It is a positive experience for almost all the teachers to supervise students' projects for the fair competition: 91% of them would do it again in the future, Figure 39.

Although the 2013 data was high at 86%, there is a 5 percent-points increase in 2014 in the teachers' attitude towards supervising a science project again in the future. This is obviously a positive trend.

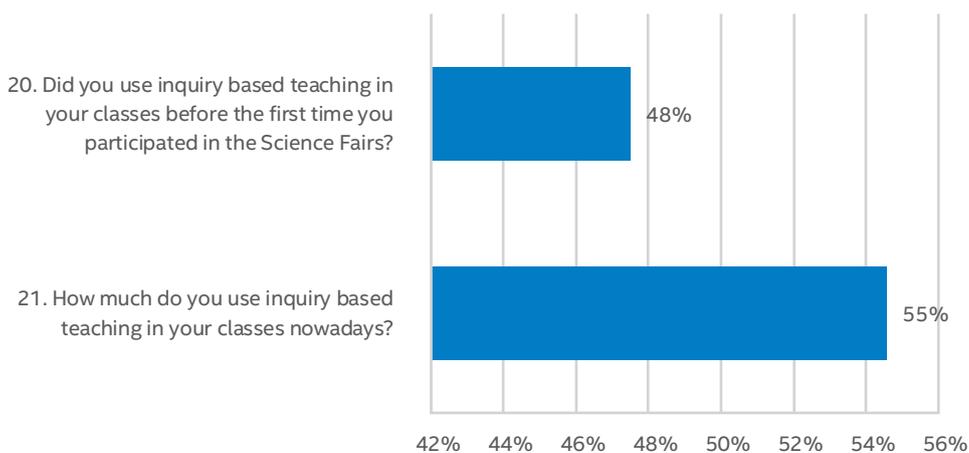


Figure 38: Use of IBSME before the science fair and afterwards (teachers).

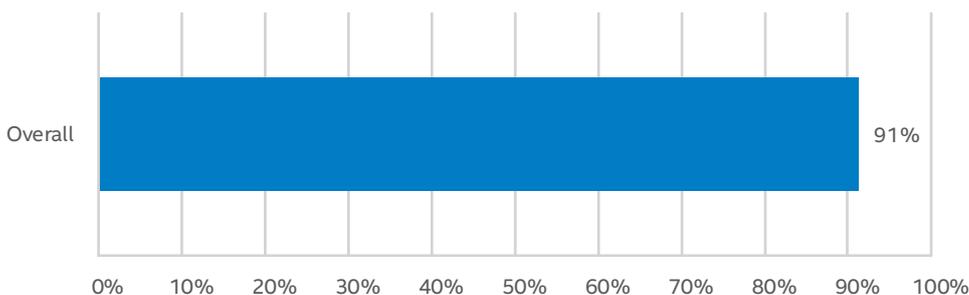


Figure 39: Would you supervise a project for a science fair again (teachers)?

**Conclusion: Average teachers' profile**

Taking into account only the major characteristics indicated in the teachers' replies to the questionnaires, one finds the average picture depicted in Figure 40. It may be instructive for the reader to compare, even at a glance, the average teachers' profile with the average students' profile in Figure 18.

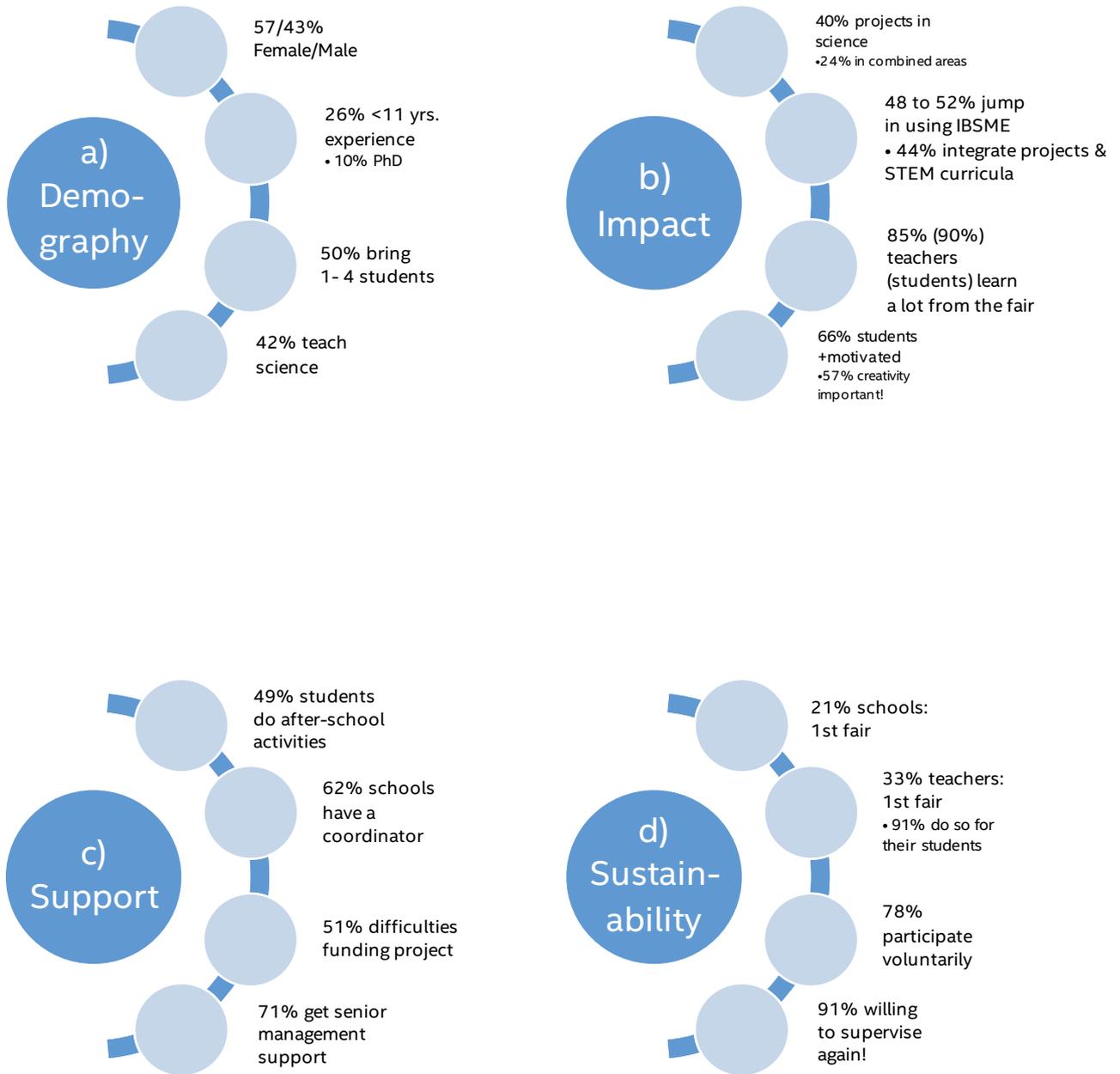


Figure 40: Average participant profile in terms of demography, impact, support and sustainability (teachers)

## Sample data comparisons

In the next section we shall analyse and summarise the data obtained directly from the students' and teachers' questionnaires that we have presented separately above. However, before that, it is interesting to extract some further information from this data. We shall provide some comparisons between the responses of two different age groups to a set of questions on their future careers, and also between the answers to some questions where gender may have an influence. We shall not exhaust the possible interpretation afforded by the detailed data available from the fairs, but will provide a few examples to show this potential.

### Age groups

First let us consider the students' age distribution. It may make sense to compare data arising from two different age groups: 14-16 and 17-19, which correspond roughly to middle school and (upper) high school students. More importantly for our purposes, the first group typically comprise students who are worrying about future career options, whereas many students in the second group have already decided about their post high-school studies. We wish to check whether any difference is borne out by the data. The analysis has to be taken *cum grano salis* because there may be significant differences in the education system of the countries those students belong to.

A further element that led us to consider these two groups of students are the contents of the following couple of graphs. We have copied in Figure 41 the students' age distribution from Figure 1: Age of respondents (students). and we show it together with the separate age distribution for the ten countries participating in the fairs that we have evaluated in this report. Since we are not doing comparisons between countries we do not show the country of origin for each curve in the graph. In this "spectral analysis" we see that the distributions have quite different average values for some countries, and that there are distinct contributors to the age peaks appearing in the overall graph. So, although the peak at 15 yrs. is mainly due to one population, there are significant contributions to it from others. The peaks between 17 and 19 yrs. are due to the sum of several causes. In the comments below one should keep in mind that the 14-16 population is about 28% of the students' sample, but the 17-19 comprises 66% of the students.

Based on the separation of students in the two age groups mentioned above (14-16 & 17-19) we have considered the following research question:

- Does participation in a fair affect more one age group than the other?

We could easily answer similar research questions for any of the items included in the students' or teachers' questionnaire. As an example and for the sake of the extent of this report, we shall apply the research

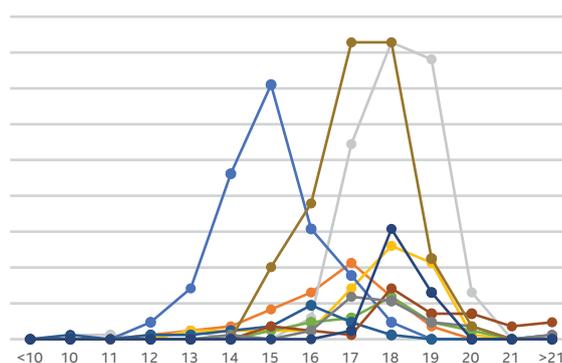
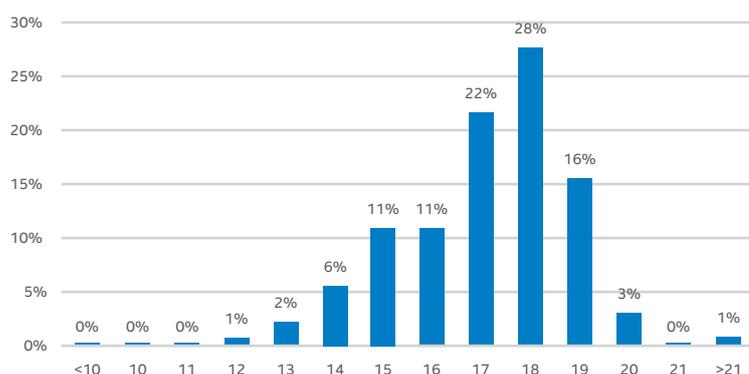


Figure 41: Age distribution of participants and spectral analysis by country (countries not shown) (students).

question only to the following subset of question 8: items 8.8, 8.9 8.10 and 8.11 in Figure 9: Agreement with different statements on the impact of the fair (students).. Specifically the questionnaire demands:

*To what extent do you agree or disagree with each of the following statements?*

And the items selected for a detailed analysis are:

*Now, I am more excited about science.*

*Now, I can see better how science is relevant to my everyday life.*

*Now, I am more likely to consider studying a scientific subject.*

*Now, I am more attracted to the prospect of a scientific career.*

These items refer to the eventual increase in the students' regard of science both in abstract and in connection to daily life, as well as science as a possible personal career for them.

The resulting data is shown Table 6: The "Population" is the total percentage of students aged 14 to 19 who marked those items relative to the total of students in all the fairs. The "Overall average" has been extracted from Figure 9: Agreement with different statements on the impact of the fair (students), and corresponds to the whole sample of students. In Table 6 we have calculated the percentage of agreement to each statement according to the responses in each age group. (The normalization has been done with respect to the population of the combined groups, not with respect to the total sample of students in this report. Therefore, the Overall averages and the averages per age group cannot be compared directly).

The results of this exercise, shown in Table 6, indicate that the results for the four items considered are quite similar. In all four cases the combined population of these two age groups is about 93% of the total number of students included in this report. Furthermore, there is about a factor of 2.5 or more difference between the number of responses of the elder students (17-19 yrs.) and the younger ones (14-16 yrs.). The fact that the impact of the fair is so

positive for more than 70% of the older students who are closer to choosing a career is welcome, as this impact in terms of attitudes and perspectives about science is a major goal of the fairs. We see that for almost 30% of the younger group of students there is also an impact. This probably opens the path for further engagement with science if the student keeps being involved in extra-curricular activities like the science fairs.

### Gender analysis

Data on gender studies of science classes has been a relevant source of information to suggest actions towards the goal of achieving gender parity or at least gender equity in science. The distribution of responding students by gender for the ten countries is shown in Figure 42. (Again, the countries are not shown). The top line represents the Overall average. We see that although the overall average for female to male students is roughly 50/50 (see also Figure 2: Gender split among the respondents (students).) there are significant differences among the countries, with only one having a close to 50/50 sample. The largest ratio of females to males is 3.8, and the smallest one is 0.43.

Similar conclusions can be extracted from the teachers' gender data, Figure 43. The bottom line represents the Overall average. With an overall ratio of females to males of 1.3, only one country achieves 50/50 parity, and it is a different country than in the students' data. The largest ratio of females to males is 4.6, larger than in the students' sample, and the smallest one is 0.16, much smaller than in the students' data.

Of course, the figures above only represent the populations of students and teachers answering the fairs questionnaires, and may not reflect the situations in the respective schools where they come from.

Another research question was motivated by the quite uneven distribution of ratings the students gave to the question # 9 on the impact of the fairs on the students, namely:

- *In your opinion, what are the advantages of doing a science fair project?*

**TABLE 6: PERCENTAGE OF AGREEMENT WITH THE STATEMENT PER AGE GROUP, POPULATION AND OVERALL ANSWERS (STUDENTS).**

	14-16 (%)	17-19 (%)	POPULATION (%)	OVERALL AVERAGE (%)
Now, I am more excited about science	29	71	93.2	75
Now, I can see better how science is relevant to my everyday life	29	71	92.0	77
Now, I am more likely to consider studying a scientific subject	28	72	93.0	62
Now, I am more attracted to the prospect of a scientific career	27	73	93.3	64

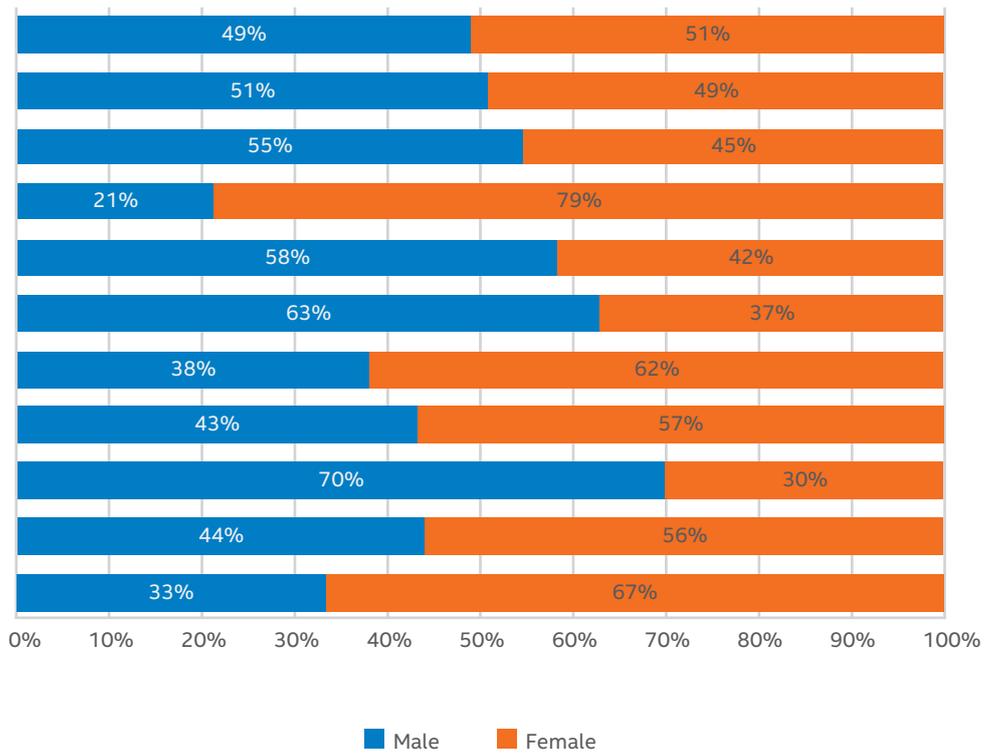


Figure 42: Gender of participating students, discriminated by country of origin (students).

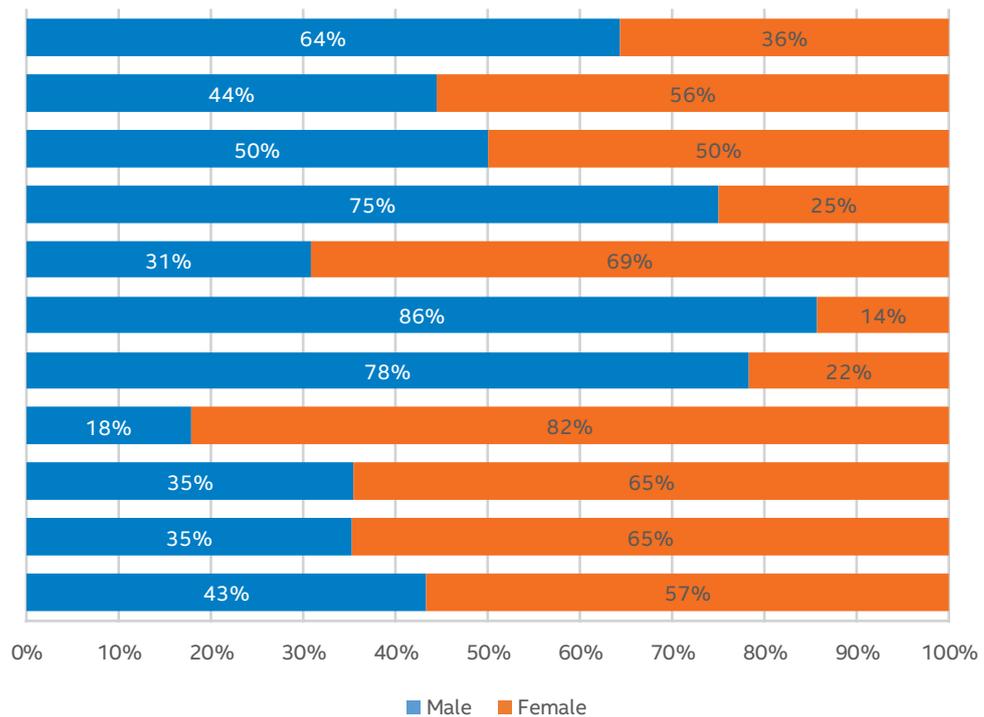


Figure 43: Gender of participating teachers, discriminated by country of origin (teachers).

The overall results were shown in Figure 10: Advantages of doing a science fair project (students).. We reproduce them here in the second column of Table 7 for ease of reference. We also provide absolute numbers of female responses, in order to provide some perspective and allow for comparisons in absolute terms. Items that have received significantly more ratings from females than

from males have been marked with an asterisk. Several conclusions are apparent. There are no gender differences in items like *You get the chance to show your work to the outside world*. Males rate 6% more than females the fact that *You have a project of your own*, but about 20% more items like *You are the one in charge*, *Mistakes are allowed*, and *No marks are involved*. Females rate between

10 and 17% more than males the following items: *You feel like a real scientist working on a real project, You get to work with teachers from various subjects, You get to work with people from out of school e.g. experts, students, etc., and You are part of a mixed group of students from various classes and levels.* Superficially one would conclude that males favour those items where they are in charge and work without pressure and independently, whereas females tend to favour those items that suggest collaboration, interaction and openness to the world. However, one should note that there was almost perfect gender parity in the students' sample and that, on the other hand, students could choose more than one option. Therefore the contents in the three columns in Table 7 should be taken into account in order to extract more accurate conclusions from the data, especially in terms of absolute numbers of students marking some option.

The target of gender equity in science classes is quite important to achieve, and one needs information about the current situation in the schools in order to produce proactive actions. We may extract some data on eventual gender-biased approaches to science projects in the fairs. When the data in Figure 4 on the major focus of the projects (students) are discriminated by gender, we find that females favour science topics over technology or engineering topics by a factor of about 7 - 9 to 1 (see Figure 44) whereas males only do 33% more scientific than technological projects, and the same amount more

technological than engineering projects. The proportion of Math projects and other kinds of projects are similar for both genders. (Note that the gender-discriminated data in the graph reflects the absolute contributions to the overall percent sum: the percentage of Science projects, for instance, 43% = 16% (M) + 27% (F)).

In comparing 2013 and 2014 data we observe the same trends, somewhat evened out this year: the ratio of science to technology or engineering topics for females was 10 to 1 last year (8 to 1 in 2014), and for males the ratio of science to technology was 1.7 (1.3 in 2014) and from technology to engineering was 1.5 (also 1.3 in 2014).

On the other hand, there is a small gender bias in the percentage of team versus individual work in the fair projects. As we see in Figure 45, male students tend to work in teams about 10% more often than females.

No gender-discriminated data is available in the 2013 report on the distribution between individual and team work in the fair projects. It would be interesting to check in future fairs whether a higher proportion of females than males do consistently work individually. This point would deserve further analysis.

When the data on the most essential contributions to the project's success according to the students

**TABLE 7: ADVANTAGES OF DOING A SCIENCE FAIR PROJECT (STUDENTS).**

	OVERALL	FEMALES / MALES	# FEMALES SELECTING IT
You have a project of your own	66%	0.94	270
You are the one in charge	35%	0.83	134
You feel like a real scientist working on a real project*	43%	1.11	193
You get the chance to show your work to the outside world	70%	1.02	298
Mistakes are allowed	18%	0.84	70
You get to work with teachers from various subjects*	23%	1.15	102
No marks are involved	13%	0.82	50
You get to work with people from out of school e.g. experts, students, etc. *	54%	1.17	246
You are part of a mixed group of students from various classes and levels*	19%	1.10	85

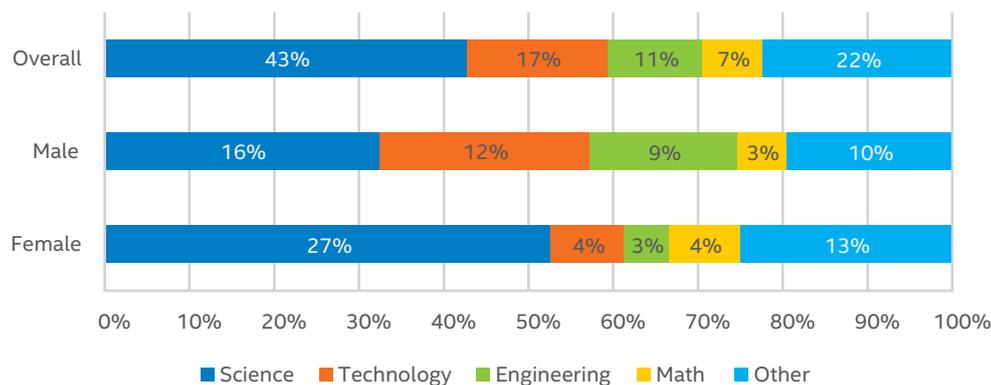


Figure 44: Major focus of the projects depending on gender (students).

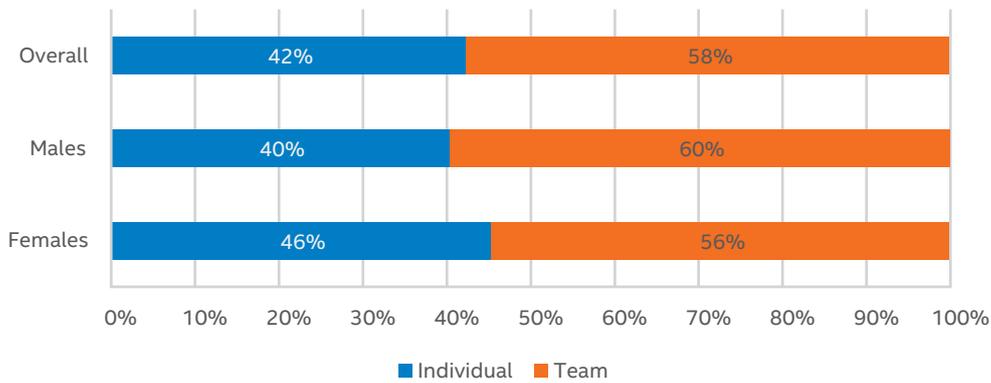


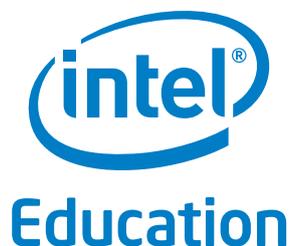
Figure 45: Gender analysis of individual versus team participation in the fair (students).

(Figure 14), is discriminated by gender, we find a perhaps surprising agreement to within a few percentage points between the ratings of both genders (see Table 8). Intelligence proved to be the only skill where there a maximum of 5% difference in responses between genders. 19% of the male students consider it an essential skill, compared to 14% of the female students. However, creativity was considered the top relevant factor by the same percentage (30%) of both genders.

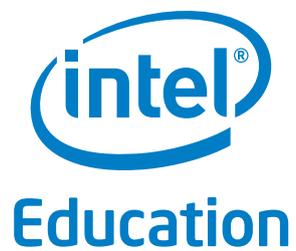
In comparing 2013 and 2014 data discriminated by gender we observe that also in 2013 intelligence proved to be the only skill where there was a relatively large difference in responses between genders in favour of males: 15% in 2013, but only 5% this year. Male students consistently consider intelligence a more essential skill than females. This trend also deserves further investigation.

TABLE 8: GENDER DIFFERENCES IN THE MOST ESSENTIAL CONTRIBUTIONS TO THE PROJECT'S SUCCESS (STUDENTS).		
OVERALL	DIFFERENCE FEMALE (%) - MALE (%)	PERSONAL TRAIT OR SKILL
34%	- 5%	Intelligence
29%	4%	Work ethic
38%	3%	Critical thinking
43%	3%	Communication skills
23%	-1%	Scientific literacy
39%	3%	Curiosity
60%	0%	Creativity
25%	0%	Collaboration
4%	-1%	Leadership





# Analysis and conclusions



# Analysis and conclusions

This is an evaluation report of a large number of 2014 fairs, but we have at hand also the report from the pilot evaluation of several 2013 fairs. An increase of the number of fairs analysed by a factor of 2.5 and of the number of respondents by 85% has led to interesting comparisons between the data from both years. This comparative analysis will be outlined in each item below, following the main conclusions from the 2014 data. The comparisons with future science fairs will likely result in the consolidation of some conclusions, and will provide more points for exploration and a still richer picture of the impact of the science fairs with each of the stakeholders involved.

In what follows the main conclusions of the previous overall analysis of the science fairs will be split into students' and teachers' results.

## Main students' results

### Demographics

- **Young participants:** With an average of 17 yrs. of age, and 93% of the students between 14 and 19, there is a good fraction (about 1/3) below 17. There are some younger students in 2014 than in 2013.
- **Gender parity:** It was almost obtained in 2014 among students. This is one of the primary goals of all science activities. In 2013 there was a clear male dominance among the students. When the population of each country is analysed, there are important (and random) gender differences among the participating students this year.

### Support

- **Difficulties:** Almost half of the students found it difficult to get hold of the materials and the equipment needed for the project. At the same level of difficulty is carrying out the different steps in the scientific method (formulating and testing hypothesis, analysing data, etc.). On the other hand, for more than 2/3 of the students the successful

development of the project results in an increase in confidence in how to use the scientific method (see below, on impact). In 2013 the difficulties were in different categories, but drawing conclusions from the data was low (35-39%) in both years.

- **Support and participation:** Much support comes from the school and the school staff. The teacher is the major factor leading to participation in the fair, followed by the recognition associated with participation. The same effects are observed in 2013.
- **Internships:** 13% of the participants on average took part in an internship related to the project. This figure is almost half of that of 2013. And about 50% of the participants attended after-school science activities (a bit less than in 2013). This facts show a large degree of student commitment.

### Impact

- **Project areas:** Science and Technology were the most common topics for the projects, with Science dominating by a factor 2.5:1. There is also a significant (1/4) presence of interdisciplinary projects. The same happened in 2013.
- **Gender differences in the project areas:** Males focus on Science projects and in the second place, in similar measure, in Engineering or Technology projects. Females favour scientific projects over all other areas. This large gender difference has been present in both years and deserves further investigation.
- **Balance:** In both years there is a predominance of team projects over individual projects. This agrees with the spirit of the science fairs as a collective enterprise, and is bound to have an impact within the classrooms.
- **Gender differences in team work:** A relatively small 10% difference is found in favour of team projects developed by males. Data from 2013 is not available.
- **Effects of project development and gender.** The advantages of doing a science project also show gender effects: female responses rate collaboration

and interaction higher, whereas males favour being in charge and the absence of marks. It is not possible to extract from the data the fraction of mixed-gender teams. This might be an issue to investigate in the future.

- **Skills:** Students improve their communication skills as a consequence of their participation in the fairs. An important asset is the chance to show their work to the society at large. Other advantages of carrying out a science fair project were the possibility of working on a project of their own and having a chance to work with people outside the school walls. This shows that students find many possible values in developing these projects and that gains other than scientific skills are also involved. Similar results were found in 2013.
- **Essential factors for success:** One of the most interesting results found was in the items that participants consider essential to the success of their project. Over 60% of the participants felt creativity was the most essential factor, followed by communication skills, curiosity and critical thinking. Similar conclusions were reached in 2013. Terms like leadership, collaboration and work ethic do not appear to be significant, as they may not be common ingredients of standard school education, especially in science classes.
- **Gender effect in personal traits:** When discriminated by gender, the data show that intelligence proved to be the only skill where there was some gender difference: female students rate intelligence lower than males on the scale of factors for project success. The effect was much larger in absolute and relative terms in 2013. This observation deserves further consideration.
- **Greater confidence:** Over 80% of the students noticed an increased confidence in identifying problems, finding solutions and using the scientific method. Even in larger numbers they had fun participating in the fair. This is an important change of the usual attitudes students have towards STEM. A large percentage of the students, about 65%, have improved in team-working capabilities and felt more likely to study a STEM degree.
- **Age group effects:** A novel investigation this year showed that students in the 17-19 year old range claim a factor of 3 more often than 14-16 year olds that, as a consequence of participation in the fair programme, they are more excited about science and its daily relevance, and are more interested in a scientific career of their own. More analyses of this kind are needed.

### Sustainability

- **Newcomers:** 3/4 of the students are first-timers at a fair. A significant 9% had participated in three or

more of these fairs. This shows an important loyalty effect, which also occurred in 2013. Both data contribute to looking into the future of fairs with confidence.

- **Hard work:** The participants worked hard for the projects they presented. For 3/4 of the students it took several months to develop the project while the presentation part varied between a few hours and a week. Similar figures were obtained in 2013, and they show a high degree of student commitment to the projects, sustained over months. This is an evident educational and personal development value that originates from the science fair competition.
- **Voluntary participation:** Overall 3/4 of the students carried out the science projects on a voluntary basis. Almost 80% were influenced by the teacher(s). These results are consistent over the two years and attest to the sustainability of the program.
- **Satisfaction:** Almost 90% of the participants wish to repeat and to recommend the experience to a friend. This makes the fairs an educational success.

## Main teachers' results

### Demographics

- **Teaching experience:** 10% of the teachers have less than 5 years of teaching experience. About 3/4 have more than 10 years of experience. 10% hold PhD degrees. There are more young teachers in 2014 than in 2013.
- **Gender:** Female teachers predominate by 14 percent-points, larger than in 2013. Female to male ratios vary widely and randomly for different fairs, as in the case of the participating students, but less in students than in teachers.
- **Students/teacher:** Almost half of the teachers accompany between 1 and 4 students while a total of 75% bring up to 10. The same figures appear in both 2013 and 2014.

### Support

- **Out-of-school activities:** Almost half of the students participated in extracurricular activities, according to the teachers, a few percent-points more than in 2013. The figures indicate that an important support for students is available which contributes to enhance their interest in STEM.
- **Difficulties encountered:** Getting students on board is not as difficult as finding funding for the projects. Supervising students outside the teacher's area is only

difficult for 1/3 of the teachers. In general, teachers mention the same difficulties for students in both years: applying the scientific method, analysing the data, etc., but 2014 teachers find less difficulties than 2013 teachers.

- **School support:** Participation in the fair gets school support in a majority of cases. Support from colleagues, parents and experts come second. Much less support comes from local authorities, local media or even the national Ministry of Education. All items rate similarly in 2013 and 2014, and especially the last group (reduced local support) would require some action.

## Impact

- **Teachers' & project areas:** Less than half are Science teachers, and similar numbers are teaching Technology, Engineering and Maths. The ratios of Science to Technology to Engineering projects reflect the teachers' areas, but a sizable fraction of projects are interdisciplinary (more than 1/4). This was also observed in 2013.
- **Curriculum and project:** There is a clear link between the national STEM curriculum and the contents of the fair projects in almost half of the cases, as in 2013. This is probably an important contributor to the sustainability of the programme, as teachers find added value in their daily tasks.
- **Learning from participation:** Almost all teachers feel they learn a lot, and also their students. In particular, students learn to communicate better and about the scientific method. The feeling of getting important personal and professional gains from participating in the fair is important for teachers and students. Big increases were seen when comparing 2013 and 2014 data in the ratings of students being rewarded for excellency in STEM and in the positive effect of the fair in promoting inquiry in their schools.
- **Advantages of fairs over classes:** Most important are a different way of interacting with students and the increased students' motivation. Opportunities to engage with the outside world are also relevant. These are skills that are not usually associated with regular classroom activities. Relative ratings were different in 2013.
- **Students' personal traits and success:** In the opinion of the accompanying teachers, creativity, communication skills and critical thinking, in that order, stand out. Intelligence was less important, as we already noticed with students' opinions. The same occurs in the 2013 report, and also factors

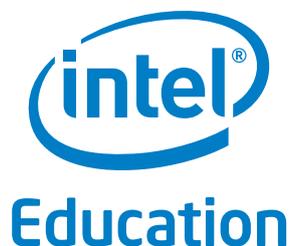
like collaboration, scientific literacy and work ethic are considered of less importance in about 1/3 or less of the answers. The capacity of leadership got almost zero attention both years also.

- **Methodology changes:** Participation in science fairs results in a noticeable increase in the use of active teaching methodologies with almost half of the teachers using Inquiry-Based Science and Mathematics Education (IBSME) before the fairs. This figure is much higher than in 2013. The science fair initiative has the ambition to help improve school education as regards the necessary transformation and updating of teachers' methodologies, so that the students' education is improved in terms of transferable knowledge, skills and competences. One of the key innovating Teaching and Learning methodologies is IBSME, and it is interesting to see that the science fairs contribute towards extending its use.

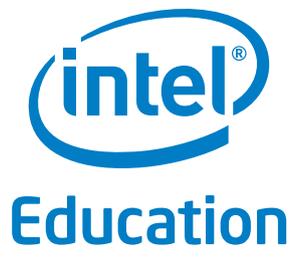
## Sustainability

- **Repeat fair participation:** Almost 2/3 of the teachers work in schools that have participated repeatedly science fairs. For about 21% of the schools this was their first fair. For the teachers the fraction of newcomers is 1/3. This demonstrates the good reception that the fairs meet with among schools. The figures are similar in both 2013 and 2014.
- **Voluntary tutoring and support:** Only for 20% of the schools it is compulsory for teachers to participate in the fair. The school designates a coordinator in 2/3 of the cases. This indicates a felt need as well as a guarantee of success for project development. Fewer compulsory participations were present in 2013.
- **Reasons for teachers' commitment:** "My students" is the reason that dominates fully, and the opportunity to attend a fair and the prestige that comes from the competition follow next. Very little importance is attributed to the prospect of promotion. These answers may help schools in promoting participation in the fairs, especially because the ratings in 2013 and 2014 are quite similar.
- **Teachers' satisfaction:** For the teachers it is a quite positive experience to supervise students' projects for the fair competition. The ratings were even higher in 2014 than in 2013, and close to unanimity. This is a remarkable result of the whole programme and, in conjunction with students' opinions, one may conclude that, both for teachers and students, participating in the science fairs is an enjoyable and positive educational experience.





# Open discussion and future work



# Open discussion and future work

In the previous section we have outlined the major observations and conclusions that can be extracted from the 2014 data and from a detailed comparison of the data belonging to 2013 and 2014. This provides a wide perspective on the impact and sustainability of the fairs, a perspective that will become much richer when the data from more fairs are incorporated in the future.

In a final section introduced in the 2013 report the authors noted a number of issues in the form of reflections, reactions and suggestions to the data contained in the study. We shall keep this section in the present report, and will put those views in a wider perspective, now that data from two years is available. Apart from opening new venues for discussion, in many of the issues raised last year the door to further discussions and interpretations remains open.

**Personal versus Online support.** It was noted in 2013 that almost all the students found the Internet / Online support useful for the development of their projects, but only a fraction of them had participated in an internship. The same situation happens this year (Figure 12: Usefulness of various sources of project support (students). and Figure 13: Participation in internships related to the project (students)).

While the importance of Internet resources in a science project is expected, it would be interesting to investigate the character and extent of the internship programs in order to suggest them for cultures where they are non-existent. The small presence of these internships (13%) contrasts with the importance of mentors and experts for the project's success (72%). This importance has been pointed out in other studies (Rillero et al, 2005, p.15)<sup>3</sup>. The strong results of today's student participants use of internet resources may indicate that the ways a mentoring relationship was once understood are being complemented by the large

number of online resources, communities and access to less personal expert relationships.

**Values and skills for success.** It is remarkable that both students and teachers rate the most essential contributions for a project success in exactly the same order and with quite similar percentages (Figure 14: Most essential contributions to the project's success (students). and Figure 36: Essential issues contributing to the success of students' science fair projects (teachers)). The sequence of decreasing importance, ranging from about 60% to 4% is creativity, communication skills, curiosity, critical thinking, scientific literacy, intelligence, work ethic, collaboration and leadership.

One concludes from the previous data and other items in the report that the relevant skills and the axiological components of the teaching and learning process are transferred quite fluidly between teachers and students participating in a fair. This is a reassuring finding which, of course, reflects the closer teacher-student relationship promoted by the fairs and are furthermore highlighted by the data on why teachers do the tutoring ("My students", Figure 37: Factors or people that influenced the decision to lead participants in the fair and made the task easier (teachers).) and who do the students consider the most effective source of support, second to Internet ("Teachers", Figure 12: Usefulness of various sources of project support (students)). The big challenge, we suppose, is how to extend this mutual appreciations to the whole science class.

**Efforts to involve younger participants.** A worry was expressed in the 2013 report concerning the years of teaching experience. Again this report illustrates in Figure 20: Years of teaching experience (teachers). that 40% of teachers have over 20 years in the field, and almost 75% over 10 years. This strongly indicates new teachers are going to be in need of support in order to get them to

<sup>3</sup> Rillero, P., Zambo, R. & Haas, N. (2005). Intel International Science and Engineering Fair 2005 Evaluation Report. Retrieved from: <http://download.intel.com/education/EvidenceOfImpact/ISEF-2005-Report.pdf>

join the science fairs with their students. Whereas this continues to be true, we have noted a welcome shift in the students' age distribution towards younger ages, Figure 1: Age of respondents (students). We should pay attention to these issues in future evaluations.

**Methodology and other impacts.** It is a very positive result in this year's data that the fraction of teachers that implement active teaching and learning methodologies is about 50%, Figure 38: Use of IBSME before the science fair and afterwards (teachers)., much larger than in 2013. The impact of the fair on the use of these methodologies is felt in both evaluations.

However, some gaps in the full picture of science activities in the school were highlighted in the 2013 report, which happen to be consolidated with the data obtained this year. We refer to last year's report for the detailed comparisons of the results displayed in Figure 30: Impact of participating in the science fairs on both teachers and students (teachers).: Impact of participating in the science fairs on both teachers and students (teachers), and in Figure 31: Advantages of doing a science fair project over a regular science class (teachers).: Advantages of doing a science fair project over a regular science class (teachers). Overall it appears the effects associated with the impact of the fairs on the students' abilities and the teachers' methodologies remain at students / teachers participating in the fair and does not get transferred to the school or even the classroom level. This issues could be tackled with the same approach that we shall mention in the paragraph below on debates and proactive actions.

**Direct Student-Teacher comparisons.** We feel that the increased availability of data in the two yearly reports and the detailed analyses that will be referred to in a moment (concerning issues like students' gender and age, etc.) can be complemented with further analyses that this report only can point at, for lack of space. As it was shown in a recent presentation by one of us<sup>4</sup> quite interesting information can be extracted from direct comparisons of students' and teachers' perceptions on the same aspects related to the development of the project, like support received, factors for success, etc. For instance, the character of the projects is perceived differently, the number of students participating in extra-school activities also shows differences (teachers are more positive in their responses), and there is also a mismatch in the perception of schools' policy regarding "compulsory" participation in fairs. Straight comparison of these groups of data indicates that they show agreements and disagreements that make for good topics for debates and action.

**Issues for debate: gender, age, etc.** The exercises provided in this report that look in detail into the students' age-group and gender effects on various issues (attitude towards science, choice of project topic, team working preferences, personality traits of importance, etc. -see the section "Sample data comparisons" in this report) open the path for wider analyses and, maybe more interestingly, provide venues for debates within the classrooms and within the schools. New suggestions on how to improve on gender equity in science, for instance, or how to promote personal and collective skills in the science classes (and not only there!) might result in significant changes both at classroom and school level.

These debates and proactive measures should also deal with how to increase the parent's influence on the students' projects, which appears to be less felt than Internet or the teachers (at 55% versus 80%, Figure 12: Usefulness of various sources of project support (students).), but even more necessarily, how to increase the contributions of local media and authorities, including the Ministries of Education. The teachers' opinion about the relative support of these stakeholders during the development of the science projects is surprisingly low (Figure 35: Organizations or people that were instrumental to carrying out the students' projects (teachers).). This disconcerting fact was also noted in the 2013 report.

**Some conclusions.** Finally, to the overall conclusions of last year's report that while the impact of the fairs is clear for those participating in the fairs, further actions should be made to

- Spread these beneficial effects to the school in general; and
- Get the involvement of other parts of the society which are currently unaware or uninterested in the fairs,

We may add a call to:

- Use the cumulative data from the fairs to promote debates and decide on actions at the classroom and school level, so that the benefits of the science fairs pervade the whole educational system, including even the students' homes.

Society at large would after all reap the benefits of having more STEM students and more STEM literate citizens.

<sup>4</sup> Designing a Science Fair Evaluation Strategy: The European Model (Results from 2013 and 2014), Dr. Àgueda Gras-Velázquez, Intel Educators Academy, Los Angeles, May 14th, 2014



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